

Unclassified

ENV/EPOC/GEEI(98)10/FINAL



PARIS

Organisation de Coopération et de Développement Economiques  
Organisation for Economic Co-operation and Development

OLIS : 30-Apr-1999

Dist. : 03-May-1999

Or. Eng.

ENVIRONMENT DIRECTORATE  
ENVIRONMENT POLICY COMMITTEE

Working Party on Economic and Environmental Policy Integration

INDUSTRIAL WATER PRICING IN OECD COUNTRIES

77524

Document complet disponible sur OLIS dans son format d'origine  
Complete document available on OLIS in its original format

ENV/EPOC/GEEI(98)10/FINAL  
Unclassified

Or. Eng.

## FOREWORD

In 1987, OECD published “Pricing of Water Services”. This publication reviewed pricing practices in several OECD countries for such water services as public supplies, sewage disposal, and direct abstractions. The study also addressed such topics as water subsidies and agricultural irrigation systems. The focus of the work was on reviewing how pricing systems for each of these components actually operate in practice (i.e. description), followed by a discussion of how the environmental and economic efficiency of those systems might be improved (i.e. prescription). Little distinction was drawn among the demands placed on water resources by individual economic sectors (e.g. households, industry and agriculture).

The OECD has recently decided to update the 1987 report, in a type of “10-year progress report”. This particular report provides information on the pricing of water services in one sector of economic activity — industry. It examines current practices and recent trends in industrial water pricing in OECD countries. Other reports in this series deal with water subsidies, and with pricing practices in the household and agriculture sectors. A synthesis of all the reports is also published under the title “*Water Pricing: Current Practices and Recent Trends*”.

This particular report was drafted by **William Baker** and **Sophie Tremolet**, of National Economic Research Associates (NERA), Economic Consultants, London, UK. It was also discussed at an Ad Hoc Meeting of OECD Water Pricing Experts (Paris, September 22-23, 1998), and has since been revised based on comments received from delegates to that meeting.

The report is published under the responsibility of the Secretary-General.

## TABLE OF CONTENTS

|                                                                           |    |
|---------------------------------------------------------------------------|----|
| FOREWORD.....                                                             | 2  |
| BACKGROUND .....                                                          | 5  |
| Introduction.....                                                         | 5  |
| OVERVIEW OF INDUSTRIAL WATER PRICING.....                                 | 7  |
| Introduction.....                                                         | 7  |
| Institutional arrangements .....                                          | 7  |
| Relative importance of industrial water use .....                         | 11 |
| Water sources for industry.....                                           | 15 |
| Types of industrial water use.....                                        | 21 |
| Price structure for water services from the public system.....            | 21 |
| Price structure for sewerage services from the public system.....         | 26 |
| Trade effluent charges .....                                              | 31 |
| Abstraction charges.....                                                  | 33 |
| Discharge charges .....                                                   | 35 |
| MAIN ISSUES AND CURRENT TRENDS.....                                       | 38 |
| Introduction.....                                                         | 38 |
| Increasing private sector involvement and commercial objectives.....      | 38 |
| Increased cost-reflectivity in tariffs.....                               | 39 |
| More “economic” tariffs .....                                             | 39 |
| Recovery of sewerage costs via explicit sewerage charges.....             | 40 |
| More self-treatment and re-use .....                                      | 40 |
| Within-country variations .....                                           | 40 |
| COMPARING INDUSTRIAL WATER PRICES ACROSS THE OECD.....                    | 41 |
| Difficulties in comparing industrial water pricing .....                  | 41 |
| A comparative framework .....                                             | 42 |
| Application of the comparative framework.....                             | 43 |
| Summary of Results .....                                                  | 44 |
| REFERENCES .....                                                          | 46 |
| ANNEX I. COMPARATIVE INDUSTRIAL WATER PRICE DATA: SELECTED OECD COUNTRIES | 48 |
| CANADA.....                                                               | 48 |
| GERMANY .....                                                             | 49 |
| MEXICO .....                                                              | 50 |
| NETHERLANDS.....                                                          | 51 |
| POLAND .....                                                              | 52 |
| PORTUGAL .....                                                            | 53 |
| UNITED KINGDOM .....                                                      | 54 |
| UNITED STATES .....                                                       | 55 |

|                                                                                                                     |     |
|---------------------------------------------------------------------------------------------------------------------|-----|
| ANNEX II: DETAILED INFORMATION ON WATER INSTITUTIONS AND INDUSTRIAL WATER PRICING PRACTICES IN OECD COUNTRIES ..... | 56  |
| AUSTRALIA .....                                                                                                     | 57  |
| AUSTRIA .....                                                                                                       | 63  |
| BELGIUM .....                                                                                                       | 66  |
| Pricing principles .....                                                                                            | 68  |
| CANADA.....                                                                                                         | 72  |
| CZECH REPUBLIC .....                                                                                                | 78  |
| DENMARK .....                                                                                                       | 83  |
| FINLAND .....                                                                                                       | 86  |
| FRANCE.....                                                                                                         | 91  |
| GERMANY .....                                                                                                       | 97  |
| GREECE .....                                                                                                        | 108 |
| HUNGARY.....                                                                                                        | 111 |
| ICELAND .....                                                                                                       | 114 |
| IRELAND .....                                                                                                       | 116 |
| ITALY.....                                                                                                          | 120 |
| JAPAN .....                                                                                                         | 126 |
| KOREA.....                                                                                                          | 131 |
| LUXEMBOURG .....                                                                                                    | 135 |
| MEXICO.....                                                                                                         | 137 |
| NETHERLANDS.....                                                                                                    | 148 |
| NEW ZEALAND.....                                                                                                    | 156 |
| NORWAY.....                                                                                                         | 160 |
| POLAND .....                                                                                                        | 162 |
| PORTUGAL .....                                                                                                      | 173 |
| SPAIN .....                                                                                                         | 179 |
| SWEDEN.....                                                                                                         | 183 |
| SWITZERLAND .....                                                                                                   | 187 |
| TURKEY .....                                                                                                        | 189 |
| UK (ENGLAND & WALES).....                                                                                           | 192 |
| UNITED STATES .....                                                                                                 | 202 |

## **INDUSTRIAL WATER PRICING IN OECD COUNTRIES**

### **BACKGROUND**

#### **Introduction**

The main objectives of this report are:

- to update inventory information about industrial water prices in OECD countries; and
- to generate comparative interpretations of that data, using an appropriate analytical framework.

The report is organised to include:

- an overview of industrial water pricing practices in OECD countries, based on more detailed
- country surveys, which are attached as Annex II;
- a discussion of some of the main issues and trends apparent from the country surveys;
- a framework for comparing water prices across industry categories and across OECD countries; and a few results of applying that framework to selected countries, to the extent that it is sensible to do so, in the light of data limitations.

The basic approach taken was to collect information on a wide range of issues that affect industrial water prices in the largest number of OECD countries possible — such as the institutional framework or the patterns of water use. In turn, the major price elements facing industrial users were analysed: not only water prices from the public supply system, but also sewerage prices from the public supply system, trade effluent charges for extra strength effluents, charges for direct industrial abstractions, and charges for direct discharges to the watercourse. Confronted with such varying price signals, industrial users can take decisions such as whether they should buy water from a public supplier, or abstract directly; or whether they should use public sewers or treat wastewater themselves, and discharge back directly into the water system.

The information and data for the study has come from 3 main sources:

- A review of the existing literature. Such material was not particularly comprehensive, and usually contained no in-depth analysis of industrial water prices.
- A broad survey of water sector government officials in OECD countries. This proved helpful in collecting both direct information and contact names in other organisations.

- Personal communications with various individuals in governmental, international, and non-governmental organisations, all of whom provided detailed information.

One important source of information, apart from government sources, proved to be water and sewerage services associations. In many countries, these associations work as a form of “clearing house” in gathering and disseminating information about their members. This proved particularly useful in decentralised structures, where central governments typically have little information themselves. In some significant cases, data was provided by other types of associations, such as an environmental consulting group (in the *US*) and a medium-sized industrial users’ association (in *Germany*). In the latter case, this Association appears to play the role which is commonly assumed by consumers’ associations — i.e. gathering price information in order to exert a downward pressure on prices charged by service providers.

In some countries, very little information was available, and data on industrial water prices does not appear to be collected by any particular institution. This is not necessarily a reflection of the quality of the water services in these countries, but can be due to a number of reasons:

- water services are provided on a decentralised basis, which makes data collection complicated (for example, in *France*, there are 15 500 different water networks, and no data is collected on industrial water prices at the central level);
- industrial users abstract water directly and do not provide data to environmental institutions or to suppliers of public water (the analysis presented in this report shows that this practice dominates in a majority of OECD countries); or
- industrial users enter into special contracts with water suppliers, and no public data is available.

In order to overcome these information constraints, it would have been necessary to conduct a survey of industrial users in order to identify their “water costs” by sector, and by user size, and by type of use. Due to constraints of time and budget, however, it was not possible to conduct these new studies, and the report had to rely on existing information. A second limitation was that, given the large number of countries to be considered, it was rarely possible to collect water price information for more than one year for most countries. Hence, it is difficult to draw conclusions about trends (such as variations in industrial water uses as a result of variations in prices).

## OVERVIEW OF INDUSTRIAL WATER PRICING

### Introduction

The detailed country surveys (provided in Annex II) are each divided into the following sections:

- the context for industrial water uses:
  - institutional set-up;
  - relative importance of industrial water use;
  - water sources for industry; and
  - types of industrial water use.
- pricing principles:
  - water price structure from public supply system;
  - structure of sewerage service (including trade effluent) charges from public sewerage system; and
  - direct abstraction and discharge<sup>1</sup> charges structure.
- price levels and trends:
  - water prices from public supply system;
  - sewerage service (including trade effluent) charges from public sewerage system; and
  - direct abstraction and discharge charges.

The earlier sections of the report summarise the key conclusions for OECD countries, and draw generalisations from the more detailed country surveys provided in Annex II.

### Institutional arrangements

In order to place water pricing practices in context, the types of institutional arrangements for the supply of water and sewerage services in each OECD country are summarised in Table 1. These institutional arrangements include the following:

- *Public supply*: which administrative level is responsible for public supply of water and sewerage services?

---

1. Direct “abstraction” and “discharge” refer, respectively, to water taken directly from and used water returned directly to the natural environment (e.g. water courses), rather than to/from a public water/sewerage supply system.

**Table 1. Institutional Arrangements**

|                         | <b>Public Supply</b>                       | <b>Ownership*</b> | <b>Management *</b> | <b>Economic Regulator</b>     | <b>Environmental Regulator</b> |
|-------------------------|--------------------------------------------|-------------------|---------------------|-------------------------------|--------------------------------|
| Australia               | Regional                                   | Both              | Both                | Regional/<br>Independent      | Independent                    |
| Austria                 | Municipal                                  | Public            | Public              | Municipal                     | Central govt                   |
| Belgium                 | Inter-municipal                            | Both              | Both                | Federal govt.<br>(prices)     | Regional                       |
| Canada                  | Regional                                   | Public            | Public              | Provincial govt               | Provincial govt                |
| Czech Republic          | Municipal                                  | Private           | Both                | Central govt                  | Central govt                   |
| Denmark                 | Municipal                                  | Public            | Public              | Municipal                     | Central<br>govt/municipalities |
| Finland                 | Municipal                                  | Public            | Public              | Municipal                     | Central govt                   |
| France                  | Municipal                                  | Public            | Both                | Municipal                     | Central govt                   |
| Germany                 | Inter-municipal/<br>Municipal/<br>Regional | Both              | Both                | Municipal/<br>Regional        | Regional                       |
| Greece                  | Municipal                                  | Public            | Public              | Central govt                  | Central govt                   |
| Hungary                 | Municipal                                  | Public            | Both                | Central govt                  | Central govt/<br>Independent   |
| Iceland                 | Municipal                                  | n.a.              | n.a.                | n.a.                          | Central govt                   |
| Ireland                 | Regional                                   | Public            | Public              | Regional                      | Central govt                   |
| Italy                   | Municipal                                  | Public            | Public**            | Central and<br>regional govts | Central and<br>regional govts  |
| Japan                   | Municipal                                  | Public            | Public**            | Central govt                  | Central govt                   |
| Korea                   | National/<br>Regional                      | Public            | Public              | Central govt/<br>Regional     | Central govt                   |
| Luxembourg              | Municipal                                  | Public            | Public              | Municipal                     | n.a.                           |
| Mexico                  | Municipal                                  | Public            | Both                | Central govt                  | n.a.                           |
| Netherlands             | Municipal                                  | Public            | Both                | Central govt/<br>Regional     | Central govt/<br>Regional      |
| New Zealand             | Municipal/<br>Regional                     | Public            | Both                | Central govt                  | Central govt                   |
| Norway                  | Municipal                                  | Both              | Both                | Central govt                  | n.a.                           |
| Poland                  | Municipal                                  | Public            | Public              | Central govt                  | Central govt                   |
| Portugal                | Municipal/<br>Regional                     | Public            | Both                | Central govt                  | Central govt                   |
| Spain                   | Municipal                                  | Public            | Both                | Central govt                  | Central govt/<br>Independent   |
| Sweden                  | Municipal                                  | Public            | Public              | Municipal                     | Regional                       |
| Switzerland             | Municipal                                  | Public            | Public              | Central govt                  | n.a.                           |
| Turkey                  | Municipal                                  | Public            | Public              | Central govt                  | Central govt/<br>Regional      |
| UK (England &<br>Wales) | Regional                                   | Private           | Private             | Independent                   | Independent                    |
| US                      | Municipal                                  | Both              | Both                | Independent                   | Independent                    |

*Notes:* \* "Both" means that both public and private ownership structures co-exist.  
 \*\* Private management exists, but is marginal.  
 "n.a." Denotes "not available".

- *Ownership:* are service suppliers publicly- or privately-owned?
- *Management:* are service suppliers publicly or privately managed?
- *Economic regulator:* at what administrative level is economic regulation exercised?
- *Environmental regulator:* how is environmental regulation exercised?

A summary of the information is presented below, together with a discussion of the implications for industrial water pricing.

### ***Administrative level in charge of public water supply***

On average, only 23 per cent of water used by industrial users comes from the public systems in OECD countries (Figure 3). As a result, public supply prices apply directly to only a minority of industrial water uses. Nevertheless, the institutional structure related to the public water supply is important for several reasons:

- It is a crucial element of the institutional structure for water and sewerage services as a whole — public suppliers often take on other tasks in addition to service supply, such as economic and environmental regulation, especially in a decentralised system, which will affect all industrial water users;
- Industrial users see public supply as an alternative to direct self-supply — they have to decide which mode of supply is more advantageous for them on the basis of price, quality of service, and reliability.

In the majority of OECD countries, water services are provided at the municipal level. Municipal provision can result in fragmentation and inefficiencies, especially when the large number of municipalities leads to the multiplication of independent water networks with, for instance, 15 500 providers in **France** (for 36 000 municipalities) and 13 500 water networks in **Italy** (with 6 600 managing municipalities). As a result, municipal provision tends to evolve towards the formation of groupings of municipalities, in order to organise supply at a larger scale; or the delegation of responsibilities for service management evolves to private companies. In some cases, water services are organised at the regional level, as in **Australia**, **Canada**, **Ireland**, or the **UK**. This means of organisation allows better planning of resources, especially when the providers' area of distribution corresponds to a river catchment area. In **Belgium**, water distribution is mostly the responsibility of municipal groups.

Finally, the existence of specialised industrial networks for water supply can also be noted. These networks exist in **Italy**, **Japan** and **Korea** where they were created to promote economic development goals, so as to cater directly to the needs of industrial water users. They generally exist in addition to local public supply networks.

### ***Public or private ownership?***

Water supply arrangements are often seen as something which should be in “public” ownership, despite large variations in water abstraction right regimes (even within the same country — e.g. in the **US**), as a result, public water supply bodies are generally publicly-owned.

However, there are exceptions to the rule of public ownership. Ownership is in private sector hands in the **UK**, and in some parts of the **US**. The privatisation of the UK water industry took place in 1989, in order to address the need for additional sources of finance and to improve the efficiency and quality of service. The trend towards privatisation has also been increasing in some other OECD countries, with, for example, the recent introduction of some private ownership in the **Czech Republic**.

### ***Public or private management?***

Even where the public water supply system is publicly-owned, service *management* can be delegated to private operators. This “model” of delegation of public service appears to be particularly well-suited to decentralised systems, in which municipalities see delegation as a way to overcome their

own lack of expertise and financial resources. In **France**, and in a growing number of other municipality-based systems, service providers can decide whether they want to manage the service themselves (*direct management*) or delegate service management to a private operator (*delegation*). In the **Czech Republic**, a variety of such systems has been adopted in different parts of the country.

### ***Economic regulation***

The economic regulator is usually in charge of setting prices, and may have other responsibilities, such as establishing service performance standards in order to guarantee customers' protection. The main concern here is with price regulation, and with the impact of economic regulation on industrial prices.

Water price regulation is generally exercised at the national level, or at the next level down in decentralised government structures. In most cases, water is treated no differently from other consumer goods, with water price regulation being carried out by the Ministry of Finance, or by the government body in charge of price regulation in general.

In decentralised systems, price regulation is often carried out by the municipalities themselves, although this can create a number of problems. In particular, due to information asymmetry, municipalities are not always in a good position to exercise control on service providers. One consequence of local price regulation is that information on prices becomes very difficult to collect, since there is usually no central data gathering mechanism. This is particularly apparent in **France** and in **Italy**, where institutions have recently been created to try to improve price information and control at the central level.

In a small (but increasing) number of countries, independent economic regulators have been set up to regulate water prices from an autonomous perspective. This system originated in the **US**, where State Public Utility Commissions regulate all privately-owned utilities in a given State. A similar, multi-utility regulator approach is taken in some **Australian** States, such as Victoria (the Office of the Regulator General), New South Wales, Tasmania, and the Australian Capital Territory. In the **UK**, a water regulator (Ofwat) was set up in parallel with the privatisation of the industry in 1989, to protect customers against abuses of monopoly power, to promote economic efficiency, and to guarantee a stable environment for investment. The regulator's independence is seen as an important element in ensuring that decisions are transparent, and are not influenced by short-term political considerations.

### ***Environmental regulation***

Environmental regulators are usually responsible for establishing and monitoring surface and ground water quality objectives, as well as for regulating polluting discharges to the aquatic environment. Therefore, in most OECD countries, where direct abstractions by industrial consumers are predominant, environmental regulators are likely to have the greatest impact on water costs for industrial users through the licensing and pricing of direct abstractions and direct discharges (where charges are made for abstractions and discharges). Environmental regulators are sometimes also responsible for water resource management, while in other cases, this responsibility may be held by another institution instead (often a separate Ministry within the government).

Environmental regulation generally takes place at the government level within the Ministry of Environment, or in some cases, at the decentralised level. For example, in **Belgium**, environmental

regulation is a regional responsibility (except for some aspects, which are under the jurisdiction of the federal government). An increasing number of countries are setting up independent environmental regulatory agencies, which look at different pollution media (on the basis of integrated pollution control policies), as is the case in the **US** (EPA) or in the **UK** (Environment Agency). These Agencies put pressure on industries to reduce the overall environmental impact of their activities. As for economic regulation, independence of the regulatory agency is seen as an important guarantee for a stable regulatory environment, unaffected by political considerations. The resources of these independent agencies sometimes come from the proceeds of environmental taxes, such as abstraction or pollution taxes.

It is also important to note the growing role of **EU** regulation, with several Directives having had a large impact on industrial water prices through the setting of tough environmental standards — for example, the Urban Wastewater Treatment Directive (91/271/EEC).

An important trend in the field of environmental regulation, especially for water resources management, is the emergence of river basin management institutions. This trend originated in **France**, with the creation of River Basin Agencies in 1964, based on river basin contours. Their role is to collect fees (resource and pollution fees), in order to grant subsidies to water users which are making a particular effort at reducing the pollution content of discharged waters. Industrial users which have their own treatment facilities, for example, are eligible to receive such grants. Similar institutions exist in **Australia**, **Spain** and in **Hungary**, and are in the process of being introduced in **Mexico**. In **Australia**, for example, the Murray-Darling Basin Commission provides elements of catchment management in a large catchment covering several States.

## Relative importance of industrial water use

In order to better assess the importance of industrial water use, a summary of the relative share of industrial water use as a proportion of total water use is presented below. In general, water use statistics in OECD countries are usually collected according to the following categories: agricultural, public supply, industrial, power production, and others.

### *Data gathering issues*

There are a number of difficulties involved in gathering reliable data on the share of industrial water use, largely because of the difficulty of identifying industrial consumption and because of the heterogeneity of the data. Thus, industrial water uses are often not very clearly-defined, and are certainly not defined in a consistent manner across all OECD countries. For instance, commercial users (such as shops) may be included under “industry” in some countries, but not in others. More importantly, the category “industrial use” may include power production in some countries, whereas in others it does not. This is an important distinction, since power production typically abstracts a significant amount of water. An example of this type of problem is the difference in data gathering methods observed in **Germany**: whereas in the former West Germany, “industry” refers to manufacturing only, in the former East Germany, it includes power stations as well. Because of this difficulty, in addition to providing statistics for water use by industrial consumers and power stations separately (where such figures are available), Table 2 also provides them as an aggregated whole.<sup>2</sup> A further difficulty is the important distinction between water “abstraction” or “use”, and water “consumption”. For example, hydropower and thermal cooling typically use large amounts of water, but have a very low *consumption* rate, i.e. it is available for

---

2. For example, **Austria's** figure for industry already includes water used for power production in thermal plants, but it was unclear whether **Denmark's** figure does.

further use afterwards. For example, the water used for power production in **Greece** (40% of water abstracted) is subsequently applied to agricultural irrigation.

Finally, defining the share of industrial consumption within “public supply” can also prove difficult. As shown in Figure 3, industrial users can obtain water from two “economic” sources: direct abstractions, or via the public supply network. The total share of publicly-supplied water which goes to industrial users is often difficult to identify, however, since the category “industrial use” usually refers to direct abstractions only. Therefore, it is likely that industrial consumption is under-estimated in some cases, since “public supply” usually also includes supply to some industrial users as well.

### ***Comparative analysis***

Data on industrial water use is presented in Figure 1 for all countries for which separate data was available for industry and power production.<sup>3</sup>

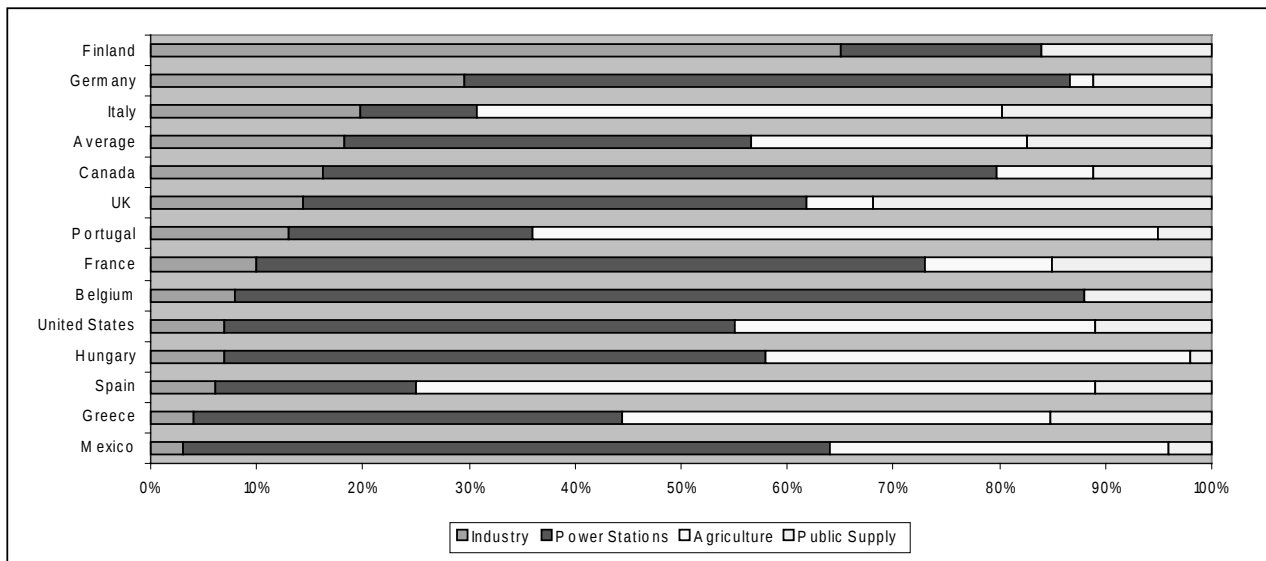
From Figure 1, it can be seen that industry’s share of total water withdrawals varies substantially in OECD countries, from about 66 per cent in **Austria**, down to 3 per cent in **Mexico**. For the countries in this sample, the average share of industrial water use (excluding power production) is 21 per cent. This figure is slightly lower than available estimates world-wide. UNIDO notes that, although agriculture accounts for most water withdrawals world-wide (69 per cent), industry is catching up quickly, and currently accounts for 23 per cent of all withdrawals.<sup>4</sup>

As explained earlier, data is more readily available for the share of industrial water use (i.e. including water used for power production). This data is shown in Table 2 and Figure 2, where “industrial use” refers to both industrial production and power production. With power production added, the share of industrial water use varies from 88 per cent in **Belgium**, down to 8 per cent in **Korea**. The main competitor for water resources is still the agricultural sector, which can account for as much as 77 per cent of total withdrawals (in **Turkey**). The distribution of water use across sectors can be influenced not only by the pattern of economic development, but also by any subsidies in place which favour particular types of use. These subsidies can be administered through different pricing practices.

### ***Trends in industrial<sup>5</sup> water use***

Industrial water use (i.e. not including for power production) has tended to decline over time in the majority of OECD countries. While the data presented here does not allow the identification any significant trends across all OECD countries, anecdotal data suggest that industrial water use in industrialised countries has decreased overall.

- 
3. These figures generally exclude use of marine water (e.g. “brackish” water in Finland). However, it was not possible to ensure a consistent definition for all countries examined, due to the variability of the available data.
  4. UNIDO (1996a).
  5. In general, industrial water use is defined in this report as *excluding* water used in the production of electricity.

**Figure 1. Industrial Water Abstractions as a Proportion of Total Abstractions**

A decreasing trend can be noticed in **West Germany**, for instance, where industrial abstractions through public supply have fallen by one-third since the 1970s, as a result of substantial efforts made by some industrial branches (such as chemicals, textiles, pulp and paper and metallurgy) to reduce their water consumption. Other countries have shown a similar pattern, including:

- **Sweden** — where there was a sharp decrease between the 1970s and the 1980s, and a slow decrease from then on (78 per cent decrease overall between the 1970s and 1990s).
- **Austria** — where industrial water use declined by 8 per cent between 1989 and 1991.
- The **Czech Republic** — where water use by industry fell by 40 per cent from 1985 to 1993, and water use by power stations declined by 20 per cent, whilst water use by the public supply system remained roughly constant.
- The **US** — where self-supplied water used by industry declined by 37 per cent from 1970 to 1990 (no data was available for publicly-supplied water in the 1970s).

In **Canada**, manufacturing water use increased between 1972 and 1981, but fell substantially from 1981 to 1991. In some countries, the reduction in industrial water use has at times been counter-balanced by an increase in water abstractions for power production. In **France**, for instance, industrial water use declined from 16 per cent of total water uses to 9.7 per cent in the last 15 years, while water used for power production increased from 25 per cent of total water use in 1981 to 63 per cent in 1994.

Industrial abstractions have also increased in a number of OECD countries, including Japan, the UK, Ireland and Denmark. In **Japan**, the use of freshwater by the chemical industry rose by 16 per cent between the 1980s and 1994, and by 3 per cent in the steel industry. In the **UK**, industrial use went up by 37 per cent between 1991 and 1995. In **Ireland**, industrial water use increased during the 1980s, largely due to accelerated industrial development. Finally, industrial water use increased in **Denmark** by 85 per cent between 1970 and 1988, although the industrial share of total water withdrawals remained roughly stable (at 28 per cent) over this period.

**Table 2. Sectoral Analysis of Water Use in OECD Countries,  
as a Percentage of Total Abstractions**

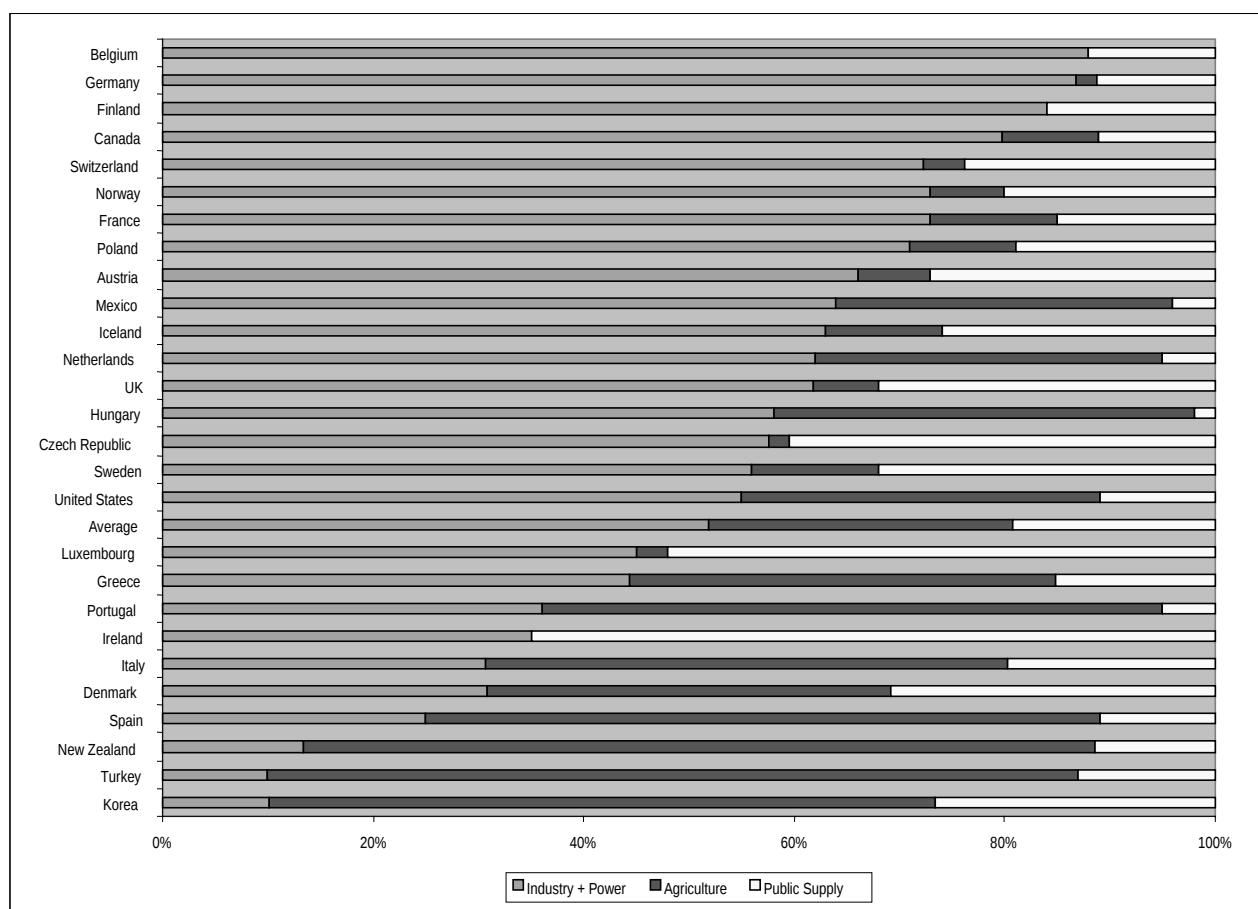
|                         | <b>Agriculture</b> | <b>Public<br/>Supply</b> | <b>Power<br/>Stations</b> | <b>Industry</b> | <b>Industry +<br/>Power</b> | <b>Others</b> |
|-------------------------|--------------------|--------------------------|---------------------------|-----------------|-----------------------------|---------------|
| Australia               | 70                 | n.a.                     | n.a.                      | n.a.            | n.a.                        | n.a.          |
| Austria                 | 7                  | 27                       | -                         | 66              | 66                          | -             |
| Belgium                 | n.a.               | 12                       | 80                        | 8               | 88                          | -             |
| Canada                  | 9                  | 11                       | 63                        | 16              | 79                          | -             |
| Czech Republic          | 2                  | 40                       | 33                        | 24              | 57                          | 2             |
| Denmark                 | 35                 | 28                       | n.a.                      | 28              | 28                          | 10            |
| Finland                 | -                  | 16                       | 19                        | 65              | 84                          | -             |
| France                  | 12                 | 15                       | 63                        | 10              | 73                          | -             |
| Germany                 | 2                  | 11                       | 56                        | 29              | 85                          | 2             |
| Greece                  | 40                 | 15                       | 40                        | 4               | 44                          | -             |
| Hungary                 | 40                 | 2                        | 51                        | 7               | 58                          | -             |
| Iceland                 | 11                 | 26                       | n.a.                      | n.a.            | 63                          | -             |
| Ireland*                | -                  | 65                       | n.a.                      | 35              | n.a.                        | -             |
| Italy                   | 50                 | 20                       | 11                        | 20              | 31                          | -             |
| Japan                   | n.a.               | n.a.                     | n.a.                      | n.a.            | n.a.                        | n.a.          |
| Korea                   | 50                 | 21                       | n.a.                      | n.a.            | 8                           | 21            |
| Luxembourg              | 3                  | 52                       | n.a.                      | n.a.            | 45                          | -             |
| Mexico                  | 32                 | 4                        | 61                        | 3               | 64                          | -             |
| Netherlands             | 33                 | 5                        | 42                        | 20              | 62                          | -             |
| New Zealand             | 73                 | 11                       | n.a.                      | n.a.            | 13                          | 4             |
| Norway                  | 7                  | 20                       | n.a.                      | n.a.            | 73                          | -             |
| Poland                  | 10                 | 19                       | n.a.                      | n.a.            | 71                          | -             |
| Portugal                | 59                 | 5                        | 23                        | 13              | 36                          | -             |
| Spain                   | 64                 | 11                       | 19                        | 6               | 25                          | -             |
| Sweden                  | 12                 | 32                       | n.a.                      | n.a.            | 56                          | -             |
| Switzerland             | 4                  | 24                       | n.a.                      | n.a.            | 73                          | -             |
| Turkey                  | 77                 | 13                       | n.a.                      | n.a.            | 10                          | -             |
| UK (England &<br>Wales) | 6                  | 31                       | 46                        | 14              | 60                          | 3             |
| US                      | 34                 | 11                       | 48                        | 7               | 55                          | -             |

\* These figures refer to publicly-supplied water only (i.e. they do not include direct water abstractions) and indicate the percentage of public supply that is used by industry (35 per cent) compared with that used for other public supply purposes (65 per cent).

*Notes:*

- "n.a." denotes "not available".
- Where data was not available, columns do not add up to 100 per cent.

Decreases in industrial water use can be explained by several factors. Industrial users appear to be more price-sensitive than domestic consumers, and they tend to minimise their consumption (where possible) through the adoption of water-saving technologies in order to reduce costs. In some cases, they are influenced by specific government programmes aimed at conserving water and/or reducing industrial pollution. This was the case in *Italy*, for example, where the reduction in water demand by industry (as a result of the adoption of water recycling and cleaner technologies) was directly influenced by the introduction of new pollution control policies in 1976. Another interesting trend in this respect is the increase in water recycling by industry, as observed in *Canada*, for instance.

**Figure 2. Industry and Power as a Percentage of Total Water Abstractions**

- Notes:
- When “other uses” were also mentioned, relative percentages were calculated on the basis of three sectors only: public supply, industry, and agriculture.
  - Ireland: as in Table 2, the figures apply to public supply only.

The impact on industrial water consumption patterns over time as a result of changes in industrial structure (from heavy industry into smaller and more technically-sophisticated industries) is more difficult to analyse. Whereas in *Italy* the de-industrialisation process (especially in the heavy industry sector) seems to have played a role in the reduction in industrial water use, the Association of Water Suppliers in the *Netherlands* (VEWIN) forecasts that water use by *large* industrial users will be declining up until the year 2000, but that consumption by the *small* business sector will be increasing over that same period. (However, this later forecast might be based on an estimated overall growth of the small business sector, rather than on an increase in the consumption rate per unit of output.)

### Water sources for industry

Differing water sources can have important impacts on the prices faced by industrial users. A distinction is drawn here between the “*environmental*” source (i.e. whether water comes from groundwater or from water sources) and the “*economic*” source (i.e. whether water comes from the public

water supply system or from direct abstractions). The price of industrial water is primarily influenced by the “economic” source of water, as this source effectively determines two very different ranges of prices: the price of publicly-supplied water and the price of direct abstractions (the latter of which is usually much lower). Industrial water users are only influenced at the margin by the “environmental” source (through variations in direct abstraction costs and charges).

### ***“Economic” sources of industrial water***

The “economic” source of industrial water determines a set of two different prices for industrial water. Industrial water users can either “take” the price which is offered by public water suppliers, or they can “make” their own price, by investing in water abstraction and treatment facilities. The option industrial users will eventually choose will depend on several factors:

- the quality of water required by the users and the use to which the water will be put;
- whether the industrial users are made to pay the full cost of water use by public suppliers; and
- whether direct abstraction licences are available and if charges are set to reflect the full economic costs of water.

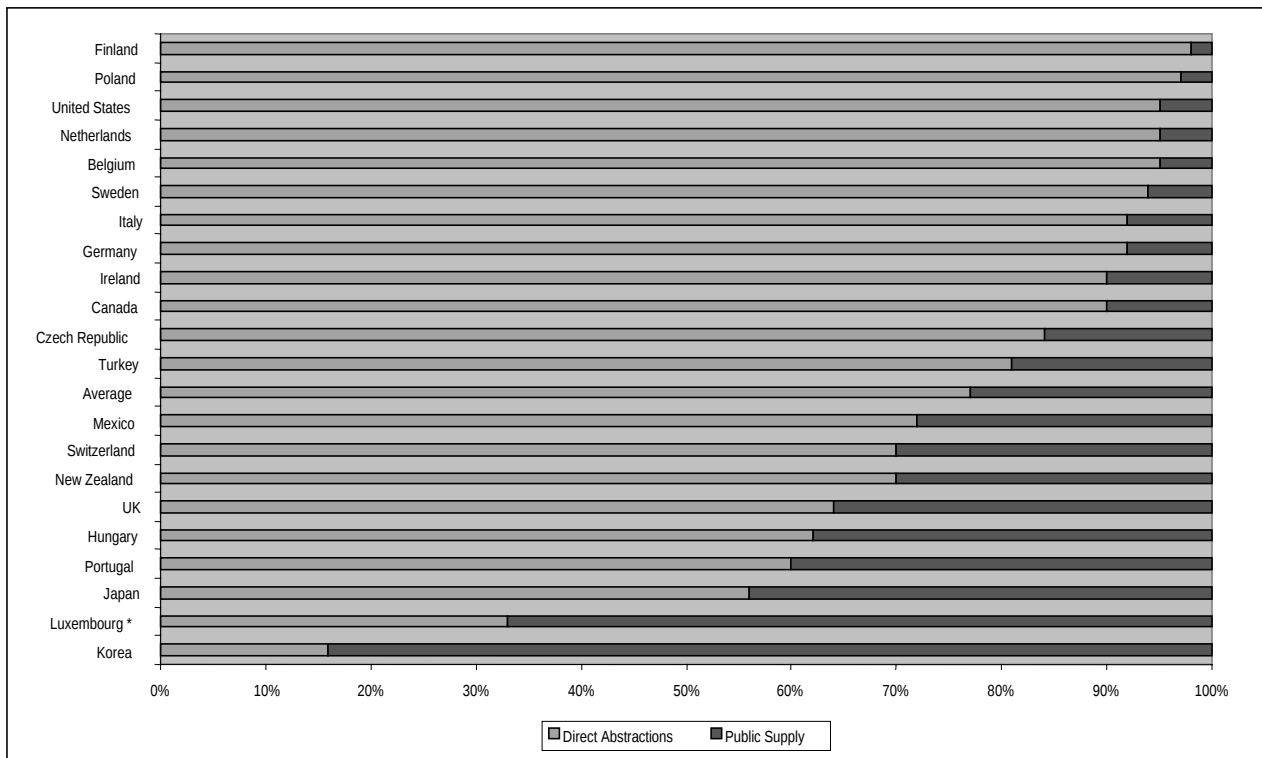
According to evidence from the majority of OECD countries, direct abstractions appear to be more advantageous than public supplies for the majority of industrial users (Figure 3).

Data on industrial water use in **Ireland** was not broken down between publicly-supplied water and directly-abstracted water, so the percentage of wastewater discharged directly was used as a proxy for the percentage of water that is abstracted directly. This assumption does not have a large impact on the results, as the rate of direct abstractions appears to be very high in the majority of countries.

Korea and Luxembourg are the only countries where direct abstractions are not predominant. In **Korea**, direct abstractions only represent 16 per cent of total water used by industry. The decline in heavy industries in **Luxembourg** may account for the strong reliance on publicly-supplied water by small businesses. In the few countries where industrial networks cater specially for the needs of industrial users, this supply is still counted as part of public supply.

There are three main reasons why industrial users tend to favour direct abstractions over public supply. First, the quality of water required by industrial users might differ substantially from the quality required in the public supply network, where water is also used for drinking purposes. Publicly-supplied water is produced to very high potable water quality standards, and these standards have been gradually tightened over recent years. This supply does not fit the needs of many industrial concerns, which can often use water of lower quality. It is only in the food and beverage industry that water must generally comply with public drinking water quality requirements.

Figure 3. “Economic” Sources of Industrial Water in Selected OECD Countries



There are only a few examples of countries where piped water of varying quality standards is supplied. In **Korea**, for instance, the price of publicly-supplied water varies according to the type of treatment applied to the water provided (raw water, filtered, purified). In addition to drinking water, water of other degrees of quality is also distributed on a limited scale by water companies in the **Netherlands**, such as non- and semi-filtered water, distilled and demineralised surface water. 62.3 million m<sup>3</sup> of this “other water” was distributed in 1995 by seven water supply companies, mostly to industrial users which did not require drinking water quality standard.

Second, especially for non-consumptive uses, it is generally easier for industries to abstract water directly from surface waters near the plant, and to discharge it back to the point of supply with minimum treatment. The costs of doing so are often lower than for using publicly-supplied water.

Finally, the preponderance of direct abstractions is probably influenced by the fact that, whereas public water prices may sometimes discriminate against industrial users (and have been increasing in order to reflect higher quality requirements), abstraction charges for industrial users are usually administratively-based, rather than reflecting the true economic costs of the water use.

As a result of these three reasons, above a certain threshold of water use, it is usually cheaper for industrial users to invest in water abstraction and treatment facilities than to pay for publicly-supplied water. In **Canada**, a quantitative evaluation was recently made, comparing the two sources of supply. The methodology used conceptualised the industrial water price for self-supplied users as being the average cost per cubic meter of the combination of water acquisition, treatment, re-circulation, and wastewater treatment. In addition, there is a small licence fee paid to the respective Provincial

Governments for access to the (provincially-owned) water resource. These charges are not related to actual water quantities abstracted — they tend instead to be set on the basis of maximum allowable intakes — and they do not provide adequate incentives to use water efficiently. The cost of using directly abstracted water calculated on this basis is very low, which probably explains why about 83 per cent of manufacturers in Canada used water from self-supplied freshwater sources in 1990.<sup>6</sup>

One important consequence of the dominance of direct abstractions is that water price data for a large percentage of industrial water users (primarily the largest users) can be difficult to ascertain because the costs of direct abstraction vary widely from one industrial concern to another, and data are not easily accessible (the information is often not public). In most cases, direct abstraction and discharge charges are the only proxies which can be used to compare the costs of self-supplied water between OECD countries. Thus, abstraction charges and discharge charges are analysed separately later in this report.

It is also important to bear in mind that, because publicly-supplied water represents such a small fraction of total industrial water use, data on public water prices gives only partial comparative information for industrial water prices as a whole.

### ***“Environmental” sources of industrial water***

The “environmental” source of water can be either groundwater or surface water. Table 3 and Figure 4 shows that, on average (in those OECD countries for which data is available), 64 per cent of industrial water abstractions come from surface water, and 36 per cent come from groundwater sources.

Whether industrial users who directly abstract their water choose to do so from surface water or from groundwater sources depends on two main cost “drivers”: the relative investment and operating costs of directly abstracting water (the setting up of abstraction facilities, borehole, or pipe) for the two sources, and the abstraction charge levied by environmental regulators, which usually varies according to the source of abstraction.

Industrial users tend to access the cheapest abstraction source available first (i.e. the source for which investment and operating costs, including charges, are minimised). The relative cost of surface water versus groundwater generally depends on the resource situation of each country. It is not necessarily true in all cases that surface water is cheaper, as the prevalence of surface water use might indicate. In **Denmark**, for instance, 99 per cent of water used is abstracted from groundwater sources because these resources are extremely abundant, even though conservation measures have recently tried to limit this use due to the increased pollution of aquifers.

The “environmental” source chosen by industry partly depends on variations in abstraction charges (where they apply). Depending on the relative scarcity of groundwater as compared to surface water, environmental regulators may set different levels of abstraction charges for water taken from the different sources.

In several *Länder* in **Germany**, for instance, groundwater abstraction charges are set higher than surface water abstraction charges. It is possible that this is related to a net increase in industrial abstractions from surface water sources, combined with a move away from groundwater abstractions.

---

6. See Tate and Scharf, 1995.

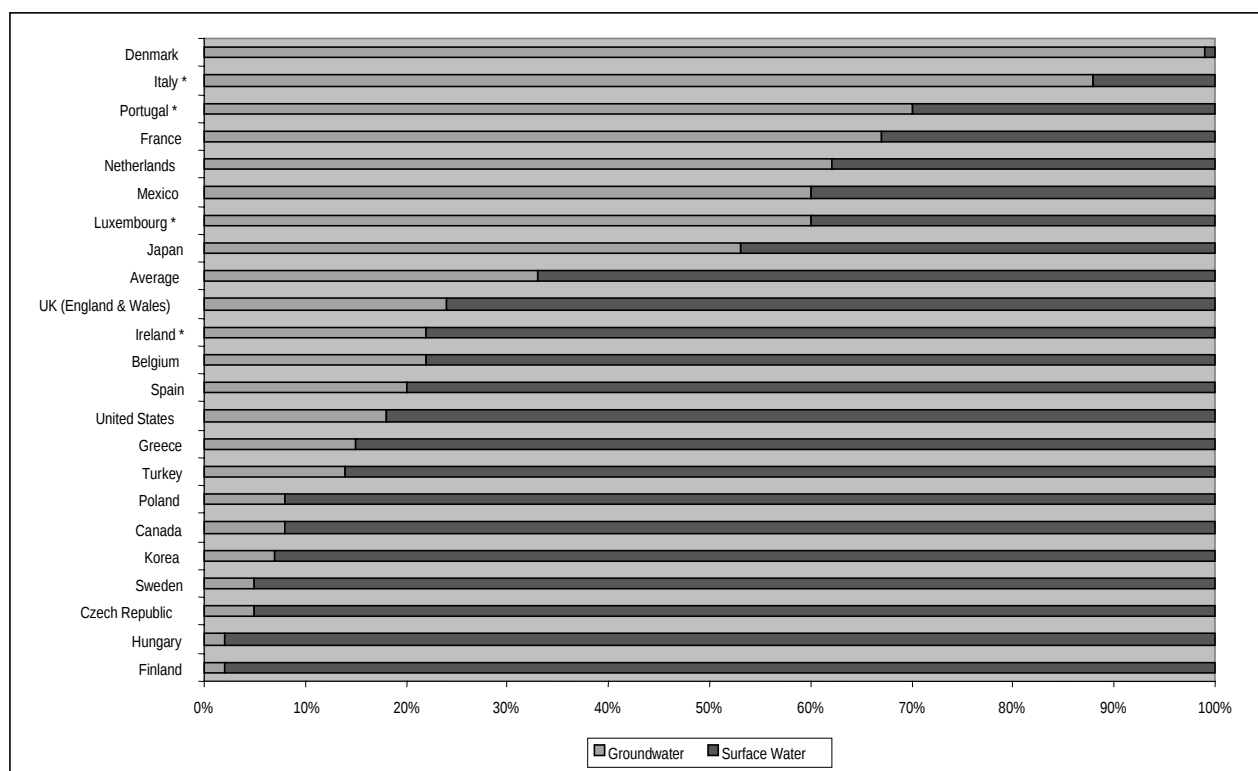
Table 3. Water Sources for Industrial Uses

|                      | “Environmental” |               | “Economic”          |               |
|----------------------|-----------------|---------------|---------------------|---------------|
|                      | Groundwater     | Surface Water | Direct Abstractions | Public Supply |
| Belgium              | 22%             | 78%           | 95%                 | 5%            |
| Canada               | 8%              | 92%           | 90%                 | 10%           |
| Czech Republic       | 5%              | 95%           | 84%                 | 16%           |
| Denmark              | 99%             | 1%            | n.a.                | n.a.          |
| Finland              | 2%              | 98%           | 98%                 | 2%            |
| France               | 67%             | 33%           | High                | Low           |
| Germany              | n.a.            | n.a.          | 92%                 | 8%            |
| Greece               | 15%             | 85%           | n.a.                | n.a.          |
| Hungary              | 2%              | 98%           | 62%                 | 38%           |
| Ireland *            | 22%             | 78%           | 90%                 | 10%           |
| Italy *              | 88%             | 12%           | 92%                 | 8%            |
| Japan                | 53%             | 47%           | 56%                 | 44%           |
| Korea                | 7%              | 93%           | 16%                 | 84%           |
| Luxembourg *         | 60%             | 40%           | 33%                 | 67%           |
| Mexico               | 60%             | 40%           | 72%                 | 28%           |
| Netherlands          | 62%             | 38%           | 95%                 | 5%            |
| New Zealand          | n.a.            | n.a.          | 70%                 | 30%           |
| Poland               | 8%              | 92%           | 97%                 | 3%            |
| Portugal *           | 70%             | 30%           | 60%                 | 40%           |
| Spain                | 20%             | 80%           | n.a.                | n.a.          |
| Sweden               | 5%              | 95%           | 94%                 | 6%            |
| Switzerland          | n.a.            | n.a.          | 70%                 | 30%           |
| Turkey               | 14%             | 86%           | 81%                 | 19%           |
| UK (England & Wales) | 24%             | 76%           | 64%                 | 36%.          |
| United States        | 18%             | 82%           | 95%                 | 5%            |
| <b>Average</b>       | <b>36%</b>      | <b>64%</b>    | <b>77%</b>          | <b>23%</b>    |

Notes: “n.a.” denotes “not available”.

\* Data for “environmental sources” was derived from the data applying to all water uses. For Italy, the data is also limited to water sourced from the public supply system.

^ Data for “economic sources” was derived from the percentage of *wastewater* discharged directly.

**Figure 4. “Environmental” Industrial Water Sources in Selected OECD Countries**

\* Data for the “environmental” source was derived from the data applying to all water uses. For Italy, the data is also limited to water sourced from the public supply system.

**Table 4. Sectoral Water Use (Excluding Power Production)  
(as a Percentage of Total Industrial Use)**

|             | Chemical          | Steel<br>&<br>Iron | Pulp<br>&<br>Paper | Food<br>&<br>Drinks | Mining | Oil<br>&<br>Petroleum | Textiles | Other |
|-------------|-------------------|--------------------|--------------------|---------------------|--------|-----------------------|----------|-------|
| Austria     | ← Together: 80% → |                    |                    | n.a.                | n.a.   | n.a.                  | n.a.     | 20%   |
| Belgium     | 18%               | 43%                | 15%                | 4%                  | 14%    | n.a.                  | n.a.     | 6%    |
| Canada      | 21%               | 22%                | 38%                | 8%                  | 1%     | 6%                    | 1%       | 3%    |
| Finland*    | 18%               | 8%                 | 71%                | 1%                  | 1%     | 1%                    | 0%       | 0%    |
| Germany     | 36%               | 10%                | 6%                 | n.a.                | 26%    | n.a.                  | n.a.     | n.a.  |
| Hungary     | 18%               | 27%                | n.a.               | 17%                 | 19%    | n.a.                  | n.a.     | 19%   |
| Italy       | 38%               | 11%                | 14%                | 13%                 | n.a.   | 2%                    | 7%       | 15%   |
| Japan       | 32%               | 25%                | 10%                | n.a.                | n.a.   | n.a.                  | n.a.     | 33%   |
| Mexico ^    | 17%               | 5%                 | 5%                 | 46%                 | -      | 12%                   | 1%       | 14%   |
| Netherlands | 59%               | 9%                 | 2%                 | 7%                  | 0%     | 21%                   | 0%       | 2%    |
| Poland      | 28%               | 13%                | 8%                 | 9%                  | 11%    | 3%                    | 3%       | 25%   |
| Portugal    | 5%                | 7%                 | 26%                | 7%                  | 3%     | n.a.                  | 45%      | 7%    |
| Sweden      | 24%               | 19%                | 42%                | n.a.                | n.a.   | n.a.                  | n.a.     | 15%   |
| Turkey ^^   | 7%                | 10%                | 14%                | 28%                 | 8%     | 4%                    | 17%      | 12%   |

Notes: “n.a.” denotes “data not available”.

\* Marine (brackish) waters have been excluded; for more detail on the distribution of water use including marine waters, see Annex II.

^ Sugar production (37%) is included in Food & Drinks.

^^ Sugar production is included in Food & Drinks, and fertiliser industry is included in Chemical. Data are approximate, and are based on 1997 industrial production.

Conversely, surface water abstraction charges from some<sup>7</sup> sources in the **UK** are weighted by a coefficient of 3, whereas groundwater abstractions are weighted by a coefficient of only 1, with the result that abstraction charges are generally higher for surface water than for ground water. It appears that the behaviour of industrial users has not been significantly influenced by these differential charges (both of which are low), as 76 per cent of water directly abstracted by industry still comes from surface water in the UK.

In **Italy**, **Luxembourg** and **Portugal**, data on the sources of water used for industrial purposes was not available, and data for all water withdrawals was used instead. In this case, the estimates of the groundwater abstraction levels are likely to be slightly higher than what they would be if only industrial water uses were taken into account, since industrial users tend to favour the use of surface water for non-consumptive uses, and they can often use lower quality water (groundwater tends to be of higher quality).

### Types of industrial water use

Information on the major types of industrial water use was not available for all OECD countries surveyed. From the available data, however, it is clear that the industrial sectors with the largest water requirements are the chemical, steel, iron and metallurgy, pulp and paper, food and drinks, and oil and petroleum industries. Table 4 illustrates the relative share of each industrial sector within the manufacturing (or processing) envelope, excluding power production.

### Price structure for water services from the public system

This Section of the report provides an overview of price structures for water supplied to industrial users through public mains, and via specialised networks for industrial users. Water prices presented here remunerate the resource, treatment, and supply costs of water service suppliers.

Few hard-and-fast generalisations can be drawn about industrial water tariff policies for all OECD countries, largely due to the diversity encountered within the countries themselves. Price structures are generally fixed at the local (municipal) level, and can vary widely within a country (e.g. in order to reflect differences in cost structures). However, a number of criteria exist which can be used to characterise and compare pricing policies for industrial users between countries, and the results of such a comparison are summarised in Table 5.

#### *Tariff structures*

Various tariff structures for industrial users are in place in OECD countries. The most common of these involve two-part tariffs, including a fixed element (which generally varies according to some characteristic of the user) and a variable element (which is usually based on average cost-pricing). The fixed element can be based on the meter size (as in **Portugal**, and generally, in **Australia**), on pipe size (as in **Japan** and **Korea**), or on property value (as is sometimes the case in **Australia**, although it is now being phased out), in order to account for the capacity required by the industrial customer — i.e. its contribution to peak demand. In some countries, the fixed element is simply presented as a meter fee (such as in **Iceland**, **Turkey**, and **Italy**).

---

7. This applies only to those rivers whose flows are “supported” by releases from reservoirs by other activities managed by the Environment Agency.

**Table 5. Price Structures for Water Services from the Public System**

|                | <b>Tariff structure</b>                                                                       | <b>FCR</b> | <b>ND</b> | <b>MC</b> | <b>DTS</b> | <b>Special tariffs</b>                     | <b>Subsidies</b> |
|----------------|-----------------------------------------------------------------------------------------------|------------|-----------|-----------|------------|--------------------------------------------|------------------|
| Australia      | Fixed + volume-based                                                                          | ✓          | ✗         | ✓         | ✓          | ✗                                          | n.a.             |
| Austria        | Fixed + volume-based                                                                          | ✓          | ✗         | n.a.      | ✗          | n.a.                                       | ✓                |
| Belgium        | Fixed (meter rental) + volume-based                                                           | ✓          | ✓         | n.a.      | ✗          | Large volumes                              | Regional         |
| Canada         | Flat rates (annual fees) or volume-based, decreasing-blocks                                   | ✗          | ✗         | ✗         | ✓          | Contract-based                             | ✓                |
| Czech Republic | n.a.                                                                                          | ✓          | ✗         | n.a.      | ✓          | Contract-based (lower quality)             | ✓                |
| Denmark        | Connection (based on area) + fixed (various bases) + volume-based                             | ✓          | ✓         | n.a.      | ✗          | ✗                                          | ✗                |
| Finland        | Connection + fixed (meter and property size) + volume                                         | ✓          | ✓         | ✗         | ✗          | Exceptionally contract-based (large users) | Negligible       |
| France         | Connection + fixed + volume decreasing-blocks                                                 | ✓          | ✓         | ✓         | ✓          | Contract-based                             | ✓                |
| Germany        | Fixed + volume-based                                                                          | ✓          | ✓         | ✓         | ✓          | Large users, contract -based               | ✗                |
| Greece         | Connection + volume-based                                                                     | n.a.       | ✗         | n.a.      | ✓          | n.a.                                       | ✓                |
| Hungary        | Volume-based                                                                                  | n.a.       | n.a.      | n.a.      | n.a.       | Capital contributions                      | ✓                |
| Iceland        | Fixed (meter fee) + volume (varies with meter size)                                           | n.a.       | n.a.      | n.a.      | ✓          | n.a.                                       | n.a.             |
| Ireland        | Connection + volume based                                                                     | ✗          | ✗         | n.a.      | ✓          | Capital contributions                      | ✓                |
| Italy          | Fixed (meter fee) + volume-based (rising blocks)                                              | ✗          | ✗         | ✓         | ✗          | Industrial networks                        | ✓                |
| Japan          | Fixed (pipe size) + volume                                                                    | ✗          | ✗         | ✗         | n.a.       | Contract-based                             | ✓                |
| Korea          | Fixed (pipe size) + volume                                                                    | ✓          | ✗         | ✗         | ✗          | ✗                                          | ✓                |
| Mexico         | Fixed +volume, majority of increasing-block tariffs                                           | ✗          | ✗         | ✗         | n.a.       | n.a.                                       | ✓                |
| Netherlands    | Connection + fixed (size of meter)+ volume-based                                              | ✓          | ✓         | ✗         | ✗          | Operating hours                            | ✗                |
| New Zealand    | Annual fee + volume-based                                                                     | n.a.       | n.a.      | ✗         | n.a.       | n.a.                                       | n.a.             |
| Norway         | Connection + fixed charge                                                                     | ✓          | n.a.      | n.a.      | n.a.       | n.a.                                       | Regional         |
| Poland         | Volume-based charge                                                                           | n.a.       | ✗         | n.a.      | n.a.       | n.a.                                       | ✓                |
| Portugal       | Fixed (meter size) +volume (increasing-blocks)                                                | ✗          | n.a.      | n.a.      | ✓          | n.a.                                       | n.a.             |
| Spain          | Diversity of structures<br>Majority: increasing two-blocks                                    | ✗          | n.a.      | n.a.      | n.a.       | n.a.                                       | ✓                |
| Sweden         | Fixed (size industrial estate, meter size) + volume-based                                     | ✓          | ✗         | ✓         | ✗          | Cooling water tariff.<br>No seasonal       | ✗                |
| Switzerland    | Fixed + volume-based                                                                          | n.a.       | n.a.      | n.a.      | n.a.       | n.a.                                       | n.a.             |
| Turkey         | Fixed + volume based                                                                          | ✗          | ✗         | ✗         | ✓          | Contracts                                  | n.a.             |
| UK             | Connection + fixed (pipe size) + volume-based                                                 | ✓          | ✓         | ✗         | ✓          | Large- user tariffs                        | ✗                |
| US             | Connection and development fees, diversity of block structures<br>More increasing-block rates | ✓          | ✗         | ✗         | ✓          | Seasonal tariffs<br>Excess use charges     | ✗                |

- Notes:
- “n.a.” = “data not available”; ✓ = yes; ✗ = no.
  - Tariff structure: What types of *tariff structures* are in place?
  - FCR: Is there *full-cost recovery*? (i.e. are total revenues required to cover operating expenditure, plus depreciation, plus a return on capital employed?)
  - ND: Is *non-discrimination* a requirement? (i.e. are the tariffs for each customer group required to reflect the costs of the customer group concerned?)
  - MC: Is there any *marginal cost pricing*?
  - DTS: Do industrial customers have a *different tariff structure* compared with other customers?
  - Special tariffs: Are there any *special tariffs* for industrial customers?
  - Subsidies: Are there any *subsidies*?

Decreasing-block tariffs, where successive blocks of water are sold at lower and lower prices, are present in some regions of the **US**, especially in industrialised regions with significant heavy industry (such as the Great Lakes), where they are seen as an instrument to favour industrial users. The use of decreasing-block tariffs used to be common in the **US** for industrial users, but they are now slowly disappearing (and have been banned entirely in Massachusetts).

Increasing-block tariffs, where successive blocks of water are sold at ever-higher prices exist in **Italy, Portugal, Spain** and the **US**. In **Spain**, there is a large diversity of tariff structures, but most involve increasing two-block tariffs. In the **US**, increasing-block tariffs are now more often favoured, especially in the West, where conservation objectives are more important due to repeated drought conditions. In Los Angeles, for instance, a seasonal increasing-block rate structure has recently been adopted, with rates being adjusted for “average prior use” by industrial users.

Flat-rate tariffs are rare for industrial users, given that industrial users are always metered, (whereas domestic water users sometimes are not), and contribute most revenue on a volumetric basis. In **Canada**, however, tariff structures are rarely based on economic principles, and some flat-rates have existed for industrial users. In particular, industrial firms can negotiate contracts with the municipalities for water services, and these contracts are normally negotiated for bulk rates, unrelated to the precise quantities of water used.

In addition, a connection charge may be levied separately, as is the case in **Denmark, Finland, France, Greece, Ireland, the Netherlands, Norway, UK** and the **US**. The basis for defining the connection charge can vary substantially. In **Denmark**, for instance, industrial users pay a charge based on a unit area of 800 m<sup>2</sup> of property.

### ***Full-cost recovery***

“Full-cost recovery” implies that at least all costs which result from the legal and administrative obligations placed on the service provider are recovered through charges. Service providers therefore usually need to recover the following costs from water users: operation and management costs, capital maintenance costs, capital costs (principal plus interest repayment), and reserves for future improvements and extensions. The absence of full cost-recovery either means that subsidies are in place to make up the difference between costs and water charges (so that the water utility can be financially sustainable), or that the asset base is being run-down.

The full-cost recovery principle is strictly applied in a relatively small number of OECD countries. In **Germany**, municipalities must comply with a set of basic pricing principles and one of these principles is that water charges must cover all costs (full-cost recovery), including an appropriate return on capital and the depreciation costs of existing assets. In **Australia**, the reform of the water sector currently taking place in many states is intended to lead to full-cost recovery, to consumption-based pricing, and to the removal of cross-subsidies between customer types.

In most countries, cost recovery does apply to operating costs, but charges are usually not sufficient to cover all capital costs, hence the existence of subsidies for investment costs. In **Hungary** and the **Czech Republic**, water subsidies were removed in 1990 and 1994 respectively, and prices are now based on economically-justified costs and reasonable profits. The investment backlog is so large, however, that subsidies are still being used to cover the costs of building new water and wastewater treatment plants.

### ***Non-discrimination***

According to full cost-recovery principles, overall costs should be recovered through water charges for all customer classes, taken as a whole. The non-discrimination principle states that each customer class should pay charges which are sufficient to recover costs engendered by the supply of water services to their particular customer class.

This principle is explicitly mentioned in the pricing policies of the **UK**, **France**, and **Germany**. In practice, it can be difficult to ascertain whether special tariffs for industrial users are justified on cost grounds (hence, non-discriminatory) or not.

In a number of cases, however, water tariffs do tend to discriminate between users, and cross-subsidies appear to be in place. As mentioned above, subsidies were abolished in 1994 in the **Czech Republic**, but some cross-subsidies from industrial users to domestic users were maintained during a transitional period, to alleviate the impact of high water prices on households following the removal of subsidies. In the future, the government's objective is to remove these cross-subsidies, and to make prices converge towards real costs. In **Greece**, volumetric rates for industrial users are generally higher than for households. In **Italy**, an increasing-block tariff structure enables water companies to offer a subsidised tariff to domestic users for the lower consumption blocks. In **Japan**, charges are based on the relative payment capacity of each customer class, and there are cross-subsidies between customer classes. In **Korea**, domestic users pay much less than industrial users, but the difference has recently been reduced due to general price increases. In **Mexico**, industrial water users, together with domestic users and power stations, subsidise agricultural users, who do not pay for water at all.

### ***Marginal cost pricing***

Marginal cost pricing, where prices are equal to marginal costs, is the most efficient pricing structure for guaranteeing that correct price signals are passed on to consumers. Due to a number of practical difficulties, however, strict marginal cost pricing has yet to be implemented in the water sector in OECD countries. In Tables 5 and 6, the category "marginal cost pricing" refers specifically to attempts that have been made to reflect marginal costs in the volume-based element of a country's tariff structure.

Strict implementation of marginal cost pricing can generate considerable administrative costs, which may counter-balance the efficiency benefits of applying a marginal cost pricing methodology in the

first place. For instance, marginal cost pricing may require the installation of complex meters capable of determining not only the total consumption level of a water user, but also the time at which the consumption took place. Marginal cost pricing for industrial users therefore remains the exception in OECD countries, with only a few examples existing. In **Germany**, for example, industrial users can form special agreements for lower rates when they buy water outside peak times. In **France**, the “Canal de Provence” company applies a marginal cost pricing methodology for all user types. In Phoenix (Arizona) in the **US**, a seasonal uniform rate structure has been adopted, based on long-term marginal costs.

Finally, seasonal variations in pricing structures can be seen as a form of marginal cost pricing. Such schemes are in place in some **US** waterworks, and in some regions of **France**.

### ***Tariff structures for industrial users vs. others***

Industrial users can be charged according to a similar tariff structure as domestic users, or they can be charged following a very different tariff structure. Thus, domestic users in a number of countries are charged on the basis of flat rates, whereas industrial users are almost always metered. This is the case in the **UK**, where domestic users are charged on the basis of the value of their property, while industrial users are metered. Similarly, in **Ireland**, domestic charges have been entirely consolidated into general taxation, but industrial users are metered and charged on a volumetric basis. In **Iceland**, domestic users pay an annual fixed charge per square meter of property, plus an overall charge per property, while industrial users are billed according to a two-part tariff, with a fixed charge (which varies according to the meter size) and a volume-based charge.

### ***Special tariffs for industrial customers***

In some countries, little information is available on tariff structures for industrial consumers because industrial users tend to enter into special contracts with water suppliers. Such contract-based tariffs are found in a number of countries, including **Canada**, the **Czech Republic**, **France**, **Germany**, and **Japan**. In **Finland**, tariff structures and levels are in most cases the same for households and industry, but in exceptional cases large users can negotiate “wholesale” tariffs, based on lower unit costs. In **Germany**, special contracts are offered in the more industrialised areas in the north. In some cases, contracts can involve the supply of lower-quality water, such as in the **Czech Republic**. In these cases, contract terms are generally not made public, so no statistics are available

In other countries, special tariffs are available for industrial customers, but they are publicly-available to an entire class of customers, and are therefore not based on bilateral negotiations. In the **UK**, “large user” tariffs were introduced in England and Wales in 1993. At the time, the economic regulator (the Director-General of Water Services) was asked to determine whether these special tariffs conformed to the requirement of avoiding “undue discrimination and preference” imposed on water companies through their licences. The regulator found that various reasons may justify discounts for industrial users, including the argument that “large users may have more stable demands, avoid some peak costs (particularly if on-site storage is provided). Where water is supplied in large pipes, some of the costs in the distribution system (including leakage) may also be avoided.” If these factors are material enough, the regulator had no opposition to them being reflected in tariffs, but preferably through standard charges available to all customers in similar circumstances, rather than by special agreement.<sup>8</sup> The rationale that lower tariffs may be available on the grounds that industrial users simply consume larger volumes of

---

8. Ofwat, RD9/93, “Tariffs for Business Customers”, June 1993.

water was specifically rejected by the UK regulator, but is applied in **Belgium**, where the largest consumers can negotiate special supply contracts with distribution companies, on the basis of which prices can be reduced by up to half the value of normal prices.

Another type of charge which is specifically applied to industrial users is a capital contribution for special investment works. These can be seen as a form of full-cost recovery pricing, since the relevant share of investment costs would be covered by industrial users in this case. In **Hungary** and **Ireland**, some waterworks have introduced capital contributions by users for additional investments, as a “one-off” charge. Capital contributions are also becoming important in New South Wales in **Australia**, partly for cost-recovery reasons, and partly to signal the differing costs (including environmental costs) of servicing new developments.

As mentioned earlier, seasonal tariffs are in place in some parts of the **US**, but are still not common in Europe. They exist in some **French** municipalities, but are explicitly banned in **Sweden**. Seasonal tariffs are one favoured way of introducing marginal cost pricing elements in the tariff structure.

### ***Subsidies for industrial users***

Subsidies can be available for water suppliers when charges are not sufficient to recover full costs, or can be paid directly to industrial users willing to improve their water abstraction or treatment capacities.

The most common type of subsidy given to water suppliers is loan reductions for investment in water and wastewater treatment plants. Such subsidies exist in **Austria**, where subsidised loans are available for water and wastewater projects. Subsidies can also take the form of direct grants: in **Greece**, for example, infrastructure costs are not generally covered by revenues, and a minimum of 35 per cent of the necessary investment is automatically granted to water companies by the central Government each year. **EU** funds may also contribute to the cost of building water and wastewater treatment plants in **Greece**, **Hungary**, and **Portugal**.

In **France**, industrial users can receive subsidies directly from the River Basin Agencies for the building of water and wastewater treatment plants for direct abstractions and discharges. However, these funds are financed by the users of the water system through pollution and abstraction charges, and are therefore better interpreted as a form of redistribution.

In **Belgium (Flanders)**, the revenues from the pollution charge are turned over to the MINA Fund, which redistributes them to (among others) specific subsidies for investment in water treatment facilities and municipal (or inter-municipal) sewerage works. This is the solution reached in Flanders, where a public-private company (overseen by the Region) has the responsibility to carry out these investments and to develop the infrastructure.

### **Price structure for sewerage services from the public system**

This Section of the report describes the structure of standard sewerage charges for public sewerage services to industrial users (Table 6). Given that industrial uses are often characterised by especially strong effluents, the structure of sewerage charges for industrial users is not complete without taking into consideration trade effluent charges (Table 7).

**Table 6. Price Structures for Sewerage Services from the Public System**

|                        | SC   | Tariff structure                                            | FCR  | ND   | MC   | DTS  | Subs  | Special tariffs                                    |
|------------------------|------|-------------------------------------------------------------|------|------|------|------|-------|----------------------------------------------------|
| Australia              | ✓    | Fixed (various basis) + volume basis (various basis)        | ✓    | ✗    | ✓    | ✓    | ✓     | n.a.                                               |
| Austria                | ✓    | Fixed (property size) or volume based on water use          | ✓    | ✗    | n.a. | ✗    | ✓     | Partial rebates if less discharges than water used |
| Belgium                | ✓    | Depends on load                                             | ✓    | ✓    | n.a. | ✓    | ✗     | n.a.                                               |
| Canada                 | ✓    | Treatment costs included in water bill if no extra strength | n.a. | n.a. | ✗    | ✓    | n.a.  | n.a.                                               |
| Czech Republic         | ✓    | n.a.                                                        | n.a. | n.a. | n.a. | n.a. | n.a.  | n.a.                                               |
| Denmark                | ✓    | Fixed (size of property) + Based on water volume            | ✓    | n.a. | n.a. | n.a. | ✗     | n.a.                                               |
| Finland                | ✓    | Paid within the water bill<br>Volume + connection charges   | ✓    | ✓    | ✗    | ✗    | negl. | n.a.                                               |
| France                 | ✓    | Percentage of water bill                                    | n.a. | n.a. | n.a. | ✓    | n.a.  | Contract-based                                     |
| Germany                | ✓    | Based on water volume or surface area                       | ✓    | ✓    | ✓    | ✓    | ✗     | Rebates if less discharges than water used         |
| Greece                 | ✓    | Based on water volume                                       | n.a. | n.a. | n.a. | n.a. | ✗     | n.a.                                               |
| Hungary                | ✓    | Based on water volume                                       | n.a. | n.a. | n.a. | n.a. | ✓     | n.a.                                               |
| Iceland                | n.a. | n.a.                                                        | n.a. | n.a. | n.a. | n.a. | n.a.  | n.a.                                               |
| Ireland                | ✗    | Within water bill, not separate                             | n.a. | n.a. | n.a. | n.a. | ✓     | Capital contributions                              |
| Italy                  | ✓    | Based on water volume                                       | ✗    | ✗    | ✓    | ✓    | ✓     | n.a.                                               |
| Japan                  | ✓    | Based on water volume                                       | ✗    | n.a. | n.a. | ✓    | ✓     | n.a.                                               |
| Korea                  | n.a. | Based on water volume                                       | ✓    | ✗    | ✗    | ✗    | ✓     | None                                               |
| Luxembourg             | ✓    | Based on water volume                                       | n.a. | n.a. | n.a. | n.a. | ✓     | n.a.                                               |
| Mexico                 | ✓    | Based on water volume                                       | ✗    | n.a. | n.a. | n.a. | ✓     | n.a.                                               |
| Netherlands            | ✓    | Function of pollutant                                       | ✓    | n.a. | n.a. | ✓    | ✓     | n.a.                                               |
| New Zealand            | n.a. | n.a.                                                        | n.a. | n.a. | n.a. | n.a. | n.a.  | n.a.                                               |
| Norway                 | n.a. | n.a.                                                        | n.a. | n.a. | n.a. | n.a. | n.a.  | n.a.                                               |
| Poland                 | ✗    | Percentage of water bill                                    | n.a. | ✗    | n.a. | ✓    | ✓     | n.a.                                               |
| Portugal               | ✓    | Based on water volume or property size                      | n.a. | n.a. | n.a. | n.a. | ✓     | n.a.                                               |
| Spain                  | ✓    | Recover operating and maintenance costs                     | ✓    | ✗    | n.a. | ✓    | ✗     | n.a.                                               |
| Sweden                 | ✗    | Fixed (size of meter or property) + volume based            | ✓    | ✗    | ✓    | ✓    | ✗     | n.a.                                               |
| Switzerland            | n.a. | n.a.                                                        | n.a. | n.a. | n.a. | n.a. | n.a.  | n.a.                                               |
| Turkey                 | ✓    | Based on water volume + Connection charge                   | ✗    | ✗    | ✗    | ✓    | ✓     | n.a.                                               |
| UK (England and Wales) | ✓    | Based on water volume<br>Surface and highway drainage       | ✓    | ✓    | n.a. | ✓    | ✗     | Large user tariffs                                 |
| US                     | ✓    | Uniform structure, or increasing-block tariffs              | n.a. | n.a. | n.a. | ✓    | n.a.  | No seasonal tariff                                 |

Notes: "n.a." = "data not available"; ✓ = yes; ✗ = no.

- SC: Is there a *separate sewerage charge*?
- Tariff structure: What are the types of *tariff structures* in place?
- FCR: Is there *full-cost recovery*? (i.e. Are total revenues required to cover operating expenditure, plus depreciation, plus a return on capital employed?)
- ND: Is *non-discrimination* a requirement? (i.e. Do the tariffs for each customers group reflect the costs of the customer group concerned?)
- MC: Is there any *marginal cost pricing*?
- DTS: Do industrial customers have a *different structure* to other customers?
- Subs.: Are there any *subsidies*?
- Special tariffs: Are there any *special tariffs* for industrial customers? This does *not* include extra strength trade effluent charges (see Table 7 for these).

**Table 7. Trade Effluent Charges**

|                      | <b>Strength charge?</b> | <b>Levied by?</b>                        | <b>Based on ?</b>                                             | <b>Specifications</b>                                     |
|----------------------|-------------------------|------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| Australia            | ✓                       | Service providers                        | List of pollutants                                            | Levied by certain providers only                          |
| Austria              | ✓                       | Some municipalities                      | For example, COD above given volume of water used             | Applies everywhere                                        |
| Belgium              | ✓                       | Municipalities — Fund                    | Pollution unit, based on industry factor                      | Some charges on water temperature                         |
| Canada               | ✓                       | Large municipalities                     | Percentage added to water bill                                | Levied by certain providers only                          |
| Czech Republic       | Discharge charges       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Denmark              | ✓                       | Municipalities                           | Volume and pollution control                                  | Levied by certain providers only                          |
| Finland              | ✓                       | Municipalities                           | Volume + pollution content (extra cost)                       | n.a.                                                      |
| France               | ✓                       | River Basin Agencies                     | Allocated pollution loads by industry<br>Pollution parameters | Charge varies with pollution location, applies everywhere |
| Germany              | ✓                       | Länder or municipalities                 | Pollution unit by pollution parameter                         | n.a.                                                      |
| Greece               | ✗                       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Hungary              | ✗                       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Ireland              | ✓                       | Local authorities                        | Volume related                                                | Levied by certain localities only                         |
| Italy                | ✓                       | Municipalities                           | Quantity + quality criteria                                   | n.a.                                                      |
| Japan                | ✓                       | n.a.                                     | n.a.                                                          | Levied by certain municipalities only                     |
| Korea                | Discharge charges       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Luxembourg           | Discharge charges       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Netherlands          | ✓                       | Water Boards                             | Charge per pollution unit                                     | Large industrials are closely monitored                   |
| Poland               | Discharge charges       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Portugal             | ✗                       | n.a.                                     | n.a.                                                          | n.a.                                                      |
| Spain                | ✓                       | River Basin Agencies invest in treatment | Pollution content in population equivalent                    | Applies everywhere                                        |
| Sweden               | ✓                       | Municipalities                           | Pollution content                                             | Contract based                                            |
| Turkey               | ✓                       | Municipalities                           | Fixed charge plus pollution content                           | Applies everywhere                                        |
| UK (England & Wales) | ✓                       | Water companies                          | “MOGDEN” formula (pollution content)                          | Varies                                                    |
| US                   | ✓                       | Water networks                           | Pollution content                                             | Monitoring expenses                                       |

“n.a.” = “data not available”; ✓ = yes; ✗ = no.

### *Separate sewerage charge*

Sewerage services are not always charged separately from water supply services. Even where sewerage services are separately identified on the utility bill, they are sometimes simply calculated as a percentage of the water supply charges. This is the case, for example, in both **Ireland** and **Poland**. In Ireland, however, there is increasing use of separate monitoring and charging for industrial wastewater treatment.

### *Tariff structures*

Two-part tariffs for sewerage charges exist in **Australia, Austria, Denmark, Finland**, and the **UK**. In other countries, such as **Germany** and **Portugal**, both tariff elements are used (volumetric and fixed), but generally only one is used at a time. In Portugal, for example, wastewater collection and treatment costs are charged either through an additional payment for each cubic meter of water supplied, or through a charge paid as part of the general municipal tax (i.e. as a function of the property price).

In countries where a specific sewerage charge is calculated, a similar type of structure to the structure used for water pricing tends to apply, albeit in a less sophisticated manner. There are also structures in place which include only a volumetric element (based on the volume of water consumed), or only a fixed element. The volume-based element is generally based on the volume of water consumed, since the volume of sewerage is difficult to measure, and is therefore not usually metered. The fixed element can be based on the size of the property (as in **Austria**), the value of the property, or on the meter size. In **Australia**, the fixed charge can be based on various criteria (the value of the property, the meter size, a discharge factor), and the volume charge can be based on the pollutant load. In **Germany**, industrial water users can obtain a rebate if they are discharging a much smaller amount of (dirty) sewage than their water intake — for instance, where water is used for cooling.

One emerging issue which makes wastewater tariff-setting more complicated than for water supply is the issue of rainwater. So-called “combined” public sewerage services must treat both wastewater discharges by water users and rain water runoff (e.g. surface drainage and highway drainage). This sometimes creates a need to substantially increase sewer capacities. In some countries (e.g. **Germany** and **Austria**), the fixed charge is based on the surface covered by the property (or the industrial estate) as a proxy indicator of the related surface drained by rainwater. This charge is levied in order to cover the costs of treating rainwater. In the **UK**, surface and highway drainage charges are calculated as an added premium, and are included in the normal fixed and variable charges. They are generally not based on the surface area being drained (on the grounds that this would be too costly to administer).

In some cases, standard sewerage charges can be difficult to distinguish from “special strength” charges, which are used to recover costs from any extra capacity built to treat industrial waste. These extra pollution charges levied by the service provider exist, for example, in **Belgium, Poland, Spain, Sweden** and the **UK**. In **Belgium** and the **Netherlands**, industrial users always pay a sewerage charge per unit of pollution produced (this is equivalent to paying a trade effluent charge). In **Finland**, a similar charge is applied using a threshold: higher or lower tariffs are levied if wastewater quality considerably differs from the average.

These “targeted” charges, along with higher sewage treatment charges generally, are causing industry to take an increasingly hard look at in-plant treatment as a strategy for avoiding these charges. Another consequence of existing pricing strategies is that sewage treatment plants sometimes serve as “nodes” which attract “clusters” of specific kinds of industry. This is the situation, for example, in **Portugal** and **Greece**. One result of this clustering is that it makes sewage disposal easier for the government to control, either through environmental regulations, or via better “targeted” prices.

### ***Full cost-recovery***

The pricing of wastewater services is generally based on accounting principles, which aim at covering some fraction of the costs of providing the services. In **Germany**, the principle of full cost-recovery applies to wastewater services in the same way as it does to water services. In **Austria**, charges reflect the full costs of providing sewage services. In **Finland**, municipalities are strongly encouraged by law to collect user charges and connection charges to cover the full costs incurred by wastewater treatment activities.

However, there is a considerable backlog of investment needs in wastewater treatment capacity in many OECD countries. For this reason, even if sewerage tariffs are set to recover operating and maintenance costs, they are often insufficient to cover future investment costs. This is particularly true in **Japan**, where the current sewerage connection rate is low by OECD standards, and in some **EU** countries, where the implementation of the Urban Wastewater Treatment Directive (91/271/EEC) has led to considerable investment needs in order to comply with more stringent standards. In **Ireland**, for example, where charges for water and sewerage services have traditionally been low, local authorities have recently started asking industrial users to make capital contributions for new investments in wastewater capacities, in order to improve the financial self-sufficiency of the service.

### ***Non-discrimination***

In **Germany**, **France**, and the **UK**, the principle of non-discrimination between customer classes applies to sewerage services in the same way as it does to water supply services. While no clear cases of cross-subsidies in the field of wastewater services were identified in this study, it is likely that they are as extensive for wastewater services as they are for water supply services.

### ***Marginal cost pricing***

Standard sewerage charges are generally less sophisticated than charges for water services. In the **US**, for instance, most sewerage rates are based on uniform structures, with no seasonal volume adjustment. However, the introduction of “extra load” charges can be seen as an attempt to introduce prices based on marginal costs, especially when pollution charges reflect the additional treatment costs imposed on the system by each type of discharge.

### ***Tariff structures for industrial users vs. others***

Sewerage tariff structures are different for industrial users, as compared with other users, when there is a specific charge for heavy loads aimed at reflecting the added costs imposed on the system.

When sewerage charges for industrial users are based on the load characteristics of the effluent, a different structure often applies to industrial users than that which applies to households.

### ***Subsidies for industrial users***

In many countries, public subsidies are employed to meet investment costs for sewerage facilities. In a number of countries, the proceeds of a special pollution charge are channelled into a fund, which then redistributes specific subsidies or “soft-loans” for investing in wastewater treatment facilities. This occurs, for example, in both **France** and **Spain**, through the River Basin Agencies. A similar system existed in the **Netherlands** until 1997, but revenues from the charge are now used to finance research. However, industrial users which discharge into the public system in that country can still receive a discount per population equivalent of discharge. Since the public facility is designed to handle a certain capacity, the discount for large users (subsidy) is maintained, in order to prevent these users from developing their own treatment facilities, which would significantly increase the costs associated with the remaining population equivalent discharges.

### ***Special tariffs for industrial customers***

In the **UK**, large-user tariffs are offered to industrial users (independently of the trade effluent charge) by some water and sewerage companies. In **Germany** and **Austria**, industrial users that can prove they discharge a lower wastewater volume into the sewer than the volume of water received can obtain a discount.

## **Trade effluent charges**

It is only when “special strength” effluent charges are levied that charges for sewerage services can accurately reflect the costs of wastewater treatment for industrial discharges. So-called “trade effluent” charges are generally specific to industrial users, since these are the heaviest polluters.

### ***The nature of trade effluent charges***

Trade effluent charges are the extra sewerage charges paid to the service provider to reflect the additional costs created by the treatment of highly-polluted (or difficult-to-treat) sewage. This type of charge can also be levied by the environmental regulator (or another environmental protection institution) as an economic instrument designed to regulate pollution flows, and based on the “polluter pays principle”.

Sewerage and sewage treatment charges are raised by the public authority when discharges are sent to the public system. In **Italy**, when separate sewerage systems exist for industry (or when the public sewerage system discharges into a treatment plant that was originally constructed for industrial effluents), it is the plant operator himself who levies the charge. Plant operators for industrial effluent treatment are usually mixed public-private syndicates, involving different levels of government (municipalities, provinces, regions), as well as chambers of commerce, local banks, etc.

Service providers generally receive the proceeds of the trade effluent charge (as in the **UK** and the **US**). In **Austria**, industrial concerns can form sewage treatment groups with municipalities, and can set tariffs on the basis of the pollution load discharged by each industrial user. In **France** and **Spain**,

revenues are channelled into an investment fund (the River Basin Agencies), which can then allocate funds to water service providers, or can commission wastewater treatment investments directly. In **France**, industrial users discharging to the public sewer have to pay a pollution charge which varies according to the pollution load of their discharge. The pollution charge is collected by the service provider through the water bill, and is paid to the River Basin Agencies. The agencies cannot initiate the construction of new works themselves, but they can provide subsidies to various classes of consumers. In the Flanders Region of **Belgium**, the charges are also given to an investment fund (MINA).

Some countries, such as **Hungary** and **Portugal**, have not introduced trade effluent charging regimes yet, but are planning to do so in the near future. For many countries, the introduction of extra strength charges has been piecemeal, and has usually been decided upon at the local level, as in **Canada**, **Denmark**, **Ireland**, and **Japan**. In **Canada**, for example, there is no well-established regime of trade effluent charges. However, if industries make extra strength discharges, additional fees can be negotiated (in a limited number of cases) as part of the contract between the industry and the respective municipality. In **Denmark**, additional trade effluent charges have been introduced by some municipalities, but others have been reluctant to do so, for fear of losing industrial users, or because of the high monitoring costs entailed. In other countries, such as **Greece**, it seems unlikely that a trade effluent charging regime will be introduced in the near future.

### ***Charging principles***

Trade effluent charges usually depend on both the metered volume of pollutant on the pollution content. Some countries, such as **Belgium** and the **Netherlands**, charge according to pollution units, which are calculated based on certain formulae for each type of pollutant. In **Belgium**, a pollution factor is calculated for each type of industrial activity, and the wastewater charge in a given year is proportional to the charge paid in the previous year. The law was recently changed to give additional incentives to polluters to reduce discharges of heavy metals.

In **France**, a charge is levied on 8 types of pollutant deemed to be the most dangerous and/or difficult-to-treat (heavy metals, phosphorus, soluble salts, etc. — the complete list is provided in Annex II). The charge is calculated as a function of the pollution produced in a normal day during the period of maximum activity. River Basin Agencies have considerable flexibility in determining pollution fees, and some agencies do not charge for certain categories (e.g. there is no charge for soluble salts in Adour-Garonne).

In other cases, such as in **Finland** and the **UK**, a charging formula is defined to reflect the costs to the water treatment companies of treating a particular effluent. The pollution content of the effluent may be defined, for example, on the basis of “chemical oxygen demand (COD)” and/or on “suspended solids”.

Other factors can affect the value of the charge, such as the location of the pollution (thus, “sensitive zones” are defined in **France** by each river basin agency) or the type of receiving body (i.e. whether lake, category of river, or estuary, etc.).

Given that trade effluents can create a risk for the wastewater treatment system as a whole (due to unexpected variations in strength characteristics and volume), some service providers have introduced capacity charges for trade effluent so as to incorporate the value of this risk into the charging system (for example, in the East of Scotland Water Authority, **UK**, and in Melbourne, **Australia**).

## Abstraction charges

Charges are frequently levied in OECD countries for direct water abstractions by industry. Most countries explicitly differentiate between industrial uses and other uses, and apply different levels of abstraction charges to these different types of uses.

Abstraction charges can either take the form of a nominal licence fee linked to an abstraction permit regime, or they can be varied according to quantity criteria and, hence, have explicit environmental objectives (e.g. consumption reduction incentives) (Table 8).

### *Are there abstraction charges in place?*

Abstraction charges for industrial water use are in place in about half of OECD countries, including **Belgium, Canada, the Czech Republic, France, Germany, Hungary, Italy, Japan, Mexico, the Netherlands, Poland, Spain, Australia**, and the **UK**. According to previous studies<sup>9</sup>, they are also in place in the **US**, but no data confirming this was provided for this particular report. No abstraction charges are in place in countries where water is deemed to be abundant, (e.g. **Sweden, Finland, and New Zealand**). Many of these charges have only recently been introduced — in 1985 in **Germany**, in 1995 in the **Netherlands**, and in 1997 in **Mexico**. **Portugal** has recently voted in favour of the introduction of an abstraction charge, but this charge has not yet been implemented. Other abstraction charge systems are much older, such as in **France**, where River Basin Agencies were created in 1964, and where a particularly sophisticated regime of abstraction and consumption charges was set up, based on a very precise zoning system defined at the river basin level. Most countries differentiate by category of use, and the references given below apply specifically to the regime for industrial users.

In **Canada**, small licence fees apply. Fees are paid to the Provinces for access to provincially-owned waters, but they are only sufficient to recover the administrative costs of the system. In other countries, charges are levied that have an explicit environmental objective, with the proceeds allocated to an environmental fund. This is the case in **Belgium, the Czech Republic, France, Hungary, and the Netherlands**. In the Netherlands, there are two abstraction charges levied: one by the Provinces for the protection of groundwater; the other by the state within the system of general taxation. In Belgium, only groundwater industrial abstractions are taxed, with the proceeds going to a Fund for the protection of groundwaters. Flanders (Belgium) takes industrial abstractions from both surface and groundwater sources. Revenues are given to the MINA Fund, which then redistributes them to projects which benefit the environment.

### *Mode of calculation: capacity vs. actual use, differentiation*

Abstraction charge regimes can apply either to “capacity” (based on the allowed capacity according to a permit) or “actual use”, which requires metering and monitoring. In **France**, there are two distinct charges: an abstraction charge, based on volumes declared by users in advance; and a use charge, which varies according to the actual level of consumption. Similarly, in **Australia**, bulk water suppliers charge industrial users for abstracting water from rivers and groundwater. These charges are based both on the entitlement to abstract water and the amount of water abstracted, where this is metered. Where charges are paid in relation to permit systems, they tend to be set on the basis of maximum allowable intakes.

---

9. OECD, 1987.

**Table 8. Charges for Industrial Water Abstraction**

|                      | <b>In place?</b> | <b>Where do funds go?</b>                                 | <b>CAP</b> | <b>ACT</b> | <b>USE</b> | <b>Variations</b>                         | <b>TR</b> |
|----------------------|------------------|-----------------------------------------------------------|------------|------------|------------|-------------------------------------------|-----------|
| Australia            | ✓                | n.a.                                                      | ✓          | ✓          | n.a.       | n.a.                                      | ✓         |
| Austria              | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✗         |
| Belgium              | ✓                | Environment                                               | ✗          | ✓          | ✗          | ✗                                         | ✗         |
| Canada               | ✓                | Administrative costs                                      | ✓          | ✗          | n.a.       | n.a.                                      | ✗         |
| Czech Republic       | ✓                | Environment                                               | n.a.       | n.a.       | ✓          | Source, Location                          | ✗         |
| Denmark              | n.a.             | n.a.                                                      | n.a.       | n.a.       | n.a.       | n.a.                                      | ✗         |
| Finland              | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✗         |
| France               | ✓                | River Basin Agencies Environment                          | ✓          | ✓          | ✓          | Source, Location                          | ✗         |
| Germany              | ✓                | Administrative costs                                      | n.a.       | n.a.       | ✓          | Source, Location                          | ✗         |
| Greece               | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✗         |
| Hungary              | ✓                | Water Fund, Environment                                   | ✗          | ✓          | ✓          | n.a.                                      | ✗         |
| Iceland              | n.a.             | n.a.                                                      | n.a.       | n.a.       | n.a.       | n.a.                                      | ✗         |
| Ireland              | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✗         |
| Italy                | ✓                | Basin authorities                                         | ✓          | ✗          | ✓          | Rebate if water-saving technologies used. | ✓         |
| Japan                | ✓                | n.a.                                                      | n.a.       | n.a.       | n.a.       | n.a.                                      | ✗         |
| Korea                | ✓                | Environment, administrative costs                         | ✗          | ✓          | ✓          | Source                                    | ✗         |
| Luxembourg           | n.a.             | n.a.                                                      | n.a.       | n.a.       | n.a.       | n.a.                                      | ✗         |
| Mexico               | ✓                | n.a.                                                      | ✗          | ✓          | ✓          | Location                                  | ✗         |
| Netherlands          | ✓                | Environment (Provinces) General taxation (State)          | ✗          | ✓          | ✓          | Rebate if prior infiltration              | ✗         |
| New Zealand          | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✓         |
| Norway               | n.a.             | n.a.                                                      | n.a.       | n.a.       | n.a.       | Permit conditions                         | ✗         |
| Poland               | ✓                | Environment                                               | n.a.       | n.a.       | ✓          | Source; location                          | ✗         |
| Portugal             | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✗         |
| Spain                | ✓                | River Basin Agencies Administrative costs and environment | ✓          | ✗          | ✓          | Water rights hierarchy; location          | ✓         |
| Sweden               | ✗                | d.n.a.                                                    | d.n.a.     | d.n.a.     | d.n.a.     | d.n.a.                                    | ✗         |
| Switzerland          | n.a.             | n.a.                                                      | n.a.       | n.a.       | n.a.       | n.a.                                      | ✗         |
| Turkey               | ✓                | General budget (State/ municipalities)                    | ✓          | ✓          | ✓          | Water rights, hierarchy; location         | ✗         |
| UK (England & Wales) | ✓                | Environment Administrative costs                          | ✓          | ✗          | ✓          | Source, loss factor, seasonal             | ✗         |
| US                   | n.a.             | n.a.                                                      | n.a.       | n.a.       | n.a.       | n.a.                                      | ✓         |

Notes: "n.a."= "data not available"; d.n.a. = "does not apply"; ✓ = yes; ✗ = no

- In place?: Is there an abstraction charge for industrial water uses?
- Where do funds go?: What agency receives the revenues?
- CAP: Is the charge based on the capacity granted to the industrial user?
- ACT: Is the charge based on the actual use of water by the industrial user?
- USE: Do abstraction charge regimes differentiate between types of uses?
- Variations: Are there other variations in the abstraction charging regime?
- TR: Is it possible to trade abstraction licences in some places?

Abstraction charges can also vary according to the type of use. Industrial uses are not necessarily specifically-differentiated: in the **Czech Republic**, the distinction is between consumptive and non-consumptive uses (but not according to user category). In **France**, consumption coefficients are calculated (for public supply, industry, power generation, and agriculture) and are used in the calculation of the abstraction charges. When distinctions by type of user are in place, industrial uses may be explicitly taxed more heavily than domestic ones (in **Poland**, for instance, abstraction charges for public supply are 6 to 47 times lower than those for industrial supply). In **Germany**, by contrast, water-intensive industries can obtain rebates. In the **Netherlands**, the abstractor can claim a subsidy which will reduce the total charge, if surface water is injected into the aquifer before groundwater abstraction occurs. Similarly, in **Italy**, industrial users are all charged the same, but a 50 per cent reduction is given if water-saving techniques are employed.

Regional variations have been introduced in order to better manage resources on the basis of relative scarcity. These exist in the majority of countries which have adopted an abstraction regime, and they contribute to an extremely diverse water pricing environment faced by industrial users within the same country. Seasonal variations are more rare (they exist in the **UK**), but they play a similar role where they do occur.

Finally, abstraction charge regimes can also vary according to the source of supply (i.e. whether water comes from groundwater or surface water). In **Belgium (Wallonia)**, charges are levied at different rates on groundwater abstractors for the production of drinking water and other uses, as well as varying according to the volume abstracted. Charges may be levied for each source by different bodies: in the **Czech Republic**, Water Basin Companies levy the surface water abstraction charge, whereas the State Fund of Environment levies the groundwater abstraction charge (higher charges apply to groundwater).

### *Trading of abstraction licences*

Some countries have introduced trading of abstraction permits, in order to better organise water resource management, without having to rely on a regime of water abstraction permits and discharges. These experiences are relatively localised (California in the **US**; irrigated areas in **Spain**; some States in **Australia**; on a voluntary basis in some parts of **Italy** during periods of temporary water stress), and there is no fully-developed nation-wide scheme in any OECD country. However there has recently been some discussion about the possibility of introducing such a scheme in the **UK**.

### **Discharge charges**

Discharge controls are imposed on direct discharges, either those which do not go through the public sewer, or those which emanate from the public sewerage and sewage treatment system following treatment. Proceeds of discharge controls always go to the government (to cover administration costs or to provide revenues for the protection of the environment) or to an environmental fund, since no service provider is involved (Table 9).

The most common form of discharge control is linked to permit procedures: in order to discharge directly back into the river or the aquifer, industrial users (and other dischargers) usually need a permit. Most countries regulate the quality of waters into which wastes can be directly discharged, and breaking these quality standards typically leads to the imposition of fines, which can be seen as an

Table 9. Discharge Charges

|                      | Charge | Levied by?                | Based on pollution content?                                                                                    | Fines? |
|----------------------|--------|---------------------------|----------------------------------------------------------------------------------------------------------------|--------|
| Austria              | X      | d.n.a                     | d.n.a                                                                                                          | d.n.a  |
| Belgium              | ✓      | State env'l fund.         | Yes; on volume >500 m <sup>3</sup>                                                                             | n.a.   |
| Czech Republic       | ✓      | n.a.                      | Pollution content                                                                                              | ✓      |
| Denmark              | X      | n.a.                      | d.n.a.                                                                                                         | n.a.   |
| Finland              | ✓      | State                     | No; case-by-case basis, large polluters only                                                                   | ✓      |
| France               | ✓      | River Basin Agency        | Charge per pollutant<br>Vary according to user<br>Regional variations                                          | ✓      |
| Germany              | ✓      | Länder/<br>Municipalities | Pollution content (definition of pollution units for each pollutant)                                           | ✓      |
| Greece               | X      | d.n.a                     | d.n.a                                                                                                          | n.a.   |
| Hungary              | X      | d.n.a                     | d.n.a                                                                                                          | n.a.   |
| Ireland              | ✓      | Local authority           | n.a.                                                                                                           | ✓      |
| Italy                | X      | d.n.a.                    | d.n.a.                                                                                                         | n.a.   |
| Korea                | ✓      | Regional                  | Pollution content (definition of pollution units for each pollutant)                                           | ✓      |
| Mexico               | ✓      | n.a.                      | Receiving body, location, volume and pollution content<br>Discount if improved treatment                       | ✓      |
| Netherlands          | ✓      | State                     | Pollution per population equivalent<br>Input-output model, for largest polluters, quality and quantity metered | ✓      |
| Poland               | ✓      | Environment Fund          | Fees vary according to pollutant, industrial sector and receiving body                                         | ✓      |
| Portugal             | n.a.   | d.n.a                     | d.n.a                                                                                                          | n.a.   |
| Spain                | ✓      | River basin agency        | Based on pollution content calculated per population equivalent                                                | n.a.   |
| Sweden               | d.n.a. | d.n.a.                    | d.n.a.                                                                                                         | d.n.a. |
| Turkey               | ✓      | State/<br>Municipalities  | Pollution content in some municipalities                                                                       | ✓      |
| UK (England & Wales) | n.a.   | n.a.                      | n.a.                                                                                                           | ✓      |
| US                   | n.a.   | n.a.                      | n.a.                                                                                                           | ✓      |

Notes: "n.a." = "data not available"; "d.n.a." = "does not apply". ✓ = yes; X = no.

alternative to a formal regime of discharge charges. In **Ireland**, for instance, charges are imposed in the licensing process, and charges for non-compliance/illegal releases can be pursued via the courts in the form of fines and/or responsibility for reimbursing the local authority for remediation costs. Some local authorities charge for direct discharges, even if no treatment has actually been carried out. In **Austria**, industrial dischargers must comply with discharge standards, and separate regulations have been promulgated for about 70 different sectors. In **Korea**, if standards for direct discharges are violated, the industrial discharger must pay an additional charge, the level of which depends on both the degree of violation of the standard and the amount of wastewater discharged.

These systems are piece-meal, however, and cannot always be enforced in a comprehensive manner. This is one of the reasons why some OECD countries have introduced a formal discharge fee, which may be calculated in various ways.

In some countries, discharge charge regimes are particularly well-defined. In the **Netherlands**, for example, charges for industrial discharges into the main watercourses are administered by the State, based either on pollution loads estimated using input-output models for each industrial sector, or — for

the largest pollutants — based on metering the quality and quantity of the effluent.<sup>10</sup> In **Mexico**, discharge charges were recently (1997) introduced, and can vary according to the receiving body, the location of the discharge, the volume, or the pollution content. In order to avoid hampering new investments, a discount may be granted if a significant effort is made towards improving pre-treatment. In **Poland**, industrial dischargers must pay fees for wastewater discharges, as well as fines for non-compliance with discharge permits. These fines increase according to the degree to which the limit is exceeded. In **Australia**, the Environment Protection Agency of New South Wales has set up a load-based licensing system for discharges to waterways.

In the **Czech Republic**, charges for wastewater discharged to surface waters were introduced in 1979, and the charge is equivalent to the running costs of a wastewater treatment plant that would remove the pollution under consideration, measured in pollution units by type of pollutant. A surcharge is also applied to cover the adverse effects on the receiving watercourse. When the polluter starts building a new wastewater treatment plant, he/she is allowed to delay the payment of 60 per cent of these charges until construction is completed, so long as the project is completed within a reasonable time. If there are delays, the polluter has to pay the full amount of deferred charges, with penalties.

In **Finland**, water protection charges are imposed on heavy polluters on a case-by-case basis by the Water Rights Court, and proceeds of these charges are “earmarked” for water protection activities. In addition, there is a fish management charge levied on polluters which might have an adverse impact on fish stocks. These charges are not, however, related to actual pollution content, and charge rates are far below any incentive level. In **France**, pollution charges apply to direct discharges, and are levied by the River Basin Agencies. These charges are calculated on the basis of a pollution load defined by industry, and then modified by a “zone factor”. Similar calculations are carried out in **Germany**, but there is a 75 per cent reduction in charge if the standards recommended in the regulations (expressed as Best Available Technique) are met.

---

10. In the **Netherlands**, “state waters” (large bodies of water of national importance, such as the river Rhine and river Meuse and lake IJssel), are managed by the central government and other bodies of surface water of lesser importance are the responsibility of the provinces or, via delegation, of the (regional) water boards.

## MAIN ISSUES AND CURRENT TRENDS

### Introduction

Based on the detailed country surveys contained in Annex II, the previous section summarised: the key features of current industrial water pricing practices in OECD countries; the institutional and regulatory framework governing the general supply of water and sewerage services; the economic and environmental context for industrial water uses; and the most important elements of pricing structures for industrial water use. Numerous examples of how specific issues are being resolved in different ways in different countries were also highlighted.

Such a survey represents a “snapshot” of current practices in OECD countries. However, it is also informative to identify the main issues and trends that have helped to shape these current practices; that is, to consider how and why current practices have evolved over time, and how they might evolve in the future. Some of the key trends in industrial water pricing practices in OECD countries are therefore identified in this Section.

Inevitably, the main issues and trends vary significantly from country to country. There are also significant variations *within* individual countries; indeed, within-country variations can sometimes be as important as between-country variations when comparing the provision of water and sewerage services. This is particularly true for large countries, such as the **US** and **Australia**, where there are significant water management structures at the state level (as well as nationally), or for countries where there is a considerable level of autonomy at the local level, such as **Austria** and **Germany**. Nevertheless, it is possible to identify a number of (largely) common issues and trends shaping industrial water pricing practices in many OECD countries.

### Increasing private sector involvement and commercial objectives

A trend common to the water sector in many countries — and which affects pricing practices for all customer groups, not just industrial users — is the increasing involvement of the private sector in the financing of the industry, and/or the increasing emphasis given to commercial objectives for water and sewerage operators. This can be seen to be occurring in countries as varied as **Australia**, **Belgium**, the **Czech Republic**, **Norway**, the **UK**, and the **US**. There are a number of reasons for this trend, including:

- the frequent need to find additional sources of finance (other than public finances) for water/sewerage industry investment requirements — perhaps as a result of the need to finance improvements in water quality, supply reliability, and environmental quality as customers’ expectations rise; and
- the common desire to maximise (or at least to improve) the efficiency with which water services are provided.

However, private investors and shareholders require an adequate return on their investment — a return which reflects its particular level of risk. The need to secure investment has therefore often resulted in increasing attention being focused on the adequate financing of water enterprises, through the recovery of appropriate revenues from customers. This has in turn created pressures in many countries for improved cost-reflectivity of tariffs and a greater degree of explicit disaggregation of the customer base (e.g. to separately identify sewerage services, or to introduce new tariffs for different categories of users, such as large users). In each of **Belgium, Denmark, France, Germany** and the **UK**, for example, there is a requirement that tariffs should not discriminate between customer groups.

In many countries, water and sewerage supply retains its public ownership context. Where public ownership remains, there seems a stronger willingness to accept historical rate structures, which have a greater tendency to reflect past subsidies (and cross-subsidies) than water sectors which are actually involved in the process of reform.

### **Increased cost-reflectivity in tariffs**

In many countries, industrial water and sewerage tariffs are now set at a level designed to ensure full cost recovery — i.e. to cover operating expenditure, depreciation, plus a return on capital employed. As discussed earlier, water suppliers also frequently have a duty to set charges which do not discriminate unduly between different customer groups. This is generally interpreted as requiring that the relative prices to different customer groups broadly reflect their relative costs of supply. Although some elements of cross-subsidy between different customer groups remain in many countries (often reflecting the “social” nature of water and sewerage provision, as well as historical legacies), there has been a tendency for the degree of cross-subsidisation to be reduced, or at least to be made more explicit, over time.

As a result of these trends, tariffs (including industrial tariffs) are more likely to accurately reflect the costs of supply than they did a decade ago. In some places — **England** and **Wales** being the best examples — this has led to an explicit reduction in tariffs for large (i.e. industrial) users, compared to tariffs for domestic users. These discounts may reflect the fact that industrial customers often do not impose costs on water and sewerage suppliers related to local distribution networks, or may not need water treated to the same quality level as households. One of the pressures leading to “large user” tariffs in the **UK** has been the introduction of some degree of competition for those industrial consumers with an annual consumption from the public supply system in excess of 250 Ml per year. Similar trends may also emerge in other countries, where limited competition is now being introduced into the water sector.

### **More “economic” tariffs**

While there is substantial uniformity in the factors that determine the overall *level* of tariffs, until recently there has been rather less attention focused on the *structure* of tariffs. This appears to be changing in many countries — not least because of an increasing recognition of the costs that increasing levels of water consumption, or increasing levels of pollutant discharge, can have on the environment.

As a result, a number of trends are apparent:

- an increasing emphasis on forward-looking marginal costs, rather than backward-looking accounting costs, in establishing the level of variable (use-related) element(s) of multi-part tariff structures. Some marginal cost pricing is in evidence in **Australia, France, Germany**, and **Italy**;

- the development of seasonal tariff structures (for example, in the **US**), which allow changes in the costs of consumption at different times of the year to be reflected in price levels;
- continuing increases in the level of metering penetration, so that it is now unusual if all industrial customers (and the large majority of commercial customers) are *not* metered;
- increasing emphasis on the use of “economic instruments” to govern abstractions from, and discharges to, watercourses. Such “economic instruments” can be in the form of charges for abstractions and discharges which reflect marginal environmental costs, but some countries (e.g. **Spain**, some States in **Australia**, and the **US**) are also developing markets to allow the trading of abstraction licences.

Nevertheless, the costs of metering customers, and the incidence effects resulting from major changes to tariff structures, will continue to provide a restraint on the speed with which more “economic” tariffs can be introduced (although the relative costs of metering may mean that this constraint will apply more to domestic customers than to industrial ones).

### **Recovery of sewerage costs via explicit sewerage charges**

Closely allied to the development of more cost-reflective tariffs has been the emerging trend towards the separate and explicit charging for sewerage and trade effluent costs (and also the development of explicit charging mechanisms for discharges to water courses). It is in fewer and fewer countries (**Ireland**, **Poland** and **Sweden** have been identified here) that the costs of sewerage services are included in the price of water services or (where sewerage services are provided by municipal governments) in general local taxes. Even here, there is a tendency (e.g. in **Ireland**) toward separate monitoring and charging for significant industrial discharges. This is particularly evident in situations where new sewage treatment facilities have recently been constructed, or where new discharge agreements have been negotiated with industries. Such charges are normally based on monitored flows and organic loads (i.e. strength-based charges).

### **More self-treatment and re-use**

In countries where sewerage service costs have risen (e.g. due to higher environmental standards) and have led to price increases, industrial users have increasingly questioned whether the public sewer system represents the most cost-effective means of discharging their sewage. As a result, there is some evidence of increased self-treatment and effluent re-use. Increased charges are also likely to have had some impact on the processes used by industry, who may adjust technologies and processes to ensure that they do not incur unnecessary costs in the treatment and disposal of their effluent.

### **Within-country variations**

Finally, it is worth re-iterating the point that regional, or within-country, variations are often as important as between-country variations. This is particularly true in countries such as the **US**, **Australia**, **Austria**, and **Germany**, where there is considerable political autonomy at the state or municipal level. Even in countries where little political influence has been devolved to the local level, local cost variations and historical legacies can lead to significant regional variations in prices and pricing practices. Such variations are an important consideration in developing a framework for comparing industrial water prices.

## COMPARING INDUSTRIAL WATER PRICES ACROSS THE OECD

### Difficulties in comparing industrial water pricing

There are a number of difficulties associated with making accurate comparisons of industrial water prices across (and within) countries:

- *Poor quality data.* In the course of this survey, very little information was available about industrial water pricing. Indeed, in some countries — despite best efforts — *no* information was often available from a public source. While this shortcoming applies to information about tariff *levels*, it is particularly problematic in the case of information about tariff *structures* — particularly, explanations of the economic, financial, environmental or social rationale for the prevailing tariff structures.
- *Comparing “like with like”.* Meaningful comparisons are further hampered by difficulties in identifying what to compare. Average prices vary according to many diverse factors: different volumes, different quality (especially for sewage discharged), the different peak (and hence cost) characteristics of the consumption; and — for abstractions in particular — variations in the time of year when the consumption occurs, the return factor, and the nature of the source.
- *Public supply vs. direct abstractions.* For direct abstractions from surface and ground waters — often the most important source of water for industry — the problems are multiplied even further. Little data is available to assess the costs of abstracting water directly to industrial users; it is therefore necessary to rely on abstraction charges as a proxy, although they only represent a very small share of total costs.
- *The predominance of special agreements.* Often, the prices charged to industrial users (from the public water supply system) are not published, and instead take the form of special agreements (which are usually kept confidential) between industrial customers and the public water supplier. Generally, it has not been possible to collect any information for this study concerning these special agreements.
- *Subsidies and cross-subsidies.* These take a number of forms: subsidies to the sector as a whole, subsidies between different customer groups (e.g. domestic customers and industrial groups), subsidies between different services (e.g. water and sewerage), and confusion with tax collection by local government.

This suggests that *any* comparative framework — at least one “generic” enough to be capable of application to a relatively large number of OECD countries — is likely to at best provide only a broad indication of the variation of industrial water prices. Thus, variations around “central” or “representative” cases are likely to be imperfectly captured.

## A comparative framework

Against the background of the shortcomings and difficulties outlined above, an attempt has nevertheless been made here to develop at least a crude methodology for comparing industrial water prices from the public water supply. The objective of this framework is to overcome the main difficulty mentioned above (i.e. “comparing like with like”). Given that prices can vary significantly within a single country, it was deemed necessary to build an index which can reflect a number of typical circumstances, defined in a comparable way across countries. For each country, a number of key features were identified which might influence industrial water prices (i.e. location and user size). This enabled the construction of a sample of 12 observations which can produce more meaningful comparisons than straight averaging across available observations.

In broad terms, this involved:

- for each country, “typical” or representative *charging systems* were identified. More specifically, this included:
  - 1) the capital city
  - 2) an industrial area
  - 3) a rural area
  - 4) the “minimum” (i.e. lowest) charge levied
  - 5) the “maximum” (i.e. highest) charge levied
  - 6) an average for the country as a whole
- for each charging system, the bill faced by “typical” or representative industrial users was then calculated. For the public water supply system in particular, three different types<sup>11</sup> of user were identified:
  - 7) a “small user”
  - 8) a “medium user”
  - 9) a “large user”
- the average price (per unit of consumption) implied by each bill for each such representative customer in each such representative charging structure was calculated
- the average (unweighted) price of these observations was calculated
- these bills were converted into a common currency — this was done in two ways: first, using market exchange rates to express each country in a common currency (US dollars); second, comparative price levels calculated on a Purchasing Power Parity basis.

The “location” criterion has two objectives: one is to reflect the price range available in the country (by taking information from the lowest priced and the highest priced location); the other is to incorporate information on population density and relative industrialisation levels (by taking information from the capital area, an industrial area, and a rural area). An alternative approach would have been to take data in locations with extreme water availability conditions (one in a dry area, one in a water-

---

11. In the subsequent application of this framework, the consumption level corresponding to each type of user varies slightly from country to country, according to data availability in each country.

abundant area), but no detailed information was available to carry out such an analysis here. Finally, an average (non-weighted) observation was used, in order to better reflect the situation of the country as a whole.

“Market exchange” rates is the most appropriate conversion unit, if the purpose of the comparison is to assess variation in water prices from a *consumer perspective* (e.g. from the perspective of an industrial water user considering in which country to establish water-intensive production). However, market exchange rates do not reflect differences in general price levels between countries and, therefore, do not reflect the comparative costs of material purchases made by water/sewerage suppliers. Exchange rates based on Purchasing Power Parity (PPP), on the other hand, are a more appropriate method of currency conversion, if the primary purpose of the comparative framework is to compare water/sewerage prices from a *supplier perspective* (e.g. in order to assess their comparative efficiency, although admittedly the data available here makes such an efficiency analysis formidably difficult).

The comparative analysis has also abstracted from the issue of subsidies (where they exist) between the local taxation system and water/sewerage concerns, especially for covering capital costs; making accurate adjustments to correct for such subsidies is not possible with available data. Moreover, such a level of detail would only be necessary if a more “dynamic” analysis was being done (i.e. to understand the potential for a rise in industrial water prices following the removal of subsidies).

The comparative framework refers solely to charging systems for industrial water drawn from the public water supply system.<sup>12</sup> However, as noted earlier, direct abstractions are often of greater importance in terms of industrial water use.

At present, limitations on data availability and comparability prevent the analysis being taken much further. Apart from figures on abstraction charges, very limited data is available on the actual costs of directly abstracting water for industrial users. *Canada*<sup>13</sup> and *Finland* are the only countries where a survey of “total costs” of direct abstractions had been carried out to date. These total costs may vary according to water availability, but also as a function of equipment costs, labour costs, etc.

However, if data collection were somehow to be standardised, it should ultimately be possible for the OECD to:

- Apply the comparative analysis to direct water abstractions (perhaps expanding the range of “typical” customers to reflect the additional variation in costs by use associated with direct abstractions in comparison to water drawn from the public supply).
- For each country, weight the results for (i) public water supply and (ii) direct abstractions, by the proportion of total industrial water demands supplied by these sources respectively.

### Application of the comparative framework

The framework described above was then applied to the eight OECD countries for which data availability was deemed to be most suitable:

---

12. Note that charges and costs connected to waste waters are not covered in this framework.

13. Tate (1995).

- Canada;
- Germany;
- Mexico;
- Netherlands;
- Poland;
- Portugal;
- United Kingdom; and
- United States.

The categorisation of “industrial area” and “rural area” has not been done on the basis of strict criteria, but rather by taking localities in “principally industrial” or “principally rural” zones. In some cases, such as **Canada**, prices were only available as provincial averages, so “mostly industrial” and “mostly rural” provinces were used as examples. In the **US**, no data point was available for Washington D.C., so New York was used as “capital city” instead. Similarly, Bonn was used as the representative city in **Germany**.

Despite best efforts, it was not possible to obtain volume data on relative uses which might have been used to weight price indices.

The results of this exercise are presented in Annex I.

## Summary of Results

As noted earlier, industrial water supply drawn from the public system (i.e. the data base used to compute the summary statistics used here) only reflects about 23 per cent of total OECD industrial water use. (The remaining 77 per cent comes from direct abstractions). Mainly because of this, it was not deemed appropriate to generate relative price indices for individual countries, and to report on these indices here. Prices of direct abstractions tend to be considerably cheaper than those from the public supply system, and can vary significantly from one country to another, depending on the available technology, resource endowments, etc. Another problem with such indices is that they would not incorporate any measure of the relative quality of service (e.g. reliability) offered in each country, so they could not be used to reach any conclusions about the relative “value for money” offered by water suppliers in different countries.

It is therefore more meaningful to use the framework to draw out general trends, rather than to make specific judgements about individual countries. One such general comparison can be obtained by generating indices for different sizes of users in different geographic areas within a country. The results of these applications are presented in Table 10, for the eight OECD countries involved in this particular data set.

**Table 10. Industrial Water Prices from the Public Systems — By User, Location**

| <b>(USD/m<sup>3</sup>)</b> | <b>Small user</b> | <b>Medium user</b> | <b>Large user</b> |
|----------------------------|-------------------|--------------------|-------------------|
| The capital city *         | 0.92              | 0.86               | 0.74              |
| An industrial area         | 1.00              | 0.91               | 0.83              |
| A rural area               | 0.85              | 0.74               | 0.70              |
| National average           | 0.88              | 0.86               | 0.70              |
| Minimum                    | 0.55              | 0.37               | 0.32              |
| Maximum                    | 1.51              | 1.51               | 1.37              |

\* Where data was not available for the Capital City itself, data for a proxy area (e.g. capital province, major city, etc.) was used instead.

From this analysis, it appears that large industrial users tend to obtain slightly lower prices, on average, than smaller ones. In general, prices in industrial areas also tend to be more expensive than in rural areas, and for all categories of users. This may be because water resources are more “stretched” in these areas, or that explicit water conservation policies have been put into place to influence users who are particularly responsive to price changes (i.e. industrial users).

## REFERENCES

- ACHTENRIEBBE G. V. HOMER, E. PAPP AND W. WIDERKEHR (1992) . “International Comparison of Drinking Water Prices”. *Aqua*, 41, No. 6, 360-363.
- BARRAQUÉ, BERNARD (1995). *Les politiques de l’eau en Europe*. Editions La Découverte.
- CRI CENTRE FOR THE STUDY OF REGULATED INDUSTRIES (1995). “European Water Charges: A Comparison of 17 Cities”.
- CRI CENTRE FOR THE STUDY OF REGULATED INDUSTRIES (1997). *Utility Regulation 1997*. Edited by Ilka Lewington.
- ECOTEC (1996). “The Application of the Polluter Pay Principle of Cohesion Fund Countries”. December 1996.
- ENVIRONMENT AGENCY (1996). *Eurowater: Economic and Financial Aspects of Water Management Policies in Five EU Member States*. Paper drafted by J. Buckland and T. Zabel.
- EUROPEAN ENVIRONMENT AGENCY (1995). “The Dob í Assessment”. Copenhagen.
- GUNDERMANN H. (1988). “Limits of International Water Price Comparisons”. *Gas Wasser Abwasser*, No.5, 45-55 (in English, French and German).
- HILLS JOHN S. (1995). *Cutting Water and Effluent Costs*. Institution of Chemical Engineers, Galliard (Printers) Ltd., United Kingdom.
- INTERNATIONAL MONETARY FUND (1997). “International Financial Statistics”. November 1997.
- IWSA (1995). “Elements Influencing the Price of Water”. In: *Water Supply*, Vol. 14. Nos. 3/4, Durban, pp 157-180, 1996. Papers presented at the 20<sup>th</sup> International Water Supply Congress and Exhibition, Durban 9-15 September 1995.
- IWSA (1993). “Policies of Tariffs”. Conference paper entitled, “19<sup>th</sup> International Water Supply Congress and Exhibition: Water and the Environment — a Common Cause”. Budapest, Hungary.
- MDIS (1992). “The Water Industry in the EC”. MDIS Report. March.
- MDIS (1993). “The Water Industry in Eastern Europe”. MDIS Report. February.
- NATIONAL UTILITY SERVICE (1997). “Cost Analysis Report: International Water Price Survey”.
- OECD (1987). “Pricing of Water Services”. OECD: Paris.

OECD (1998). “Main Economic Indicators”. OECD: Paris.

OECD (FORTHCOMING 1999). *Water Pricing: Current Practices and Recent Trends*. OECD: Paris.

STADTFELD O. AND K. SCHLAWECK (1988). “International Comparison of Water Prices”. *Aqua*, No.4, 173-177.

TATE D.M., AND D.N. SCHARF (1995). “Water Use in Canadian Industry, 1991”, *Social Science Series* No.31, Water and Habitat Conservation Branch: Ottawa, Canada.

UNIDO (1996a). “Industry and Water: Options for Management and Conservation — Technical Report: Findings and Recommendations”. Unpublished document.

UNIDO (1996b). “Industry, Sustainable Development and Water Programme Formulation — Technical Report: Global Assessment of the Use of Freshwater Resources for Industrial and Commercial Purposes”. Unpublished document.

VALIRON, F. (1991). “Gestion des Eaux — Coût et prix de l'alimentation en eau et de l'assainissement”. Cours de l'Ecole Nationales des Ponts et Chaussées.

WATER REPORT (1996). “Canada Best, Germany Worst in Water Survey”, Vol. 11, 13 November 96.

WORLD BANK (1997). “Water Pricing Experiences: An International Perspective”. World Bank Technical Paper No.386 (edited by Ariel Dinar and Ashok Subramanian).

## ANNEX I.

### COMPARATIVE INDUSTRIAL WATER PRICE DATA: SELECTED OECD COUNTRIES

**CANADA**

|                   |                                                        |
|-------------------|--------------------------------------------------------|
| CAD/USD           | 1.3771 (Market exchange rate, end of period July 1997) |
| PPP exchange rate | 1.5762 (OECD, 1998).                                   |

**Average bills (CAD/bill)**

|                    | Name             | 10m <sup>3</sup> /month | 35m <sup>3</sup> /month | 100m <sup>3</sup> /month |
|--------------------|------------------|-------------------------|-------------------------|--------------------------|
| Capital province   | Ontario          | 23.09                   | 35.62                   | 71.35                    |
| An industrial area | British Columbia | 17.92                   | 21.39                   | 33.46                    |
| A rural area       | Saskatchewan     | 20.95                   | 38.38                   | 88.93                    |
| Minimum            | Quebec           | 14.93                   | 17.55                   | 26.43                    |
| Maximum            | Territories      | 41.21                   | 70.36                   | 178.49                   |

**Average bills (USD/bill/year-Market exchange rate)**

|                    | Name             | 120m <sup>3</sup> /year | 420m <sup>3</sup> /year | 1 200m <sup>3</sup> /year |
|--------------------|------------------|-------------------------|-------------------------|---------------------------|
| Capital province   | Ontario          | 201.21                  | 310.39                  | 621.74                    |
| An industrial area | British Columbia | 156.15                  | 186.39                  | 291.57                    |
| A rural area       | Saskatchewan     | 182.56                  | 334.44                  | 774.93                    |
| Minimum            | Quebec           | 130.10                  | 152.93                  | 230.31                    |
| Maximum            | Territories      | 359.10                  | 613.11                  | 1 555.36                  |

**Average water prices (USD/m<sup>3</sup>- Market exchange rate)**

|                    |                  | 120m <sup>3</sup> /year | 420m <sup>3</sup> /year | 1 200m <sup>3</sup> /year |
|--------------------|------------------|-------------------------|-------------------------|---------------------------|
| Capital province   | Ontario          | 1.68                    | 0.74                    | 0.52                      |
| An industrial area | British Columbia | 1.30                    | 0.44                    | 0.24                      |
| A rural area       | Saskatchewan     | 1.52                    | 0.80                    | 0.65                      |
| Minimum            | Quebec           | 1.08                    | 0.36                    | 0.19                      |
| Maximum            | Territories      | 2.99                    | 1.46                    | 1.30                      |

**Average water prices (USD/m<sup>3</sup>- PPP exchange rate)**

|                    |                  | 120m <sup>3</sup> /year | 420m <sup>3</sup> /year | 1 200m <sup>3</sup> /year |
|--------------------|------------------|-------------------------|-------------------------|---------------------------|
| Capital province   | Ontario          | 1.46                    | 0.65                    | 0.45                      |
| An industrial area | British Columbia | 1.14                    | 0.39                    | 0.21                      |
| A rural area       | Saskatchewan     | 1.33                    | 0.70                    | 0.56                      |
| Minimum            | Quebec           | 0.95                    | 0.32                    | 0.17                      |
| Maximum            | Territories      | 2.61                    | 1.28                    | 1.13                      |

*Note:* These rates apply to commercial establishments only. While this may include small industries, the rates do *not* apply for major industrial operations.

**GERMANY**

DEM/USD 1.7919 (Market Exchange rate, end of period July 1997)  
 PPP exchange rate 1.5336 (OECD, 1998).

**Average water prices (DEM/m<sup>3</sup>)**

|                    | <b>Name</b> | <b>7 500 m<sup>3</sup>/y</b> | <b>100 000 m<sup>3</sup>/y</b> |
|--------------------|-------------|------------------------------|--------------------------------|
| Medium city        | Bonn        | 2.842                        | 2.637                          |
| An industrial area | Dusseldorf  | 2.772                        | 2.020                          |
| A rural area       | Augsburg    | 2.515                        | 2.340                          |
| Minimum            | Ingolstadt  | 1.630                        | 1.568                          |
| Maximum            | Wiesbaden   | 5.680                        | 5.612                          |

**Average water prices (USD/m<sup>3</sup>- Market exchange rate)**

|                    | <b>Name</b> | <b>7 500 m<sup>3</sup>/y</b> | <b>100 000 m<sup>3</sup>/y</b> |
|--------------------|-------------|------------------------------|--------------------------------|
| Medium city        | Bonn        | 1.586                        | 1.472                          |
| An industrial area | Dusseldorf  | 1.547                        | 1.127                          |
| A rural area       | Augsburg    | 1.404                        | 1.306                          |
| Minimum            | Ingolstadt  | 0.910                        | 0.875                          |
| Maximum            | Wiesbaden   | 3.170                        | 3.132                          |

**Average water prices (USD-PPP exchange rate)**

|                    | <b>Name</b> | <b>7 500 m<sup>3</sup>/y</b> | <b>100 000 m<sup>3</sup>/y</b> |
|--------------------|-------------|------------------------------|--------------------------------|
| Medium city        | Bonn        | 1.853                        | 1.719                          |
| An industrial area | Dusseldorf  | 1.808                        | 1.317                          |
| A rural area       | Augsburg    | 1.640                        | 1.526                          |
| Minimum            | Ingolstadt  | 1.063                        | 1.022                          |
| Maximum            | Wiesbaden   | 3.704                        | 3.659                          |

**MEXICO**

New pesos/USD 7.8857 (Market exchange rate, end of period July 1997)  
 PPP exchange rate 15.939 (OECD, 1998).

**Average bills (New pesos/bill)**

|                    | <b>Name</b>      | <b>50m<sup>3</sup>/month</b> | <b>100m<sup>3</sup>/month</b> | <b>1 000m<sup>3</sup>/month</b> | <b>10 000m<sup>3</sup>/month</b> |
|--------------------|------------------|------------------------------|-------------------------------|---------------------------------|----------------------------------|
| Capital city       | Federal District | 127.5                        | 295                           | 7150                            | 71500                            |
| An industrial area | Monterrey        | 147.5                        | 405                           | 5660                            | 0                                |
| A rural area       | Puebla           | 78                           | 151                           | 2 890.4                         | 0                                |
| Minimum            | Colima           | 62.5                         | 160                           | 0                               | 0                                |
| Maximum            | Guadalajara      | 116.55                       | 299.55                        | 5 549.55                        | 84 174.55                        |

**Average bills (USD/bill- Market exchange rate)**

|                    | <b>Name</b>      | <b>50m<sup>3</sup>/month</b> | <b>100m<sup>3</sup>/month</b> | <b>1 000m<sup>3</sup>/month</b> | <b>10 000m<sup>3</sup>/month</b> |
|--------------------|------------------|------------------------------|-------------------------------|---------------------------------|----------------------------------|
| Capital city       | Federal District | 16.17                        | 37.41                         | 906.70                          | 9 067.05                         |
| An industrial area | Monterrey        | 18.70                        | 51.36                         | 717.75                          | n.a.                             |
| A rural area       | Puebla           | 9.89                         | 19.15                         | 366.54                          | n.a.                             |
| Minimum            | Colima           | 7.93                         | 20.29                         | 0.00                            | n.a.                             |
| Maximum            | Guadalajara      | 14.78                        | 37.99                         | 703.75                          | 10 674.33                        |

**Water price (USD/m<sup>3</sup>- Market exchange rate)**

|                    | <b>Name</b>      | <b>50m<sup>3</sup>/month</b> | <b>100m<sup>3</sup>/month</b> | <b>1 000m<sup>3</sup>/month</b> | <b>10 000m<sup>3</sup>/month</b> |
|--------------------|------------------|------------------------------|-------------------------------|---------------------------------|----------------------------------|
| Capital city       | Federal District | 0.32                         | 0.37                          | 0.91                            | 0.91                             |
| An industrial area | Monterrey        | 0.37                         | 0.51                          | 0.72                            | n.a.                             |
| A rural area       | Puebla           | 0.20                         | 0.19                          | 0.37                            | n.a.                             |
| Minimum            | Colima           | 0.16                         | 0.20                          | n.a.                            | n.a.                             |
| Maximum            | Guadalajara      | 0.30                         | 0.38                          | 0.70                            | 1.07                             |

**Water price (USD- PPP exchange rate)**

|                    | <b>Name</b>      | <b>50m<sup>3</sup>/month</b> | <b>100m<sup>3</sup>/month</b> | <b>1 000m<sup>3</sup>/month</b> | <b>10 000m<sup>3</sup>/month</b> |
|--------------------|------------------|------------------------------|-------------------------------|---------------------------------|----------------------------------|
| Capital city       | Federal District | 0.16                         | 0.19                          | 0.45                            | 0.45                             |
| An industrial area | Monterrey        | 0.19                         | 0.25                          | 0.36                            | n.a.                             |
| A rural area       | Puebla           | 0.10                         | 0.09                          | 0.18                            | n.a.                             |
| Minimum            | Colima           | 0.08                         | 0.10                          | n.a.                            | n.a.                             |
| Maximum            | Guadalajara      | 0.15                         | 0.19                          | 0.35                            | 0.53                             |

## NETHERLANDS

|                   |                                                        |
|-------------------|--------------------------------------------------------|
| Guilders/USD      | 2.0172 (Market exchange rate, end of period July 1997) |
| PPP exchange rate | 1.8973 (OECD, 1998).                                   |

Average prices for different customer sizes (Guilders/m<sup>3</sup>)

|                    | Name                                          | 10 000m <sup>3</sup> /year<br>Capacity: 5m <sup>3</sup> /h | 100 000m <sup>3</sup> /year<br>Capacity: 15m <sup>3</sup> /h | 100 000m <sup>3</sup> /year<br>Capacity 50m <sup>3</sup> /h |
|--------------------|-----------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------|
| Capital city       | Amsterdam                                     | 2.77                                                       | 2.42                                                         | 2.42                                                        |
| An industrial area | Rotterdam                                     | 2.35                                                       | 1.94                                                         | 1.94                                                        |
| A rural area       | Friesland                                     | 2.15                                                       | 1.65                                                         | 1.99                                                        |
| Minimum            | N.V. Tilburgsche<br>Waterleiding Maatschappij | 1.21                                                       | 1.08                                                         | 1.09                                                        |
| Maximum            | N.V. Duinwaterbedrijf Zuid-<br>Holland        | 3.25                                                       | 3.24                                                         | 3.25                                                        |

Average prices for different customer sizes (USD/m<sup>3</sup> - Market exchange rate)

|                    | Name                                          | 10 000m <sup>3</sup> /year<br>Capacity: 5m <sup>3</sup> /h | 100 000m <sup>3</sup> /year<br>Capacity: 15m <sup>3</sup> /h | 100 000m <sup>3</sup> /year<br>Capacity 50m <sup>3</sup> /h |
|--------------------|-----------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------|
| Capital city       | Amsterdam                                     | 1.37                                                       | 1.20                                                         | 1.20                                                        |
| An industrial area | Rotterdam                                     | 1.16                                                       | 0.96                                                         | 0.96                                                        |
| A rural area       | Friesland                                     | 1.07                                                       | 0.82                                                         | 0.99                                                        |
| Minimum            | N.V. Tilburgsche<br>Waterleiding Maatschappij | 0.60                                                       | 0.54                                                         | 0.54                                                        |
| Maximum            | N.V. Duinwaterbedrijf Zuid-<br>Holland        | 1.61                                                       | 1.61                                                         | 1.61                                                        |

## Average prices for different customer sizes (USD- PPP exchange rate)

|                    | Name                                          | 10 000m <sup>3</sup> /year<br>Capacity: 5m <sup>3</sup> /h | 100 000m <sup>3</sup> /year<br>Capacity: 15m <sup>3</sup> /h | 100 000m <sup>3</sup> /year<br>Capacity 50m <sup>3</sup> /h |
|--------------------|-----------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------|
| Capital city       | Amsterdam                                     | 1.46                                                       | 1.28                                                         | 1.28                                                        |
| An industrial area | Rotterdam                                     | 1.24                                                       | 1.02                                                         | 1.02                                                        |
| A rural area       | Friesland                                     | 1.13                                                       | 0.87                                                         | 1.05                                                        |
| Minimum            | N.V. Tilburgsche<br>Waterleiding Maatschappij | 0.64                                                       | 0.57                                                         | 0.57                                                        |
| Maximum            | N.V. Duinwaterbedrijf Zuid-<br>Holland        | 1.71                                                       | 1.71                                                         | 1.71                                                        |

**POLAND**

|                      |                                                        |
|----------------------|--------------------------------------------------------|
| Zlotys/USD           | 3.2385 (Market Exchange rate, end of period June 1997) |
| Relative price index | n.a.                                                   |

**Water prices (Zlotys/m<sup>3</sup>)**

|                    | <b>Name</b>     | <b>Uniform price</b> |
|--------------------|-----------------|----------------------|
| Capital province   | Warsaw Province | 1.45                 |
| An industrial area | Krakow          | 2.12                 |
| A rural area       | Bialystok       | 1.00                 |
| Minimum            | Lebork          | 0.65                 |
| Maximum            | Zator           | 3.06                 |

**Water prices (USD/ m<sup>3</sup> - Market exchange rate)**

|                    | <b>Name</b>     | <b>Uniform price</b> |
|--------------------|-----------------|----------------------|
| Capital province   | Warsaw Province | 0.45                 |
| An industrial area | Krakow          | 0.65                 |
| A rural area       | Bialystok       | 0.31                 |
| Minimum            | Lebork          | 0.20                 |
| Maximum            | Zator           | 0.94                 |

**PORTUGAL**

|                   |                                                        |
|-------------------|--------------------------------------------------------|
| Escudos/USD       | 180.91 (Market Exchange rate, end of period July 1997) |
| PPP exchange rate | 256.51 (OECD, 1998).                                   |

**Water prices (Escudos/m<sup>3</sup>)**

|                    | <b>Name</b>            | <b>&lt;100m<sup>3</sup>/month</b> | <b>&gt;100m<sup>3</sup>/month</b> |
|--------------------|------------------------|-----------------------------------|-----------------------------------|
| Capital city       | Lisboa                 | 181.70                            | 181.70                            |
| An industrial area | Porto                  | 270.00                            | 317.50                            |
| A rural area       | Evora                  | 137.50                            | 145.00                            |
| Minimum            | Vila Nova da Barquinha | 75.00                             | 75.00                             |
| Maximum            | Oeiras                 | 281.00                            | 380.00                            |

**Water prices (USD/m<sup>3</sup> - Market exchange rate)**

|                    | <b>Name</b>            | <b>&lt;100m<sup>3</sup>/month</b> | <b>&gt;100m<sup>3</sup>/month</b> |
|--------------------|------------------------|-----------------------------------|-----------------------------------|
| Capital city       | Lisboa                 | 1.00                              | 1.00                              |
| An industrial area | Porto                  | 1.49                              | 1.76                              |
| A rural area       | Evora                  | 0.76                              | 0.80                              |
| Minimum            | Vila Nova da Barquinha | 0.41                              | 0.41                              |
| Maximum            | Oeiras                 | 1.55                              | 2.10                              |

**Water prices (USD/m<sup>3</sup> -PPP exchange rate)**

|                    | <b>Name</b>            | <b>&lt;100m<sup>3</sup>/month</b> | <b>&gt;100m<sup>3</sup>/month</b> |
|--------------------|------------------------|-----------------------------------|-----------------------------------|
| Capital city       | Lisboa                 | 0.71                              | 0.71                              |
| An industrial area | Porto                  | 1.05                              | 1.24                              |
| A rural area       | Evora                  | 0.54                              | 0.57                              |
| Minimum            | Vila Nova da Barquinha | 0.29                              | 0.29                              |
| Maximum            | Oeiras                 | 1.10                              | 1.48                              |

## UNITED KINGDOM

|                   |                                                        |
|-------------------|--------------------------------------------------------|
| £/USD             | 1.6713 (Market exchange rate, end of period July 1997) |
| PPP exchange rate | 1.8472 (OECD, 1998).                                   |

## Tariff structure

|                    | Name       | Fixed charge (£/year) |        |          | [Variable charge]<br>p/m <sup>3</sup> |
|--------------------|------------|-----------------------|--------|----------|---------------------------------------|
|                    |            | (1/2")                | (2")   | (6")     |                                       |
| Capital city       | Thames     | 19.00                 | 304.00 | 1 000.00 | 53.62                                 |
| An industrial area | Yorkshire  | 23.00                 | 196.00 | 662.00   | 69.80                                 |
| A rural area       | Wessex     | 24.00                 | 300.00 | 1 000.00 | 77.76                                 |
| Minimum            | Hartlepool | 24.00                 | 24.00  | 24.00    | 38.50                                 |
| Maximum            | Mid Sussex | 19.50                 | 581.00 | 5 086.00 | 109.15                                |

## Total bill (£/year)

|                    | Name       | 100m <sup>3</sup> /year | 1 000m <sup>3</sup> /year | 200 000m <sup>3</sup> / year |
|--------------------|------------|-------------------------|---------------------------|------------------------------|
| Capital city       | Thames     | 73                      | 840                       | 108 240                      |
| An industrial area | Yorkshire  | 93                      | 894                       | 140 262                      |
| A rural area       | Wessex     | 102                     | 1 078                     | 156 520                      |
| Minimum            | Hartlepool | 63                      | 409                       | 77 024                       |
| Maximum            | Mid Sussex | 129                     | 1 673                     | 223 386                      |

## Total bill (USD/year- Market exchange rate)

|                    | Name       | 100m <sup>3</sup> /year | 1 000m <sup>3</sup> /year | 200 000m <sup>3</sup> / year |
|--------------------|------------|-------------------------|---------------------------|------------------------------|
| Capital city       | Thames     | 122.00                  | 1 403.89                  | 180 907.51                   |
| An industrial area | Yorkshire  | 155.43                  | 1 494.14                  | 234 419.88                   |
| A rural area       | Wessex     | 170.47                  | 1 801.66                  | 261 591.88                   |
| Minimum            | Hartlepool | 105.29                  | 683.56                    | 128 730.21                   |
| Maximum            | Mid Sussex | 215.60                  | 2 796.08                  | 373 345.02                   |

Average price (USD/m<sup>3</sup> — Market exchange rate)

|                    | Name       | 100m <sup>3</sup> /year | 1 000m <sup>3</sup> /year | 200 000m <sup>3</sup> / year <sup>14</sup> |
|--------------------|------------|-------------------------|---------------------------|--------------------------------------------|
| Capital city       | Thames     | 1.22                    | 1.40                      | 0.77                                       |
| An industrial area | Yorkshire  | 1.55                    | 1.49                      | 1.00                                       |
| A rural area       | Wessex     | 1.70                    | 1.80                      | 1.11                                       |
| Minimum            | Hartlepool | 1.05                    | 0.68                      | 0.55                                       |
| Maximum            | Mid Sussex | 2.16                    | 2.80                      | 1.59                                       |

Average price (USD/m<sup>3</sup> -PPP exchange rate)

|                    | Name       | 100m <sup>3</sup> /year | 1,000m <sup>3</sup> /year | 200,000m <sup>3</sup> / year |
|--------------------|------------|-------------------------|---------------------------|------------------------------|
| Capital city       | Thames     | 1.35                    | 1.55                      | 0.85                         |
| An industrial area | Yorkshire  | 1.72                    | 1.65                      | 1.10                         |
| A rural area       | Wessex     | 1.88                    | 1.99                      | 1.23                         |
| Minimum            | Hartlepool | 1.16                    | 0.76                      | 0.60                         |
| Maximum            | Mid Sussex | 2.38                    | 3.09                      | 1.75                         |

14. Average prices for large users incorporate a reduction of 15 per cent, to reflect the impact of the “large user” tariffs.

## UNITED STATES

## Monthly water charge (USD/Gallon)

|                    | Name               | 2-Inch Meter<br>Light Industrial<br>50 000 CF | 4-inch Meter<br>Light Industrial<br>1 000 000 CF | 8-inch Meter<br>Light Industrial<br>1 500 000 CF |
|--------------------|--------------------|-----------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| Large city         | New York, NY       | 505.00                                        | 10 100.00                                        | 15 150.00                                        |
| An industrial area | Dallas, TX         | 494.54                                        | 9 775.40                                         | 14 732.60                                        |
| A rural area       | High Point, NC     | 568.56                                        | 9 526.31                                         | 14 207.86                                        |
| Minimum            | Tampa, FL          | 450.00                                        | 900.00                                           | 1 350.00                                         |
| Maximum            | Virginia Beach, VA | 1 381.70                                      | 27 350.00                                        | 41 105.00                                        |

Monthly water charge (USD/m<sup>3</sup>)

|                    | Name               | 2-Inch Meter<br>Light Industrial<br>1 415.59m <sup>3</sup> | 4-inch Meter<br>Light Industrial<br>28 311.80m <sup>3</sup> | 8-inch Meter<br>Light Industrial<br>42,467.70m <sup>3</sup> |
|--------------------|--------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| Large city         | New York, NY       | 505.00                                                     | 10 100.00                                                   | 15 150.00                                                   |
| An industrial area | Dallas, TX         | 494.54                                                     | 9 775.40                                                    | 14 732.60                                                   |
| A rural area       | High Point, NC     | 568.56                                                     | 9 526.31                                                    | 14 207.86                                                   |
| Minimum            | Tampa, FL          | 450.00                                                     | 900.00                                                      | 1 350.00                                                    |
| Maximum            | Virginia Beach, VA | 1 381.70                                                   | 27 350.00                                                   | 41 105.00                                                   |

Average water price (USD/m<sup>3</sup>)

|                    | Name               | 2-Inch Meter<br>Light Industrial<br>1 415.59m <sup>3</sup> | 4-inch Meter<br>Light Industrial<br>28 311.80m <sup>3</sup> | 8-inch Meter<br>Light Industrial<br>42 467.70m <sup>3</sup> |
|--------------------|--------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| Large city         | New York, NY       | 0.36                                                       | 0.36                                                        | 0.36                                                        |
| An industrial area | Dallas, TX         | 0.35                                                       | 0.35                                                        | 0.35                                                        |
| A rural area       | High Point, NC     | 0.40                                                       | 0.34                                                        | 0.33                                                        |
| Minimum            | Tampa, FL          | 0.32                                                       | 0.03                                                        | 0.03                                                        |
| Maximum            | Virginia Beach, VA | 0.98                                                       | 0.97                                                        | 0.97                                                        |

**ANNEX II:**

**DETAILED INFORMATION ON WATER INSTITUTIONS  
AND INDUSTRIAL WATER PRICING PRACTICES  
IN OECD COUNTRIES**

## AUSTRALIA

### Context for industrial water uses

#### *Institutional arrangements*

Provision of water services is a responsibility of the State governments. Public water companies were set-up at state level, either as integrated state enterprises (e.g. South Australia, Western Australia) or as regional companies based on catchment areas (e.g. New South Wales). They have historically been state-owned, but there is currently a movement towards the corporatisation of water utilities. States such as New South Wales, Tasmania, Victoria, and the Australian Capital Territory have set up independent regulators with water responsibilities, separating economic regulation functions from the water businesses.

The National government focuses on policy development, principally (since 1994) through the Council of Australian Governments (COAG) Water Reform Agenda and National Competition Policy. For environmental regulation, the national government initiated a national programme for water resources management (the National Water Quality Management Strategy) under the supervision of the National Environment Protection Council, the environmental federal regulator.

The Murray-Darling Basin Commission also provides elements of catchment management in a large catchment, including parts of several States.

#### *Relative importance of industrial water use*

Of total water consumption in Australia, the largest proportion, around 70 per cent, is used by irrigated agriculture. Urban domestic users account for the next largest consumption (480 litres per person per day), and they represent around 90 per cent of water and sewer connections.

No information was available on industrial use as a percentage of total water use. Similarly, no information was available on the sources of industrial water use or the types of industrial uses.

### Pricing principles

#### *Pricing structure for water from the public supply system*

Each state has responsibility for setting water prices in their area, and each administers this responsibility in a slightly different way. Prices usually comprise a fixed annual charge and a variable

charge, but other criteria can also be taken into account, such as the value of the property.<sup>15</sup> The proportion of revenues raised through usage charges often differs between household users and other users (including industrial users), as shown in Table 1.1. Details of the tariff structures in the major urban water businesses are given in Table 1.2.

**Table 1.1. Proportion of Income from Usage Charges**

| Water Business                |       | Residential <sup>1</sup> |        |        | Other  |        |        |
|-------------------------------|-------|--------------------------|--------|--------|--------|--------|--------|
|                               |       | 1993/4                   | 1994/5 | 1995/6 | 1993/4 | 1994/5 | 1995/6 |
| ACTEW Corporation             | Water |                          |        |        |        |        |        |
|                               | Sewer |                          |        |        |        |        |        |
| Barwon Water                  | Water |                          | 55%    | 49%    |        | 78%    | 76%    |
|                               | Sewer |                          | 46%    | 41%    |        | 57%    | 53%    |
| Brisbane Water                | Water |                          |        |        | 25%    | 28%    | 31%    |
|                               | Sewer |                          |        |        |        |        |        |
| Central Gippsland Water       | Water |                          |        | 35%    |        |        | 89%    |
|                               | Sewer |                          |        | 5%     |        |        | 1%'    |
| Central Highlands Water       | Water |                          |        |        |        |        |        |
|                               | Sewer |                          |        |        |        |        |        |
| City West Water <sup>2</sup>  | Water |                          | 64%    | 66%    |        | 34%    | 31%    |
|                               | Sewer |                          | 3%     | 6%     |        | 4%     | 4%     |
| Coliban Water                 | Water | 45%                      | 45%    | 53%    | 50%    | 49%    | 67%    |
|                               | Sewer |                          |        |        | 31%    | 65%    | 62%    |
| Gold Coast Water              | Water |                          |        |        |        | 1%     | 0.3%   |
|                               | Sewer |                          |        |        |        | 1%     | 3%     |
| Hunter Water Corporation      | Water | 67%                      | 69%    | 76%    | 67%    | 69%    | 76%    |
|                               | Sewer | 36%                      | 41%    | 30%    | 36%    | 41%    | 30%    |
| Melbourne Water Corporation   | Water |                          |        |        |        |        |        |
|                               | Sewer |                          |        |        |        |        |        |
| Power and Water Authority     | Water | 100%                     | 100%   | 100%   | 100%   | 100%   | 100%   |
|                               | Sewer |                          |        |        |        |        |        |
| SA Water                      | Water |                          | 46%    | 53%    |        | 55%    | 63%    |
|                               | Sewer |                          |        |        |        |        |        |
| South East Water <sup>2</sup> | Water |                          | 60%    | 59%    |        | 19%    | 24%    |
|                               | Sewer |                          | 6%     | 6%     |        | 0%     | 0%     |
| Sydney Water Corporation      | Water | 52%                      | 62%    | 67%    | 44%    | 53%    | 79%    |
|                               | Sewer |                          |        |        | 25%    | 31%    | 25%    |
| Water Corporation (WA)        | Water | 55%                      | 54%    | 53%    | 34%    | 35%    | 37%    |
|                               | Sewer |                          |        |        |        |        |        |
| Yarra Valley Water            | Water |                          |        | 62%    |        |        | 31%    |
|                               | Sewer |                          |        | 6%     |        |        | 0.003% |

*Notes:* 1. Where no figures are given for "Residential", but a figure is given for "Other", the "Other" figure is the overall proportion.  
 2. City West Water and South East Water 1994/5 figures are based on the six months ending 30 June 1995.

*Source:* Water Services Association of Australia (1996).

Reform of the water sector currently taking place in many States is likely to lead to better cost recovery, to consumption-based pricing, and to the removal of some cross-subsidies between customer types. The 1994 COAG report on water resource policy also established that charging arrangements must comprise a fixed charge, representing the customer's actual cost of access to the service, as well as a volume-based charge by 1998.

15. Property charges are generally being phased out in Australia. They have been used in the past to redistribute income from the commercial and industrial sectors to the household sector.

Requirements for industrial users to pay capital contributions are becoming important in New South Wales, partly for cost-recovery reasons, and partly to signal the differing costs (including the environmental costs) of serving new developments.

### ***Sewerage and trade effluent charges***

Sewerage charges are generally made up of a fixed annual charge and a variable charge, partly based on marginal costs. Australian sewage services broadly achieve full cost recovery. Although the aim is to phase out cross-subsidies, some still remain in place, however. In particular, some small, rural-based schemes receive subsidies.

Some water businesses have also introduced trade effluent charges based on the volume and quality of wastewater discharged.

### ***Abstraction and discharge charges***

Abstraction charges are in place in certain areas of the country. In New South Wales, individuals or entities must have a licence to use water from regulated streams. License holders are entitled to a specified quantity of water, determined on a needs basis. They can either apply for secure entitlements (more expensive) or entitlements which expose them to water cuts when stream flows are too low. License holders pay license fees (covering less than the costs of administration), metering charges (metering costs are fully recovered) and volumetric charges when the quantity of water extracted is regulated and can be measured. Users pay only a portion of operating costs and no capital costs for dams or weirs. It is likely that reforms across Australia will involve the allocation and trading of water entitlements between user categories.

In addition, Australian bulk water suppliers (e.g. the Department of Land and Water Conservation in NSW) charge industrial users for abstracting water from rivers and groundwater. These charges are based both on the entitlement to abstract water and on the amount of water actually used (when this is metered).

## **Price levels and trends**

### ***Water from public supply system***

Information on water tariffs in the major urban water utilities is given in Table 1.2, together with information on sewerage tariffs.

### ***Sewerage and trade effluent charges***

Information on sewerage tariffs in the major urban water utilities is also provided in Table 1.2. Trade effluent charges in the Melbourne area are given in Table 1.3. Other utilities have trade effluent charges, but no detailed information was available for this study.

**Table 1.2. Industrial Pricing Structure for Australian Major Urban Water Businesses (1995/96)**

| Water Business                                             | Location (City, State) | Water                                                                                                                                                                                              |                                                      | Sewerage                                                             |                                                                                                                                                               | Other                                                                                                                        |
|------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
|                                                            |                        | Fixed charge/year                                                                                                                                                                                  | Variable charge                                      | Fixed charge/year                                                    | Variable charge                                                                                                                                               |                                                                                                                              |
| Central Highlands Water                                    | Ballarat, Victoria     | \$297/service                                                                                                                                                                                      | \$0.49/Kl                                            | \$198/property                                                       | Trade waste based on lab tests                                                                                                                                |                                                                                                                              |
| Brisbane Water                                             | Brisbane, Queensland   | \$0.00488/\$ of NAV or varies on service size;<br>20mm \$330<br>25mm \$515<br>40mm \$1318<br>50mm \$2060<br>100mm \$8240                                                                           | \$0.80/Kl (User Pays)<br>\$0.91/Kl (Valuation Based) | \$0.003664 per \$ unimproved land value                              | None                                                                                                                                                          | Stepped pedestal charge not included                                                                                         |
| ACTEW (Australian Capital Territory Electricity and Water) | Canberra, ACT          | \$130/property                                                                                                                                                                                     | \$0.60/Kl                                            | \$170 based on meter size                                            | \$0.90/Kl                                                                                                                                                     |                                                                                                                              |
| City West Water                                            | Melbourne, Victoria    | Property Values (NAV)                                                                                                                                                                              | \$0.65/Kl                                            | Property Value (NAV)                                                 | No charge other than Trade Waste based on volume and quality                                                                                                  |                                                                                                                              |
| Central Gippsland Water                                    | Trairaigon, Victoria   | Variable depending on delivery infrastructure, volume, water quality                                                                                                                               |                                                      | Variable depending on delivery infrastructure, volume, water quality |                                                                                                                                                               | \$23/Property                                                                                                                |
| Gold Coast Water                                           | Gold Coast, Queensland | Base \$266/improvement to property except for large industrial charges 90% of prior year consumption @ \$0.76/Kl                                                                                   |                                                      |                                                                      | \$0.00/Kl for 0-340Kl<br>\$0.99/Kl in excess of 340Kl except for large industrial charged<br>\$0.99Kl in excess of 90% of prior year consumption <sup>7</sup> | \$335 for first pedestal/property<br>\$302/pedestal in excess of one pedestal                                                |
| Hunter Water                                               | Newcastle, NSW         | \$73.50 x meter factor<br>Meter Factor<br>20mm 1.00<br>1.50<br>4.00<br>6.25<br>16.00<br>100mm 25.00<br>150mm 56.25<br>200mm 100.00<br>250mm 156.25<br>300mm 225.00<br>400mm 400.00<br>500mm 625.00 | Meter Size<br>25mm<br>40mm<br>50mm<br>80mm           | \$0.804/Kl for 0-1000Kl<br>\$0.742/Kl in excess of 1000Kl            | \$312.60 x meter factor x discharge factor                                                                                                                    | \$0.37/Kl of water volume consumed x discharge factor based on industry type<br><br>\$78.00 Environmental Improvement Charge |

| Water Business                   | Location (City, State)     | Water                                                                    |                                                                                        | Sewerage                                                                                                                               |                                                                                                                                          |                       |
|----------------------------------|----------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|                                  |                            | Fixed charge/year                                                        | Variable charge                                                                        | Fixed charge/year                                                                                                                      | Variable charge                                                                                                                          | Other                 |
| PAWA (Power and Water Authority) | Darwin, Northern Territory | None                                                                     | \$0.46/Kl                                                                              | Number of Pedestals<br>\$278 for 1-2<br>+\$189 for 3-24<br>+\$178 for 25-49<br>+165 for 50-99<br>+\$153 for 100-149<br>+\$148 for 150+ | Volume based charges for larger consumers<br>(few consumers charges confidential)                                                        |                       |
| SA Water                         | Adelaide, South Australia  | \$113/property                                                           | \$0.20/Kl for 0-136Kl<br>\$0.88/Kl in excess for 136Kl                                 | Min \$194<br>\$2.32 over \$1000 capital value                                                                                          | No volume of Trade Waste charge. Consultative and regulatory process in place requires customer to pretreat to agreed discharge standard | Special Levy<br>0.50% |
| South East Water Limited         | Melbourne, Victoria        | Property Value \$0.2585/\$NAV                                            | \$0.65/Kl in excess of free allowance.<br>Free allowance<br>1 Kl = Fixed charge/\$0.65 | Property Value<br>\$0.04216/\$NAV                                                                                                      | No charge other than Trade Water based on volume and quality                                                                             |                       |
| Yarra Valley Water               | Melbourne, Victoria        | None                                                                     | \$0.65/Kl                                                                              | Property Value<br>\$0.04216/\$NAV<br>Minimum \$146.40                                                                                  | No charge other than Trade Water based on volume and quality                                                                             |                       |
| Sydney Water                     | Sydney, Australia          | \$80 for 20mm meter varies based on meter size and assessed annual value | \$0.70/Kl                                                                              | \$261.50 for 20mm meter varies based on meter size, discharge factor and assessed annual value                                         | \$0.53/Kl. Trade Waste on volume and quality calculation                                                                                 |                       |

*Note:* NAV = Net Annual Value of unimproved property.  
Kl = Kilo litres of water or wastewater.

*Source:* Water Services Association of Australia.

**Table 1.3. Trade Effluent Charges in Melbourne (1997)**

| <b>Description</b>                                                                   | <b>Charge</b>  |
|--------------------------------------------------------------------------------------|----------------|
| Fees for new application                                                             |                |
| Maximum discharge specified in application (kL/day)                                  |                |
| Less than 0.5                                                                        | Nil            |
| 0.5 - less than 4                                                                    | \$22.50        |
| 4 - 20                                                                               | \$55.00        |
| 21 - 50                                                                              | \$110.00       |
| 51 - 100                                                                             | \$165.00       |
| 101 - 1000                                                                           | \$551.00       |
| Above 1000                                                                           | \$1102.00      |
| Charges for oxidised forms of sulphur                                                |                |
| Concentration of oxidised forms of sulphur (mg/l) 100 - 500                          | \$0.66         |
| Above 500                                                                            | \$0.94         |
| Charges for Biochemical Oxygen Demand (BOD) and Suspended Solids (SS)                | \$353.00       |
| - Category 1: Volume less than 1 000 kL/year, and SS concentration below 600 mg/l    | \$0.485 per kL |
| - Category 2: Volume greater than 1 000 kL/year, and SS concentration below 600 mg/l | \$0.293 per kL |
| - Category 3: SS concentration above 600 mg/l                                        | \$0.313 per kg |
| Volume                                                                               | \$0.154 per kg |
| BOD                                                                                  |                |
| Suspended Solids                                                                     |                |
| Charges for Total Concentration of Nitrogen                                          | \$0.600 per kg |
| Mean value greater than 50 mg/l                                                      |                |

Source: City West Water, South East Water, Yarra Valley Water.

## REFERENCES

DEPARTMENT OF TREASURY AND FINANCE, PRIVATISATION AND INDUSTRY REFORM DIVISION. Melbourne.

WATER SERVICES ASSOCIATION OF AUSTRALIA (1997). "The Australian Urban Water Industry — WSAA Facts '96". Melbourne, 1997.

WATER SERVICES ASSOCIATION OF AUSTRALIA. Communication with Dr. John Langford.

## AUSTRIA

### Context for industrial water uses

#### *Institutional arrangements*

Austria's 2 350 municipalities are responsible for the provision of water services in most areas, and generally do so via autonomous water utilities (*Stadtwerke*), similar to those found in Germany. A growing number of municipalities have formed inter-communal groupings: there are 188 syndicates for water services, and about 230 for wastewater services. However, due to an abundance of water resources, direct abstractions — even by domestic users — are common. In regions with low population densities, user groups have been formed for the management of water resources.

The Ministry of Agriculture is responsible for the management of water resources at the federal level. The Ministry of Environment has a limited role in water management, but is responsible for supervising federal financial assistance for water supply, sewerage and wastewater treatment investments. A Federal Environment Agency, created in 1985, provides support to the government on all environmental policy issues. National environmental laws are applied at *Land* level.

#### *Relative importance of industrial water use*

There is little abstraction for electrical power production, as power production is mainly based on hydro-electric resources. Total water use in Austria amounts to about 2.6 billion m<sup>3</sup> (out of an estimated available 84 billion m<sup>3</sup>), more than two thirds of which are used by industry and agriculture.

**Table 2.1. Water Uses by Type (1991)**

| Users      | Millions m <sup>3</sup> | %   |
|------------|-------------------------|-----|
| Industry   | 1 680                   | 66  |
| Households | 670                     | 27  |
| Irrigation | 170                     | 7   |
| Total      | 2 520                   | 100 |

Source: Barraqué (1995).

Between 1989 and 1991, industrial water users reduced their abstractions by 8 per cent. There was also a marked reduction in wastewater discharged by industry between 1979 and 1989, from 17 million COD population-equivalent down to 2.7 million.

### ***Water sources for industry***

Of the approximately 1.7 billion m<sup>3</sup> of water used by industry, 0.7 billion m<sup>3</sup> comes from groundwater and 1 billion m<sup>3</sup> is surface waters, most of which is used as cooling water.

### ***Types of industrial water uses***

The largest industrial users of water are metal producers, and the chemical and paper industries. Together, these account for 80 per cent of industrial water demands.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Pricing principles vary from one *Land* to another. Tariffs are usually in two parts: a relatively high connection charge, and a charge based on the volume consumed.

Subsidised loans are available for water and wastewater projects: the total federal expenditure on subsidies for investments in water supply, sewerage networks and wastewater treatment was set at Sch 3.9 billion per year between 1993 and 1996, with overall public and private investment of Sch 12-14 billion per year.

#### ***Sewerage and trade effluent charges***

Sewage charges are determined by the municipalities, and are made up of two components: a connection charge (based on the surface area covered by the property), and a water use charge. The latter charge can either be based on volume of water consumed or on the size of the property (in built-up areas). Charges reflect the full capital and operational costs of providing the water services. If the user can prove that a share of the water received from the pipe is not discharged to the sewer, the sewerage charge can be lowered. In some municipalities, a premium can be added as a pollution charge. For example, the pollution charges can be based on a measure of chemical oxygen demand (COD). This additional payment is only made above a certain minimum consumption threshold.

Industrial concerns can form sewage treatment groups with municipalities in certain areas. In this case, tariffs are set by agreement between users on the basis of the pollution load discharged by each industrial user. These contracts are usually based on water volume, or COD/BOD levels.

#### ***Abstraction and discharge charges***

There is no resource cost to any user for using surface or groundwater, and there are no pollution charges for discharging into natural waters. Economic sectors must comply with discharge standards, with separate regulations having been (or will soon be) promulgated for about 70 different sectors.

## **Price levels and trends**

### ***Water from the public supply system***

Prices can vary considerably — between Sch 5 and 25 per m<sup>3</sup>.

### ***Sewerage and trade effluent charges***

For domestic users, sewage charges are estimated to amount to, on average, between Sch 15 and 25 per m<sup>3</sup>.

### ***Direct abstraction or self-treatment***

There is neither a direct abstraction charge nor a direct discharge charge.

## **REFERENCES**

- BETRIEBSERGEBNISSE DER WASSERWERKE ÖSTERREICHS (1996). Statistik DW 1.
- FEDERAL MINISTRY OF AGRICULTURE AND FORESTRY. *Watermarks - Data and Facts*.
- FEDERAL MINISTRY FOR THE ENVIRONMENT, YOUTH AND FAMILY AFFAIRS.
- OECD (1995). *Environmental Performance Review: Austria*. OECD: Paris
- ÖSTERREICHISCHE VEREINIGUNG FÜR DAS GAS-UND WASSERFACH.
- ÖSTERREICHISCHER WASSER-UND ABFALLWIRTSCHAFTSVERBAND.
- WASSER - GEBÜHRENSTATISTIK. Statistik DW 2.

## BELGIUM<sup>16</sup>

### Context for industrial water uses

#### *Institutional arrangements*

Water resource management used to be under the joint supervision of the municipalities and the Federal state. Recently, regional governments have assumed responsibility for overall resource management. Management structures for water supply can be very diverse.

In the Flemish region, four main public companies are responsible for water supply (VMW, AWW, PIDPA and TMVW). Together with the regional authority, they have formed a co-ordinating body (VIWC), in order to better supervise the distribution of water resources. Other small utilities distribute water across the region. The distribution of piped water is under municipal responsibility, although it is generally handled by inter-municipal associations.

In the Walloon region, more than 100 water utilities are in operation, with 20 water companies or inter-communal organisations<sup>17</sup>, one regional utility, and 82 municipal services.

In Brussels, two inter-municipal utilities distribute tap water to 60 municipalities.

Wastewater treatment remains a municipality responsibility, but an increasing number of inter-communal organisations are now emerging. Since the 1980s, the regions have been responsible for funding wastewater treatment investments through inter-communal bodies. For instance, in the Flemish region, water mains at a supra-municipal level are built and maintained by the region itself (Aquafin).

Prices for piped water are set by individual distribution companies, under the supervision of the Federal Ministry of Economic Affairs, which is in charge of ensuring that all price increases are justified.

#### *Relative importance of industrial water use*

Water is distributed across sectors in both the Walloon and Flemish regions as indicated in Tables 3.1 and 3.2. Due to the high level of abstraction by the power production industry for cooling

---

16. Belgium consists of three regions — Wallonia, Flanders, and the city of Brussels. Due to the data received for this study, this section concentrates on the Walloon and Flemish regions.

17. These are responsible for more than 90 per cent of water resources, of which three organisations – the SWDE (*Société wallonne des distributions d'eau*), the CIBE (*Compagnie intercommunale Bruxelles des eaux*) and the CILE (*Compagnie intercommunale Liegeoise des eaux*) – account for 70 per cent of total water supply.

purposes in both regions, industry as a whole accounts for a very large share of total abstractions. There is very little agricultural use of water.

The Walloon region is a net exporter of water resources to the Flemish region and to other countries, such as the Netherlands.

**Table 3.1. Water Abstractions by Type in the Walloon Region (1995)**

| Use (millions m <sup>3</sup> ) | Groundwater | Surface Water | Total | %    |
|--------------------------------|-------------|---------------|-------|------|
| Public supply*                 | 320         | 80            | 400   | 11.5 |
| Industry                       | 55          | 220           | 275   | 7.9  |
| Power production               | -           | 2 800         | 2 800 | 80.5 |
| Agriculture                    | 5           | -             | 5     | 0.1  |
| Total                          | 380         | 3 100         | 3 480 | 100  |

*Note:* \* About a third of groundwater and two thirds of surface water abstracted for public supply are exported to Flanders and Brussels.

*Source:* Clignet (undated).

**Table 3.2. Water Abstractions by Type in the Flemish Region (1996)**

| Use (millions m <sup>3</sup> ) | Groundwater | Surface Water | Total | %    |
|--------------------------------|-------------|---------------|-------|------|
| Manufacturing industry         | 76          | 775           | 851   | 20.4 |
| Power production (cooling)*    | 1           | 2 165         | 2 166 | 51.8 |
| Construction                   | 3           | 2             | 5     | 0.1  |
| Agriculture                    | 9           | 1             | 10    | 0.2  |
| Other                          | 56          | 1 090         | 1 146 | 27.5 |
| Total                          | 145         | 4033          | 4 178 | 100  |

*Note:* \* The origin of cooling water cannot be completely determined, but it is mainly from surface sources.

*Source:* Vlaamse Milieumaatschappij.

### **Water sources for industry**

The majority of abstractions for industrial purposes are from surface water, as illustrated in Tables 3.3 and 3.4. It can also be seen that direct abstraction is a significantly more important source of water for industry than the public water supply.

**Table 3.3. Industrial Water Use by Type of User in the Flemish Region (Thousand m<sup>3</sup>, 1996)**

| Industry                           | Public supply | Direct abstractions | Total (%) |
|------------------------------------|---------------|---------------------|-----------|
| Food processing industry           | 13 227        | 43 359              | 1         |
| Power production                   | 2 284         | 2 284 189           | 51        |
| Chemicals, refined petroleum, etc. | 50 472        | 713 365             | 17        |
| Basic metals                       | 2 262         | 46 279              | 1         |
| Paper and paper products           | 2 003         | 27 069              | 0         |
| Textiles                           | 3 234         | 11 179              | 0         |
| Others                             | 47 975        | 1 268 290           | 30        |
| Total                              | 121 457       | 4 393 730           | 100       |

*Note:* The origin of cooling water cannot be completely determined, but it is mainly from surface sources.

*Source:* Vlaamse Milieumaatschappij.

**Table 3.4. Industrial Water Use by Type of User in the Walloon Region (Thousand m<sup>3</sup>, 1995)**

| Industry              | Public supply | Direct abstractions |             | Total<br>% |
|-----------------------|---------------|---------------------|-------------|------------|
|                       |               | Surface water       | Groundwater |            |
| Food and beverage     | 2 880 313     | 674 768             | 4 341 709   | 4          |
| Power production      | 28 700        | 3 718 210           | 1 036 383   | 2          |
| Chemical              | 3 336 214     | 27 292 413          | 6 948 299   | 18         |
| Solid waste treatment | 27 662        | 414 487             | 22 827      | 0          |
| Water treatment       | 0             | 1 149 047           | 336 971     | 1          |
| Garages               | 195 711       | 4 959               | 32 765      | 0          |
| Metallurgy            | 941 738       | 88 604 677          | 2 392 252   | 43         |
| Paper                 | 1 536 818     | 30 839 098          | 22 144      | 15         |
| Stone                 | 180 996       | 2 379 457           | 26 444 298  | 14         |
| Leather               | 32 231        | 125 413             | 100 564     | 0          |
| Textiles              | 695 307       | 63 804              | 1 331 626   | 1          |
| Gas turbines          | 0             | 340 117             | 0           | 0          |
| Glass                 | 1 166 602     | 3 172 771           | 93 721      | 2          |
| Others                | 687 507       | 66 345              | 674 186     | 1          |
| Total                 | 11 709 799    | 158 845 566         | 43 777 745  |            |

Source: Ministère de la région Wallonne (1997).

## Pricing principles

### *Pricing structure for water from the public supply system*

In the Walloon region, water prices are made up of several elements: a standing charge for meter rental, a volume-based charge, value-added tax (VAT of 6 per cent) and two fees levied by municipalities: an abstraction charge (BEF3/m<sup>3</sup>) and a wastewater treatment charge. Drinking water is generally charged at cost price, which is composed of two elements: one to cover the costs of water production (with cross-subsidisation from one region to another to compensate differences in production costs), and one fixed by municipalities to cover the costs of distribution services.

Industrial users in the Region of Wallonia generally pay prices equal to those paid by domestic users. However, slightly lower tariffs apply for higher volumes. The largest consumers can therefore negotiate with distribution companies for special supply contracts, on the basis of which prices can be reduced to half the level of domestic prices. Some special tariffs can also be granted to industrial consumers in certain areas, in order to promote economic development.

In the Flemish region, water prices include various elements: a standing charge for meter rental, a volume based charge and a value added tax (VAT at 6 per cent). In one district, an unmetered system is still partially in force. A wastewater levy is collected in Flanders. Piped water is billed at slightly above cost level, covering the costs of water production and distribution, as well as an abstraction charge (of BEF 3/m<sup>3</sup>) on surface and groundwaters. In principle, industrial users pay the same water prices as households, but in reality, industrial high-volume water consumers can elect to either pay a regressive tariff, or to negotiate separate contracts with water providers.

### *Sewerage and trade effluent charges*

In Flanders, the wastewater treatment levy depends on the resulting pollution. Large consumers (defined as consuming more than 500 cubic meter per year — there are around 30 000 of them) have three options with respect to the calculation of their sewerage levy: (i) they can have authorised laboratories

monitor the pollution loads and calculate subsequent wastewater levies for them; (ii) they can accept the pollution conversion factors by type of pollution and industrial sector established by the central administration, multiplied by the consumption in either  $\text{m}^3$  or in tonnes of output; or (iii) they can apply the zero-discharge principle, according to which they receive no discharge permit and therefore do not make any discharges.

In the Walloon region, the wastewater treatment charge for industrial users is different from that for domestic users. Whereas households pay BEF 16/ $\text{m}^3$ , industrial users pay BEF 360 per unit of pollution, according to a decree of the 30 April 1990 which introduced the wastewater fee. The pollution unit is determined according to a formula in the text of the decree: a pollution factor is calculated for each type of industrial activity. This formula was recently modified in order to give additional incentives to polluters to reduce discharges of heavy metals. The wastewater charge for industrial users in a given year is proportional to the charge which was paid in the previous year. Wastewater used for cooling in industrial processes — and which are not in contact with any polluting materials — are taxed according to the temperature at which they are discharged. The proceeds of these taxes go into a fund which supports the building of wastewater treatment infrastructure.

### ***Abstraction and discharge charges***

In the Walloon region, abstraction charges are paid by drinking water producers, and by groundwater abstractors for uses other than the production of drinking water. The latter charge varies between BEF 0-3 per  $\text{m}^3$  according to the volume abstracted. Revenues from this charge go to a Fund for the protection of groundwaters, which finances the inventory and quality control of groundwaters.

In Flanders, abstraction charges have been paid by piped water producers for both groundwater and surface water abstractions since 1997. For consumption below 500 cubic meters, no abstraction charge is levied. The charge paid by drinking water producers is currently equal to BEF 1.5 per  $\text{m}^3$ , while all other groundwater abstractors pay a charge of BEF 3 per  $\text{m}^3$ , multiplied by a CSE-factor (which is now below one, and which is planned to increase over a five-year period up to one). The revenues of these abstraction charges go to the MINA Fund, which in turn finances supra-municipal wastewater collections and wastewater treatment plants.

### **Price levels and trends**

#### ***Water from public supply system***

In the Walloon region, industrial water prices tend to be lower on average than domestic prices. Average tariffs for an annual industrial consumption of 10 000 $\text{m}^3$  are shown in Table 3.5, and compared with tariffs for domestic consumers with an annual consumption of 120  $\text{m}^3$ . Prices include VAT (at 6 per cent) and wastewater charges, which are based on different criteria for domestic and industrial users.

Although comparable data for industrial water prices in other regions was not available, it appears that industrial water prices in Flanders are on average lower than water prices for domestic users. Prices differ from one distribution area to another, but reforms are currently taking place that aim to reduce these differences.

**Table 3.5. Water and Sewerage Tariffs (1996)**

| Area                             | Tariff before tax (BEF/m <sup>3</sup> ) |          | Tariff after tax (BEF/m <sup>3</sup> ) |          |
|----------------------------------|-----------------------------------------|----------|----------------------------------------|----------|
|                                  | Industrial                              | Domestic | Industrial                             | Domestic |
| Minimum (Libramont)              | 18.91                                   | 6.83     | 36.04                                  | 23.24    |
| Maximum (SWDE- Vervier/Gileppe)  | 80.05                                   | 84.17    | 100.85                                 | 105.22   |
| Average in the Walloon region*   | 53.22                                   | 57.46    | 72.41                                  | 76.91    |
| Average in Brussels region**     | n.a.                                    | 59.26    | n.a.                                   | 76.81    |
| Average in the Flemish region*** | n.a.                                    | 41.86    | n.a.                                   | 58.71    |

Sources: \* Ministère de la Région Wallonne, Direction Générale des ressources naturelles et de l'environnement, Division de l'eau.

\*\* Institut Bruxellois pour la gestion de l'environnement (BGE).

\*\*\* Vlaamse Milieumaatschappij voor Watervoorziening, Brussel.

Table 3.5 also shows domestic tariffs for Brussels and Flanders, demonstrating the significant variations in water prices from one region to another.

### ***Sewerage and trade effluent charges***

In the Flemish region, the tax per unit of pollution was fixed at BEF 980 for the year 1997 (this was calculated on the basis of the effluents during the previous year). Annual revenues from the wastewater levy on large users amounted to just over BEF 4 billion in 1997, while levies paid by small (domestic) users amounted to 6 billion.

In the Walloon region, the tax per unit of pollution has been fixed at BEF 360 since the introduction of the tax by decree on 30 April 1990. Annual revenues from the wastewater tax on industrial users are around BEF 600 million, whilst the tax paid by domestic users raises around BEF 2 200 million per year.

### ***Direct abstraction or self-treatment***

In the Flemish region, an abstraction charge is paid by small groundwater abstractors (there are around 102 000 of these in the Flemish region). These charges amounted to around BEF 190 millions in 1997, and these funds went to the MINA-Fund.

In the Walloon region, the abstraction charge paid by groundwater abstractors for uses other than the production of drinking water varies between BEF 0-3 per m<sup>3</sup>, according to the volume abstracted.

## REFERENCES

CLIGNET (UNDATED) MICHEL. Directeur à la Division de l'Eau, Direction Générale des Ressources Naturelles et de l'Environnement, Ministère de la Région Wallonne; "La politique de l'eau en région Wallonne et son coût".

MINISTÈRE DE LA RÉGION WALLONNE (1997). Direction Générale des Ressources Naturelles et de l'Environnement, Division de l'Eau, "5<sup>e</sup> Rapport Annuel d'Activités: La taxe sur le déversement des eaux usées industrielles et domestiques — La redevance sur les prises d'eau potabilisable et la contribution de prélèvement sur les prises d'eau souterraine non potabilisable" (Juin): Namur.

VLAAMSE MILIEUMAATSCHAPPIJ (1998). *International Milieubeleid*. Erembodegem.

## CANADA

### Context for industrial water uses

#### *Institutional arrangements*

Water resources in Canada are the property of the Provinces, and almost all water utilities are publicly-owned. Provinces have authority over domestic and industrial water supply, pollution control, hydroelectric power development, irrigation and recreation. Most Provinces regulate water supply at the municipal level, except for Alberta and Nova Scotia, which do so at the provincial level. Each municipality defines its own rate regulation system. Recently, there have been some moves to introduce private ownership.

#### *Relative importance of industrial water use*

Canadian industry, composed primarily of mineral extraction, manufacturing and thermal power sectors, uses large amounts of water as a basic and essential input to production, as shown in Table 4.1.

**Table 4.1. Water Uses by Type (1991)**

| <b>Sector</b>      | <b>% of water use</b> |
|--------------------|-----------------------|
| Agriculture        | 9                     |
| Mineral extraction | 1                     |
| Manufacturing      | 16                    |
| Thermal power      | 63                    |
| Public supply      | 11                    |
| Total              | 100                   |

Source: Tate, personal communication.

Industrial water use has grown consistently during the period 1972-1991, as shown in the series of industrial water use surveys conducted by Environment Canada and Statistics Canada.<sup>18</sup> Manufacturing water use grew between 1972 and 1981, but fell substantially from 1981 to 1991. Ontario was the major user, accounting for 54 per cent of all withdrawals in 1972 and up to 74 per cent in 1991.

---

18. Tate (1995). Most of the data contained in this section comes from this source.

### *Water sources for industry*

In general, smaller plants tend to be served from municipal water systems whereas larger operations tend to be self-supplied.<sup>19</sup> In the manufacturing industry, 83 per cent of manufacturers surveyed in 1991 took water from self-supplied freshwater sources, and only 10 per cent were connected to public utility systems. In the mineral extraction industry, only 5 per cent of businesses surveyed used public utility supply.

**Table 4.2. Water Sources for Industry**

| Million m <sup>3</sup><br>per year | Public<br>Municipal | Fresh water<br>Self supplied |        |       | Brackish water<br>Self supplied |           |       | Total   |
|------------------------------------|---------------------|------------------------------|--------|-------|---------------------------------|-----------|-------|---------|
|                                    |                     | Surface                      | Ground | Other | Ground                          | Tidewater | Other |         |
| Manufacturing                      | 712.5               | 6132.7                       | 131.9  | 115.9 | 8.4                             | 173.5     | 7.1   | 7282.0  |
| Mineral extraction                 | 20.2                | 283.9                        | 27.6   | 15.7  | 3.7                             | 5.7       | 6.9   | 363.7   |
| Thermal power generation           | 165.1               | 26035.1                      | 8.8    | 0     | 0                               | 2148.4    | 0     | 28357.4 |
| Total                              | 897.8               | 32451.7                      | 168.3  | 131.6 | 12.1                            | 2327.6    | 14    | 36003.1 |

Source: Tate and Scharf (1995).

The food and beverage industry, which in many cases is self supplied, may draw a significant portion of their water requirements from municipal systems for water quality reasons.

### *Type of industrial water use*

Total water use is dominated by the thermal power generation industry, which accounts for over two-thirds of total gross water use by the industry, followed by manufacturing and mineral extraction industries.

In the manufacturing sector, the five largest water-using manufacturing groups are: paper and allied products, primary metals, chemicals and chemical products, food, and petroleum and coal product industries (Table 4.3).

Water use in the manufacturing sector has significantly declined since 1981, due to a general decline in manufacturing activity and structural changes in the types of activities undertaken. By contrast, water use in thermal power generation has increased due to rapid growth in demand for electricity and a gradual increase in the proportion of generating capacity accounted for by nuclear power plants (which use relatively more cooling water than conventional thermal plants).

The two largest users, thermal power and manufacturing, have a very low re-circulation rate, which may suggest that the potential for re-circulation has not been fully exploited.

19. It is generally uneconomic for smaller plants to have their own water supply systems, whereas larger plants can often benefit from economies of scale in doing so.

**Table 4.3. Water abstraction and consumption in Canadian manufacturing (1986)**  
(million m<sup>3</sup>)

| Industry group                      | Total intake | Consumption* |
|-------------------------------------|--------------|--------------|
| Foods                               | 564          | 24           |
| Beverages                           | 63           | 12           |
| Rubber products                     | 23           | 2            |
| Plastic products                    | 30           | 3            |
| Primary textiles                    | 95           | 2            |
| Textile products                    | 13           | 2            |
| Wood products                       | 56           | 2            |
| Paper and allied products           | 3 029        | 200          |
| Primary metals                      | 1 718        | 43           |
| Fabricated metal products           | 25           | 1            |
| Transportation equipment            | 117          | 4            |
| Non-metallic mineral products       | 90           | 18           |
| Refined petroleum and coal products | 487          | 33           |
| Chemicals and chemical products     | 1 674        | 59           |
| Total                               | 7 984        | 405          |

Note: \* Consumption = total intake - total discharge.

Source: Tate and Scharf (1991).

## Pricing principles

### *Pricing structure for water from the public supply system*

Few formal principles are used for industrial water pricing at the municipal level in Canada. Canadian water and sewer rates vary widely, primarily because each municipality is free to establish its own set of practices and criteria. Prices are the combined result of historical practice, special arrangements, some cross subsidies, etc. Metering has only recently been introduced. Most tariffs are flat rates, with some use of constant and declining block rates (for industrial tariffs, four jurisdictions had a constant unit charge rate structure in 1988, two used decreasing-block rates, and one used increasing-block rates). Flat rates apply mainly to residential, rather than to commercial, customers; the latter are more frequently metered and charged on a volumetric basis.

Commercial rates show the same patterns as domestic rates, but they tend to be higher. Industrial firms often negotiate contracts with municipalities for the provision of water services, which means that industrial water price data are often difficult to obtain. These contracts are normally negotiated at bulk rates and are often unrelated to the precise quantities of water used — i.e. they are somewhat akin to flat rates. Industrial water users can also obtain partial credit for clean return flows, such as when water is used for cooling purposes.

### *Sewerage and trade effluent charges*

Effluent discharge fees have been discussed theoretically in Canada, but very little progress has been made to institute them.

For industries discharging to municipal systems, treatment costs are built into the water tariffs if there are no “extra strength” discharges involved. If industries make extra strength discharges, additional

fees often form part of the contracts that individual firms negotiate with their respective municipalities. Increasingly, many of the larger municipalities use extra strength sewer surcharges to cover part of the cost of industrial waste treatment. Most commonly, they take the form of a percentage added to the basic water supply bill. In 1991, 23 per cent of water prices contained such sewer charges, which had the effect of raising basic water bills by 30 per cent.

### ***Abstraction and discharge charges***

A small license fee is paid by users to the respective Provinces for access to the provincially-owned water resources. These charges are not related to actual water quantities abstracted: they tend to be set on the basis of maximum allowable intakes. No incentives to use water efficiently are built into the system. In most cases, the charges merely cover the administrative costs of licensing. The licence fee accounts for less than one per cent of total water costs for directly abstracted water.

### **Price levels and trends**

#### ***Water from public supply system***

For the volume-based rates, unit prices are very low, usually under CAD 1.00 per cubic metre. Despite this, unit prices increased by an average of 67 per cent from 1986 to 1991. There is little variation in prices according to customer size. The total commercial water prices (CAD per month) for various levels of consumption are given in Table 4.4. In general, water prices form less than one per cent of the cost of manufacturing.

**Table 4.4. Total commercial water prices (CAD/month) for selected volumes of service, by Province (1991)**

| <b>Province</b>  | <b>10 m<sup>3</sup>/month</b> | <b>35m<sup>3</sup>/month</b> | <b>100m<sup>3</sup>/month</b> |
|------------------|-------------------------------|------------------------------|-------------------------------|
| Newfoundland     | 18.16                         | 18.89                        | 20.94                         |
| P.E.I.           | 25.32                         | 28.53                        | 38.91                         |
| Nova Scotia      | 26.93                         | 34.20                        | 51.77                         |
| New Brunswick    | 26.50                         | 31.29                        | 43.69                         |
| Quebec           | 14.93                         | 17.55                        | 26.43                         |
| Ontario          | 23.09                         | 35.62                        | 71.35                         |
| Manitoba         | 24.37                         | 41.39                        | 102.10                        |
| Saskatchewan     | 20.95                         | 38.38                        | 88.93                         |
| Alberta          | 28.57                         | 46.74                        | 99.34                         |
| British Columbia | 17.92                         | 21.39                        | 33.46                         |
| Territories      | 41.21                         | 70.36                        | 178.49                        |
| Canada Total     | 20.48                         | 28.65                        | 52.92                         |

Source: Tate and Lacelle (1995).

### ***Sewerage and trade effluent charges***

As described above, sewerage charges are generally built into water tariffs when the sewage being discharged is not "extra strength". For extra strength effluent, additional charges are paid, but are

negotiated on a contractual basis between municipalities and industrial users, so no generalised data was available for this study.

### ***Direct abstraction or self-treatment***

Tate (1995a) has calculated water costs for direct abstraction and self-treatment, which is the source of the vast majority of water used for industrial purposes in Canada. Industrial water prices for self-supplied users can be conceptualised as being the average cost per cubic meter of: water acquisition, water treatment, re-circulation, and wastewater treatment. Acquisition costs take into account the amount paid by firms to water utilities, the operation and maintenance costs of plants, and the licence fees paid to the Provinces: they account for 65 per cent of water use costs for the manufacturing industry as a whole. Within acquisition costs, plant operation and maintenance costs account for 85 per cent of the total.

These costs are shown in the Table 4.5. Water treatment costs are particularly low for power plants, which, in any case, are publicly-owned and pay very little for their water.

**Table 4.5. Total Water Costs (CAD million) by cost component and industry group (1991)**

| Industry group                  | Acquisition | Intake treatment | Recirculation | Discharge treatment | Total     |
|---------------------------------|-------------|------------------|---------------|---------------------|-----------|
| Food products                   | 46.8        | 5.6              | 2.9           | 14.8                | 70.0      |
| Beverage products               | 11.3        | 2.7              | 0.4           | 1.1                 | 15.5      |
| Rubber products                 | 2.3         | 0.8              | 0.7           | 0.0                 | 3.8       |
| Plastic products                | 7.7         | 0.6              | 1.6           | 0.1                 | 10.0      |
| Primary textiles                | 4.1         | 1.7              | 1.5           | 1.9                 | 9.2       |
| Textile products                | 1.7         | 0.2              | 0.3           | 0.3                 | 2.5       |
| Wood products                   | 4.3         | 1.0              | 0.2           | 0.8                 | 6.3       |
| Paper and allied                | 210.8       | 36.3             | 20.7          | 100.3               | 368.1     |
| Primary metals                  | 410.1       | 22               | 41.0          | 49.2                | 522.3     |
| Metal fabricating               | 302         | 0.7              | 0.6           | 5.2                 | 9.7       |
| Transportation equipment        | 9.9         | 1.1              | 1.8           | 6.5                 | 19.3      |
| Non-metallic mineral products   | 6.9         | 1.2              | 0.8           | 0.8                 | 9.7       |
| Petroleum and coal products     | 21.4        | 28.6             | 13.1          | 24.6                | 87.7      |
| Chemicals and chemical products | 71.9        | 18.9             | 11.2          | 16.0                | 118.0     |
| Manufacturing total             | 812.4       | 121.5            | 96.7          | 221.7               | 1 252.2   |
| Mining industries               | 53 984      | 3 188            | 16 953        | 38 443              | 112 568   |
| Thermal power generation        | 6.5         | 23.0             | n.a.          | n.a.                | n.a.      |
| Canada total                    | 54 802.9    | 3 332.5          | 17 049.7      | 38 664.7            | 113 820.2 |

*Source:* Tate and Lacelle (1995).

## REFERENCES

ENVIRONMENT CANADA. Communication with Mr. Don Tate.

TATE, D.M, AND R. RIVERS (1990). "Industrial Water Pricing for Ontario: Towards Realistic Pricing". Proceedings of the Joint Symposium on International and Transboundary Water Resource Issues, AWRA and CWRA, Toronto (April 1-4).

TATE, D.M, S. RENZETTI, AND H.A. SHAW (1992). *Economic Instruments for Water Management: The Case for Industrial Water Pricing*. Social Science Series No. 26, Ecosystem Sciences and Evaluation Directorate , Economics and Conservation Branch: Ottawa, Canada.

TATE, D.M, AND D.M. LACELLE (1995). *Municipal Water Rates in Canada: Current Practices and Prices, 1991*. Social Science Series No. 30, Water and Habitat Conservation Branch, Ottawa: Canada.

TATE, D.M, AND D.N. SCHARF (1995). *Water Use in Canadian Industry, 1991*. Social Science Series No. 31, Water and Habitat Conservation Branch: Ottawa, Canada.

TATE, D.M. (1996). *Economic Aspects of Sustainable Water Management in Canada*. Ecosystem Sciences and Environmental Resources Directorate: Ottawa, Canada.

## CZECH REPUBLIC

### Context for industrial water uses

#### *Institutional arrangements*

The Ministry of Agriculture in the Czech Republic ensures the development of water supply and sewerage services through legislation, development programmes, subsidies for water supply systems and wastewater treatment investment (in co-operation with the Ministry of Finance). It also holds the government's "golden share" in the Water Supply and Sewerage Companies. The Ministry of Environment covers water protection and manages the State Fund of Environment, which financially supports the construction of sewerage and wastewater treatment plants.

The responsibility for water supply and wastewater treatment is entrusted to municipalities, according to Law 410/1992. The water and sewerage companies cover mainly district areas, with some corresponding nearly to the areas of former regions. There are over one hundred large water and sewerage companies in the Czech Republic.

The ownership of these water supply and sewerage companies has been transferred from the state to a more diversified share-holder base, although the state has retained a "golden share" in most companies. The following company structures have been adopted:

- joint-stock companies with municipalities as majority share-holders;
- associations of municipalities (or joint-stock companies) as infrastructure owners and separate companies for operations (joint-stock companies, limited companies); and
- municipality companies operated by the municipality itself or by a private company.<sup>20</sup>

---

20 The Prague water works and Prague sewerage and water courses covered by the City of Prague are currently being privatised.

### ***Relative importance of industrial water uses***

The transition to a market economy has been accompanied by a reduced demand for water across all sectors, but particularly from industry. As seen in Table 5.1, water use by industry declined by 40 per cent between 1985 and 1993 and water use by power stations fell 20 per cent during the same period, whilst water use by the public supply system remained roughly stable. In 1996, industry received 109 million m<sup>3</sup> of water through public water supply companies (i.e. around 18 per cent of water distributed), and abstracted 583 million m<sup>3</sup> directly from surface and groundwater sources (i.e. 23 per cent of all water abstracted — Table 5.1).

**Table 5.1. Water Uses in the Czech Republic (1985-1993)**

| Type of user<br>(in million m <sup>3</sup> ) | 1985             |                  |       |     | 1993        |       |     |
|----------------------------------------------|------------------|------------------|-------|-----|-------------|-------|-----|
|                                              | Surface<br>water | Ground-<br>water | Total | %   | Groundwater | Total | %   |
| Power stations                               | 1 150            | 10               | 1 160 | 33  | 10          | 920   | 33  |
| Agriculture                                  | 50               | 10               | 60    | 2   | 10          | 50    | 2   |
| Industry                                     | 1 010            | 60               | 1 070 | 30  | 50          | 650   | 24  |
| Public supply                                | 700              | 480              | 1 180 | 34  | 460         | 1 090 | 40  |
| Others                                       | 50               | 0                | 50    | 1   | 0           | 45    | 2   |
| Total                                        | 2 960            | 560              | 3 520 | 100 | 530         | 2 755 | 100 |

Source: Czech Ministry for the Environment (1994).

### ***Water sources for industry***

As shown in Table 5.1, surface water accounts for approximately 80 per cent of water sources in the Czech republic. In particular, industrial users mostly use surface water (up to 95 per cent of their water uses are from these sources). Direct abstractions accounted for 84 per cent of total industrial consumption.

### **Pricing principles**

#### ***Water price structures from public supply system***

Prices for drinking water supply and for the withdrawal of surface water from water courses are included in the system of price regulation. According to the Prices Act (No. 526/1990), some prices are regulated according to a number of rules: there can be maximum prices; fixed prices; minimum prices; materially regulated prices under conditions; maximum range of price increases in a defined period; maximum share of increased input prices in a defined period; and finally, a mandatory process of price formation, defining what can be included in the price. The latter structure was applied for water prices in 1993. In 1994, water subsidies were stopped, and prices must now be based on economically-justified costs and reasonable profits.

There are no distinctions by size of user, although water services are more expensive for industrial users than for household customers, due to the need to alleviate the impact on domestic users of the removal of subsidies.

There are no seasonal variations in water prices, except for water use in through-flow cooling of heat power stations. Lower contractual prices do exist in some specific cases, mainly due to the lower quality of water being provided.

### ***Sewerage and trade effluent charges***

No precise data was available on sewerage and trade effluent charges. From the pricing structure for households, it appears that sewerage charges are included in the price of water, and account for approximately 25 per cent of the total price.

### ***Abstraction charges***

Abstraction charges vary according to the source of supply (groundwater vs. surface water) and the location and the type of use (consumptive vs. non-consumptive). Water Basin Companies levy the surface water abstraction charges and the State Fund of Environment levies the groundwater abstraction charge. Charge levels increase with inflation in order to cover the expenses of Water Basin Companies, other than those expenses subsidised by the state (e.g. navigation, flood control). The abstraction charges for groundwater are higher — originally with the purpose of ensuring the priority use of groundwater resources for drinking water supply, for which abstraction is free of charge.

### ***Discharge charges***

Charges for wastewater discharged to surface waters are set by Governmental Decree (No. 35/1979). The charge is equivalent to the annual running costs of a wastewater treatment plant that would remove the particular pollution under consideration. The pollution units are defined as follows:

- BOD - 0.25 mg/l;
- SS - 0.50 mg/l;
- crude oil - 0.05 mg/l;
- crude oil discharged to water coursed used for drinking water supply - 0.01 mg/l;
- dissolved anorganic salts - 5.00 mg/l;
- apparent alkalinity or acidity - 0.0025 mmol/l.

There is also a surcharge to take into account any adverse effects on the receiving water course. When the polluter starts building a wastewater treatment plant, he is allowed to delay the payment of 60 per cent of these charges until construction is completed, providing completion takes place in due time. If there are delays, the polluter has to pay the full amount of deferred charges, with penalties.

A new law for discharge charges is currently under preparation. The charge will increase so as to make it more profitable for the polluter to treat wastewater rather than to discharge it untreated into water courses. The scheme will also take into account further pollution elements such as COD, N, P, and specific organic materials.

## **Price levels and trends**

### ***Water services from public supply system***

During the communist era, the operation of water and sewerage enterprises was subsidised, so the price of water and sewerage for households was 0.80 KΦs/m<sup>3</sup> (broken down into 0.60 KΦs/m<sup>3</sup> for water, and 0.20 KΦs/m<sup>3</sup> for sewerage), and for other users was 3.70 KΦs/m<sup>3</sup> and 2.35 KΦs/m<sup>3</sup> for water and sewerage respectively. Economic reforms and the removal of subsidies in 1994 led to a sharp increase in prices, and hence to a decline in consumption. Industrial water prices are currently more expensive than those of households, to alleviate the impact of high water prices on households following the removal of subsidies. A main priority for the future is to make prices converge, so as to eliminate this cross-subsidy in the long-run.

In 1997, the price of water supplied to industry from community systems (drinking water) was between 4.97 and 28.33 KΦ/m<sup>3</sup>. These variations are a result of differing cost structures between individual localities, which are mainly affected by the size and location of customers, by the nature of sources, and by the degree of exploitation of existing water and sewage plant capacities. The average price (out of 86 of the main water supply and sewerage companies) was 16.06 KΦ/m<sup>3</sup> (including VAT of 5 per cent).

### ***Sewerage and trade effluent charges***

The price of sewerage services offered by water supply and sewerage companies range from 4.52 to 31.27 KΦ/m<sup>3</sup> in 1997, with an average value of 13.30 KΦ/m<sup>3</sup> (including VAT of 5 per cent).

### ***Direct abstraction or treatment***

For groundwater, an abstraction charge of 2 KΦ/m<sup>3</sup> is levied when the abstraction exceeds 15 000m<sup>3</sup> per year or 1 250m<sup>3</sup> per month. For public drinking water supply, there is no abstraction charge (Governmental Decree No. 35/1979).

For surface water, the abstraction charge varies between river basins as shown in Table 5.2. In this table, prices are quoted in KΦ/m<sup>3</sup>, excluding VAT (equal to 5 per cent).

For discharges, charges for specific types of pollution (crude oil, dissolved anorganic salt, apparent alkalinity or acidity) are calculated as follows:

- **oil:** wastewater volume multiplied by a rate comprised between 2 KΦ/m<sup>3</sup> and 6 KΦ/m<sup>3</sup> for 5 to 50 mg/l of oil

- **dissolved anorganic salt:** tons of dissolved anorganic salt, multiplied by a rate comprised between 1 200 Kč/t and 240 Kč/t for a load ranging between 0.01 m<sup>3</sup>/s and 10 m<sup>3</sup>/s
- **alkalinity or acidity:** alkalinity or acidity (in kmol) multiplied by a rate of 270 Kč/kmol

There are no distinctions according to the size of industrial user, and no seasonal variations in the charges.

**Table 5.2. Price of Surface Water for Industrial Users (Kč/m<sup>3</sup>) (1996/1997)**

|         | <b>River basin</b>  | <b>1996</b> | <b>1997</b> |
|---------|---------------------|-------------|-------------|
| Vltava  | consumptive use     | 0.95        | 1.03        |
|         | non-consumptive use | 0.46        | 0.51        |
| Labe    | consumptive use     | 0.83        | 0.99        |
|         | non-consumptive use | 0.33        | 0.45        |
| Ohře    | consumptive use     | 1.43        | 1.52        |
|         | non-consumptive use | -           | -           |
| Morava  | consumptive use     | 1.76        | 1.92        |
|         | non-consumptive use | 0.42        | 0.46        |
| Odra    | consumptive use     | 0.94        | 1.18        |
|         | non-consumptive use | -           | -           |
| Average | consumptive use     | 1.18        | 1.33        |
|         | non-consumptive use | 0.40        | 0.47        |

Source: Ministry of Agriculture of the Czech Republic.

## REFERENCES

- MINISTRY OF AGRICULTURE. DEPARTMENT OF THE STATE WATER MANAGEMENT (1997). Communication with Ing. Stanislav Morava, Director.
- MINISTRY OF THE ENVIRONMENT (1994). *Environmental Yearbook* (1993/1994).
- MINISTRY OF THE ENVIRONMENT (1997). Communication with Mr Vladislav Bízek, Vice-minister.

## DENMARK

### Context for industrial water uses

#### *Institutional arrangements*

Drinking water and wastewater services are both the responsibility of local authorities, which maintain their own water supply and wastewater treatment companies. There are about 300 water utilities managed by 275 municipalities, and two regional water services for Copenhagen and Gentofte. In addition, private co-operatives of users manage small networks in small towns and rural areas. There are no private utilities for water services, as it is forbidden to make a profit out of the management of natural resources in Denmark, following a 1926 law. There are a handful of private undertakings for wastewater treatment, however.

The 1991 environmental protection law (*Miljøbeskyttelsesloven*) stressed the principle of local autonomy for water resource management. Regional authorities co-ordinate with municipalities to produce 4-year plans for the management of water resources. They are also responsible for controlling water abstraction rates and the issuing of licences. The Danish Environmental Protection Agency supervises the national environment, and acts as the appeal authority for local decisions.

#### *Relative importance of industrial water use*

Total water abstracted for all purposes amounts to around 1 300 million m<sup>3</sup> per year. In 1995, about half of the water abstracted was distributed through 2 900 common utilities. Water abstractions in the country were broken down as shown in Table 6.1. The *share* of water used for industrial purposes appears to have remained roughly stable over the period 1970-1988, at 28 per cent, although there was an increase in absolute magnitude (together with water abstractions as a whole) of about 85 per cent.

**Table 6.1. Water abstractions by type of users in million m<sup>3</sup> per year (1970-1988)**

| User         | 1970 |      | 1988  |       |
|--------------|------|------|-------|-------|
| Domestics    | 280  | 39%  | 360   | 27.5% |
| Institutions | 60   | 8%   | 60    | 4.5%  |
| Industry     | 200  | 28%  | 370   | 28%   |
| Agriculture  | 130  | 18%  | 450   | 35%   |
| Others       | 50   | 7%   | 65    | 5%    |
| Total        | 720  | 100% | 1 305 | 100%  |

Source: Barraqué (1995).

### ***Water sources for industry***

Given that groundwater resources are very abundant in Denmark, 99 per cent of the Danish water supply is drawn from groundwater. Surface water is used as a supplement only in the metropolitan areas. In order to limit over-utilisation of aquifers, conservation measures have been taken whose aim is to constrain the development of large water user industries. A large share of industrial wastewater is treated by wastewater utilities, rather than by the industries themselves.

### ***Types of industrial water uses***

No information was available for this study on types of industrial water uses.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Municipalities (or user co-operatives) are responsible for fixing water prices, which must reflect the price of maintaining and building infrastructure and seek to cover the full amount of capital and operational costs. Water prices are composed of five elements: a fixed annual fee, a volume-related water charge, a wastewater fee (see below), a tax on drinking water (or “green tax”) and VAT (at 25 per cent). In addition, the customer must pay a connection fee: industrial users pay a charge based on a unit area of 800m<sup>2</sup> of property. The fixed fee can have several different bases. The proceeds of the tax on drinking water are used to co-finance a wide range of environmental projects. In general, prices for domestic and industrial users are the same, and the price per cubic metre remains the same, regardless of the level of consumption.

However, there are some examples of quantity discounts for industrial users. In addition, industrial users can deduct the recently-introduced tax on drinking water from their VAT proceeds.

#### ***Sewerage and trade effluent charges***

Sewerage charges are included in the price of water: charges are calculated on the basis of the amount of water consumed. There is a connection fee for connection to the sewer. Wastewater charges cover the costs of treatment and there are no public subsidies.

In 126 municipalities, additional trade effluent charges are payable by industrial consumers with BOD (DBO<sub>5</sub>) discharge content above 400mg per litre.<sup>21</sup> The municipality is responsible for choosing the charging formula, but the charge must correspond to the actual added costs of treating the water. The charge level is generally based on the volume and the characteristics of the effluent. In 31 cities, industries can also be charged according to content levels of other pollutants (COD, nitrogen, phosphorus). For certain specific substances, contracts are negotiated directly between the municipality and the polluting industry. It appears that some cities have not introduced additional trade effluent charges, either for fear of losing industrial users, or due to the high monitoring costs entailed. Trade effluent charges have therefore been limited to a small number of industries.

---

21. Barraqué (1995).

### ***Abstraction and discharge charges***

There are no discharge charges for industries which discharge directly to surface waters, but industries which do so are required to cover their own treatment costs. A general discharge tax has been passed and will be implemented in the next few years. The proceeds will not be earmarked for environmental projects.

### **Price levels and trends**

#### ***Water from public supply system***

Data for all components of industrial water prices in Denmark (including sewerage) are shown in Table 6.2. Prices can vary considerably throughout the country. They have sharply increased in the last five years, in order to reflect additional wastewater investments.

**Table 6.2. Water Prices in Denmark (1995)**

| <b>Price component</b>                            | <b>Mean</b> | <b>Maximum</b> | <b>Minimum</b> |
|---------------------------------------------------|-------------|----------------|----------------|
| Connection fee (DKK)                              | 10 000.00   | 20 500.00      | 1 225.00       |
| Fixed annual fee (DKK)                            | 266.00      | 1 000.00       | 30.00          |
| Volume-related water charge (DKK/m <sup>3</sup> ) | 3.27        | 8.25           | 0.50           |
| Wastewater fee (DKK/m <sup>3</sup> )              | 10.29       | 22.00          | 3.19           |
| Tax on drinking water (DKK/m <sup>3</sup> )       | 2.00        | n.a.           | n.a.           |
| Total price incl.VAT (DKK/m <sup>3</sup> )        | 20.64       | 39.08          | 10.58          |

Source: Danish Water Supply Association (1997).

The tax on drinking water will increase to 5 DKK/m<sup>3</sup> in 1998. Since 1987, the connection charge has been restricted to DKK 30 000 per 800m<sup>2</sup> of industrial area, as this charge was seen as a good source of income for municipalities wanting to upgrade local wastewater treatment capacities.

### ***Sewerage and trade effluent charges***

Sewerage charges are indicated in Table 6.2. The average charge for trade effluent in 1992, was ECU 1.35/ m<sup>3</sup>. More detailed data for trade effluent charges was not available, as most of them are the product of negotiations between municipalities and industrial users.

### ***Direct abstraction or self-treatment***

No such charges were payable.

## **REFERENCE**

DANISH WATER SUPPLY ASSOCIATION (1997). As quoted in BAKGAARD (1997). "Introduction to Water Supply in Denmark", *Water Supply*, August.

## FINLAND

### Context for industrial water uses

#### *Institutional arrangements*

In Finland, 452 municipalities are responsible for the management of water services, under the control of regional and national level bodies. There are more water and sewerage networks than municipalities, however, since users can form co-operatives to organise their own water and wastewater services. In 1996, there were 1120 water and 650 sewage works, serving at least 200 persons each. Since 1983, the Ministry of the Environment (protection) and the Ministry of Agriculture and Forestry (supply and sewerage) share the responsibility for water policy.

A typical feature of the legislation is the case-by-case consideration of abstraction and pollution permits instead of the application of general norms. The permits are renewed every 4 to 8 years.

#### *Relative importance of industrial water use*

Industry is the largest water consumer in Finland. Economic fluctuations as well as improvements in production methods, especially in the forest industry, greatly affect total water consumption. The share of industrial uses (excluding marine water) went from 58 per cent to 65 per cent between 1989 and 1995.

**Table 7.1. Water Consumption by Sector (1995)**

| Sector                   | Excl. marine (brackish)  |     | Incl. Marine (brackish)  |     |
|--------------------------|--------------------------|-----|--------------------------|-----|
|                          | Mn m <sup>3</sup> / year | %   | Mn m <sup>3</sup> / year | %   |
| Agriculture              | 0                        | 0   | 0                        | 0   |
| Public supply            | 410                      | 16  | 410                      | 5   |
| Industry                 | 1 630                    | 65  | 2 720                    | 36  |
| Power stations (cooling) | 490                      | 19  | 4 510                    | 59  |
| Industry + power         | 2 120                    | 84  | 7 230                    | 95  |
| Total                    | 2 530                    | 100 | 7 640                    | 100 |

Source: Ministry of the Environment, Finland.

#### *Water sources for industry*

Almost all industrial water use in Finland is directly abstracted by industry itself, with only 2 per cent being supplied through the public system. Most of the directly abstracted water (98% of it) is taken from surface water sources. In comparison, only 40 per cent of the water for the public supply system is sourced from surface waters, with the other 60 per cent coming from groundwater.

### *Types of industrial water uses*

In industry, water is mainly used for cooling purposes (87 per cent of industrial water uses, including power production and the use of marine waters), and as a solvent for raw materials and chemicals. The pulp and paper industry is by far the biggest industrial water user within manufacturing industry. In 1995, however, the pulp and paper industry consumed 45 per cent of manufacturing industry total (71 per cent of total water).

Table 7.2 indicates water consumption levels by type of industrial user (only those which are obliged to monitor wastewater discharges, i.e. large users). Table 7.3. provides the same figures, but *excluding* power production.

**Table 7.2. Water consumption by industry (including power production) obliged to monitor wastewater (million m<sup>3</sup>, 1995)<sup>22</sup>**

| Industry               | Total     | %   | % without power production |
|------------------------|-----------|-----|----------------------------|
| Pulp and paper         | 1 227 220 | 17  | 45                         |
| Mechanical forestry    | 7 760     | 0   | 0                          |
| Oil and petrochemical  | 863 860   | 12  | 32                         |
| Fertiliser             | 85 350    | 1   | 3                          |
| Other chemical         | 262 150   | 4   | 10                         |
| Stone quarrying        | 15 420    | 0   | 1                          |
| Metal ore mining       | 2 650     | 0   | 0                          |
| Basic metal processing | 237 060   | 3   | 9                          |
| Metal product          | 5 460     | 0   | 0                          |
| Textiles               | 71        | 0   | 0                          |
| Leather and fur        | 7         | 0   | 0                          |
| Dairy products & meat  | 3 530     | 0   | 0                          |
| Food (permanent)       | 11 280    | 0   | 0                          |
| Food (seasonal)        | 5 990     | 0   | 0                          |
| Separate power plants  | 4 524 200 | 62  | d.n.a.                     |
| Total                  | 7 252 008 | 100 | 100                        |

Source: Finnish Environment Institute.

**Table 7.3. Industrial water use, excluding power production (1995)**

| Industry        | Excl. marine (brackish) |     | Incl. Marine (brackish) |     |
|-----------------|-------------------------|-----|-------------------------|-----|
|                 | Million m <sup>3</sup>  | %   | Million m <sup>3</sup>  | %   |
| Chemical        | 289                     | 18  | 336                     | 12  |
| Steel & Iron    | 130                     | 8   | 248                     | 9   |
| Pulp & Paper    | 1 160                   | 71  | 1 211                   | 45  |
| Food & Drinks   | 13                      | 1   | 34                      | 1   |
| Mining          | 17                      | 1   | 18                      | 1   |
| Oil & Petroleum | 10                      | 1   | 868                     | 32  |
| Textiles        | 0                       | 0   | 0                       | 0   |
| Other           | 7                       | 0   | 8                       | 0   |
| Total           | 1 626                   | 100 | 2 723                   | 100 |

Source: Ministry of the Environment.

22. These figures include consumption of marine (brackish) water.

It is also important to note that less than 10 per cent of industrial wastewater (even excluding cooling water) goes to the municipal sewer (7 per cent in 1992) — a factor which keeps the wastewater bill from public sewerage services extremely low for industrial users in Finland.

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

Water charges are based on contracts between consumers and the water supply system. Charge types can vary from one municipality to the other. Charges collected by the municipal water and sewerage plants can take the following forms:

- connection fees — which are meant to cover the investment costs; based, for example, on the size of the property.
- user and consumer charges — based on the amount of water consumed and the amount and quality of wastewater produced.
- annual basic charges — water meter charges or other charges based on some characteristics of the property.
- additional charges for special services

Municipal water charges are composed of fixed components (connection, meter) and a volume component. In 1995, industry (including power production) paid water charges to public water systems of about 50 million FIM (less than 5 per cent of water charge revenues to public water systems).

### ***Sewerage and trade effluent charges***

Water Courts set wastewater treatment requirements for both public sewer systems and for industrial plants on a case-by-case basis: the limiting values for the discharges are mostly given as total load per unit of time. Sometimes, limits are also given as a specific load per ton of product, or as removal efficiencies.

Sewerage charges to the public sewer system are billed together with the water bill. Wastewater charges are determined (in general terms) by law: municipalities have the right to collect user charges and initiation charges to cover the costs incurred by wastewater treatment activities (including sewerage). Municipal waste water charges are composed of fixed components (connection, meter) and a volume component. In 1995, industry (including power production) paid waste water charges to public sewer systems of 30 million FIM.

### ***Abstraction and discharge charges***

The various types of charges relating to water rights in Finland are, in one way or another, connected with other obligations included in the permit applications.

Permit-holders (heavy polluters) may incur an obligation to pay an annual water conservation charge to the state, according to the Water Act. The revenues collected are used for water pollution control activities, especially for research. Total revenues are about 2 million FIM/year.

Water protection charges are imposed on heavy polluters by the Water Rights Court; they are earmarked for water protection activities by the State (revenue: 2.3 million FIM in 1993).

There is also a fish management charge which is imposed on polluters and those who build in the watercourse, according to a decision by the Water Rights Court. Proceeds are earmarked to finance the costs incurred by the State in preserving fish stocks (revenue: 3.6 million FIM in 1993).

## **Price levels and trends**

### ***Water from public supply system***

After a sharp increase during the mid-70s in the price of water supplied through public utilities, the real price of water stayed practically unchanged throughout the 1980s. Larger increases were experienced again in the mid-1990s. In February 1998, the average volume-based component of the water charge was FIM 5.30/m<sup>3</sup>. The total price, including fixed components (connection, meter), was FIM 6.90/m<sup>3</sup> on average.

### ***Sewerage and trade effluent charges***

In February 1998, the average volume-based component of the sewerage charge was FIM 7.60/m<sup>3</sup>. The total charge, including fixed components (connection, meter), was FIM 8.40/m<sup>3</sup> on average. Higher charges apply for especially dirty water, based on incremental treatment costs.

### ***Direct abstraction or self-treatment***

The water protection (conservation) charge levied on large polluters (imposed by the water courts) is defined on a case-by-case basis, and there are no standardised rules for its determination. Charge rates are far below any incentive levels. In total, FIM 2 million per year is raised by the water protection charge for the entire country.

## REFERENCES

FINNISH ENVIRONMENT INSTITUTE. *Industrialised Water Statistics*.

FINNISH WATER AND WASTE WORKS ASSOCIATION (1998). *Charges in Public Water Supply and Sewer Systems* (in Finnish): Helsinki.

KATKO TAPIO, S. (1994). "Water Management in Finland". *European Water Pollution Control*, Vol. 4, No. 6.

MINISTRY OF THE ENVIRONMENT (1998). Communication with Mr. Timo Parkkinen, Senior Economic Advisor.

MINISTRY OF THE ENVIRONMENT (1995). "Industrial Wastewaters" (in Finnish). Memo YSO 2/1995: Helsinki.

MINISTRY OF THE ENVIRONMENT (1996). "Trends in the Finnish Environment: Indicators for the 1997 OECD Environmental Performance Review of Finland", by Ulla Rosenström, Markku Lehtonen, Jarmo Muurman: Helsinki.

REPO, MAIRE AND MARIA-LEENA HÄMÄLÄINEN (EDS.) (1994). "Industrial Water Statistics, 1992". Published by National Board of Waters and the Environment, July: Helsinki.

## FRANCE

### Context for industrial water uses

#### *Institutional arrangements*

Municipalities are responsible for providing water and sewage services. There are 36 500 municipalities in France, and this fragmented structure results in a highly decentralised management of water services and pricing policies. The municipalities own the infrastructure and mayors are responsible for the quality and the reliability of supply. Neighbouring municipalities often work together under various administrative and legal frameworks of widely varying natures and sizes, and the arrangements are often different for water supply than they are for sewage. As a result of these groupings, there were around 15 500 different water undertakings in France in 1990.

Municipalities can organise water and wastewater services in a number of ways. One option is to run the services themselves – *régie*, under which a municipality-owned water company is required to keep its accounts separate from that of the commune itself, in order to avoid cross-subsidies between taxpayers and water users. An alternative is to delegate management responsibility to private companies, under various contract forms. These contracts can take different forms; from *management* contracts (whereby the service is managed by a private firm, which receives a fee agreed in advance but the risks remain with the municipality) to *affermage* contracts (whereby the service is run by a private firm which services the equipment and takes the commercial risks, but investment decisions are made and funded by the municipality), to *concession* contracts (the private firm also undertakes investment). The majority of municipalities have delegated their services.

Six River Basin Agencies (*Agences de l'Eau*) were created in 1964, and have since played a significant role in the pricing of water resources through the levying of abstraction and pollution fees. The proceeds are used to fund infrastructure development programmes, such as the construction of water works.

#### *Relative importance of industrial water use*

Water abstractions in France are relatively moderate in comparison with other countries. Industrial direct abstractions accounted for 9.7 per cent of total abstractions in 1992, or 73 per cent when including water use for power production. Industrial water use has declined in the last 15 years, from 16 per cent in 1981. On the other hand, the use of water for power production has increased noticeably: from 25 per cent of total water uses in 1981, to 63 per cent in 1994, but this type of use has little impact on available resources.

**Table 8.1. Annual Water Abstractions by Type (1994)**

| User type                  | Million m <sup>3</sup> | %    |
|----------------------------|------------------------|------|
| Public supply              | 5 931                  | 14.5 |
| Industry                   | 3 954                  | 9.7  |
| Power production (cooling) | 25 814                 | 63.5 |
| Agriculture                | 4 971                  | 12.3 |
| Total                      | 40 670                 | 100  |

Source: Ministère de l'Environnement (1996).

### ***Water sources for industry***

There was no precise information available for this study on the extent of direct abstractions by industry, but these are assumed to be large. About one-third of industrial direct abstractions came from surface water, the rest from groundwater sources.

### ***Types of industrial water uses***

No information was found for this study on the types of industrial water uses.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Water prices from the public system are determined by the mayor in each municipality. In the case of direct management, water prices are defined annually according to a vote by the local council. In the case of delegated management, a price is negotiated between the local authority and the water supply operator for the duration of the contract. Due to the need for equality in the provision of services, all customers with the same consumption profiles and/or conditions of service should be charged identically. However, local authorities have substantial flexibility in setting their pricing structures: they can adopt seasonal tariffs, and they can apply different tariff structures to different types of users, categorised by meter diameters. Different tariffs for different classes of customer can only be justified on the basis of varying cost structures, since municipalities are not meant to discriminate between customer classes. In particular, the discounted price granted to any user within a customer class should be offered to all other customers within that class. The most frequently used water tariff structure for industrial users is decreasing-block tariffs, with no seasonal variations.

Tariffs are usually comprised of a fixed yearly charge; a charge by cubic meter of water supplied (water is normally metered); and a charge by cubic meter of sewage processed (this volume is not metered and is usually assumed to be the same as the amount of water supplied). In addition to the basic price of water specified in the contracts, tariffs include a variety of other components: surcharges to finance the activities of the River Basin Agencies (abstraction and pollution fees), levies for other state agencies (Rural Development Agency, and National River Agency), and VAT (albeit at a reduced rate — 5.5 per cent) which applies to the entire bill.

Marginal cost pricing is rare, but exists in a few instances. For example, the Canal of Provence company levies charges for water at a marginal rate, based on long-run marginal costs, to municipalities, agricultural, and industrial users. Tariffs depend on whether use is regular or not, on the season of use,

and on how far users are from the abstraction point. In 1988, base prices varied from 0.59F/m<sup>3</sup> to 3.36F/m<sup>3</sup>.

### ***Sewerage and trade effluent charges***

The six River Basin Agencies levy annual pollution charges, according to the quantity and characteristics of pollution produced by consumers.<sup>23</sup> The proceeds of these charges are paid to operators of sewage treatment plants to recover treatment costs.

Pollution charges are usually determined as a standing charge based on allocated pollution loads, although users can specifically ask to pay a volumetric pollution charge. Industrial users are classified into groups and each group of industries is listed in the relevant rule (Arrêté 1975), together with the values of the pollution parameters to be used in calculating the charges. The charge is calculated as a function of pollution produced in a normal day, during the period of maximum activity.

The following substances are taken into consideration when determining the charges:

- MES: suspended solids (kg/day)
- MO: organic matter  $\frac{(\text{COD} + 2 \text{BOD}_5)}{3}$  (kg/day)
- MI: toxic substances, measured with the Daphnes test
- SS: soluble salts (in mho/cm x m<sup>3</sup>)
- NR: reduced nitrogen (kg/day)
- AOX: halogenated hydrocarbons (kg/day)
- METOX: heavy metals
- P: total phosphorus (kg/day)

For each of these pollutants, an allocated pollution load is defined by industry, to which a specific charge is applied (Table 8.3).

In addition, each River Basin Agency is divided into a number of zones, each of which are given a grading, to differentiate between up-stream, down-stream, and seaside pollution. The coefficient corresponding to each zone will affect the level of the pollution fee levied on emissions in that zone to promote pollution control.

### ***Abstraction charges***

The six River Basin Agencies must receive users' declarations for the use of groundwater in excess of 8 m<sup>3</sup>/hour, and the use of surface waters above 2-5 per cent of the flow. Volumes declared by users then serve as the basis for the calculation of an abstraction and a consumption charge, paid annually to the Agencies. Abstraction charges are calculated in order to guarantee "best resource management" policies. These vary according to the volume and type of water used, as well as to the geographical area. Rates are determined by the Agencies, in consultation with the Basin Committees, in order to allow sufficient funding for agencies' intervention programmes, and for the "best use" of resources.

---

23. These charges are also paid by domestic consumers, through the public supply system.

Each river basin is divided into abstraction zones, which are given a grading (usually between 1 and 3, with 3 being the level associated with the highest charges) to reflect water scarcity. Abstraction charges are higher for groundwater than for surface water, since groundwater is generally regarded as requiring special conservation measures. The charging policy attempts to charge more for better quality water, in order to preserve the source and prevent over-abstraction.

Abstraction charges differ according to the type of use. They are divided between a small abstraction charge and a use charge, with the latter varying according to the assumed level of consumption. Consumption factors vary according to the type of water use and from one zone to another, in order to foster the best allocation of resources.

## Price levels and trends

### *Water from public supply system*

Price data for industrial users are extremely difficult to obtain, since industrial tariffs are generally determined through individual contracts between the water supply company and the industrial consumer. Average prices for various levels of consumption (these do not necessarily represent typical industrial consumption levels) are presented in Table 8.2.

**Table 8.2. Average price per m<sup>3</sup> for various levels of annual consumption (1990-1993)**

| Consumption: m <sup>3</sup> per year | Water (F /m <sup>3</sup> )* | Sewerage (F /m <sup>3</sup> )* |
|--------------------------------------|-----------------------------|--------------------------------|
| 100                                  | 5.52                        | 3.12                           |
| 150                                  | 5.18                        | 3.08                           |
| 200                                  | 4.99                        | 3.06                           |

Note: \* These figures exclude taxes, and pollution and abstraction fees.

Source: LATTS (1996).

The water supply share accounted for 60 per cent of water prices in 1985, and sewage for 26 per cent, whilst the water share accounted for only 44.5 per cent of the water bill in 1994 (35 per cent for sewage).<sup>24</sup>

### *Trade effluent charges*

In addition to the standard water bill (which includes sewage charges as shown above), water users must also pay a pollution fee to the River Basin Agencies. The charges for different pollution criteria are given in Table 8.3. These values are only given for the first year of the intervention programme of each River Basin Agency. Some interventions might be phased in gradually over the period. For instance, in Loire-Bretagne, METOX will be charged at FF 475/kg in 1998 and FF 950/kg during the period 1999-2001. Also, the pollution charge may be affected by the geographical location of the pollution.

---

24. Guellec (1995).

**Table 8.3. Pollution Fees for Various River Basin Agencies (1997)**

| River Basin  | Adour-Garonne | Artois-Picardie | Loire-Bretagne | Rhin-Meuse | Rhone-Mediterranee-Corse | Seine-Normandie |
|--------------|---------------|-----------------|----------------|------------|--------------------------|-----------------|
| MES (F/kg)   | 189.50        | 172             | 107.63         | 149.73     | 131                      | 169.93          |
| MO (F/kg)    | 347.13        | 362             | 209.87         | 299.45     | 393                      | 400.77          |
| NR (F/kg)    | 343.07        | 234             | 320.82         | 205.45     | 196.5                    | 424.16          |
| P (F/kg)     | 460.81        | 963             | 1 221.54       | 311.41     | 490.5                    | 362.24          |
| MI (F/kg)    | 6 547         | 6 684           | 9 425          | 4 864.9    | 7 026                    | 9 678           |
| AOX (F/kg)   | 812           | 1 462           | -              | 3099.96    | 1 093                    | 2 609           |
| METOX (F/kg) | 674.97        | 2 089           | 0              | 826.66     | 1 093                    | 2 609           |
| SS (F/mho)   | -             | 2 259           | -              | 169.52     | 426                      | 355             |

Source: Agences de l'Eau, 7èmes Programmes d'Intervention, 1997-2001.

### **Abstraction and consumption charges**

Abstraction and consumption charges are made up of two main elements: a charge for abstractions (applied to the volume of water actually abstracted) and a charge for consumption (applied to the volume of water abstracted and not discharged back to the mains). Base rates vary from one River Basin Agency to another, and their complexity depends on whether the Agency differentiates between groundwater and surface water sources. Base rates for abstraction and consumption charges can vary considerably between River Basin Agencies (Table 8.4).

**Table 8.4. Base Rates for Abstraction and Consumption Charges (1997-2001)**

| <b>F /m<sup>3</sup></b>   | <b>Loire-Bretagne</b> |
|---------------------------|-----------------------|
| Base rate for abstraction | 2.06                  |
| Base rate for consumption | 22.90                 |
| <b>F /m<sup>3</sup></b>   | <b>Rhin-Meuse</b>     |
| Groundwater               | 0.0258                |
| Surface water             | 0.0116                |
| Net consumption           | 0.1100                |
| Not drinking water        | 1.1400                |
| Resource under threat     | 0.2300                |

Source: Agences de l'Eau, 7èmes Programmes d'Intervention, 1997-2001.

These charges are then modified to reflect the source of water and the type of use. On average, consumption coefficients for the various uses across River Basin Agencies are as shown in Table 8.5. A consumption coefficient of 0.35 indicates that 65 per cent of volumes abstracted are put back into the stream after wastewater treatment.

**Table 8.5. Consumption Coefficients**

| <b>Water use</b>         | <b>Consumption coefficient</b> |
|--------------------------|--------------------------------|
| Public supply            | 0.35                           |
| Industry                 | 0.07                           |
| Power generation         | 0.005                          |
| Agriculture (irrigation) | 0.70                           |

*Source:* Agences de l'Eau.

## REFERENCES

- AGENCES DE L'EAU. "7ème Programme d'interventions, 1997-2001" (for Adour-Garonne, Artois-Picardie, Loire-Bretagne, Rhin-Meuse, Rhône-Méditerranée-Corse, Seine-Normandie).
- BOISTARD, P. (1993). "Qualité et prix des services publics de distribution d'eau potable. Approche d'un prix de la qualité de l'eau et de la desserte". Doctorat de l'Ecole Nationale des Ponts et Chaussées, Septembre.
- GUELLEC, A. (1995). "Le prix de l'eau: de l'explosion à la maîtrise?" Assemblée Nationale, rapport d'information, no. 2342.
- LATTS AND ECOLOGIC (1996). "France". In SOPHIE CAMBON-GRAU AND BERNARD BARRAQUÉ. *Comparing Water Prices in Europe: Final Report*.
- MINISTÈRE DE L'ENVIRONNEMENT (IFEN) (1996). "Données Economiques de l'Environnement". *Economica*, editor.
- VALIRON, F. (1991). "Gestion des Eaux: Coût et prix de l'alimentation en eau et de l'assainissement". Cours de l'Ecole Nationale des Ponts et Chaussées.

## GERMANY

### Context for industrial water uses

#### *Institutional arrangements*

The 16 German regions (or *Länder*) are responsible for water resource management and protection. Each *Land* can individually pass water laws and decide on the system of abstraction and pollution charges. At the service management level, differences exist between the former-East Germany and West Germany. There were 19 800 independent water networks in 1991 across the country, with 6 100 of these based in eastern Germany.

In western Germany, local authorities are responsible for the management of water and wastewater services, according to the principles of local autonomy. Users (including industry) can form associations for the management of water networks. The largest networks are managed by municipalities, or municipality groupings, which are also responsible for environmental protection and pollution control at the local level. Management structures vary widely from one municipality to another. The most common is a municipal company, managed as a private company, but with municipal funds. Other municipalities rely on one company for several urban services, which typically include water, gas, electricity and transport. Some municipalities have delegated services to private companies, under various contractual forms.

In the former-East Germany, water and sewerage treatment services used to be the responsibility of 15 regional authorities (Wasser und Abwasser Betriebe), whose boundaries were based on administrative (rather than hydrologic) criteria. German unification (October 1990) led to the restructuring of water services in the former-East Germany: 12 were privatised and 3 became public companies. It was necessary to adapt the structure and the pricing patterns which had governed water services, as price determination had previously been based on planned economy principles, and to incorporate the very high subsidies. Pricing principles already in use in the former-West Germany were extended to the entire country. The German federal government conducted a review of these companies in an effort to combine the water and wastewater sectors with those of the former Federal republic. When this is finalised, these new private companies will be subject to VAT and tax on capital gains from the national government. It is believed that this could increase the prices that companies will have to charge water consumers by 30 per cent.

#### *Relative importance of industrial water use*

Industrial abstractions and power stations represent a substantially higher share of total abstractions in western Germany: 90 per cent compared to 69.4 per cent (including the mines) in the eastern part of the country. This also reflects the relatively larger share of agricultural abstractions in the East.

**Table 9.1. Annual Water Abstractions in Germany, in '000 m<sup>3</sup> (1997)**

| <b>Sector</b>                           | <b>Total Germany</b> |        | <b>West</b> |        | <b>East</b> |        |
|-----------------------------------------|----------------------|--------|-------------|--------|-------------|--------|
| Agriculture                             | 1.6                  | 3.5%   | 0.3         | 0.6%   | 1.0         | 12.0%  |
| Industries (and power stations in East) | 10.0                 | 21.6%  | 10.1        | 23.2%  | 4.9         | 60.0%  |
| Power sector                            | 28.1                 | 60.7%  | 29.2        | 67.0%  | n.a.        | 0.00%  |
| Mines in East                           | 0.8                  | 1.7%   | n.a.        | 0.0%   | 0.8         | 9.4%   |
| Public supply                           | 5.8                  | 12.5%  | 4.0         | 9.3%   | 1.5         | 18.6%  |
| Total                                   | 46.3                 | 100.0% | 43.6        | 100.0% | 8.1         | 100.0% |

Source: Umwelt Bundesamt (1998).

Since the 1970s, industrial abstractions through public supply have been reduced by one third in the former-West Germany, disconnecting the linkage between economic growth and increased water demand. Some industrial branches have made a substantial effort at reducing their water consumption levels (such as chemicals industry, textiles, pulp and paper industry and metallurgy), and have also increased water recycling.

### ***Water sources for industry***

There has been a net increase in industrial abstractions from surface water, as compared with groundwater abstractions. Most industrial water users are connected to the municipalities' sewage network; there appears to be relatively little self-treatment at present.

Approximately 92 per cent of industrial water is sourced through direct abstractions, with the remaining 8 per cent drawn from the public supply system. Power plants are the largest water consumers, followed by the three industrial branches of chemicals, mining, and iron and steel, which together make up more than two-thirds of industrial water use for manufacturing activities.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Water prices are set by each water distribution network, generally under the supervision of capital-owners (i.e. the municipalities and the Cartel office, the latter of which controls unfair practices).

For networks under the exclusive responsibility of the municipality, the prices are subject to the local rates law of the länder (*Kommunalabgabengesetze*), which stipulates that pricing policies must abide by five principles, namely:

- water charges must cover all costs (*full-cost recovery*);
- users must pay in accordance to the costs generated by the demands of their respective customer group;
- charges must take account of cost structure through two-part tariffs, with both a fixed charge (relating to the infrastructure) and a volumetric charge;
- charges must allow for an appropriate return on capital; and
- charges must cover the depreciation costs of existing assets.

As a result of the second principle, water prices for industrial water consumers can be considerably lower than for households, since delivering water to one large plant is cheaper than supplying the same amount to a number of households. There can also be special agreements between customers and water suppliers for lower rates when they are buying water outside of peak times. Increased demand may lead to so-called “jump costs”, which must be allocated to their source.

For other types of water utility, prices are controlled by contracts. Industrial water consumers generally sign contracts with water providers. The conditions for these special contracts differ, and start from minimum consumption levels of 3 000 m<sup>3</sup> and go up to 600 000 m<sup>3</sup>. They are mostly offered in northern Germany (e.g. North Westphalia), where industrial users are concentrated. Many of these special tariffs are confidential.

### ***Sewerage and trade effluent charges***

The financing of the sewerage network and sewage treatment is fully integrated into the budgets of municipalities, which levy a sewerage charge based either on the volume of clean water consumed or on the surface area covered by the industrial concern, especially when a rainwater charge is added. Charging policies are based on four principles:

- charges are set in proportion to the service provided;
- charges reflect the benefit a user derives plus the costs incurred in providing the service;
- charges should not be differentiated between users; and
- charges should be set at cost recovery rates.

In many municipalities, industrial water users can obtain a rebate if they are discharging a much smaller amount of sewage than their water intake (e.g. in the case of water used for cooling). Some municipalities, such as Wiesbaden, calculate the sewage charge on the basis of discharges equivalent to 90 per cent of water intake.

### ***Direct abstraction charges***

The first abstraction charge was introduced in Baden-Württemberg in 1985, following considerable debate. In total, 11 *Länder* have now introduced abstraction charges through their *Länd* water acts. Charge levels are very low, and are not intended to have a large incentive effect on users. Groundwater abstraction charges tend to be higher than surface water abstraction charges.

### ***Discharge charges***

The Federal Government is the competent authority for developing framework legislation on wastewater charging. The 1976 *German Effluent Charges Act* (amended in 1994) obliges the *Länder* to impose effluent water charges for discharges to surface water, groundwater, and the sea. The *Länder* are responsible for implementing the federal legislation and for passing their own laws; they may also delegate the collection of charges to the municipalities.

Wastewater charges are based on units of pollution, as defined by the Federal Act for each type of pollutant. They are only payable above certain threshold values for each pollution parameter. The

pollution units used for different parameters are illustrated in Table 9.2. Charge rates are set at a national level and are applied universally throughout the country. In 1997, the pollution unit charge was set at DM 70 per unit (representing a six-fold increase since its first implementation in 1981).

**Table 9.2. Pollution Units for Different Parameters**

| Pollutants                          | One Toxicity Unit                  | Threshold Values as concentrations & annual loads |
|-------------------------------------|------------------------------------|---------------------------------------------------|
| Chemical Oxygen Demand              | 50 kg oxygen                       | 20 mg l <sup>-1</sup> & 250 kg <sup>-1</sup>      |
| Phosphorus (1990)                   | 3 kg                               | 0.1 mg l <sup>-1</sup> & 15 kg <sup>-1</sup>      |
| Nitrogen (1990)                     | 25 kg                              | 5 mg l <sup>-1</sup> & 125 kg <sup>-1</sup>       |
| Halogenated Organic Compounds (AOX) | 2 kg halogens, as organic chlorine | 100 ug l <sup>-1</sup> & 10 kg <sup>-1</sup>      |
| Mercury                             | 20g                                | 1 ug l <sup>-1</sup> & 100 g <sup>-1</sup>        |
| Cadmium                             | 100g                               | 5 ug l <sup>-1</sup> & 500 g <sup>-1</sup>        |
| Chromium                            | 500g                               | 50 ug l <sup>-1</sup> & 2.5 kg <sup>-1</sup>      |
| Nickel                              | 500g                               | 50 ug l <sup>-1</sup> & 2.5 kg <sup>-1</sup>      |
| Lead                                | 500g                               | 50 ug l <sup>-1</sup> & 2.5 kg <sup>-1</sup>      |
| Copper                              | 1000g                              | 100 ug l <sup>-1</sup> & 5.0 kg <sup>-1</sup>     |
| Fish Toxicity                       | 3000m <sup>3</sup> effluent/GF*    | GF=2                                              |

*Note:* \*GF is the factor of dilution at which the effluents are no longer toxic.

*Source:* UK Environment Agency (1996).

Effluent charges are intended to influence the behaviour of polluters, and, to a lesser extent, to raise revenues. This is expressed as a 75 per cent reduction in charges if the standards contained in the regulations (expressed as Best Available Technique) are met. Tougher incentives will be introduced in 1999.

## Price levels and trends

### *Water from public supply system*

The fact that prices are based on full-cost recovery principles is sometimes seen as the reason why water prices in Germany are amongst the highest in Europe, and even in the OECD as a whole. Water prices vary across the country, due to varying conditions in catchment, treatment, storage, transport and distribution of water — factors which have a sizeable impact when prices are set on the principle of full-cost recovery.

Information presented here about industrial water prices is based on an annual survey of water and wastewater prices, conducted by VEA (*Bundesverband der Energie - Abnehmer E.V.*), an association of medium-sized companies. That survey's intention is to show the minimum prices available, so it combines information about the standard prices, determined for a type of user by the local utility, and "special contract" prices, if offered to industrial customers. Data are provided for 63 cities in western Germany and 18 in the new *Länder*. For each municipality, typical industrial bills are provided for customers with the following characteristics: 7 500 m<sup>3</sup> yearly consumption with a pipe of 50 mm, and 100 000 m<sup>3</sup> yearly consumption with a pipe of 150 mm. Tariffs presented are "net", but take into account the basic fixed charge, the volumetric charge, and special taxes (*Bigge-Beitrag* or *RTV-Beitrag*).

The average charge for small industrial users was DM 2.917 in western Germany and DM 3.332 in eastern Germany; for large industrial users, it was DM 2.788 and 3.072 respectively. Industrial prices were cheaper in the West than in the East by about 10-15 per cent. Detailed survey results are presented in Table 9.5.

### ***Sewerage and trade effluent charges***

Methods for calculating wastewater service charges can vary considerably from one municipality to the other. Therefore, it is difficult to compare sewage treatment charges, and even more difficult to compare the entire bill. In the survey presented here, total prices were calculated by adding the median value of the water bill and the wastewater charge per m<sup>3</sup>. The average sewage charge was DM 3.44 in western Germany and DM 4.73 in eastern Germany (i.e. nearly 40 per cent higher in the latter due to high investment costs in water treatment works).

### ***Direct abstraction or self-treatment***

As explained above, abstraction charges have been introduced in 11 *Länder* across Germany. These charges are different for groundwater and surface water abstractions, and are illustrated in Tables 9.3 and 9.4.

**Table 9.3. Charges for surface water abstractions by selected German Länder (DM/m<sup>3</sup>) (1995)**

| Use                 | Baden<br>Württemberg | Hamburg | Hessen | Niedersachsen <sup>1</sup> | Sachsen | Thuringen | Brandenburg |
|---------------------|----------------------|---------|--------|----------------------------|---------|-----------|-------------|
| Public water supply | 0.10                 | x       | x      | 0.10                       | 0.03    | 0.05      | 0.04*       |
| Heat pumps          | 0.01                 | x       | x      | 0.04 (0.01)*               | 0.04    | 0.10*     | 0.04*       |
| Cooling             | 0.01                 | x       | x      | 0.01                       | 0.01    | 0.03      | 0.01        |
| Irrigation          | 0.01                 | x       | x      | 0.01                       | 0.01    | 0.03      | 0.0028      |
| Other uses          | 0.04                 | x       | x      | 0.04 (0.01)*               | 0.04    | 0.10      | 0.04        |
| Fish farming        | 0.04*                | x       | x      | 0.04 (0.01)*               | 0.04+   | 0.10+     | 0.04*       |
| Industrial          | 0.04*                | x       | x      | 0.04 (0.01)*               | 0.04    | 0.10+     | 0.04*       |
| Mining              | 0.04*                | x       | x      | 0.04 (0.01)*               | 0.00    | 0.10*     | 0.04*       |

Notes: 1 Reduced rate available for other uses.

\* Use not specified by individual Länder, for comparative purposes assumed to be "Other use".

+ Use not specified for surface water charge, but charge specified for groundwater use, for comparative purposes assumed to be "Other use".

x Land does not operate a surface water abstraction charge.

Source: UK Environment Agency (1996)

**Table 9.4. Charges for groundwater abstractions by some German *Länder* (DM/m<sup>3</sup>) (1995)**

| Use                 | Baden<br>Württemberg | Hamburg<br>1 & 2  | Hessen <sup>2</sup> | Niedersachsen<br>3 & 4 | Sachsen      | Thuringen    | Brandenburg   |
|---------------------|----------------------|-------------------|---------------------|------------------------|--------------|--------------|---------------|
| Public water supply | 0.10                 | <b>0.05-0.11</b>  | <b>0.40</b>         | 0.10                   | 0.03         | 0.05         | <b>0.05*</b>  |
| Heat pumps          | 0.01                 | <b>0.10-0.17</b>  | <b>0.80^</b>        | <b>0.12 (0.03)*</b>    | <b>0.15*</b> | <b>0.15*</b> | <b>0.05*</b>  |
| Cooling             | <b>0.10</b>          | <b>0.10-0.17</b>  | <b>1.00</b>         | <b>0.05</b>            | <b>0.15</b>  | <b>0.25</b>  | <b>0.05</b>   |
| Irrigation          | <b>0.10</b>          | <b>0.10-0.17</b>  | <b>0.80^</b>        | 0.01                   | <b>0.05</b>  | <b>0.05</b>  | <b>0.0035</b> |
| Other uses          | <b>0.10</b>          | <b>0.10-0.17</b>  | <b>0.40</b>         | <b>0.12 (0.03)*</b>    | <b>0.15</b>  | <b>0.15</b>  | <b>0.05</b>   |
| Fish farming        | <b>0.10*</b>         | <b>0.10-0.17*</b> | <b>0.10</b>         | 0.005                  |              | <b>0.10</b>  | <b>0.05*</b>  |
| Industrial          | <b>0.10*</b>         | <b>0.10-0.17*</b> | <b>0.80^</b>        | <b>0.12 (0.03)*</b>    | <b>0.15</b>  | <b>0.20</b>  | <b>0.05*</b>  |
| Mining              | <b>0.10*</b>         | <b>0.10-0.17*</b> | <b>0.80^</b>        | <b>0.12 (0.03)*</b>    | <b>0.03*</b> | <b>0.15*</b> | <b>0.05*</b>  |

- Notes:* Figures in bold indicate that higher groundwater charges exist than surface water charges.
- 1 Charge differentiates between "high chloride groundwater near surface" and "good groundwater".
  - 2 No surface water charge.
  - 3 Reduced rate available for other uses.
  - 4 Groundwater control charge of 0.05 DM/m<sup>3</sup>.
- \* Use not specified by individual *Länder*, for comparative purposes assumed to be "Other use".
- ^ Charges assumed for other commercial uses.

*Source:* UK Environment Agency (1996).

**Table 9.5. Water and Sewerage Prices (1997)**

| City                | Name of undertaking | Average Water Price     |         |             |                        | DM/m <sup>3</sup><br>(b) | Wastewater           | Combined                    |
|---------------------|---------------------|-------------------------|---------|-------------|------------------------|--------------------------|----------------------|-----------------------------|
|                     |                     | 7 500 m <sup>3</sup> /y | 100 000 | Mean<br>(a) | Change over<br>1996(%) |                          | DM/m <sup>3</sup> /y | DM/m <sup>1</sup><br>(a+ b) |
| <u>West Germany</u> |                     |                         |         |             |                        |                          |                      |                             |
| Ingolstadt          | Stadtwerke          | 1 630                   | 1 568   | 1 599       | 0,0                    | 2,50                     |                      | 4 099                       |
| Hannover            | HASTRA              | 1 806                   | 1 634   | 1 720       | 0,0                    |                          |                      | 1 720                       |
| Flensburg           | Stadtwerke          | 1 878                   | 1 649   | 1 764       | 0,0                    | 3,62                     |                      | 5 384                       |
| Munchen             | Stadtwerke          | 1 893                   | 1 859   | 1 876       | 0,0                    | 3,30                     |                      | 5 176                       |
| Neumunster          | Stadtwerke          | 1 985                   | 1 955   | 1 970       | 5,3                    | 4,72                     |                      | 6 690                       |
| Aachen              | STAWAG              | 2 421                   | 1 638   | 2 030       | 0,0                    | 4,02                     | 1,91                 | 6 050                       |
| Emden               | Stadtwerke          | 2 108                   | 2 059   | 2 084       | 0,0                    | 5,00                     | 1,05                 | 7 084                       |
| Peine               | Stadtwerke          | 2 238                   | 2 207   | 2 223       | 6,7                    | 4,42                     |                      | 6 643                       |
| Oldenburg           | EWE                 | 2 296                   | 2 273   | 2 285       | 0,0                    | 3,26                     |                      | 5 545                       |
| Gelsenkirchen       | Gelsenwasser        | 2 432                   | 2 202   | 2 317       | 0,0                    | 2,34                     | 1,40                 | 4 657                       |
| Lubeck              | Stadtwerke          | 2 352                   | 2 325   | 2 339       | 0,0                    | 3,72                     |                      | 6 059                       |
| Karlsruhe           | Stadtwerke          | 2 426                   | 2 303   | 2 365       | 9,2                    | 2,49                     |                      | 4 855                       |
| Dortmund            | DEW                 | 2 469                   | 2 311   | 2 390       | 0,0                    | 2,89                     | 1,56                 | 5 283                       |
| Dusseldorf          | Stadtwerke          | 2 772                   | 2 020   | 2 396       | 0,0                    | 2,91                     | 1,87                 | 5 306                       |
| Bochum              | Stadtwerke          | 2 612                   | 2 188   | 2 400       | 0,0                    | 2,88                     | 1,15                 | 5 280                       |
| Munster             | Stadtwerke          | 2 443                   | 2 360   | 2 402       | 0,0                    | 2,49                     | 0,70                 | 4 892                       |
| Nurnberg            | EWAG                | 2 432                   | 2 410   | 2 421       | 0,0                    | 3,70                     |                      | 6 121                       |
| Augsburg            | Stadtwerke          | 2 515                   | 2 340   | 2 428       | 0,0                    | 2,21                     | 1,83                 | 4 638                       |
| Koln                | GEW                 | 2 630                   | 2 233   | 2 432       | 4,4                    | 2,79                     | 2,35                 | 5 222                       |
| Coburg              | SUC                 | 2 447                   | 2 421   | 2 434       | 7,0                    | 2,72                     | 1,35                 | 5 154                       |
| Bamberg             | Stadtwerke          | 2 476                   | 2 454   | 2 465       | 11,3                   | 2,07                     | -                    | 4 535                       |
| Baden-Baden         | Stadtwerke          | 2 516                   | 2 510   | 2 513       | 0,0                    | 2,55                     | -                    | 5 063                       |
| Hildesheim          | Stadtwerke          | 2 558                   | 2 477   | 2 518       | 0,1                    | 3,60                     |                      | 6 118                       |

**Table 9.5. Water and Sewerage Prices (1997)**

| City           | Name of undertaking | Average Water Price     |         |             |                        | Wastewater<br>DM/m <sup>3</sup> /y | Combined<br>DM/m <sup>1</sup><br>(a+ b) |
|----------------|---------------------|-------------------------|---------|-------------|------------------------|------------------------------------|-----------------------------------------|
|                |                     | 7 500 m <sup>3</sup> /y | 100 000 | Mean<br>(a) | Change over<br>1996(%) | DM/m <sup>3</sup><br>(b)           |                                         |
| Furth          | Stadtwerke          | 2 537                   | 2 510   | 2 524       | 8,6                    | 2,40                               | 4 924                                   |
| Bielefeld      | Stadtwerke          | 2 588                   | 2 515   | 2 552       | 8,5                    | 4,22                               | 6 772                                   |
| Ludwigsburg    | Stadtwerke          | 2 580                   | 2 524   | 2 552       | 0,0                    | 2,75                               | 5 302                                   |
| Ulm            | Stadtwerke          | 2 571                   | 2 553   | 2 562       | 4,1                    | 3,52                               | 6 082                                   |
| Kaiserslautern | Stadtwerke          | 2 619                   | 2 602   | 2 611       | 4,0                    | 3,30                               | 5 911                                   |
| Neunkirchen    | KEW                 | 2 806                   | 2 463   | 2 635       | 1,0                    | 3,14                               | 5 775                                   |
| Krefeld        | SWK                 | 2 844                   | 2 511   | 2 678       | 1,9                    | 4,95                               | 7 628                                   |
| Braunschweig   | Stadtwerke          | 2 720                   | 2 703   | 2 712       | 0,0                    | 3,50                               | 6 212                                   |
| Wolfsburg      | Stadtwerke          | 2 900                   | 2 545   | 2 723       | 3,8                    | 3,81                               | 6 533                                   |
| Hamburg        | HWW                 | 2 859                   | 2 600   | 2 730       | 2,6                    | 4,97                               | 7 700                                   |
| Bonn           | Stadtwerke          | 2 842                   | 2 637   | 2 740       | 7,9                    | 1,88                               | 4 620                                   |
| Neuss          | Stadtwerke          | 2 826                   | 2 688   | 2 757       | 0,0                    | 3,98                               | 6 737                                   |
| Bremen         | Stadtwerke          | 2 767                   | 2 752   | 2 760       | 0,0                    | 5,20                               | 7 960                                   |
| Mannheim       | MVV                 | 2 816                   | 2 743   | 2 780       | 3,7                    | 2,64                               | 5 420                                   |
| Hannover       | Stadtwerke          | 2 816                   | 2 792   | 2 804       | 3,7                    | 2,69                               | 5 494                                   |
| Aschaffenburg  | Stadtwerke          | 2 811                   | 2 801   | 2 806       | 7,7                    | 2,80                               | 5 606                                   |
| Duisburg       | Stadtwerke          | 2 867                   | 2 810   | 2 839       | 0,0                    | 3,90                               | 6 739                                   |
| Kiel           | Stadtwerke          | 2 916                   | 2 801   | 2 859       | 0,0                    | 3,06                               | 5 919                                   |
| Herford        | Stadtwerke          | 2 860                   | 2 860   | 2 860       | 0,0                    | 5,36                               | 8 220                                   |
| Wurzburg       | Stadtwerke          | 2 998                   | 2 973   | 2 986       | 0,0                    | 2,02                               | 5 006                                   |
| Koblenz        | VWM                 | 3 025                   | 2 964   | 2 995       | 0,0                    | 3,97                               | 6 965                                   |
| Hanau          | Stadtwerke          | 3 064                   | 3 018   | 3 041       | 7,0                    | 4,44                               | 7 481                                   |
| Essen          | Stadtwerke          | 3 105                   | 3 080   | 3 068       | 0,5                    | 2,20                               | 5 268                                   |
| Worms          | Stadtwerke          | 3 164                   | 2 991   | 3 078       | 8,1                    | 1,92                               | 4 998                                   |
| Gottingen      | Stadtwerke          | 3 184                   | 3 158   | 3 171       | 6,7                    | 2,40                               | 5 571                                   |

**Table 9.5. Water and Sewerage Prices (1997)**

| City                                      | Name of undertaking | Average Water Price     |              |              |                        | Wastewater<br>DM/m <sup>3</sup> /y | Combined<br>DM/m <sup>1</sup><br>(a+ b) |
|-------------------------------------------|---------------------|-------------------------|--------------|--------------|------------------------|------------------------------------|-----------------------------------------|
|                                           |                     | 7 500 m <sup>3</sup> /y | 100 000      | Mean<br>(a)  | Change over<br>1996(%) | DM/m <sup>3</sup><br>(b)           |                                         |
| Hagen                                     | Stadtwerke          | 3 295                   | 3 070        | 3 183        | 6,7                    | 3,44                               | 6 623                                   |
| Wuppertal                                 | WSW                 | 3 539                   | 3 004        | 3 272        | 0,0                    | 3,54                               | 6 812                                   |
| Saarbrücken                               | Stadtwerke          | 3 305                   | 3 300        | 3 303        | 8,2                    | 5,91                               | 9 213                                   |
| Heilbronn                                 | Stadtwerke          | 3 438                   | 3 365        | 3 402        | 0,0                    | 2,62                               | 6 022                                   |
| Berlin                                    | BWB                 | 3 450                   | 3 450        | 3 450        | 16,9                   | 4,85                               | 8 300                                   |
| Stuttgart                                 | TWS AG              | 3 593                   | 3 570        | 3 582        | 5,9                    | 3,06                               | 6 642                                   |
| Heidelberg                                | Stadtwerke          | 3 998                   | 3 958        | 3 978        | 6,7                    | 2,80                               | 6 778                                   |
| Pforzheim                                 | Stadtwerke          | 4 033                   | 3 980        | 4 007        | 6,6                    | 3,95                               | 7 957                                   |
| Offenbach                                 | EVO                 | 4 092                   | 3 940        | 4 016        | 0,0                    | 3,16                               | 7 176                                   |
| Kassel                                    | Stadtwerke          | 4 038                   | 4 009        | 4 024        | 0,0                    | 3,60                               | 7 624                                   |
| Eschwege                                  | Stadtwerke          | 4 048                   | 4 006        | 4 027        | 22,9                   | 4,50                               | 8 527                                   |
| Frankfurt                                 | Stadtwerke          | 4 100                   | 4 100        | 4 100        | 2,5                    | 3,45                               | 7 550                                   |
| Mainz                                     | Stadtwerke          | 4 160                   | 4 070        | 4 115        | 0,0                    | 1,85                               | 5 965                                   |
| Darmstadt                                 | Sudhessische        | 4 593                   | 4 240        | 4 417        | 0,0                    | 8,20                               | 12 617                                  |
| Wiesbaden                                 | Stadtwerke          | 5 680                   | 5 612        | 5 646        | 1,8                    | 2,84                               | 8 486                                   |
| <b>Average Water price - West Germany</b> |                     | <b>2 917</b>            | <b>2 788</b> | <b>2 852</b> | <b>3,2</b>             | <b>3,44</b>                        | <b>6 233</b>                            |
| <b>East Germany</b>                       |                     |                         |              |              |                        |                                    |                                         |
| Senftenberg                               | WAL                 | 2 215                   | 2 129        | 2,172        |                        | 6,10                               | 8 272                                   |
| Potsdam                                   | Wasserbetriebe      | 2 420                   | 2 390        | 2 405        |                        | 3,50                               | 5 905                                   |
| Cottbus                                   | LWG                 | 2 500                   | 2 376        | 2 438        |                        | 5,95                               | 8 385                                   |
| Zwickau                                   | Wasserw.            | 2 822                   | 2 710        | 2 766        |                        | 5,32                               | 8 096                                   |
| Schwerin                                  | Stadtwerke          | 3 036                   | 2 989        | 3 013        |                        | 6,34                               | 9 353                                   |
| Frankfurt/O.                              | FWA mbH             | 3 046                   | 2 985        | 3 016        |                        | 6,13                               | 9 146                                   |

**Table 9.5. Water and Sewerage Prices (1997)**

| City                                       | Name of undertaking  | Average Water Price     |              |              |                        | Wastewater<br>DM/m <sup>3</sup> /y | Combined<br>DM/m <sup>1</sup><br>(a+ b) |
|--------------------------------------------|----------------------|-------------------------|--------------|--------------|------------------------|------------------------------------|-----------------------------------------|
|                                            |                      | 7 500 m <sup>3</sup> /y | 100 000      | Mean<br>(a)  | Change over<br>1996(%) | DM/m <sup>3</sup><br>(b)           |                                         |
| Chemnitz                                   | Stadtwerke           | 3 096                   | 3 029        | 3 063        | 0,0                    | 3,64                               | 6 703                                   |
| Leipzig                                    | Komm. Wasserw.       | 3 214                   | 2 975        | 3 095        | 3,6                    | 4,90                               | 7 995                                   |
| Dessau                                     | Stadtwerke           | 3 310                   | 3 240        | 3 275        |                        | 4,62                               | 7 895                                   |
| Dresden                                    | DWA                  | 3 420                   | 3 184        | 3 302        | 0,0                    | 3,28                               | 1,95 6 582                              |
| Rostock                                    | EURAWASSER           | 3 581                   | 3 081        | 3 331        |                        | 4,92                               | 8 251                                   |
| Halle                                      | HW u. A              | 3 730                   | 2 943        | 3,337        | 0,0                    | 3,57                               | 3,35 6 907                              |
| Magdeburg                                  | Stadtwerke           | 3 444                   | 3 325        | 3 385        |                        | 4,93                               | 1,94 8 315                              |
| Halle                                      | MIDEWS               | 3 650                   | 3 200        | 3 425        |                        |                                    |                                         |
| Erfurt                                     | Stw. Wasserversg     | 3 784                   | 3 694        | 3 739        |                        | 3,81                               | 7 549                                   |
| Gera                                       | Zv. Mittl. Elstertal | 4 014                   | 3 271        | 3 643        |                        | 3,21                               | 6 853                                   |
| Jena                                       | Stadtwerke           | 4 108                   | 3 936        | 4 022        |                        | 5,00                               | 9 022                                   |
| Gotha                                      | W.-Abw.-Zw.-verb     | 4 580                   | 3 833        | 4 207        |                        | 4,85                               | 9 057                                   |
| Berlin*                                    |                      | 3.450                   | 3.450        | 3.450        |                        | 4.85                               | 8.30                                    |
| Wasserbetr;                                |                      |                         |              |              |                        |                                    |                                         |
| <b>Average Water Price -- East Germany</b> |                      | <b>3 332</b>            | <b>3 072</b> | <b>3 202</b> |                        | <b>4,73</b>                        | <b>7 936</b>                            |

Source: VEA. (1997) and Umwelt Bundes Amt (Berlin).

## REFERENCES

FEDERAL ENVIRONMENT AGENCY. Personal communication.

FEDERAL MINISTRY FOR THE ENVIRONMENT. "Environmental Policy in Germany: Water Resources Management in Germany". Leaflet.

KRAEMER, ANDREAS (1994). "Paying for Water and Sewerage in Germany". Institute for European Environmental Policy: Bonn.

UMWELT BUNDESAMT. Direct Communication with Mrs C. Markard.

VEA, BUNDESVERBAND DER ENERGIE — ABNEHMER E.V. (1997). "Survey of Industrial Water Prices in Germany". Hanover.

## **GREECE**

### **Context for industrial water uses**

#### ***Institutional arrangements***

In Athens and Thessaloniki, Greece's two largest cities, responsibility for providing water and wastewater services falls with the State, and water services have effectively been entrusted to two large companies: in Athens, EYDAP, a private sector company supervised by the Ministry for Public Works and the Environment; and in Thessaloniki, OYT, a public sector company (with a wastewater services arm, OAT). In the 70 towns with a population above 10 000, municipal companies (DEYA) are responsible for managing water and wastewater services. In smaller towns and rural areas, municipalities are directly responsible for providing the services. There is no move towards private sector involvement, except for some small wastewater treatment works.

The Ministry of Industry is responsible for water resource management, and the Ministry of Interior oversees water supply. The creation of an Environmental Protection Agency was planned in the 1986 Law on the protection of the environment, but it has yet to be created.

#### ***Relative importance of industrial water use***

Industrial and energy production uses account for only 5 per cent of total water consumption. The largest share of water consumed goes to irrigation (80 per cent) and 15 per cent goes to drinking water. A considerable amount (40 per cent of total water used – 5 billion m<sup>3</sup> a year) is used for cooling purposes in power generation, and then is used for irrigation purposes (i.e. it is multi-purpose). Thus, although power production uses significant quantities of water for cooling purposes, it does not “consume” this water, but returns it instead to the system for reuse.

#### ***Water sources for industry***

Of total water abstractions, surface waters account for 85-90 per cent and groundwaters for 10-15 per cent. Some industries abstract water from groundwater sources directly. One-quarter of the water resources used in Greece are imported from abroad.

#### ***Types of industrial water uses***

Out of the 120 million m<sup>3</sup> of water used by industry each year, 75 per cent goes to the manufacturing sector and a quarter goes to power production.

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

Water prices are fixed by each municipality but they must first be vetted by the “prefects” (representatives of the State in each of the 54 prefect districts). In Athens, prices must be approved by the Ministry of Public Works and the Environment. Prices must cover running costs and enable companies to meet their investment needs, but they must correspond to socially-acceptable levels.

Price levels and price structures can vary considerably from one municipality to another. Charges are usually based on volumetric rates. The largest water systems meter water consumption and may distinguish between the different types of users. Volumetric rates for industrial users are generally higher than for households. Companies levy connection charges and infrastructure charges. According to 1991 data, these connection charges were between 1 400-30 000 drachmas for connection to water mains, and between 1 000-285 000 for connection to the sewers.

Infrastructure costs are generally not fully covered by revenues, and municipalities receive grants from the government. A minimum of 35 per cent of the necessary investments each year is automatically paid to each company by the central government. Recently, substantial EU funds have contributed to the construction of water and wastewater treatment works.

### ***Sewerage and trade effluent charges***

Wastewater price levels usually include a volumetric charge applied to a percentage of water consumption. There are no regimes for trade effluent charges, but industrial users must obtain licences to discharge into rivers.

### ***Abstraction and discharge charges***

There are no water resource charges based on abstraction levels or discharge charges based on pollution levels. There is only one income-related tax (a 3 per cent surcharge on income received by entities leasing private properties), the proceeds of which go towards supporting waste-water companies.

## **Price levels and trends**

### ***Water from public supply system***

In the district of Athens (under the management of EYDAP), the price of water for industrial users in 1997 was 230 drachmas for consumption between 0-1 000 m<sup>3</sup>, and 270 drachmas for consumption over 1 000 m<sup>3</sup>.

In Thessaloniki, industries and craft industries have to pay 78 drachmas per m<sup>3</sup> and other professionals have to pay 207 drachmas per m<sup>3</sup>.

In the 11 industrial areas currently in place in Greece, prices are relatively low because groundwater is pumped and distributed among industrial users in each area (Table 10.1).

**Table 10.1. Water charges in Industrial Areas (1997)**

| <b>Industrial Area</b> | <b>Mean price (GRD/m<sup>3</sup>)</b> | <b>Consumption (m<sup>3</sup>/year)</b> |
|------------------------|---------------------------------------|-----------------------------------------|
| Alexand                | 130                                   | 10,800                                  |
| Drama                  | 55                                    | 216,000                                 |
| Ionina                 | 57                                    | 54,000                                  |
| Kilkis                 | 37                                    | 605,000                                 |
| Komotini               | 38                                    | 1,480,500                               |
| Lamia                  | 76                                    | 226,200                                 |
| Larisa                 | 99                                    | 86,100                                  |
| Meligalas              | 48                                    | 1,500                                   |
| Patra                  | 51                                    | 2,160,000                               |
| Serres                 | 50                                    | 48,000                                  |
| Tripoli                | 58                                    | 24,600                                  |

For the rest of the country, 1991 water charges for industrial users were as shown in Table 10.2.

**Table 10.2. Water and Wastewater Charges for Industrial Users (1991)**

| <b>Type of charge</b> | <b>Ecu/ m<sup>3E</sup></b> |
|-----------------------|----------------------------|
| Water                 |                            |
| average               | 0.2                        |
| range                 | 0.09-0.48                  |
| Sewerage              |                            |
| average               | 0.65                       |
| range                 | 0.08-1.58                  |

*Source:* Ecotec (1996).

## REFERENCE

WATER SUPPLY AND SEWERAGE COMPANY OF ATHENS. Personal communication with Mrs. Yiotacou.

## HUNGARY

### Context for industrial water uses

#### *Institutional arrangements*

During the socialist era, there were 33 state-owned waterworks covering the entire country. Following liberalisation, water supply and wastewater treatment were devolved to 180 waterworks under the responsibility of 2 457 municipalities (according to Act No. LXV, 1990) and 5 regional, state-owned, waterworks. The waterworks companies were set up as shareholder companies; private capital participation has therefore been growing, and is now dominant. The companies operate under a variety of contractual forms, including concession contracts.

At the national level, responsibilities for water administration fall under the Ministry of Transport, Telecommunications and Water Management, and are separated from responsibilities for environmental protection (including water quality control supervision) which fall under the Ministry for Environment and Regional Policy. In addition, the National Water Authority (OVF) was set up in 1990 to exercise control over the 12 Hungarian Water Authorities, which are river management and regulatory bodies organised along river basin lines.

#### *Relative importance of industrial water use*

Industry accounts for approximately 55 per cent of total water uses, while domestic consumption accounts for approximately 10 per cent, and agriculture for 35 per cent.<sup>25</sup>

#### *Water sources for industry*

In 1995, surface waters accounted for 98 per cent of water sourced for industrial purposes. The processing industry used 382.6 million m<sup>3</sup> of water, 236.2 million m<sup>3</sup> of which were from direct abstractions (62 per cent). In some regions, public waterworks offer lower quality water (drawn from surface waters) for industrial purposes.

#### *Types of industrial water uses*

Within the processing industry, water use was broken down in 1995 as shown in Table 11.1. Metallurgy is the largest water user in the processing industry, accounting for 36 per cent of the total water used in the processing industry, followed by the chemical industry (at 24 per cent).

---

25. The Dobris Assessment.

**Table 11.1. Industrial Water Uses and Source of Supply, Million m<sup>3</sup> (1995)**

| <b>Economic sector</b>                 | <b>Total purchased water</b> | <b>From this: direct abstractions</b> |
|----------------------------------------|------------------------------|---------------------------------------|
| Agriculture                            | 3.8                          | 3.5                                   |
| Mining                                 | 97.9                         | 93.7                                  |
| Processing industry total              | 382.6                        | 236.2                                 |
| Metallurgy                             | 136.9                        | 94.0                                  |
| Engineering industry                   | 19.7                         | 9.0                                   |
| Chemical industry                      | 92.1                         | 42.5                                  |
| Light industry                         | 42.5                         | 23.1                                  |
| Food industry                          | 84.6                         | 63.2                                  |
| Building industry                      | 0.3                          | 0.1                                   |
| Trade, road vehicle repair             | 2.3                          | 1.7                                   |
| Transport, post and telecommunications | 6.9                          | 3.2                                   |
| Other branches                         | 13.7                         | 1.2                                   |
| Sub-Total                              | 507.5                        | 339.6                                 |
| Electricity, heat                      | 4 146.3                      | 4 135.2                               |
| Grand total                            | 4 653.8                      | 4 474.8                               |

Source: Ministry of Transport, Communication and Water Management (1996).

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

New principles for price-setting were introduced by law in January 1990, requiring that prices must cover real production costs. In effect, subsidies from the central government were eliminated. Following this reform, more independence was given to water service suppliers: there is now no specific regulation for water prices as such and only general price regulation principles apply. Prices are set by municipalities, except in the case of state-owned regional waterworks, for which they are determined by the State administration.

Charges are based on volumes used. Metering is widespread for both domestic and industrial users. Water tariffs have historically been low, especially for domestic users, and have not been sufficient to cover investment costs. Domestic consumers are subsidised above a certain threshold, whereas industrial users tend to pay the full price. Some waterworks have introduced capital contributions by users for additional investments, as a “one-off” charge. In order to cover investment costs, waterworks can receive state subsidies (up to 30-50 per cent of the costs of priority investments), or funds from the municipalities’ budgets, the Water Fund, the Central Environmental Fund (within the Ministry for the Environment), or the EU Phare programme.

### ***Sewerage and trade effluent charges***

Sewerage charges are calculated on a volumetric basis, according to the amount of water consumed.

Some revenues are raised from punitive charges imposed on industrial users that cause harmful pollution. The charge amount depends on the volume of pollution, which is quantified by laboratories operated by the district water authorities. However, there is no established charge based on the pollution content of the effluent.

***Abstraction and discharge charges***

Abstraction charges are paid by all water abstractors. These charges depend on the volume and the type of water use. The revenues go to a Water Fund, which is administered within the Ministry of Transport, Telecommunications and Water Management.

There are no discharge fees, but the introduction of such a charge is currently under discussion.

**Price levels and trends*****Water from public supply system***

Since 1989, the cost of water has gone up eight-fold, resulting in a 20 per cent decrease in consumption levels. In real terms, however, prices still do not reflect the full cost of providing the service. More detailed price data was not available.

***Sewerage and trade effluent charges***

Detailed price data was not available for this study.

***Direct abstraction or self-treatment***

Detailed price data was not available for this study.

**REFERENCES**

- ALFOLDI, L. (1991). "Le prix des services publics d'eau et d'assainissement en Hongrie". In VALIRON, F. *Gestion des Eaux: Coût et prix de l'alimentation en eau et de l'assainissement*.
- MINISTRY OF TRANSPORT, COMMUNICATION AND WATER MANAGEMENT (1996) "Water Management Data. In: *Infrabooks 19*. Prepared by the Water Management Division and Division of Water Damage Protection.
- MINISTRY FOR ENVIRONMENT AND REGIONAL POLICY, ENVIRONMENTAL PROTECTION DEPARTMENT. Communication with Dr. Katalin Gara, Counsellor.
- NATIONAL WATER AUTHORITY. Communication with Mrs. Horváth.

## ICELAND<sup>26</sup>

### Context for industrial water uses

#### *Institutional arrangements*

Water supply is in the hands of regionally-based water and sewerage companies in Iceland, such as Reykjavik Water Works for the metropolitan area of Reykjavik, an institution which dates back to 1906. Water companies are classified as “food production” companies, and hence, are subject to strict controls by the Health Authorities.

#### *Industrial water uses*

Industrial use (together with power production) is the largest consumer of water, accounting for 63 per cent of Iceland’s water use, while the public supply system accounts for 26 per cent and agriculture for only 11 per cent.

### Water and sewerage prices

In Reykjavik, water price structures for industrial consumers differ from those imposed on domestic users. Domestic users pay an annual fixed charge equal to 76 IKR per m<sup>2</sup> of property, plus 2 000 IKR per property. In contrast, industrial users pay a fixed charge of 14.34 IKR per m<sup>3</sup>, and a volume-based charge that varies according to the meter size (Table 12.1).

For wastewater services, the charging principle is the same for all categories of users. Payment for usage of the sewerage system is calculated as between 0.13 and 0.16 per cent of the value of the property connected to the sewer.

---

26. Incomplete information was obtained on Iceland.

**Table 12.1. Variable charges, Reykjavik Water Works (IKR) (1997)**

| <b>Meter size</b> | <b>Variable charge</b> |
|-------------------|------------------------|
| 0.50"             | 4 551                  |
| 0.75"             | 4 636                  |
| 1.00"             | 5 969                  |
| 1.25"             | 6 682                  |
| 1.50"             | 8 037                  |
| 2.00"             | 9 809                  |
| 3.00"             | 25 717                 |
| 4.00"             | 27 045                 |

*Source:* Reykjavik Water Works.

## REFERENCE

REYKJAVIK WATER WORKS. Communication with Mr Bjarni Larusson.

## **IRELAND**

### **Context for industrial water uses**

#### ***Institutional arrangements***

There are 27 rural counties and 5 urban counties in the Republic of Ireland. Counties are sub-divided into 6 boroughs and 54 urban districts, which are the public entities in charge of the provision of water services. There are about 1 000 public drinking water supply networks, of which many are small rural networks. In total, 88 local authorities manage water services, with some inter-communal groupings, such as in Dublin. This can create administrative problems, given that many rivers form the boundaries between water authorities. In some cases, particularly in rural areas, these services are provided by local community initiatives, assisted by government grants. These "Group Water Schemes" are privately run. Recently, responsibility for administering grants was devolved to local authorities, and a new investment programme was established to allow local authorities to take over and refurbish such schemes.

Although wastewater treatment is relatively under-developed in the country, large investments are currently being made in order to comply with the EU Urban Wastewater Treatment Directive. The State has budgeted for £900 million in expenditures on capital works for water and sewerage systems between 1994 and 1999.

At the national level, water policy is under the control of the Department of Environment (DoE), but there are some attempts at local management with the introduction of river management contracts.

#### ***Relative importance of industrial water use***

There is comparatively little industrial water use in Ireland, since industrialisation is a relatively recent phenomenon. Approximately 35 per cent of water is used for commercial or industrial purposes, the remaining 65 per cent being used by households. In Dublin, 41 per cent of water supplied by Dublin Corporation goes to the commercial/industrial sector, while 59 per cent is consumed by households.

About 60 per cent of wastewater is generated by the industrial sector, which is also responsible for most of the wastewater treatment carried out in the country.

#### ***Water sources for industry***

In the country as a whole, 78 per cent of water used is sourced from surface waters. Less than 2 per cent of the groundwater potential is extracted, mainly in the east and midlands.

Industry directly carries out about 90 per cent of its own water pollution treatment, and self-treatment is especially common in the food processing industry. (This indicator was also used in this study as a proxy for the percentage of direct abstractions.)

### ***Types of industrial water use***

In the 1980s, the development of large power stations and large new industrial water users (especially following the expansion of water consumption by the food processing industry) has increased the share of industrial demand, and has led to increasing costs of water supply and wastewater services.

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

Each local authority is free to set its own charging regime. According to existing legislation, charges are simply meant to relate to the costs of management, maintenance, and operation of services. This results in considerable variation in tariffs between local authorities, depending on their individual circumstances.

Domestic users are not metered. They used to pay for water through rates (local government taxation), but local rates for households were discontinued in 1978. Since then, revenue shortfalls have been met through a Rates Support Grant from the central government.

Industrial and commercial customers with water demands above a certain level (defined by the relevant authority) are subject to an extra charge for water. They also still have to pay local rates on their property to the local authority. A proportion of these users (mainly large industrial users) is charged on a metered basis. These charges appear to cover operating costs, while charges on households used to cover only about one-third of total costs of services (prior to the consolidation of domestic charges into general taxation). In Greater Dublin, it appears that, while 35 per cent of the water distributed is used for commercial or industrial purposes, these users contribute 48 per cent of the water utility revenues.

As water prices are barely sufficient to recover operating costs, investment costs are largely subsidised by the government. Large new works are entirely subsidised by the central government, with support from EU cohesion funds. Non-domestic water users, however, are increasingly required to pay a contribution to capital costs.

### ***Sewerage and trade effluent charges***

Water charges to non-domestic users generally include a contribution to wastewater treatment, often billed together with the water supply charges. Industrial users have recently been required to make capital contributions to the cost of municipal treatment plants to which they discharge. Capital contributions are set by negotiation between the firm and the local authority. As a result of these contributions, industry is usually involved at an early stage in the planning of new developments, which should also enable capacity to be built in accordance with industrial needs. Contributions are usually paid up-front, but, in some cases, yearly contributions are charged instead. These contributions accounted for about 33 per cent of total capital costs, according to a recent estimate. Elements in the calculation of these contributions generally relate to the volume of wastewater discharged, and the load characteristics of the

effluent. Capacity charges (based on peak demand by the industry as a proportion of the treatment plant's capacity) are used in one local authority.

All discharges, both to surface water and to sewers, must be authorised by local authorities. Treatment conditions for industrial wastewater are generally set out in the firm's water pollution licence, which is usually granted by the local authorities. For the largest pollution sources, however, and following the 1992 *Environmental Protection Agency Act*, an independent service for integrated control within the Environmental Protection Agency is responsible for granting pollution permits.

Local authorities can impose fines for non-compliance with regulations, or for the illegal release of wastewater. The degree to which these fines are used varies from authority to authority. They can also charge for water discharges, even if no treatment is carried out by the authorities on such discharges.

The results of a survey of 33 local authorities shows the rising penetration of trade effluent charges in Ireland. In addition to those already levying industrial effluent charges, a further six respondents were considering adopting charges in the future. The introduction of volume-related charges wastewater charges appears to have positively contributed to reducing wastewater discharges (Table 13.1).

**Table 13.1. Charges for Wastewater Services**

| Type of Charge                        | % of respondents | Basis of Charge                           |
|---------------------------------------|------------------|-------------------------------------------|
| Capital contributions from industry   | 36               | Half were volume-related                  |
| Industrial effluent operating charge  | 48               | Volume-related                            |
| Industrial effluent monitoring charge | 85               | Mainly related to frequency of monitoring |
| Domestic charges <sup>1</sup>         | 30               | Fixed charges                             |
| Total number of respondents           | 33               |                                           |

*Note:* 1. Domestic charges have now been consolidated into general taxation.

*Source:* Scott (1994).

### ***Abstraction charges***

No environmental or abstraction charge, designed to reflect the scarcity of resources, is in place.

### **Price levels and trends**

#### ***Water from public supply system***

Data on water prices are not collected at the central level. However, some data is available for the Dublin region.<sup>27</sup>

In the Dublin Corporation area, 2 147 commercial operations were metered in 1994, and paid a standard charge of ECU 0.5459 per 1 000 litres in 1996. A further, 3 140 commercial entities did not have metering facilities, and paid a standard minimum charge of ECU 93.54 per year. However, only a small proportion of the latter were industrial users.

27. All information on Dublin tariffs is drawn from Ecotec (1996).

***Sewerage and trade effluent charges***

In Dublin, the only customers which pay sewage charges are the 255 industrial users who hold trade effluent licences. The charge was ECU 0.133 per m<sup>3</sup> in 1996. For some users, the charge is based on a metered amount of water entering the plant, with an allowance for water consumed in the plant. For users who meter their discharges to the sewer, the charge is based on measured sewage. These charges do not vary according to the load.

***Direct abstraction or self-treatment***

There are no direct abstraction charges. Although discharge charges are sometimes payable by industrial users, no specific price information was available for this study.

**REFERENCES**

- BARRETT ALAN, JOHN LAWLOR, AND SUSAN SCOTT (1997). *The Fiscal System and the Polluter Pays Principle: A Case Study of Ireland*. Ashgate Publishing.
- SCOTT, SUSAN AND JOHN LAWLOR (1994). *Wastewater Services: Charging Industry the Capital Cost*. Economic & Social Research Institute, Policy Research Series, Paper No. 22, December.
- ECONOMIC AND SOCIAL RESEARCH INSTITUTE. Communication with Susan Scott.

## ITALY

### Context for industrial water uses

#### *Institutional arrangements*

Responsibility for the management of water resources is fragmented in Italy, with various layers of management at the provincial (94 provinces), regional (20 regions), river basin, and national governmental levels.

Water supply services as well as the operation of supply and sewerage networks have traditionally fallen under municipalities' control (8 092 *comuni* in total). In practice, many municipalities have formed inter-communal groups, such as *consorzi*, to oversee the management of these services. Because of the Mediterranean climate, there are also several independent water networks and aqueducts for water transfers across river basins, managed by authorities at a higher level. Pollution control is the responsibility of Regions through Regional Environment Agencies. Finally, industrial users can also use dedicated collective networks, especially in industrial districts where most firms use the same technologies and have the same requirements with respect to water quality.<sup>28</sup>

In total, there are 13 500 water networks and 6 600 managing municipalities. Many municipalities have entrusted the management of services to entities called the *azienda speciale* or *azienda municipalizzata*. These are local public bodies, under the control of the municipality, which are responsible for organising various urban services. They have separate budgets, but no management autonomy. Private water companies supply only around 4 per cent of water delivered through community systems.<sup>29</sup>

#### *Relative importance of industrial water use*

Industrial water use represents about 17 per cent of total water use, having declined from 20 per cent in the 1970s (Table 14.1). If energy production is added, it appears that industrial concerns were responsible for about 30 per cent of water consumed in the mid 1980s. This relatively low share of industrial use is due to high water requirements for irrigation, which accounted for around 60 per cent of the total water used.<sup>30</sup> There has been a specific reduction in water demand by industry due to the adoption of water recycling and cleaner technologies, which were influenced by the introduction of

---

28. These collective networks, especially in the South, have been set up by the State in order to foster industrial development in under-developed regions.

29. Barraqué (1995).

30. These figures are only a rough estimate, since no consistent accounting of resource use has been carried out.

pollution control policies in 1976, and also by a de-industrialisation process, especially in the heavy industry sector.

**Table 14.1. Water Use in Italy (Billion m<sup>3</sup>/year, 1998)**

| Use        | Current estimates |     |
|------------|-------------------|-----|
|            | Volume            | %   |
| Domestic   | 7.9               | 20  |
| Irrigation | 20.1              | 50  |
| Industrial | 8.0               | 20  |
| Energy     | 4.5               | 11  |
| Total*     | 40.6              | 100 |

Source: IRSA-CNR (1999, forthcoming).

### ***Water sources for industry***

The large majority of industrial users abstract water directly from surface waters (especially for cooling in power production or for use in paper mills), or from groundwaters. For direct abstractions, they simply pay an abstraction charge plus any additional costs they may have in treating the water to the required standard for their use.

Industry uses only 10 per cent of the water supplied by public community systems (commercial and light industrial uses account for 19 per cent of end-uses — Table 14.2). Public water supply in itself accounts for only 15 per cent or so of total water use in the country. In some regions, where the problems of water conservation are more acute, water-intensive industries are gathered into collective networks, specifically aimed at influencing industrial uses, for environmental purposes. In other cases, collective dedicated networks have been set-up to promote industrial development, especially in Southern Italy.

**Table 14.2. Breakdown of Water Consumption Supplied by Public Networks, By Use and Population Size (thousand m<sup>3</sup>, 1991)\***

| Use                             | Population Size |                |                 |                   | Total     |
|---------------------------------|-----------------|----------------|-----------------|-------------------|-----------|
|                                 | 0-20.000        | 20.000-100.000 | 100.000-500.000 | More than 500.000 |           |
| Domestic                        | 36.214          | 309.845        | 616.919         | 1.250.180         | 2.213.158 |
| Commercial and light industrial | 11.350          | 88.362         | 195.438         | 310.104           | 605.254   |
| Public                          | 5.356           | 39.922         | 79.396          | 210.738           | 335.412   |
| Irrigation                      | 1.019           | 9.306          | 10.079          | 11.703            | 32.107    |
| Total                           | 53.939          | 447.435        | 901.832         | 1.782.725         | 3.185.931 |

Note: \* Data refer only to firms that are members of Federgasacqua (55 per cent of the total).

Source: Federgasacqua (1994).

### ***Types of industrial water use***

Industrial water uses were last estimated by the *Conferenza Nazionale sulle Acque* in 1971, when coefficients of water consumption per employee were calculated to evaluate total water consumption, a method which is likely to provide only a rough approximation. Table 14.3 illustrates that

the chemical industry was the largest water user in 1971 (38 per cent of total manufacturing use), followed by the food and iron industries.

**Table 14.3. Industrial Water Demand in Italy Estimated by CNA**  
Million m<sup>3</sup>/year, 1971)

| Industry           | Water abstraction | %   |
|--------------------|-------------------|-----|
| Paper              | 750               | 14  |
| Chemistry          | 2 000             | 38  |
| Iron               | 600               | 11  |
| Coke               | 20                | 0   |
| Petrochemical      | 120               | 2   |
| Mechanics          | 460               | 9   |
| Textiles and dye   | 390               | 7   |
| Glass              | 50                | 1   |
| Ceramics           | 50                | 1   |
| Abrasives          | 10                | 0   |
| Cement             | 20                | 0   |
| Leather            | 50                | 1   |
| Food and beverages | 700               | 13  |
| Total              | 5 220             | 100 |

Source: Rusconi (1995).

Table 14.4 indicates the average water consumption per employee in various industrial sectors, and how these have changed over time. The changes may indicate both changes in the relative importance of the sectors, and the introduction of water-saving technologies in some sectors.

**Table 14.4. Average Water Consumption in Selected Industrial Sectors**  
(m<sup>3</sup>/year/employee)

| Sector           | 1972   | 1986  | % change |
|------------------|--------|-------|----------|
| Pasta            | 3 500  | 2 257 | -28%     |
| Sweets           | 500    | 388   | -22%     |
| Food conserves   | 2 200  | 4 554 | 107%     |
| Cheese           | 1 100  | 660   | -40%     |
| Sugar            | 4 000  | 1 772 | -56%     |
| Textile          | 1 500  | 1 725 | 15%      |
| Tanning          | 1 200  | 912   | -24%     |
| Metals           | 3 900  | 1 950 | -50%     |
| Mechanic         | 550    | 424   | -23%     |
| Automobile       | 600    | 1 164 | 94%      |
| Chemistry        | 5 500  | 5 115 | -7%      |
| Gum              | 1 700  | 340   | -80%     |
| Synthetic fibers | 5 000  | 1 000 | -80%     |
| Paper            | 16 000 | 7 360 | -54%     |

Source: IRSA-CNR (1999, forthcoming).

## Pricing principles

### *Pricing structure for water from the public supply system*

Each of the 13 500 water networks has its own water tariff, but price increases must be approved by a committee at the provincial level. Up to 1994, the Inter-Ministerial Committee on prices (*Comitato Interministeriale Prezzi*) determined pricing rules, but it has now been abolished and is due to be replaced with price regulation agencies. Law 36/1994 specified the creation of a regulating agency – the *Comitato di Vigilanza sull'Uso delle Risorse Idriche*, but regulatory activities still remain split between various agencies.

Prices are generally charged on a volumetric basis, since most users are metered. Non-metered users pay a fixed amount, based on an indicator, such as the price of their property. The largest networks typically use a two-part tariff structure, with a fixed charge (meter fee) and a volumetric charge, which increases in relation to consumption. The volumetric charge therefore generally follows an increasing-block structure (with the blocks set within each municipality), favouring lower consumption levels.

Industrial and commercial users do not qualify for the lower-block subsidised tariffs that are available to domestic users (the *tariffa agevolata*), and they are generally charged much more than households for the flat rate part of the tariff (*tariffa base*), which is set to reflect average costs. As a result, industrial users drawing water from the public system pay more on average than householders, thus they cross-subsidise domestic water users. In addition, they generally do not require water of potable quality (as supplied through the public system). Thus, industrial users generally prefer to abstract water directly.

A number of important reforms have taken place in the Italian water sector in the last 10 years. Law No. 36/1994 provided for self-financing of water services, with a new charging system which must finance the long-run cost of services.

### *Sewerage and trade effluent charges*

Those municipalities which are responsible for sewerage networks apply a tax proportional to the volume of water delivered for sewerage services to the public system. The price of sewerage services is established on the basis of quantity and quality criteria, according to a formula defined in Law No. 319/1976.

### *Abstraction and direct discharge charges*

In theory, records of licensed surface abstractions are kept by licensing authorities (such as the regions and some departments of the Ministry of Public Works), but it is understood that these records are often absent or of poor quality. Abstraction charge levels vary according to the type of water use (irrigation, public supply, power production, industrial processes, etc.) and are based on the licensed levels, not on actual abstractions. If the abstraction is multi-purpose, the highest charge applies.

In many cases, industrial sewage is sent as liquid waste to specified plants, for treatment under private agreements. The plant operators are usually mixed public-private syndicates, and they levy the charges directly.

## Price levels and trends

### *Water from public supply system*

Prices rose significantly during the 1980s, with Italy experiencing the highest growth rate in Europe, according to Peruzzi (1990). Prices are reported to have risen by 87 per cent on average between 1980 and 1985. Prices still remain relatively low, however. Water services only recover 60 per cent of total costs, on average. At the end of the 1980s, it was decided that prices should cover at least 80 per cent of costs (excluding capital costs). Public subsidies (governmental and European) are still required for new investments.

### *Sewerage and trade effluent charges*

No information was obtained on sewerage and trade effluent charges.

### *Direct abstraction or self-treatment*

Abstraction charges were defined under Law No.36/94, according to category of user (Table 14.5). In the North, where water is abundant, the costs of direct water abstraction are low. The minimum charge is 3 million lire per year.

**Table 14.5. Abstraction Charges**

| Use                  | Unity of measure<br>( <i>modulo</i> ) | Charge 1933<br>LIT | Charge 1994<br>LIT | Charge 1933 at 1994<br>prices |
|----------------------|---------------------------------------|--------------------|--------------------|-------------------------------|
| Irrigation (*)       | 1000 l/sec                            | 200                | 70.400             | 255.785                       |
| Irrigation (*)       | 1 ha                                  | 2                  | 640                | 2.558                         |
| Farm fishing         | 100 l/sec                             |                    | 500.000            | 255.785                       |
| Sport facilities     | 100 l/sec                             |                    | 500.000            |                               |
| Human consumption    | 100 l/sec                             | 200                | 3.000.000          |                               |
| Industrial uses (**) | 100 l/sec                             | not charged        | 22.000.000         |                               |
| Hydropower           | 1 kW                                  | 12                 | 20.467             | 15.347                        |

Note: (\*) The charge for irrigation is reduced by 50 per cent if residual water is left to percolate into groundwater.

(\*\*) The charge for industrial uses is reduced by 50 per cent if the user employs water recycling and water saving technologies.

Source: Massarutto (1996)

For the manufacturing industry, the water charge is 22 million lire per litre per “module” (3 million m<sup>3</sup> per year). This charge is discounted by 50 per cent if the process entails water reuse or recycling, or if the water is discharged after use without quantitative or qualitative alteration. For power generation, the charge is equal to 20.467 million lire per kW of “nominal power” (i.e. of the maximum power production maximum capacity).

## REFERENCES

AUTORITA DI BACINO DEL PO. Communication with Giuseppe Placentini.

FEDERGASACQUA. Communication with Ing. Drusiani, Director of Water Services.

IRSA-CNR (1999, forthcoming). *Un Futuro Per L'acqua in Italia*.

MALAMAN R. (1995). *La gestione delle risorse idriche*. Il Mulino: Bologna.

MASSARUTTO, ANTONIO, AND ECOLOGIC (1996). "Italy". In: *Comparing Water Prices in Europe: Water Prices in Italy*. September 1996.

MASSARUTTO, ANTONIO (1997). "Water Management Systems in Italy". Unpublished report.

UNIVERSITÀ DA BOCCONI (MILANO). Communication with Dr. Antonio Massarrutto.

## JAPAN

**Context for industrial water uses*****Institutional arrangements***

Most water for domestic and commercial purposes is supplied by water utilities, which are managed by 3 233 municipalities under local monopolies. Utilities serving populations of 5 000 or less are defined as small water-supply systems, and those serving larger populations are defined as waterworks. There were 12 080 water utilities in Japan in 1993, of which 1 969 were waterworks. Of these waterworks, only 12 were privately managed.

Industrial users can be supplied directly by specialised industrial water utilities. These are facilities which are built and managed by local governments and other utilities to supply industrial water in accordance with Section 3 of Article 2 of the Industrial Water Supply Business Law. There were 130 industrial water utilities in Japan as of April 1994, together with 226 specialised systems, each designed to provide water for industrial use. About 60 per cent of these specialised systems were built with government subsidies (Table 15.1). In 1994, they had the capacity to supply about 21 869 million m<sup>3</sup> per day to 6 211 industrial entities.

**Table 15.1. Industrial Water Networks (1994)**

| Type of network            | Ownership                                     | Number     |
|----------------------------|-----------------------------------------------|------------|
| Industrial water utilities | Local government                              | 122        |
|                            | Business consortia                            | 6          |
|                            | Private company                               | 1          |
|                            | Japan Regional Development Corporation        | 1          |
|                            | <i>Total</i>                                  | <i>130</i> |
| Industrial supply systems  | With national government subsidies            | 127        |
|                            | With national subsidies for coal mining areas | 14         |
|                            | Unsubsidised                                  | 85         |
|                            | <i>Total</i>                                  | <i>226</i> |

*Source:* Survey by the Ministry of International Trade and Industry.

The supervision of water and wastewater services is vertically-separated in Japan. The Ministry of Health and Welfare is in charge of drinking water services, while sewerage and sewage treatment is regulated separately by the Construction Ministry, together with local authorities. The coverage of water services has noticeably improved in recent years, but coverage of sewerage services remains comparatively low.

### *Relative importance of industrial water use*

Industrial water use in 1993 amounted to approximately 149 million m<sup>3</sup> per day of fresh water, and about 40 million m<sup>3</sup> per day of sea water, for a total daily consumption of approximately 189 million m<sup>3</sup> per day.<sup>31</sup> No information was obtained on total abstractions, so it was not possible to assess the importance of industrial uses as a proportion of total use.

### *Water sources for industry*

Sources of fresh water for industry in 1993 are shown in Table 15.2. Ignoring recycled water, industrial users received about 13 million m<sup>3</sup> per day from water utilities. The percentage of water supplied by industrial utilities increased from 14.2 per cent in 1965, to 36.8 per cent in 1993.<sup>32</sup>

**Table 15.2. Sources of Freshwater for Industry (1993)**

| Source                           | Million m <sup>3</sup> per day | %    |
|----------------------------------|--------------------------------|------|
| Water mains                      | 15                             | 10.5 |
| Industrial water supply services | 13                             | -    |
| Public supply services           | 3                              | -    |
| Surface water                    | 9                              | 6    |
| Groundwater                      | 10                             | 6.7  |
| Other sources                    | 0.4                            | 0    |
| Recycled water                   | 114                            | 76.8 |
| Total                            | 148.4                          | 100  |

Source: Japanese National Land Agency (1996).

### *Types of industrial water use*

The main industrial users are presented in Table 15.3. The three largest industrial water consumers are the chemical, steel, and the paper/paper product industries. Use of freshwater by the chemical industry has risen sharply since the 1980s (it was only 41 million m<sup>3</sup> per day in 1985). Water use in the steel industry also increased, albeit more marginally: from 36 million m<sup>3</sup> per day in 1985, to slightly above 37 million in 1994. Other important users are the processing and assembly industries, such as transportation equipment and food processing.

**Table 15.3. Water Consumption by Major Industrial Users (1994)**

| Main industry                 | thousand m <sup>3</sup> /day | %          |
|-------------------------------|------------------------------|------------|
| Pulp and paper                | 15 288                       | 10         |
| Chemical                      | 47 797                       | 32         |
| Iron and steel                | 37 250                       | 25         |
| Machinery for transport       | 10 840                       | 7          |
| <b>Total (all industries)</b> | <b>147 550</b>               | <b>100</b> |

Source: Ministry of International Trade and Industry.

31. Japanese National Land Agency (1996).

32. Ministry of International Trade and Industry, Census of Manufactures.

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

The general water pricing principle applied is that prices should relate to the costs of efficient management, not to actual costs. According to the 1957 Waterworks Law, water charges should be justifiable, and should be determined clearly on a fixed-rate basis.

Prices usually contain two elements: a basic charge based on the water pipe diameter, and a volumetric charge. Consumers have had to pay volume-related charges since the establishment of a modern water supply system in 1887, when basic rates and excess rates were also introduced. All consumers are now metered. Charges based on pipe-size were introduced in 1965. Despite efforts made to reflect costs in prices, unit prices for large water supply operations remained at least 5 per cent below unit costs between 1970 and 1992.

For volumetric charges, water users are classified as follows: domestic, commercial, industrial, and public bath. Charges correspond to the sharing ability of each category, which implies that there could be some cross-subsidies between categories. Water charges are determined by each water company according to their specific costs of provision, generating substantial differences in prices across the country. Most industries enter into contracts with the local water supplier for a fixed quantity: the industrial user typically has to pay a fixed amount for this given quantity. Local authorities are required to notify the Ministry of price increases. Private suppliers also need the approval of the Ministry for price changes.

### ***Sewerage and trade effluent charges***

Users of the sewerage system have to pay a wastewater charge, based on the volume of water consumed, to cover maintenance and management expenditure related to wastewater services. They also have to pay about 30 per cent of corresponding investment expenditures, the rest being covered by state subsidies. Rates are collected on the basis of the following rules:

- they must be appropriate for the users' condition of use;
- they must not exceed reasonable costs under an efficient administration;
- they must be clearly set with reference to fixed percentages or amounts; and
- they must not grant unfair discriminatory treatment to specific users.

Subsidies are received from a variety of sources, including the Ministry of Construction which subsidises the construction and improvement cost of the municipalities for sewage works, on the basis of Article 34 of the Sewerage Law. Local public bodies can also provide subsidies, and they can issue local bonds in order to cover these costs. Finally, local residents may be asked to contribute directly through the payment of beneficiary charges, which are charged per square meter of property in the year in which service from the plant begins.

Some municipalities apply a scheme of progressive rates based on wastewater quality to levy additional charges for large quantities of wastewater, with a trade effluent load above water quality standards. Sewerage system user charges are subject to the national consumption tax.

### ***Abstraction and discharge charges***

Industrial users that abstract water directly are required to pay an abstraction charge.

### **Price levels and trends**

#### ***Water from public supply system***

Average price levels charged by industrial water utilities are presented in Table 15.4. These prices are much lower than those charged by public supply utilities to the rest of the population, where prices in 1993 were on average Yen 169 per m<sup>3</sup>, with the price for domestic users averaging Yen 127.4 per m<sup>3</sup>.

**Table 15.4. Price Levels Charged by Industrial Water Utilities (Yen per m<sup>3</sup>)**

| <b>Fiscal year</b> | <b>1992</b> | <b>1993</b> | <b>1994</b> |
|--------------------|-------------|-------------|-------------|
| Average price      | 18.84       | 20.67       | 20.90       |

*Source:* Ministry of International Trade and Industry.

Prices and tariff structures were also obtained for two important water utilities in the country: Tokyo Metropolitan Water Works and Nagoya City Water Works (Tables 15.5 and 15.6).

In Nagoya, the charging system also combines elements based on pipe size and on the volume of water consumed, with an increasing-block structure in order to promote water conservation.

**Table 15.5. Tokyo Metropolitan Water Works: Monthly Water Charges (June 1994)**

| <b>Meter size<br/>mm</b> | <b>Basic charge<br/>Yen</b> | <b>Volume-based charge (Yen per m<sup>3</sup>)</b> |                           |                           |                            |                             |                                |                                |
|--------------------------|-----------------------------|----------------------------------------------------|---------------------------|---------------------------|----------------------------|-----------------------------|--------------------------------|--------------------------------|
|                          |                             | <b>1-10m<sup>3</sup></b>                           | <b>11-20m<sup>3</sup></b> | <b>21-30m<sup>3</sup></b> | <b>31-100m<sup>3</sup></b> | <b>101-200m<sup>3</sup></b> | <b>201-1 000 m<sup>3</sup></b> | <b>&gt;1 001 m<sup>3</sup></b> |
| 13                       | 920                         | 0                                                  | 130                       | 175                       | 215                        | 300                         | 375                            | 415                            |
| 20                       | 1 230                       | 0                                                  | 130                       | 175                       | 215                        | 300                         | 375                            | 415                            |
| 25                       | 1 520                       | 0                                                  | 130                       | 175                       | 215                        | 300                         | 375                            | 415                            |
| 30                       | 3 420                       | 215                                                | 215                       | 215                       | 215                        | 300                         | 375                            | 415                            |
| 40                       | 6 850                       | 215                                                | 215                       | 215                       | 215                        | 300                         | 375                            | 415                            |
| 50                       | 20 700                      | 375                                                | 375                       | 375                       | 375                        | 375                         | 375                            | 415                            |
| 75                       | 45 600                      | 375                                                | 375                       | 375                       | 375                        | 375                         | 375                            | 415                            |
| 100                      | 94 500                      | 415                                                |                           |                           |                            |                             |                                |                                |
| 150                      | 159 000                     | 415                                                |                           |                           |                            |                             |                                |                                |
| 200                      | 342 000                     | 415                                                |                           |                           |                            |                             |                                |                                |
| 250                      | 468 000                     | 415                                                |                           |                           |                            |                             |                                |                                |
| 300                      | 798,000                     | 415                                                |                           |                           |                            |                             |                                |                                |

*Source:* Japan Water Works Association.

**Table 15.6. Business Tariffs in Nagoya (Yen) (1992)**

| Type of user                             | Size of meter mm | Basic usage m <sup>3</sup> | Basic charge yen | 9-10 m <sup>3</sup> | 11-20 m <sup>3</sup> | 21-30 m <sup>3</sup> | 34-50 m <sup>3</sup> | 51-100 m <sup>3</sup> | 101-300 m <sup>3</sup> | >301 m <sup>3</sup> |
|------------------------------------------|------------------|----------------------------|------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|------------------------|---------------------|
| Specified business, factories and others | 20-25            | 20                         | 3 900            | n.a.                | n.a.                 | 247                  | 257                  | 272                   | 282                    | 287                 |
|                                          | 40-50            | 30                         | 8 600            | n.a.                | n.a.                 | n.a.                 | 257                  | 272                   | 282                    | 287                 |
|                                          | >75              | 50                         | 19 200           | n.a.                | n.a.                 | n.a.                 | n.a.                 | 272                   | 282                    | 287                 |
|                                          | 40-50            | 30                         | 8 600            | n.a.                | n.a.                 | n.a.                 | 257                  | 272                   | 282                    | 287                 |
| Electric gilding                         | >75              | 50                         | 19 200           | n.a.                | n.a.                 | n.a.                 | n.a.                 | 272                   | 272                    | 272                 |

Source: Japan Water Works Association.

### ***Sewerage and trade effluent charges***

No precise data for industrial sewerage charges was obtained for this study.

### ***Direct abstraction or self-treatment***

No information on the levels of abstraction charges paid by industrial users was available for this study.

## **REFERENCES**

- JAPANESE NATIONAL LAND AGENCY (1996). *Water Resources in Japan — Present State of Water Resources Development, Conservation and Utilisation*.
- OECD (1994). *Environmental Performance Review: Japan*. OECD: Paris.
- JAPAN INDUSTRIAL WATER ASSOCIATION. Communication with Mr Akimoto.
- JAPAN SEWAGE WORKS ASSOCIATION (1997). *Sewage Works in Japan*.
- JAPAN WATER WORKS ASSOCIATION. Communication with Mr Shimazaki.

## KOREA

### Context for industrial water uses

#### *Institutional arrangements*

In Korea, water supply is under the exclusive responsibility of government-owned organisations, both at the national and local levels. These organisations are the owners and direct managers of the water supply systems. Central government is responsible for multi-regional water supply (when water is distributed between more than one city), including industrial supply, while local government is mostly responsible for domestic and industrial supply in relatively small areas. Locally-governed organisations mostly buy raw water from central-government sources, through the Korea Water Resources Corporation, which is commissioned by the central government. Government organisations also own wastewater treatment operations.

#### *Relative importance of industrial water use*

Industry accounts for between 8 and 11 per cent of total water abstractions (Table 16.1). Growth in industrial water use has been relatively limited over recent years.

**Table 16.1. Annual Water Abstractions by Type of Users (1997)**

| Type of water user | Percentage of total abstractions (%) |
|--------------------|--------------------------------------|
| Domestic users     | 21                                   |
| Industrial users   | 8                                    |
| Agricultural       | 50                                   |
| River maintenance  | 21                                   |

Source: Korean Ministry of Environment.

#### *Water sources for industry*

**Table 16.2. Industrial Water Use by Industrial Complexes (1994)**

|                                       | Total | National complexes | Local complexes | Agricultural and industrial complexes | Others |
|---------------------------------------|-------|--------------------|-----------------|---------------------------------------|--------|
| Amount ('000s m <sup>3</sup> per day) | 5 061 | 1 742              | 1 105           | 139                                   | 2 075  |
| Percentage use                        | 100   | 34.4               | 21.8            | 2.8                                   | 41.0   |

Source: Korea Water Resource Management Authority (1994).

Direct abstractions account for approximately 16 per cent of total industrial water uses, with the remaining 84 per cent being drawn from the public supply system.

### ***Types of industrial water use***

No data was available for this study on the types of industrial water uses, but some data were available on the type of water discharges. With respect to discharges, the textile, food, chemical and pulp/paper industries are the sectors which exert the largest pollution burden on *inland* waters. The country's largest iron, steel and heavy chemical plants together represent 35 per cent of total effluents, but these mostly exert pressures on *coastal* waters.

**Table 16.3. Industrial Water Use by River Basin**

| River basin                     | Han river | Nakdong river | Geum river | Youngsan and Seomjin rivers | Total |
|---------------------------------|-----------|---------------|------------|-----------------------------|-------|
| Million m <sup>3</sup> per year | 830       | 603           | 206        | 188                         | 1 827 |

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Pricing principles differ between nationally-governed and locally-governed industrial complexes. The Korea Water Resource Corporation sets prices for bulk water delivered from its supply infrastructure to both municipalities and industries. Prices take account of social considerations, and cover 75 to 79 per cent of actual (operational plus capital) production costs, depending on the degree of water treatment involved.

Most municipalities finance the cost of water services partly through property taxes, and partly through user charges. Households still pay much less than industrial users, but recent significant price increases in the household sector have somewhat reduced this price difference.

#### ***Sewerage and trade effluent charges***

Industrial users can either discharge wastewater directly back to the river, or they can discharge to the public wastewater system, for which the wastewater treatment standards are more stringent.

There is an emission charge system, put in place in 1983, and last revised in 1994. It is more a non-compliance charge mechanism than a user-pays system, since initially it only came into operation when violations of permit conditions were detected. Since 1994, however, charges have been made up of a new fixed basic charge, payable without violation of effluent limits and dependent on the size of the firm, and an effluent charge which varies with the amount of pollutants discharged in excess of the permitted amount. Effluent charges are calculated on the basis of 15 specified pollutants (e.g. BOD, COD, suspended solids, lead, cadmium, phenols).

### ***Abstraction and discharge charges***

When a direct discharge occurs, and if standards are violated, the violating company must pay an additional charge which depends on the degree of violation of the standard and the amount of wastewater being discharged.

### **Price levels and trends**

#### ***Water from public supply system***

For nationally-governed complexes, rates for multi-regional water supply are evenly-imposed, with no differentiation based on the type of use (i.e. domestic or industrial). Water tariffs only distinguish between the type of water required, and are thus dependent on the type of treatment applied.

**Table 16.4. Water Tariffs for Nationally-Governed Industrial Complexes (1998)**

|                    | <b>Average</b> | <b>Raw water</b> | <b>Filtered</b> | <b>Purified</b> |
|--------------------|----------------|------------------|-----------------|-----------------|
| Won/m <sup>3</sup> | 115.81         | 94.68            | 145.68          | 157.52          |

Source: Ministry of Environment, Water Supply Policy Division.

For locally-governed complexes, water tariffs for industrial users are usually much higher than for domestic users (industrial tariffs are equal to between 155-200 per cent of domestic tariffs). Water tariffs for locally-governed industrial complexes (i.e. where prices are autonomously regulated by local authorities) are four times higher than in nationally-governed industrial complexes.

**Table 16.5. Water Tariffs for Locally-Governed Industrial Complexes (Won/m<sup>3</sup>)**

| <b>City</b> | <b>Basic rates</b> |                   |
|-------------|--------------------|-------------------|
|             | <b>Domestic</b>    | <b>Industrial</b> |
| Seoul       | 120                | 187-413           |
| Pusan       | 170                | 350-600           |
| Incheon     | 130                | 255-290           |
| Taegu       | 160                | 300-493           |

Source: Ministry of Environment, Water Supply Policy Division.

In locally-governed industrial complexes, these higher prices result from adding a fixed rate (based on the water pipe diameter) to a differential rate (based on the amount of water used).

### ***Sewerage and trade effluent charges***

Trade effluent charges for some Korean cities are presented in Table 16.6.

**Table 16.6. Trade Effluent Charges in Selected Korean Cities (1998)**

| <b>City</b>  | <b>Won per ton</b> |
|--------------|--------------------|
| Seoul        | 106                |
| Pusan        | 146                |
| Incheon      | 88                 |
| Taegu        | 68                 |
| <b>Total</b> | <b>90</b>          |

*Source:* Korean Delegation to the OECD

***Direct abstraction or self-treatment***

No information was obtained for this study on abstraction and discharge charges.

**REFERENCES**

KOREA WATER RESOURCE MANAGEMENT AUTHORITY (1994). "Survey of Water Use".

OECD (1997). *Environmental Performance Reviews: Korea*. OECD: Paris

MINISTRY OF ENVIRONMENT, WATER SUPPLY POLICY DIVISION. Communication with Mr. Kim Jong Chon, Director.

## **LUXEMBOURG**

### **Context for industrial water uses**

#### ***Institutional arrangements***

Water supply and wastewater services are the responsibility of municipalities. The municipalities have created 11 inter-communal syndicates to organise water supply across the Duchy, with only a handful of municipalities remaining autonomous control. However, municipalities do distribute water to final users in an autonomous way. Large industrial users can obtain water directly from the syndicates, which can also serve isolated users who happen to be close to syndicates' main networks. Wastewater services are also the responsibility of municipalities for which the private sector does not play a role.

The Environment Ministry is the main authority for water services.

#### ***Relative importance of industrial water use***

The total quantity of water distributed through the public supply system is estimated to be between 34-45 million m<sup>3</sup>, to which must be added approximately 20 million m<sup>3</sup> of water which is abstracted directly by industry. Public water suppliers deliver about 110 000 m<sup>3</sup> per day, of which the metal industry accounts for 25 per cent. Industrial use has sharply declined in recent years, especially in the mining and metal industries.

Industrial abstractions account for roughly 45 per cent of total abstractions, with households and agriculture making up 52 and 3 per cent respectively.

#### ***Water sources for industry***

Industry has to use groundwater sources (more than half of all water resources are drawn from groundwater at the national level).

#### ***Types of industrial water uses***

No data was obtained for this study on the main types of industrial water uses.

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

Municipalities determine water prices on a metered basis. Despite the fact that syndicates supply municipalities at the same price, there can be wide variations in water prices between one municipality and another.

### ***Sewerage and trade effluent charges***

There is a drainage charge, usually based on the volume of water consumed. The amounts charged vary from one region to another.

### ***Abstraction and discharge charges***

Water abstractions are subject to the authorisation of the Ministry of the Interior (groundwater), the Ministry of Agriculture (non-navigable surface waters) and the Ministry of Public Works (navigable surface waters). The Ministry of Agriculture and the Ministry of Public Works are also responsible for granting authorisation for the discharge of wastewater into surface waters, in co-ordination with the Ministry of Environment, which sets the standards for the quality allowable to receiving waters.

## **Price levels and trends**

### ***Water from public supply system***

Water appears to be undervalued in Luxembourg, since prices only cover operating and distribution costs. The full costs of supplying water are covered by the municipality itself, through an indirect subsidy. No price data was available for this study.

### ***Sewerage and trade effluent charges***

No price data was available for this study.

### ***Direct abstraction or self-treatment***

No price data was available for this study.

## **REFERENCE**

SYNDICAT DES EAUX ESCH-SUR-SÛRE (SEBES). Communication with Mr Guy Hansen, Director.

## MEXICO

### Context for industrial water uses

#### *Institutional arrangements*

Water supply used to be organised centrally in Mexico, until decentralisation was introduced in this sector of the economy in 1983, as in others (e.g. health, education). This involved devolving responsibility for *resource management* to the 31 States and Mexico City (who have their own water laws, based on a federal model), and devolving responsibility for *water supply* to municipalities (which created operating bodies – *organismos operadores* – that are regulated by the water laws of each State). There were 360 decentralised operating bodies in 1995, serving areas of more than 50 000 people. In total, there were 802 distribution entities, including smaller entities in rural areas.

A government agency (the National Water Commission, or *Comisión Nacional del Agua* – CNA) was created in 1989. This Commission is responsible for price and quality regulation, for supporting the institutional and financial development of water operating bodies, as well as for granting guidance to State institutions for the management of water resources. In the case of disagreement between the CNA and the industry, the government acts as arbitrator through the judicial system. The Commission is supporting the formation of River Basin Councils (*Consejos de Cuencas*) to give consumer groups more power in future policy design.

#### *Relative importance of industrial water use*

Agriculture is the dominant user of water in Mexico, although it is not responsible for the majority of abstractions, because of the importance of abstractions for hydroelectricity (although none of this water is actually “consumed”). Industry only accounts for 3.5 per cent of abstractions (Table 18.1).

#### *Water sources for industry*

Table 18.1 also shows that about 40 per cent of industrial abstractions come from surface waters and around 60 per cent from groundwater. Economic sources of supply are indicated in Table 18.2. Direct abstractions represent about 72 per cent of industrial water uses, while public systems supply only 28 per cent of water consumed by industry. The same proportions apply to discharges: 72 per cent are direct discharges, while 28 per cent are discharges to the sewers. The food processing and chemical industries tend to be the largest industrial consumers of public water supply, together with other small industrial users.

**Table 18.1. Water Abstractions By Type of User (1998)**

| Water Uses               | Abstraction (km <sup>3</sup> ) | %     |
|--------------------------|--------------------------------|-------|
| Public supply            | 15.0                           | 7.1   |
| Agriculture              | 62.5                           | 29.8  |
| Industry                 | 7.5                            | 3.5   |
| Power production         |                                |       |
| - Thermoelectricity      | 0.94                           | 0.4   |
| - Hydroelectricity       | 122.0                          | 58.3  |
| Aqua-culture and fishing | 1.3                            | 0.9   |
| Recreation and tourism   | 0.03                           | 0     |
| Total                    | 209.27                         | 100.0 |

Source: Comisión Nacional del Agua for 1998, Subdirección General de Administración de Agua.

**Table 18.2 Estimates of Industrial Abstractions in Mexico (Million m<sup>3</sup>) (1998)**

| Industry                  | Survey size | Abstraction                 |     |       |        |               | Consumption rate (%) |
|---------------------------|-------------|-----------------------------|-----|-------|--------|---------------|----------------------|
|                           |             | Needs (m <sup>3</sup> /ton) | %   | Total | Direct | Public supply |                      |
| Sugar production          | 61          | 50                          | 37  | 2 189 | 2 189  | 0             | 20                   |
| Pulp and paper            | 736         | 80                          | 5   | 277   | 277    | 0             | 45                   |
| Food and beverage         | 23 637      | 20                          | 9   | 558   | 195    | 363           | 40                   |
| Textiles                  | 2 873       | 125                         | 1   | 86    | 86     | 0             | 20                   |
| Iron and steel industry   | 1 383       | 4.5 - 20                    | 5   | 304   | 304    | 0             | 40                   |
| Chemical industry         | 3 634       | 100                         | 17  | 993   | 496    | 497           | 28                   |
| Oil and petrochemical     | -           | -                           | 12  | 681   | 681    | 0             | 20                   |
| Subtotal                  | 31 424      | -                           | 87  | 5 088 | 4 228  | 860           |                      |
| Other industries- average | 91 922      | 0.0086 (4)                  | 13  | 790   | 0      | 790           | 20                   |
| TOTAL                     | 123 346     |                             | 100 | 5 878 | 4 228  | 1 650         |                      |

Source: Comisión Nacional del Agua, with information from REPDA, "Red de agua y auditorías técnicas".

### ***Types of industrial water use***

As shown in Table 18.2, the sugar production industry is the largest industrial abstractor in Mexico (37 per cent), followed by the chemical (17 per cent) and oil and petrochemical industries (12 per cent). The highest consumption rate is found in the pulp and paper industry (45 per cent), followed by the food and beverage and the steel and iron industries.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

The *Comisión Nacional del Agua* is responsible for price regulation through price controls which are revised annually. Adjustments take place every three to six months to reflect changes in the inflation index, but not in the exchange rate. There are four tariff groups: industrial, hydro-electric, urban, and

agricultural users. The first three groups subsidise agricultural users, who do not pay for water. The tariff structure is not designed to reflect incremental (marginal) costs.

The majority of tariffs of the operating bodies have increasing-block structures (74 per cent), while 26 per cent have a decreasing-block tariff structure. The block structure is not homogeneous and varies from one operating body to another. Tariffs are currently not sufficient to cover the operating and investment costs of the operating bodies. This is partly due to the low return rate of payments by water users, despite the fact that the national water regulation law (*Ley de Aguas Nacionales*) allows companies to disconnect non-paying customers.

### ***Sewerage and trade effluent charges***

No price information was available for this study on sewerage and effluent charges. However, the general tendency in Mexico is to include charges for wastewater treatment costs in all new projects.

### ***Abstraction and discharge charges***

The 1997 *Federal Water Law* introduced an abstraction charge for both surface and groundwaters. This charge varies depending on the region in which the abstraction is located, and on the type of water use (Art. 223). Zones of “water availability” (*zona de disponibilidad*) are defined at the sub-state level; zone 1 groups representing the driest areas in the country (where charges need to be highest), and zone 9 includes the areas where water resources are most abundant (Table 18.3).

The same law also introduced a discharge charge as well, which applies to discharges which do not fall within discharge standards set for each category of pollutant. This charge varies according to the type of receiving body and the type of pollutant (Art. 278). By December 1999 at the latest (or earlier for the largest polluters), polluters will have to present an action plan to reduce their discharges down to allowable levels.

### **Price levels and trends**

#### ***Water from public supply system***

Water and sewerage tariffs for 273 operating bodies are presented in Table 18.4. Price structures for industrial users in Mexico City and in the capital cities of the various states are shown in Table 18.5. For industrial users, 1995 prices varied between 0.30 pesos per m<sup>3</sup> for small industrial users in Zacapu, Michoacan, up to 25.91 pesos per m<sup>3</sup> for large industrial users in Taxco, Guerrero. Prices for domestic users were between 0.15 and 26.75 pesos per m<sup>3</sup>.

#### ***Sewerage and trade effluent charges***

Sewerage prices are indicated in Table 18.4.

**Direct abstraction or self-treatment**

Abstraction charges are levied as shown in Table 18.3, for the zones of water availability described above.

**Table 18.3. Abstraction Charges (1998)**

| Area   | Public Supply*         | Industrial use**  | Power stations         | Aquaculture            | Resorts                |
|--------|------------------------|-------------------|------------------------|------------------------|------------------------|
| Unit   | \$/1000 m <sup>3</sup> | \$/m <sup>3</sup> | \$/1000 m <sup>3</sup> | \$/1000 m <sup>3</sup> | \$/1000 m <sup>3</sup> |
| Zone 1 | 170.32                 | 9.3273            | 1.9611                 | 1.5234                 | 5.3057                 |
| Zone 2 | 170.32                 | 7.4617            | 1.9611                 | 1.5234                 | 5.3057                 |
| Zone 3 | 170.32                 | 6.2181            | 1.9611                 | 1.5234                 | 5.3057                 |
| Zone 4 | 170.32                 | 5.1300            | 1.9611                 | 1.5234                 | 5.3057                 |
| Zone 5 | 170.32                 | 4.0418            | 1.9611                 | 1.5234                 | 5.3057                 |
| Zone 6 | 170.32                 | 3.6530            | 1.9611                 | 1.5234                 | 5.3057                 |
| Zone 7 | 79.34                  | 2.7498            | 1.9611                 | 0.7505                 | 2.6142                 |
| Zone 8 | 39.65                  | 0.9773            | 1.9611                 | 0.3534                 | 1.2311                 |
| Zone 9 | 19.77                  | 0.7326            | 1.9611                 | 0.1680                 | 0.5855                 |

*Note:* For industrial use, the unit is: Mexican peso per cubic meter (\$/m<sup>3</sup>). The unit for the other categories is Mexican peso per 1,000 cubic meter (\$/1000 m<sup>3</sup>).

\* Public supply refers to companies under a public concession supplying water to metered domestic customers.

\*\* Refers to tariffs for industrial users who directly abstract water.

*Source:* Ley Federal de Derecho de Agua para 1998, 2 semestre.

**Table 18.4. Minimum and Maximum Tariffs by Types of Users (1995) in a Sample of 273 Municipios (m<sup>3</sup> and Pesos)**

| Municipality               | Minimum Range |      | Maximum Range |       |
|----------------------------|---------------|------|---------------|-------|
|                            | Range         | Cost | Range         | Cost  |
| <b>AGUASCALIENTES</b>      |               |      |               |       |
| AGUASCALIENTES             | 0 - 40        | 3.45 | <3000         | 6.12  |
| <b>BAJA CALIFORNIA</b>     |               |      |               |       |
| CD. MORELOS                | 0 - 5         | 0.64 | 05 - 20       | 3.71  |
| ENSENADA                   | 0 - 5         | 3.29 | 05 - 10       | 7.77  |
| GUADALUPE VICTORIA         | 0 - 5         | 0.64 | 05 - 20       | 3.71  |
| MEXICALI                   | 0 - 5         | 2.48 | <10,000       | 4.95  |
| TECATE                     | 0 - 5         | 3.98 | 05 - 30       | 10.21 |
| TIJUANA                    | 0 - 5         | 7.6  | <1000         | 7.95  |
| SAN FELIPE                 | 05 - 20       | 1.19 | 60 - 100      | 3.9   |
| <b>BAJA CALIFORNIA SUR</b> |               |      |               |       |
| CD. CONSTITUCIÓN           | 0 - 100       | 1.93 | <500          | 4.12  |
| PAZ, LA                    | 0 - 100       | 2.17 | <500          | 5.36  |
| LORETO                     | 0 - 100       | 1.02 | <500          | 3.04  |
| LOS CABOS                  | 0 - 100       | 2.27 | <1000         | 3.86  |
| SANTA ROSALÍA              | 100 - 125     | 1.15 | <500          | 3.46  |
| <b>CAMPECHE</b>            |               |      |               |       |
| CD. DEL CÁRMEN             | 0 - 30        | 1.23 | <210          | 2.5   |
| <b>COAHUILA</b>            |               |      |               |       |
| ALLENDE                    | 0 - 15        | 1.49 | <200          | 3.08  |
| CANDELA                    | 0 - 10        | 1.12 | <200          | 2.72  |
| CASTAÑOS                   | 0 - 25        | 2.11 | <200          | 3.48  |
| CUATRO CIÉNEGAS            | 11 - 15       | 1.42 | <200          | 2.94  |
| FRANCISCO I. MADERO        | 0 - 10        | 1.34 | <200          | 2.92  |
| MATAMOROS                  | 0 - 30        | 2.62 | <200          | 4.66  |
| MONCLOVA-FRONTIERA         | 0 - 50        | 2.1  | <200          | 3.39  |
| PARRAS DE LA FUENTE        | 0 - 14        | 0.77 | 0 - 101       | 3.01  |
| PIEDRAS NEGRAS             | 0 - 15        | 1.66 | <200          | 5.45  |
| RAMOS ARISPE               | 0 - 10        | 0.99 | <200          | 2.2   |
| SABINAS-MUZQUIZ-SN.        | 0 - 10        | 1.4  | <200          | 3.59  |
| JUÁN DE S.(CARB.)          |               |      |               |       |
| SABINAS                    | 0 - 10        | 1.72 | <200          | 3.5   |
| SALTILLO                   | 0 - 10        | 1.53 | <200          | 4.59  |
| SAN BUENAVENTURA           | 0 - 10        | 1.6  | <200          | 4.56  |
| SAN PEDRO DE LAS COLONIAS  | 0 - 10        | 1.25 | <200          | 2.68  |
| TORREÓN                    | 0 - 10        | 1.18 | <200          | 3.79  |
| VIESCA                     | 0 - 30        | 2.62 | <200          | 4.66  |
| <b>COLIMA</b>              |               |      |               |       |
| COLIMA-VILLA DE            | 0 - 30        | 1.03 | <100          | 1.95  |
| ALVAREZ                    |               |      |               |       |
| MANZANILLO                 | 0 - 30        | 2.29 | <800          | 7.89  |
| <b>CHIAPAS</b>             |               |      |               |       |
| CINTALAPA                  | 0 - 20        | 0.63 | <150          | 1.05  |
| CHIAPA DE CORZO            | 0 - 10        | 0.86 | 11 - 20       | 1.2   |
| HUIXTLA                    | 0 - 30        | 0.78 | <100          | 7.56  |
| PALENQUE                   | 16 - 30       | 2    | <61           | 3.5   |
| TAPACHULA                  | 0 - 50        | 1.08 | <350          | 1.9   |

| Municipality             | Minimum Range |      | Maximum Range |       |
|--------------------------|---------------|------|---------------|-------|
|                          | Range         | Cost | Range         | Cost  |
| TUXTLA GUTIÉRREZ         | 16 - 40       | 1.85 | <250          | 3.05  |
| YAJALÓN                  | 0 - 15        | 0.5  | <50           | 0.54  |
| <b>CHIHUAHUA</b>         |               |      |               |       |
| CHIHUAHUA                | 0 - 20        | 1.07 | <500          | 4.11  |
| CD. DELICIAS             | 0 - 10        | 1.29 | <101          | 1.34  |
| <b>DISTRITO FEDERAL</b>  |               |      |               |       |
| DISTRITO FEDERAL         | 0 - 30        | 1.5  | <960          | 7.15  |
| <b>DURANGO</b>           |               |      |               |       |
| GÓMEZ PALACIO            | 11 - 15       | 0.49 | <90           | 3.16  |
| LERDO                    | 0 - 30        | 2.2  | <50           | 2.53  |
| TLAHUALILO               | 0 - 30        | 5.28 | <200          | 9     |
| SANTIAGO PAPASQUIARO     | 0 - 10        | 3.29 | 11 - 30       | 3.9   |
| VICENTE GUERRERO         | 0 - 15        | 0.48 | 16 - 25       | 2.52  |
| VILLA UNIÓN              |               |      |               |       |
| <b>GUANAJUATO</b>        |               |      |               |       |
| ACÁMBARO                 |               |      |               |       |
| APASEO EL ALTO           | 0 - 20        | 1.1  | <40           | 1.6   |
| APASEO EL GRANDE         | 0 - 14        | 2.07 | <15           | 2.1   |
| CELAYA                   | 0 - 50        | 2.2  | <50           | 2.75  |
| CD. MANUEL DOBLADO       | 0 - 14        | 3.08 | <240          | 4.82  |
| GUANAJUATO               |               |      |               |       |
| MOROLEÓN                 | 0 - 13        | 2.69 | <100          | 3     |
| SAN DIEGO DE LA UNIÓN    |               |      |               |       |
| SAN FELIPE               | 0 - 10        | 2    | <90           | 7     |
| SAN FRANCISCO DEL RINCÓN | 14 - 26       | 1    | <300          | 2     |
| SAN JOSÉ ITURBIDE        |               |      |               |       |
| SAN LUIS DE LA PAZ       |               |      |               |       |
| SILAO                    | 0 - 20        | 1.75 | <300          | 3.52  |
| PURÍSIMA DE BUSTOS       | 0 - 26        | 1    | <300          | 2.21  |
| TARIMORO                 |               |      |               |       |
| VALLE DE SANTIAGO        | 0 - 26        | 1.33 | <300          | 1.8   |
| <b>GUERRERO</b>          |               |      |               |       |
| ACAPULCO                 | 0 - 10        | 3.51 | <2,500        | 9.3   |
| ARCELIA                  | 0 - 15        | 1.32 | <5000         |       |
| ATOYAC DE ALVAREZ        | 0 - 15        | 0.97 | <5000         | 5.44  |
| AZOYU                    | 0 - 15        | 0.98 | <5000         | 4.53  |
| BUENAVISTA DE CUELLAR    | 16 - 30       | 3.91 | <5000         | 9.85  |
| CD. ALTAMIRANO           | 0 - 15        | 2.52 | <5000         | 8.84  |
| COYUCA DE BENITEZ        | 0 - 15        | 1.13 | <5000         | 5.73  |
| COYUCA DE CATALÁN        | 0 - 15        | 1.36 | <5000         | 6.01  |
| CUAJINICUILAPA           | 0 - 15        | 1.24 | <5000         | 5.2   |
| CHILPANCINGO             |               |      |               |       |
| TLACOTEPEC               | 0 - 15        | 1.29 | <5000         | 6.55  |
| HUITZUCO                 | 0 - 15        | 1.63 | <5000         | 8.92  |
| IGUALA                   | 0 - 15        | 4.99 | <5000         | 9.63  |
| IXTAPA-ZIHUATANEJO       | 0 - 15        | 3.05 | <5000         | 5.21  |
| OMETEPEC                 | 0 - 15        | 0.85 | <5000         | 4.91  |
| PETATLÁN                 | 0 - 15        | 1.45 | <5000         | 6.53  |
| QUECHULTENANGO           | 0 - 15        | 0.57 | <5000         | 5.11  |
| SAN LUIS ACATLÁN         | 0 - 15        | 1.28 | <5000         | 5.35  |
| SAN MARCOS               | 0 - 15        | 0.69 | <5000         | 4.25  |
| TAXCO                    | 0 - 15        | 4.81 | <5000         | 25.91 |
| TECPAN DE GALEANA        | 0 - 15        | 1.03 | <5000         | 5.23  |

| Municipality                   | Minimum Range |      | Maximum Range |       |
|--------------------------------|---------------|------|---------------|-------|
|                                | Range         | Cost | Range         | Cost  |
| TEOLOAPAN                      | 0 - 15        | 1.63 | <5000         | 8.42  |
| TIXTLA DE GUERRERO             | 0 - 15        | 1.32 | <5000         | 5.73  |
| TLAPA DE COMONFORT             | 0 - 15        | 1.1  | <5000         | 5.86  |
| ZIRÁNDARO                      | 0 - 15        | 1.01 | <5000         | 5.38  |
| <b>HIDALGO</b>                 |               |      |               |       |
| ACTOPAN                        | 0 - 50        | 1.5  | <250          | 2.25  |
| PACHUCA                        | 0 - 50        | 1.02 | <250          | 1.97  |
| TULANCINGO                     | 0 - 50        | 1.35 | <250          | 2.64  |
| VALLE DE MEZQUITAL             |               |      |               |       |
| <b>JALISCO</b>                 |               |      |               |       |
| CD. GUZMÁN                     |               |      |               |       |
| GUADALAJARA                    | 0 - 19        | 2.08 | <50 000       | 21.35 |
| LAGOS DE MORENO                |               |      |               |       |
| OCOTLAN                        |               |      |               |       |
| PUERTO VALLARTA                | 0 - 30        | 2.5  | <1 500        | 5.65  |
| <b>MEXICO</b>                  |               |      |               |       |
| GRUPO A (METROPOLITAN AREA)    | 0 - 25        | 1.23 | <480          | 6.38  |
| GRUPO B                        | 0 - 25        | 1.01 | <480          | 5.15  |
| <b>MICHOACAN</b>               |               |      |               |       |
| CUITZEO                        | 0 - 15        | 0.87 | <90           | 1.15  |
| HUANDACAREO                    |               |      |               |       |
| LA HUACANA                     |               |      |               |       |
| LAZARO CÁRDENAS                | 0 - 15        | 0.87 | <75           | 1.15  |
| MORELIA                        | 0 - 1000      | 3.5  | 0 - 1000      | 3.5   |
| PÁTZCUARO                      | 0 - 15        | 1.28 | <16           | 6.53  |
| PURÉPERO                       | 0 - 15        | 1.4  | 15 - 30       | 1.82  |
| TLALPUJAHUA                    | 0 - 15        | 0.7  | 30 - 45       | 1.13  |
| URUAPAN                        | 0 - 15        | 0.87 | <75           | 1.15  |
| ZACAPU                         | 0 - 20        | 0.3  | <75           | 0.47  |
| ZITACUARO                      | 15 - 30       | 1.35 | <75           | 1.45  |
| <b>NAYARIT</b>                 |               |      |               |       |
| LAS VARAS                      | 0 - 10        | 1.3  | 11 - 30       | 3.6   |
| SANTIAGO IXCUINTLA             | 0 - 10        | 3    | <100          | 4.8   |
| SAN JUAN DE ABAJO              | 0 - 10        | 0.4  | <10           | 0.4   |
| SANTA MA. DEL ORO              |               |      |               |       |
| VILLA HIDALGO                  | 0 - 15        | 2.06 | <15           | 3     |
| TEPIC                          | 0 - 19        | 1.84 | <50 000       | 18.95 |
| <b>NUEVO LEON</b>              |               |      |               |       |
| MONTERREY Y AREA METROPOLITANA | 0 - 25        | 1.99 | 100 - 199     | 7.32  |
| <b>OAXACA</b>                  |               |      |               |       |
| CIUDAD IXTEPEC                 | 0 - 15        | 3    | <400          | 3.9   |
| EL ESPINAL                     | 0 - 15        | 3    | <400          | 3.9   |
| HUAJUAPAN DE LEÓN              | 0 - 15        | 3    | <400          | 3.9   |
| JUCHITÁN DE ZARAGOZA           | 0 - 15        | 3    | <400          | 3.9   |
| MATIAS ROMERO                  | 0 - 15        | 3    | <400          | 3.9   |
| OAXACA DE JUÁREZ               |               |      |               |       |
| PUERTO ANGEL                   | 16 - 200      | 3    | <400          | 4.5   |
| PUERTO ESCONDIDO               | 0 - 15        | 4.2  | <400          | 5.46  |
| SALINA CRUZ                    | 0 - 15        | 3    | <400          | 3.9   |

| Municipality           |            |     | Minimum Range |      | Maximum Range |       |
|------------------------|------------|-----|---------------|------|---------------|-------|
|                        |            |     | Range         | Cost | Range         | Cost  |
| SANTA MA.              | ASUNCIÓN   |     | 0 - 10        | 0.7  | 11 - 20       | 1     |
| TLAXIACO               |            |     |               |      |               |       |
| SANTIAGO               | PINOTEPA   |     | 0 - 15        | 6    | <400          | 7.8   |
| NACIONAL               |            |     |               |      |               |       |
| ST                     | DOMINGO    |     | 0 - 15        | 3    | <400          | 3.9   |
| TEHUANTEPEC            |            |     |               |      |               |       |
| TAMAZULAPAN            | DEL        |     | 0 - 10        | 1.2  | <50           | 1.6   |
| PROGRESO               |            |     |               |      |               |       |
| <b>PUEBLA</b>          |            |     |               |      |               |       |
| ACATZINGO DE HIDALGO   |            |     |               |      |               |       |
| AMOZOC                 | SISTEMA LA |     | 0 - 12        | 1.58 | <50           | 3     |
| MALINCHE               |            |     |               |      |               |       |
| SAN MARTÍN             | TEXMELUCAN |     | 0 - 15        | 3    | <240          | 6     |
| CHOLULA                |            |     |               |      |               |       |
| PUEBLA                 |            |     | 0 - 120       | 1.45 | <120          | 3.28  |
| TEPEACA                |            |     | 0 - 20        | 1.72 | <500          | 3.45  |
| ZACATLÁN               |            |     | 0 - 50        | 1.84 | <50           | 4.03  |
| <b>QUERETARO</b>       |            |     |               |      |               |       |
| AMEALCO                |            |     | 0 - 100       | 3.05 | 0 - 3000      | 6.42  |
| ARROYO SECO            |            |     | 0 - 100       | 1.79 | 0 - 3000      | 5.36  |
| CADEREYTA              |            |     | 0 - 100       | 2.12 | 0 - 3000      | 6.04  |
| COLÓN                  |            |     | 0 - 100       | 0.95 | <3000         | 4.92  |
| CORREGIDORA            |            |     | 0 - 100       | 1.74 | 0 - 3000      | 4.96  |
| E. MONTES              |            |     | 0 - 100       | 1.7  | 0 - 3000      | 5.59  |
| HUIMILPAN              |            |     | 0 - 100       | 1.64 | <3000         | 4.92  |
| JALPAN                 |            |     | 0 - 100       | 1.79 | 0 - 3000      | 5.36  |
| L. MATAMOROS           |            |     | 0 - 150       | 1.65 | 0 - 3000      | 5.04  |
| EL MARQUÉS             |            |     | 0 - 100       | 1.7  | 0 - 3000      | 6.62  |
| P. ESCOBEDO            |            |     | 0 - 100       | 1.3  | 0 - 3000      | 5.7   |
| PEÑAMILLER             |            |     | 0 - 100       | 0.95 | <3000         | 4.92  |
| QUERÉTARO              |            |     | 0 - 100       | 2.86 | 301 - 3000    | 15.68 |
| SAN JOAQUÍN            |            |     | 0 - 100       | 2.12 | 0 - 3000      | 6.04  |
| SAN JUÁN DEL RÍO       |            |     | 0 - 100       | 1.48 | 0 - 3000      | 8.66  |
| SANTA ROSA JAUREGUIO   |            |     | 0 - 100       | 1.7  | 0 - 3000      | 6.62  |
| TEQUISQUIAPAN          |            |     | 0 - 100       | 1.51 | 0 - 3000      | 10.52 |
| TOLIMÁN                |            |     | 0 - 100       | 0.95 | <3000         | 4.92  |
| <b>QUINTANA ROO</b>    |            |     |               |      |               |       |
| TODO EL ESTADO         |            |     | 0 - 10        | 1.34 | <1000         | 23.33 |
| <b>SAN LUIS POTOSI</b> |            |     |               |      |               |       |
| AHUALULCO              |            |     | 10 - 20       | 1.87 | <100          | 4.4   |
| ARMADILLO              | DE         | LOS | 10 - 20       | 1.7  | <100          | 4     |
| INFANTE                |            |     |               |      |               |       |
| CÁRDENAS               |            |     | 10 - 20       | 1.7  | <100          | 4     |
| CERRITOS               |            |     | 10 - 20       | 1.7  | <100          | 4     |
| CD. DEL MAÍZ           |            |     | 10 - 20       | 1.7  | <100          | 4     |
| CD. FERNÁNDEZ          |            |     | 10 - 20       | 1.7  | <100          | 4     |
| CD. VALLES             |            |     | 10 - 20       | 1.7  | <100          | 4     |
| EBANO                  |            |     | 10 - 20       | 1.7  | <100          | 4     |
| MATEHUALA              |            |     | 10 - 20       | 1.87 | <100          | 4.4   |
| MATLAPA                |            |     | 10 - 20       | 1.7  | <100          | 4     |
| <b>SAN LUIS POTOSI</b> |            |     |               |      |               |       |
| RAYÓN                  |            |     | 10 - 20       | 1.7  | <100          | 4     |
| RIO VERDE              |            |     | 10 - 20       | 1.7  | <100          | 4     |
| SAN ANTONIO            |            |     | 10 - 20       | 1.87 | <100          | 4.4   |

| Municipality                | Minimum Range |      | Maximum Range |      |
|-----------------------------|---------------|------|---------------|------|
|                             | Range         | Cost | Range         | Cost |
| SAN CIRO DE ACOSTA          | 10 -20        | 1.7  | <100          | 4    |
| SANTA MA. DEL RÍO           | 10 -20        | 1.5  | <100          | 2    |
| SAN LUIS POTOSI             | 0 - 10        | 1.86 | <250          | 4    |
| SOLEDAD DE GRACIANO SÁNCHEZ | 10 -20        | 1.7  | <100          | 4    |
| VILLA HIDALGO               | 10 -20        | 1.7  | <100          | 4    |
| VILLA DE ZARAGOZA           | 10 -20        | 1.7  | <100          | 4    |

**Table 18.5. Tariff structures for industrial users in the Federal District and state capitals**  
**Consumption range (m<sup>3</sup> 1995)**

| Locality         | 10     | 20     | 30     | 40     | 50     | 100    | 200      | 300      | 400      | 500      | 750       | 1000      | 1500      | 3000      | 5000      | 7500   | 10000  | 15000   | 20000   |
|------------------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|--------|--------|---------|---------|
| Aguascalientes   | 138.00 | 138.00 | 138.00 | 138.00 | 216.50 | 781.00 | 2 812.00 | 4 218.00 | 5 624.00 | 7 030.00 | 10 545.00 | 14 060.00 | 21 090.00 | 42 180.00 | 30 600.00 |        |        |         |         |
| Mexicali         | 43.39  | 80.59  | 117.79 | 154.99 | 198.49 | 415.99 | 802.99   | 1 189.99 | 1 573.99 | 1 963.99 | 2 926.49  | 3 888.99  | 5 813.99  | 11 588.99 | 19 288.99 | 28 914 | 38 539 |         |         |
| Paz<br>, la      | 21.70  | 43.40  | 65.10  | 86.80  | 108.50 | 217.00 | 770.00   | 1 380.00 | 1 840.00 | 2 300.00 | 4 020.00  | 5 360.00  |           |           |           |        |        |         |         |
| Saltillo         | 15.32  | 31.82  | 50.87  | 73.22  | 98.32  | 252.52 | 659.52   | 1 118.52 |          |          |           |           |           |           |           |        |        |         |         |
| Colima           | 30.90  | 30.90  | 30.90  | 46.00  | 62.50  | 160.00 | 390.00   | 585.00   |          |          |           |           |           |           |           |        |        |         |         |
| Tuxtla gutierrez | 31.80  | 41.05  | 59.55  | 78.05  | 98.05  | 204.05 | 456.55   | 746.55   | 1 051.55 | 1 356.55 |           |           |           |           |           |        |        |         |         |
| Chihuahua        | 32.05  | 32.05  | 32.05  | 56.85  | 81.14  | 185.86 | 537.05   | 900.05   | 1 263.05 | 1 633.63 |           |           |           |           |           |        |        |         |         |
| Distrito federal | 15.00  | 30.00  | 45.00  | 102.00 | 127.50 | 295.00 | 770.00   | 1 350.00 | 1 800.00 | 2 675.00 | 4 687.50  | 7 150.00  | 10 725.00 | 21 450.00 | 35 750.00 | 53 625 | 71 500 | 107 250 | 143 000 |
| Chilpancingo     | 20.00  | 44.00  | 74.00  | 110.00 | 153.20 | 539.00 | 1 837.00 | 3 385.00 | 5 243.00 | 7 472.00 | 14 159.50 | 20 847.00 |           |           |           |        |        |         |         |
| Pachuca          | 51.11  | 51.11  | 51.11  | 51.11  | 51.11  | 128.61 | 283.61   | 459.61   | 656.61   | 853.61   | 1 346.11  | 1 838.61  |           |           |           |        |        |         |         |
| Guadalajara      | 39.45  | 41.55  | 62.55  | 83.55  | 116.55 | 299.55 | 624.55   | 1 094.55 | 1 709.55 | 2 324.55 | 3 749.55  | 5 549.55  | 10 049.55 | 23 274.55 | 40 174.55 | 62 174 | 84 174 | 129 174 | 175 174 |
| Toluca           | 10.10  | 20.20  | 43.80  | 58.40  | 73.00  | 246.00 | 896.00   | 1 344.00 | 1 792.00 | 2 575.00 | 3 862.50  | 5 150.00  | 7 725.00  | 15 450.00 |           |        |        |         |         |
| Morelia          | 35.00  | 70.00  | 105.00 | 140.00 | 175.00 | 350.00 | 700.00   | 1 050.00 | 1 400.00 | 1 750.00 | 2 625.00  | 3 500.00  |           |           |           |        |        |         |         |
| Tepic            | 35.00  | 36.85  | 55.35  | 73.85  | 103.35 | 266.85 | 556.85   | 974.35   | 1 519.35 | 2 064.35 | 3 326.85  | 4 926.85  | 8 926.85  | 20 676.85 | 35 676.85 | 55 176 | 74 676 | 115 176 | 155 676 |
| Monterrey        | 19.90  | 39.80  | 68.25  | 105.25 | 147.50 | 405.00 | 1 132.00 | 1 698.00 | 2 264.00 | 2 830.00 | 4 245.00  | 5 660.00  | 8 490.00  | 16 980.00 |           |        |        |         |         |
| Oaxaca           | 6.40   | 12.80  | 19.20  | 25.60  | 47.50  | 126.00 | 252.00   | 474.00   | 632.00   | 950.00   | 1 425.00  | 1 900.00  |           |           |           |        |        |         |         |
| Puebla           | 20.50  | 35.00  | 49.50  | 64.00  | 78.00  | 151.00 | 268.40   | 596.40   | 924.40   | 1 252.40 | 2 072.40  | 2 890.40  | 4 532.40  |           |           |        |        |         |         |
| Queretaro        | 286.01 | 286.01 | 286.01 | 286.01 | 286.01 | 286.01 | 1 088.01 | 2 299.01 | 3 867.01 | 5 435.01 | 9 355.01  | 13 275.01 | 21 115.01 | 44 635.01 | 54 475.01 |        |        |         |         |
| Chetumal         | 13.40  | 56.57  | 83.17  | 109.77 | 136.37 | 410.16 | 1 137.51 | 1 374.05 | 2 324.05 | 3 274.05 | 9 446.75  | 14 914.25 | 26 644.63 |           |           |        |        |         |         |
| San luis potosi  | 18.60  | 37.20  | 55.80  | 74.40  | 93.00  | 186.00 | 399.00   | 744.00   | 1 144.00 | 1 544.00 |           |           |           |           |           |        |        |         |         |
| Culiacan         | 50.87  | 50.87  | 61.57  | 82.97  | 104.37 | 219.37 | 472.37   | 741.37   | 1 026.37 | 1 319.37 | 2 097.87  | 2 910.37  | 4 615.37  | 10 115.37 | 17 875.37 |        |        |         |         |
| Hermosillo       | 22.00  | 44.00  | 66.00  | 88.00  | 110.00 | 220.00 | 517.00   | 814.00   | 1 111.00 | 1 408.00 |           |           |           |           |           |        |        |         |         |
| Villahermosa     | 120.54 | 120.54 | 120.54 | 120.54 | 120.54 | 152.94 | 327.94   | 515.94   | 703.94   | 896.74   | 1 426.74  |           |           |           |           |        |        |         |         |
| Cd. Victoria     | 51.42  | 51.42  | 51.42  | 75.52  | 99.62  | 225.82 | 524.32   | 854.32   | 1 205.32 | 1 556.32 |           |           |           |           |           |        |        |         |         |
| Jalapa           | 12.33  | 25.80  | 39.60  | 54.40  | 72.00  | 165.00 | 414.00   | 702.00   | 936.00   | 1 170.00 |           |           |           |           |           |        |        |         |         |
| Zacatecas        | 20.00  | 46.00  | 84.00  | 112.00 | 140.00 | 350.00 | 880.00   | 1 590.00 | 2 120.00 | 2 650.00 | 4 725.00  | 6 300.00  | 9 450.00  | 22 200.00 | 42 500.00 | 72 000 |        |         |         |

## REFERENCES

COMISIÓN NACIONAL DEL AGUA. Communication with Dr Gustavo Pazsoldan.

LEY FEDERAL DE DERECHO DE AGUA (1997).

## NETHERLANDS

### Context for industrial water uses

#### *Institutional arrangements*

Responsibilities for the management of water resources are divided between the government, the 12 Provinces, and approximately 23 water boards.<sup>33</sup> The water boards (*waterschappen*) are among the oldest forms of administration in the Netherlands, having come into existence in the Middle Ages to manage the continual threat of flooding created by surface waters.

The granting of abstraction and discharge permits (and the upholding of their conditions) takes place at various levels of government, as shown in Table 19.1.

**Table 19.1 Division of Responsibility Between Government Levels**

| Act                         | Activity                                    | Specification                                              | Authority                                                                            |
|-----------------------------|---------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Water Management Act        | Surface water abstraction                   | State waters<br>Other waters                               | Central government<br>Province/Regional water board<br>Province                      |
| Groundwater Act             | Groundwater abstraction and infiltration    |                                                            |                                                                                      |
| Surface Water Pollution Act | Direct discharges                           | State waters<br>Other waters                               | Central government<br>Province/Regional water board<br>Province/Regional water board |
|                             | Indirect discharges through sewerage system | Specific industrial sectors<br>Other industrial discharges | Municipalities                                                                       |

Source: VEWIN.

Water supply services are managed separately from wastewater services (as in Germany). Water supply services are the municipalities' responsibility, which can run the services themselves (as non-profit companies), or can delegate the management to private companies. Private companies operate in several municipalities (*Waterleidingbedrijven*). Water supply companies belong to VEWIN, the Netherlands Water Works Association, which takes part in the development of the national water policy. Although there are 647 municipalities, there were only 36 water distribution companies in 1997, down from around 100 in the 1970s, as a result of a large consolidation.

33. In addition to "all-in" water-boards, other boards exist for the purification of water, and for water quantity or flood protection, making a total of 66 boards (down from 129 in 1990).

Wastewater services are managed by the *waterschappen*, which collect wastewater from municipalities and individual users, and run their own wastewater works. These bodies have nearly become local authorities in their own right. There are approximately 500 wastewater treatment plants in the Netherlands.

### ***Relative importance of industrial water use***

About 1 300 million m<sup>3</sup> of water was drawn from the mains in 1990. As shown in Table 19.2, water use by industrial users accounted for a mere 18 per cent of this. According to VEWIN's projections, total water use in the Netherlands should increase in the future, with the largest increases affecting the small business sector. Conversely, water use by large industrial users was expected to decline up to the year 2000.

**Table 19.2. Water Consumption by Type of Users (Million m<sup>3</sup>)**

| User categories                                    | Yearly consumption |      | Projections |      |
|----------------------------------------------------|--------------------|------|-------------|------|
|                                                    | 1990               |      | 2000        |      |
| Paid-for consumption                               |                    |      |             |      |
| up to 300 m3 per connection (households)           | 713                | 58%  | 845         | 59%  |
| 300 to 10 000 m3 per connection (small businesses) | 237                | 19%  | 333         | 23%  |
| 10 000 m3 and more per connection (industrial)     | 217                | 18%  | 154         | 11%  |
| Non-paid-for consumption                           | 70                 | 6%   | 91          | 6%   |
| Total                                              | 1 237              | 100% | 1 423       | 100% |

Source: VEWIN and VROM.

### ***Water sources for industry***

Water in the public supply system is mainly drawn from groundwater sources (62 per cent). The industrial sector directly abstracts 33 per cent of its needs (442 million m<sup>3</sup> per year) and takes the other 67 per cent from the public supply system. About two-thirds of these direct abstractions are drawn from groundwater sources. Surface waters are mainly drawn from the Rhine and Meuse rivers (which contribute 80 per cent of fresh water resources of the Netherlands).

In addition to drinking water, water of other degrees of quality is also distributed on a limited scale by the water companies, such as non- and semi-filtered water, and distilled and demineralised surface water. In 1995, seven water supply companies distributed 62.3 million m<sup>3</sup> of this "other water", mostly to industrial users which did not require drinking water quality standard.

### ***Types of industrial water uses***

The chemical and petroleum industries were the largest industrial water users, accounting for about 80 per cent of total industrial water uses in 1986. They were followed by the metal industry, which accounted for 8.5 per cent of total industrial water uses.

**Table 19.3. Water Usage Industry (By Category), Mineral Extraction and (electric) Power Stations (Thousand m<sup>3</sup>, 1986)**

|                                                | Public supply  | Ground-water   | Surface Water    |                      | Total Water Usage |
|------------------------------------------------|----------------|----------------|------------------|----------------------|-------------------|
|                                                |                |                | Total            | For cooling purposes |                   |
| <b>Mineral extraction</b>                      | 508            | n/a            | n/a              | n/a                  | n/a               |
| <b>Industry by category</b>                    |                |                |                  |                      |                   |
| Food industry                                  | 34 031         | 119 066        | 132 833          | 127 482              | 285 932           |
| Textile industry                               | 3 149          | 3 693          | 3 750            | 2 935                | 10 591            |
| Leather, rubber industry                       | 2 455          | 12 697         | 3 251            | 3 186                | 18 402            |
| Paper industry                                 | 3 935          | 36 648         | 38 658           | 29 085               | 79 240            |
| Chemical & petroleum industry                  | 85 613         | 57 708         | 3 321 881        | 3 250 436            | 3 465 202         |
| of which petroleum industry                    | 37 092         | 333            | 849 366          | 849 151              | 886 791           |
| Building materials industry                    | 2 679          | 10 709         | 5 905            | 2 240                | 19 292            |
| Metal industry                                 | 55 283         | 70 576         | 242 179          | 203 432              | 368 038           |
| of which basic metals industry                 | 35 574         | 50 606         | 231 690          | 195 645              | 317 870           |
| Other industry                                 | 2 854          | n/a            | n/a              | n/a                  | n/a               |
| <b>Total industry &amp; mineral extraction</b> | <b>190 505</b> | <b>318 482</b> | <b>3 799 655</b> | <b>3 665 831</b>     | <b>4 308 642</b>  |
| (Electric) power stations                      | 2 028          | 1 070          | 9 199 606        | 9 190 170            | 9 202 702         |

Source: Finance Ministry.

## Pricing principles

### *Pricing structure for water from the public supply system*

Water charges are made up of two components: a fixed charge and a variable charge levied on a volumetric basis. Both the fixed charge and the volumetric charge vary with the level of consumption (proxied by the size of meter in the case of the fixed charge). A connection charge is also levied. Large consumers may also pay an “operating hours” charge, whereby the longer the operating time, the lower the charge rate.

Each water company designs its own tariff structures, and charges for large users are usually different from those for domestic users.

Water tariffs also include two groundwater taxes, as described below.

### *Sewerage and trade effluent charges*

Standard wastewater service charges are levied by the water boards as a tax on land owners and all other users (including industrial users). Charge levels are determined on the basis of full-cost recovery principles, within limits fixed at the national level (subsidies are very rare). Municipalities can also impose a sewerage levy for those using the public sewerage system.

For wastewater treatment services, industrial water users (as well as other users) must also pay a pollution charge which is proportional to the quantity of pollution discharged. Charges are based on estimates, and only very large industrial plants (or in controversial cases) are actually metered. For other services, the wastewater charge is based on the value of the property. Bases for the charges are re-evaluated every 5 years.

### **Abstraction charges**

Water abstraction charges for groundwater abstractions were introduced in January 1995. The Provinces levy a charge (*Grondwaterheffing*), in order to contribute towards the costs of research for developing groundwater policy plans. This charge can vary between 1-6 cents per m<sup>3</sup>.

Another tax on groundwater abstraction was introduced by the Finance Ministry (*Grondwaterbelasting*), as part of a general tax reform in the Netherlands.<sup>34</sup> This tax is paid by both water supply companies and other users, including industry and agriculture. However, if surface water is injected into aquifers prior to groundwater abstraction, the abstractors can claim a subsidy, effectively reducing the original abstraction charge. An increase in this groundwater abstraction tax for "other users" to 0.34 guilders per cubic metre is currently being discussed. However, this abstraction tax is only paid by large abstractors (i.e. those consuming more than 100 000 cubic metres a year). This "large user" definition will be gradually modified over the coming years, with the quantity specification being adapted downwards.

### **Discharge charges**

The goal of the 1970 *Surface Water Pollution Act* was to protect surface waters via the regulation of effluent discharges. According to this Act, industrial operations are required to obtain a permit to discharge pollutants, even when the discharge is released into municipal sewers. These permits determine the pollution standards that should be met for discharges. The authority granting the permit varies, depending on the nature of the discharge (Table 19.1).

The Act also introduced effluent charges for discharges to state waters, based on the polluter-pays principle.<sup>35</sup> Initially, charges were introduced to raise funds in order to finance sewage treatment measures. More recently, they have also been used to cover the costs of state water management. The state water effluent charge is set for each year, and needs to be approved by Parliament. It is levied by the *Rijswaterstaat*, an institution under the Ministry of Traffic and Water, which is responsible for the management of the main road and water infrastructure facilities.

The quantity and quality of discharges from standard industrial processes are estimated through a set of coefficients, using input-output models which evaluate the amount of pollutants discharged by a given industry on the basis of the quantity of inputs. The quantity is then converted to "population equivalents", to which a charge rate per "population equivalent" is applied (the charge was 70 guilder per "population equivalent" in 1998). For the largest pollutants (producing more pollution than 1 000 "population equivalents" per day), the actual quality and quantity of the discharge must be measured.

The fee varies according to the region in which the industrial user is located. These regional differences are not based on different environmental conditions or quality objectives, but reflect regional differences in the costs of building and operating the treatment plants.

Charges for heavy metals were also introduced in 1993.

---

34. This reform involves a shift towards lower income taxes and higher consumption and environmental taxes.

35. State waters include the main surface water bodies managed by the government, such as the river Rhine, river Meuse, and Lake IJssel.

## Price levels and trends

### *Water from public supply system*

Data on typical bills for large consumers is included in Table 19.5.

### *Sewerage and trade effluent charges*

A list of wastewater levies collected by the Water Boards is presented in Table 19.6. The state water trade effluent charge is also indicated in this Table. When it was first introduced in 1971, the rate was only 2 guilders per “population equivalent”. By 1997, it had increased to 65 guilders per “population equivalent”, and to 70 guilders in 1998. Trade effluent charges for discharging to provincial waters vary between 65 and 135 guilders per “population equivalent”.

### *Direct abstraction or self-treatment*

Abstraction charges levied by the Provinces vary between 1-6 cents per m<sup>3</sup>. Abstraction charges levied by the central government were determined in the 1995 Act as follows:

**Table 19.4. Abstraction Charges and Rebates - NLG/m<sup>3</sup> (1995)**

| <b>Source</b>                | <b>Water companies</b> | <b>Other users (incl. Industrials)</b> |
|------------------------------|------------------------|----------------------------------------|
| Groundwater abstraction      | 0.34                   | 0.17                                   |
| Infiltration water (subsidy) | 0.285                  | 0.115                                  |

**Table 19.5. Average Prices for Three Types of Consumers (NLG/m<sup>3</sup>) (1997)**

| <b>Water Supply Companies by Province</b>                          | <b>Usage<br/>10 000m<sup>3</sup>/year<br/>Hourly capacity<br/>5m<sup>3</sup>/h</b> | <b>Usage<br/>100 000m<sup>3</sup>/year<br/>Hourly capacity<br/>15m<sup>3</sup>/h</b> | <b>Usage<br/>100 000m<sup>3</sup>/year<br/>Hourly capacity<br/>50m<sup>3</sup>/h</b> |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>GRONINGEN</b>                                                   |                                                                                    |                                                                                      |                                                                                      |
| Gemeentelijk Waterbedrijf Groningen                                | 2.46                                                                               | 2.42                                                                                 | 2.43                                                                                 |
| N.V. Waterleidingmaatschappij voor de Provincie Groningen          | 1.54                                                                               | 1.51                                                                                 | 1.38                                                                                 |
| <b>FRIESLAND</b>                                                   |                                                                                    |                                                                                      |                                                                                      |
| N.V. Waterleiding Friesland                                        | 2.15                                                                               | 1.65                                                                                 | 1.99                                                                                 |
| <b>DRENTHE</b>                                                     |                                                                                    |                                                                                      |                                                                                      |
| N.V. Waterleiding 'Drenthe'                                        | 1.33                                                                               | 1.13                                                                                 | 1.38                                                                                 |
| <b>OVERIJSEL</b>                                                   |                                                                                    |                                                                                      |                                                                                      |
| Waterleiding Maatschappij Overijssel N.V.                          | 1.95                                                                               | 1.81                                                                                 | 1.93                                                                                 |
| <b>FLEVOLAND</b>                                                   |                                                                                    |                                                                                      |                                                                                      |
| N.V. Flevolandse Drinkwater Maatschappij                           | 2.08                                                                               | 2.04                                                                                 | 1.61                                                                                 |
| <b>GELDERLAND</b>                                                  |                                                                                    |                                                                                      |                                                                                      |
| Nuon Zuid-Gelderland (VNB)                                         | 1.61                                                                               | 1.60                                                                                 | 1.60                                                                                 |
| Nuon Zuid-Gelderland (Arnhem)                                      | 1.50                                                                               | 1.49                                                                                 | 1.49                                                                                 |
| Nuon Zuid-Gelderland (Nijmegen)                                    | 1.49                                                                               | 1.48                                                                                 | 1.48                                                                                 |
| N.V. Waterleiding Maatschappij Oosteliji Gelderland                | 2.10                                                                               | 2.19                                                                                 | 2.50                                                                                 |
| N.V. Waterleiding Maatschappij Gelderland                          | 2.09                                                                               | 2.15                                                                                 | 2.48                                                                                 |
| <b>UTRECHT</b>                                                     |                                                                                    |                                                                                      |                                                                                      |
| N.V. Bronwaterleiding 'Doorn' (1996)                               | 2.39                                                                               |                                                                                      |                                                                                      |
| N.V. Waterleidingbedrijf Midden-Nederland                          | 1.64                                                                               | 1.53                                                                                 | 1.64                                                                                 |
| <b>NOORD-HOLLAND</b>                                               |                                                                                    |                                                                                      |                                                                                      |
| Nutsbedrijf Amstelland N.V. (Amstelveen)                           | 2.17                                                                               | 2.15                                                                                 | 2.15                                                                                 |
| Nutsbedrijf Amstelland N.V. (Ouder-Amstel)                         | 1.92                                                                               |                                                                                      |                                                                                      |
| Gemeentewaterleidingen Amsterdam                                   | 2.77                                                                               |                                                                                      | 2.42                                                                                 |
| N.V. PWN Waterleidingsbedrijf Noord-Holland                        | 2.55                                                                               | 1.99                                                                                 | 2.55                                                                                 |
| Waterleidingbedrijf Zuid-Kennemerland N.V.                         | 3.19                                                                               | 3.18                                                                                 | 3.19                                                                                 |
| N.V. Energiebedrijf Zuid-Kennemerland                              | 2.38                                                                               |                                                                                      |                                                                                      |
| <b>ZUID-HOLLAND</b>                                                |                                                                                    |                                                                                      |                                                                                      |
| N.V. Watermaatschappij Zuid-Holland Oost                           | 2.83                                                                               | 2.79                                                                                 | 2.89                                                                                 |
| N.V. Watermaatschappij Zuid-Holland Oost (Vanen)                   | 2.59                                                                               | 2.57                                                                                 | 2.64                                                                                 |
| N.V. Watermaatschappij Zuid-Holland Oost (Alphen a/d Rijn)         | 3.01                                                                               | 2.99                                                                                 | 3.08                                                                                 |
| N.V. Waterbedrijf Europoort (Delft)                                | 2.91                                                                               | 2.59                                                                                 | 2.63                                                                                 |
| N.V. Waterbedrijf Europoort (Dordrecht)                            | 1.99                                                                               | 1.98                                                                                 | 1.99                                                                                 |
| N.V. Waterbedrijf Europoort (Hoeksche waard)                       | 1.99                                                                               | 1.62                                                                                 | 1.89                                                                                 |
| N.V. Waterbedrijf Europoort (Rotterdam e.o.)                       | 2.35                                                                               | 1.94                                                                                 | 1.94                                                                                 |
| N.V. Waterbedrijf Europoort (Schiedam)                             | 2.35                                                                               | 2.34                                                                                 | 2.34                                                                                 |
| N.V. Waterbedrijf Europoort (Vlaardingen en Maassluis)             | 2.31                                                                               | 2.11                                                                                 | 2.11                                                                                 |
| N.V. Waterbedrijf Europoort (Westland)                             | 2.22                                                                               | 2.21                                                                                 | 2.22                                                                                 |
| N.V. Duinwaterbedrijf Zuid-Holland                                 | 3.25                                                                               | 3.24                                                                                 | 3.25                                                                                 |
| <b>ZEELAND</b>                                                     |                                                                                    |                                                                                      |                                                                                      |
| N.V. Delta Nutsbedrijven                                           | 2.26                                                                               | 1.82                                                                                 | 2.43                                                                                 |
| N.V. Delta Nutsbedrijven (Noord-Brabant)                           | 1.63                                                                               | 1.40                                                                                 | 1.62                                                                                 |
| N.V. Waterleiding Maatschappij 'Noord-West Brabant'                | 1.63                                                                               | 1.62                                                                                 | 1.40                                                                                 |
| N.V. Nutsbedrijf Regio Eindhoven                                   | 1.54                                                                               | 1.55                                                                                 | 1.46                                                                                 |
| N.V. Waterleidingmaatschappij Oost-Brabant                         | 1.70                                                                               | 1.49                                                                                 | 1.69                                                                                 |
| N.V. Waterleidingmaatschappij Oost-Brabant (Helmond/Mierlo)        | 1.84                                                                               | 1.62                                                                                 | 1.83                                                                                 |
| N.V. Waterleidingmaatschappij Oost-Brabant ('s-Hertogenbosch e.o.) | 1.59                                                                               | 1.38                                                                                 | 1.52                                                                                 |
| N.V. Tilburgsche Waterleiding Maatschappij                         | 1.21                                                                               | 1.08                                                                                 | 1.09                                                                                 |
| <b>LIMBURG</b>                                                     |                                                                                    |                                                                                      |                                                                                      |
| N.V. Waterleiding Maatschappij Limburg                             | 2.65                                                                               | 2.69                                                                                 | 2.83                                                                                 |
| N.V. Nutsbedrijven Maatsricht                                      | 2.66                                                                               | 2.65                                                                                 | 2.65                                                                                 |

Source: VEWIN.

Table 19.6. Wastewater Levies (1993-1995)

| Province                         | In Guilders per Unit of Pollution |        |        |
|----------------------------------|-----------------------------------|--------|--------|
|                                  | 1993                              | 1995   | 1997   |
| <b>STATE WATER</b>               |                                   |        |        |
| <b>Rijkswateren</b>              |                                   |        |        |
| Freshwater                       | 45.50                             | 60,00  | 65,00  |
| Salt water                       | 44.00                             | 60,00  | 65,00  |
| <b>PROVINCES</b>                 |                                   |        |        |
| <b>Groningen</b>                 |                                   |        |        |
| Provincie Groningen              | 75.00                             | 78,00  | 86,04  |
| <b>Friesland</b>                 |                                   |        |        |
| WS Friesland                     | 78.24                             | 91,80  | 89,04  |
| <b>Drenthe</b>                   |                                   |        |        |
| ZS Drenthe                       | 62.40                             | 71,64  | 73,08  |
| <b>Overijssel</b>                |                                   |        |        |
| ZS West-Overijssel               | 78.60                             | 78,60  | -      |
| WS Regge en Dinkel               | 60.72                             | 81,84  | 84,72  |
| WS Groot-Salland                 |                                   |        | 78,60  |
| <b>Flevoland</b>                 |                                   |        |        |
| Heemraadschap Fleverwaard        | 80.00                             | 92,00  | 104,00 |
| <b>Gelderland</b>                |                                   |        |        |
| ZS Oost-Gelderland               | 52.20                             | 58,80  | -      |
| ZS Veluwe                        | 68.16                             | 66,00  | -      |
| ZS Rivierenland                  | 102.96                            | 105,60 | 107,04 |
| WS Veluwe                        |                                   |        | 75,48  |
| WS Rijn en IJssel                |                                   |        | 69,00  |
| <b>Utrecht</b>                   |                                   |        |        |
| Provincie Utrecht                | 87,96                             | 99,36  | -      |
| HH De Stichtse Rijnlanden        |                                   | 99,36  | 109,68 |
| WS Vallei en Eem                 |                                   |        | 88,80  |
| <b>Noord-Holland</b>             |                                   |        |        |
| HH Uitwaterende sluizen          | 81,00                             | 86,00  | 100,00 |
| ZS Amstel en Gooiland            | 92,10                             | 103,80 | -      |
| Amsterdam                        | 67,00                             | 72,12  | -      |
| HH Amstel, Gooi en Vecht         |                                   |        | 90,00  |
| <b>Zuid-Holland</b>              |                                   |        |        |
| HH Delfland                      | 59,40                             | 72,00  | 83,16  |
| HH Rijnland                      | 85,40                             | 90,00  | 90,00  |
| HH Schieland                     | 82,86                             | 86,04  | 88,00  |
| WS Woerden                       | 72,00                             | -      | -      |
| ZS Hollandse Eilanden en Waarden | 85,80                             | 88,32  | 88,32  |
| <b>Zeeland</b>                   |                                   |        |        |
| WS Het Vrije van Sluis           | 123,00                            | 138,00 | 135,00 |
| WS De Drie Ambachten             | 82,00                             | 86,00  | 86,00  |
| WS Hulster Ambacht               | 113,00                            | 123,00 | 126,00 |
| WS Noord- en Zuid-Beveland       | 102,50                            | 110,00 | -      |
| WS Tholen                        | 86,00                             | 92,00  | -      |
| WS Schouwen Duiveland            | 108,00                            | 108,00 | -      |
| WS Walcheren                     | 85,00                             | 85,00  | -      |
| WS Zeeuwse Eilanden              |                                   |        | 99,00  |

|                                      |               |               |               |
|--------------------------------------|---------------|---------------|---------------|
| <b>Noord-Brabant</b>                 |               |               |               |
| HH West-Brabant                      | 67,00         | 85,00         | 90,00         |
| WS De Dommel                         | 59,88         | 64,08         | 72,00         |
| WS De Aa                             | 49,80         | 60,84         | 66,84         |
| HH Alm en Biesbosch                  | 80,00         | 90,00         | 102,24        |
| WS Maaskant                          | 73,20         | 64,08         | 75,24         |
| Tilburg                              | 48,00         | -             |               |
| <b>Limburg</b>                       |               |               |               |
| ZS Limburg                           | 72,60         | 83,90         | 86,40         |
| <b>Highest Levy</b>                  | <b>123,00</b> | <b>138,00</b> | <b>135,00</b> |
| <b>Lowest Levy (during the year)</b> | <b>44,00</b>  | <b>58,80</b>  | <b>65,00</b>  |

Notes: HH = Hoogheemraadschap.  
 ZS = Zuiveringsschap.  
 WS = Waterschap.

Source: Vereniging.

## REFERENCES

- BAARDWIJK, FRANS A.N. (1990). "Water Pollution Abatement in the Netherlands: Policy and Results". In *UNEP Industry and Environment*, July-December.
- BRESSERS, HANS TH.A. (1998). "A Comparison of the Effectiveness of Incentives and Directives: The Case of Dutch Water Quality Policy". *Policy Studies Review*, Spring, Vol. 7, No. 3, 500-518.
- MINISTRY OF ENVIRONMENT. Communication with Drs. V.W.J Van den Bergen.
- MINISTRY OF HOUSING, SPATIAL PLANNING AND THE ENVIRONMENT. "Drinking Water in the Netherlands". Leaflet.
- SCHOOT UITERKAMP, J.F.J. (1993). "Role of the Water Charging System in the Netherlands". Conference on Environmental Taxes and Liability Schemes, Copenhagen.
- VEWIN (1995). "Waterleidingstatistiek 1995".
- VEWIN (1997). "Tarievenoverzicht leidingwater per 1 januari".

## NEW ZEALAND

### Context for industrial water uses

#### *Institutional arrangements*

Under the 1991 Resource Management Act, local authorities have primary responsibility for most environmental issues. Regional councils have powers to control water abstraction and diversion, and discharges to water, while district councils influence water quality through their land planning functions. Discharge consents and water permits are thus determined at the local level.

Responsibility for the management of fresh water belongs with the 12 regional councils and four unitary authorities, which are also responsible for providing water supply and wastewater treatment services to urban and rural areas. Services are generally integrated, with the same operator providing bulk and retail water, and wastewater treatment and drainage. In Auckland and Wellington, however, bulk and retail supply are provided by distinct entities. Water services are generally managed by council business units, and a few councils have formed “Local Authority Trading Enterprises” (LATEs). Many small towns or isolated communities have private water supplies.

The Ministry for the Environment has overall responsibility for environmental policy advice, especially for water resource management, including the development of policies on water quality and resource allocation issues.

#### *Relative importance of industrial water use*

Industry only accounts for 13 per cent of total water use, with the largest component used by agriculture and livestock (72.5 per cent of withdrawals). In the mid-1980s, New Zealand eliminated a wide range of subsidies that were distorting resource use in agriculture, amongst which was the heavy subsidisation of water use.

**Table 20.1. Water Consumption By Type of Use (1996)**

| <b>Sector</b> | <b>% of total withdrawals</b> |
|---------------|-------------------------------|
| Irrigation    | 55.0                          |
| Livestock     | 17.5                          |
| Industry      | 13.0                          |
| Public supply | 10.5                          |
| Other         | 4.0                           |

*Source:* OECD, Statistics New Zealand.

***Water sources for industry***

Industry sources about 30 per cent of its water requirements from public supply systems and 70 per cent from direct abstractions, whereas 87 per cent of households are connected to the public supply system.

***Types of industrial water uses***

No data was obtained for this study on industrial water uses.

**Pricing principles*****Pricing structure for water from the public supply system***

There are a variety of pricing policies at both the retail and bulk levels of water supply. The Wellington Regional Council recovers the estimated costs of bulk water supply through a cost-based charge, based on the proportion of total water consumed by retail suppliers. Most suppliers meter industrial users and charge for the water consumed, as well as applying an annual supply charge. Where usage charges are applied, they often fail to apply a marginal-cost approach. In many cases, they do not include the opportunity cost of capital, the costs of environmental damage, or future investment requirements. The price structures shown in Table 20.2 can be used by local authorities, in accordance with the Resource Protection Act.

***Sewerage and trade effluent charges***

Sewerage charges are generally based on the value of the property. Drainage charges are rarely charged separately. The structures shown in Table 20.3 can potentially be adopted by local authorities.

***Abstraction and discharge charges***

Permits are required for abstractions and discharges, with a maximum life of 35 years. According to the Resource Management Act, local authorities are not allowed to raise revenues by allocating permits, even though they can impose charges on a cost-related basis.

**Price levels and trends*****Water from public supply system***

No price data were obtained for this study.

***Sewerage and trade effluent charges***

No price data were obtained for this study.

**Table 20.2. Charging for Water**

| <b>Charging Mechanism</b>                             | <b>Incidence</b>                                                                                          | <b>Nature</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part of the general rate (s.12)                       | Every SRP (separately rateable property)                                                                  | <ul style="list-style-type: none"> <li>• uniform or differential basis</li> <li>• max. gen. rate = 1.25 cents in the \$ of net capital value, or its equivalent on land value</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                        |
| Part of a uniform annual general charge (UAGC) (s.19) | Every SRP                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| A separate rate for water (s.16 &17)                  | Every SRP in the district or part thereof:<br>-- On services and serviceable properties only              | <ul style="list-style-type: none"> <li>• uniform or differential basis</li> <li>• for ordinary supply of water only (s681 Local Government Act - bylaw to define ord. Supply)</li> <li>• instead of levying a separate rate on all SRPs, can levy only on serviceable properties</li> <li>• can levy up to a half rate on serviceable properties</li> </ul>                                                                                                                                                                                                                     |
| Separate uniform annual charge for water (s.20 &17)   | -- on all SRP's in the district or part of the district<br>-- On services and serviceable properties only | <ul style="list-style-type: none"> <li>• instead of or in addition to levying a rate of s16</li> <li>• s25(l)(b) - these are exempt from the calculation of the 30% max proportion of rates</li> <li>• instead of levying a separate uniform annual charge on all properties, can levy, for the ord. supply of water (within the meaning of any bylaw) only on serviced and serviceable properties</li> <li>• can levy up to a half charge on serviceable properties</li> <li>• s25(l)(b) - these are exempt from the calculation of the 30% max proportion of rates</li> </ul> |
| Separate uniform annual charge for water (s.20 &17)   | -- in respect of each separately used or inhabited portion of property                                    | <ul style="list-style-type: none"> <li>• for ordinary supply of water as defined by bylaw</li> <li>• s25(l)(b) - these are exempt from the calculation of the 30% max proportion of rates</li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |
| Charges for water by quantity consumed (s.26)         | -- per unit of water consumed                                                                             | <ul style="list-style-type: none"> <li>• instead of, or in addition to, levying a rate under s16 or a charge under s20 or 224, may levy charges or a scale of charges according to the quantity of water consumed (of such amount as may be fixed by resolution publicly notified, or by agreement with consumer)</li> <li>• ordinary supply of water (as defined by bylaw)</li> <li>• extraordinary supply - (bylaw to define) - charges fixed by resolution publicly notified</li> </ul>                                                                                      |
| Charges in respect of water meters (s.27)             |                                                                                                           | <ul style="list-style-type: none"> <li>• annual charges for use of water meter (s27(l)(a))</li> <li>• may sell meter to consumer, and charge for any repairs (s27(l)(b))</li> <li>• any amount fixed under s27(l) may be combined with s26 charges or s16 rates</li> </ul>                                                                                                                                                                                                                                                                                                      |

Source: Simpson Grierson Law (1997).

**Table 20.3. Charging for Sewerage**

| <b>Charging Mechanism</b>                                                              | <b>Incidence</b>                                                                                                                   | <b>Nature</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part of the general rate (s.12)                                                        | Every SRP                                                                                                                          | <ul style="list-style-type: none"> <li>• uniform or differential basis</li> <li>• max. gen. rate = 1.25 cents in the \$ of net capital value, or its equivalent on the land value</li> </ul>                                                                                                                                                                                                                                                                                               |
| Part of uniform annual general charge (s.19)<br>A separate rate for sewerage (s.16&17) | Every SRP<br><br>-- on every SRP in the district or part of the district benefiting on serviced and serviceable properties only    | <ul style="list-style-type: none"> <li>• uniform or differential basis</li> <li>• instead of levying a separate rate on all properties, can levy only on serviced and serviceable properties</li> <li>• can levy up to a half rate on serviceable properties</li> </ul>                                                                                                                                                                                                                    |
| Separate uniform annual charge for sewerage (s.20&17)                                  | -- on all separately rateable properties in the district or part of the district<br>-- on serviced and serviceable properties only | <ul style="list-style-type: none"> <li>• instead of or in addition to levying a rate under s16</li> <li>• s25(l)(b) - these are exempt from the calculation of the 30% max proportion of rates</li> <li>• instead of levying a charge on all properties, can levy only on serviced and serviceable properties</li> <li>• can levy up to a half charge on serviceable properties</li> <li>• s25(l)(b) - these are exempt from the calculation of the 30% max proportion of rates</li> </ul> |
| Sewerage charge (s.30)                                                                 | -- per urinal or water closet connected                                                                                            | <ul style="list-style-type: none"> <li>• instead of, or in addition to, levying a rate under s16 or charge under s20</li> <li>• a charge of a uniform sum annually on each connection</li> <li>• one household is deemed to have only one connection</li> <li>• may have a scale of charges for multiple connections</li> </ul>                                                                                                                                                            |

## REFERENCES

NEW ZEALAND BUSINESS ROUNDTABLE (1995). "Reform of the New Zealand Water Industry".

OECD (1996). *Environmental Performance Review: New Zealand*. OECD: Paris.

OECD WORKSHOP ON THE SUSTAINABLE MANAGEMENT OF WATER IN AGRICULTURE (1997). "New Zealand Contributed Paper". (Athens, 3-6 November).

SIMPSON GRIERSON (1997). "Description of Local Authorities Existing Powers". Paper commissioned by the Department of Internal Affairs - Te Tari Taiwhenua.

## **NORWAY**

### **Context for industrial water uses**

#### ***Institutional arrangements***

There are some 1 600 water supply and distribution plants in Norway, of which some 1 200 are owned by municipalities, and the rest privately owned. Local government chooses the service provider. Water supply entities are local monopolies, and all water users are obliged to connect to the public system.

#### ***Relative importance of industrial water use***

Industrial water use accounts for 73 per cent of total water abstractions, with domestic use and agriculture making up 20 and 7 per cent of the remainder, respectively.

#### ***Water sources for industry***

No data was available for this study on the water sources for industry or on the types of industrial water uses.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

The pricing policies of municipal entities are regulated by the Government. The price structure consists of an access price and an annual flat rate price, the latter of which is levied as a local tax ("water and wastewater tax"), and must be sufficient to recover costs. All revenues are "earmarked" for local water supply. Water companies may receive federal grants for investments with benefits beyond the local borders, however, as well as for the building of new (or the upgrading of existing) water plants.

Industrial users are usually metered, and the water tax is adjusted accordingly, but municipalities are not allowed to give discounts to large industrial users.

Private water supply companies have their own statutes, but must also recover their total costs.

#### ***Sewerage and trade effluent charges***

No data was obtained for this study on the pricing principles for sewerage charges.

***Abstraction and discharge charges***

Discharge permits are required for effluent discharge and water abstraction; these are issued by county authorities. The local government can fine water companies for violation of water quality or discharge levels.

**Price levels and trends**

No data was available for this study on price levels of water and wastewater services.

**REFERENCES**

OECD (1993). *Environmental Performance Review: Norway*. OECD: Paris.

SJOHOLT, K.E. (1996) .“Water Subsidies and their Environmental Implications: Norway”. Manuscript.

## POLAND

### Context for industrial water uses

#### *Institutional arrangements*

At the national level, water resource management is the responsibility of the Ministry of Environmental Protection and Natural Resources. Water supply and sewage disposal are under the supervision of the Ministry of Building, Physical Planning and Municipal Economy. The main instrument of protection is water permits issued by Voivodships (Provincial) Inspectorates for Environmental Protection. However, given that provincial boundaries do not correspond to river basin boundaries, the creation of river basin management structures was proposed in 1991, and is currently under consideration.

The water supply system has been significantly decentralised. Following the 1990 local government reforms, about 2 500 Polish *gminas* (communities) were created. These have broad powers, and are responsible for providing various local services, including water and wastewater treatment services. In order to fulfil these tasks, the *gminas* took over about 1 000 public utilities which were previously under state control. They either have full control over these companies, or they supervise them under a contractual (concession) arrangement. Privatisation is currently under consideration in order to increase utilities' investment capacity. Polish water companies are grouped in an industry association (*Wodociugi Polskie*).

#### *Relative importance of industrial water use*

The breakdown of water abstractions by type is given in Table 22.1.

**Table 22.1. Water Uses by Type (1995)**

| Type                     | Million m <sup>3</sup> | %     |
|--------------------------|------------------------|-------|
| Industry                 | 8 353.6                | 71.4  |
| Agriculture and forestry | 1 176.8                | 10.1  |
| Public supply            | 2 167.4                | 18.5  |
| Total                    | 11 697.8               | 100.0 |

Source: Central Statistical Office of Poland (1996).

#### *Water sources for industry*

Overall, industrial users directly abstract 97 per cent of their water needs. Of these direct abstractions, 92 per cent come from surface waters and 8 per cent from other types of water (including groundwater at 4.5 per cent). These figures are summarised in Table 22.2.

**Table 22.2. Industrial Water Abstractions by Economic Source (1996) (Million m<sup>3</sup>)**

| Sector | Surface water | Direct abstractions<br>Groundwater | Mining water | Sub-total | Public supply | TOTAL  |
|--------|---------------|------------------------------------|--------------|-----------|---------------|--------|
| Total  | 7 783.3       | 381.4                              | 266.9        | 8 431.6   | 215.8         | 8647.5 |
| %      | 90%           | 4%                                 | 3%           | 98%       | 2%            | 100%   |

Source: Central Statistical Office of Poland (1996).

### *Types of industrial water uses*

Industrial water abstractions by source and by sector are provided in Table 22.3.

**Table 22.3. Industrial Water Abstractions by Source and by Sector (1995) (Million m<sup>3</sup>)**

| Sector                                       | Direct abstractions | Public supply | Total   |
|----------------------------------------------|---------------------|---------------|---------|
| Total                                        | 8 431.6             | 215.8         | 8 647.5 |
| Mining of coal and lignite                   | 163.5               | 38.3          | 201.8   |
| Mining of metal ores                         | 54.5                | 0.4           | 54.9    |
| Other mining                                 | 103.2               | 8.3           | 111.5   |
| Foods and beverages                          | 132.6               | 17.5          | 150.1   |
| Textiles                                     | 29.2                | 11.4          | 40.7    |
| Clothes and fur                              | 1.2                 | 0.1           | 1.2     |
| Leather and footwear                         | 4.3                 | 0.6           | 4.9     |
| Wood                                         | 8.8                 | 0.8           | 9.6     |
| Pulp and paper                               | 131.1               | 10.9          | 142.0   |
| Coke, refined petroleum products             | 40.4                | 6.7           | 47.1    |
| Chemical products                            | 461.2               | 13.2          | 474.4   |
| Rubber and plastic products                  | 24.1                | 0.3           | 35.7    |
| Other mineral produces (non-metallic)        | 32.9                | 8.2           | 37.9    |
| Metals                                       | 153.4               | 29.9          | 169.1   |
| Manufactured metal products                  | 7.8                 | -             | 9.4     |
| Other machinery and equipment                | 27.0                | 0.0           | 35.2    |
| Electricity, gas, steam and hot water supply | 6923.1              | 5.3           | 6959.8  |
| Other                                        | 55.3                | 0.0           | 72.0    |

Source: Central Statistical Office of Poland (1996), Table 12 (62).

### **Pricing principles**

#### *Pricing structure for water from the public supply system*

The process of determining charges and the subsidisation of particular consumer groups is highly politicised in the context of local government. Domestic charges are based on metered volumes. Industrial users have to pay extra charges both for groundwater and surface water abstraction, and for effluent discharges. These charges are also based on metered volumes.

### ***Sewerage and trade effluent charges***

Sewerage charges for all categories of users are calculated as a percentage of water charges. There are special regulations to specify quality standards for industrial and trade effluents discharged to the municipal sewerage system. Water users exceeding these limits are subject to an additional charge or penalty.

### ***Abstraction and discharge charges***

Water abstraction charges are differentiated by type of use (industrial, energy, household, municipal and agricultural), by type of water (groundwater, surface water), and by region. Fees for municipalities, households and agriculture are significantly lower (between 6 and 47 times) than fees for industry. Within industry, preferential rates are given to the food and drug industries, and to electricity and heat generation. All revenues are channelled into the national and Voivodship environmental funds, without being “earmarked” for any specific purpose beyond that.

Fees for wastewater discharges and fines for non-compliance are used in association with permits for wastewater discharges. Fees are differentiated by type of pollutant and by sector (see Table 22.4). Rates are doubled for discharges into lakes and retention reservoirs. There are also fines for non-compliance with discharge permits, which are progressive according to the degree to which the limit is exceeded. Rates are equal for all industries, and are much lower for municipalities. All fines are channelled into environmental funds.

## **Price levels and trends**

### ***Water from public supply system***

Data on water and sewerage prices for industrial users and for households are presented in Table 22.5.

### ***Sewerage and trade effluent charges***

Data on water and sewerage prices (for industrial and households) are also presented in Table 22.5.

### ***Direct abstraction or self-treatment***

Wastewater discharge fees are shown in Table 22.4.

**Table 22.4. Selected Fees for Wastewater Discharges (1992)**

|                                                                                          | BODs  | COD   | (US\$/tonne <sup>b</sup> )<br>Suspended solids | Heavy metals |
|------------------------------------------------------------------------------------------|-------|-------|------------------------------------------------|--------------|
| Power generation, fuel processing, chemical, metallurgical, machine and light industries | 1 489 | 1 027 | 64                                             | 7 407        |
| Paper and pulp industries                                                                | 617   | 398   | 64                                             | 7 407        |
| Food industries                                                                          | 384   | 257   | 64                                             | 7 407        |
| Urban municipal sewage                                                                   | 144   | 87    | 64                                             | 7 407        |
| Rural municipal sewage, hospitals and social care institutional                          | 129   | 77    | 64                                             | 7 407        |
| Coal mining: saline water discharged from dosing reservoirs                              | -     | -     | -                                              | 7 407        |

*Notes:* a. Double rates apply for discharges into lakes and retention reservoirs.

b. Converted at mid-1992 exchange rate of ZI 13 500 per US\$.

*Source:* OECD.

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area              | Town                | Domestic |          | Industry |          |
|----------------------------|---------------------|----------|----------|----------|----------|
|                            |                     | Water    | Sewerage | Water    | Sewerage |
| Province: Bialskopodlaskie | Biala Podlaska      | 0.70     | 0.95     | 0.90     |          |
|                            | Losice              | 0.90     | 1.50     | 1.10     | 1.50     |
|                            | Miedzyrzec Podlaski | 0.90     | 1.30     | 0.90     | 1.61     |
|                            | Parczew             | 0.80     | 1.48     | 1.20     | 2.22     |
|                            | Radzyn Podlaski     | 1.00     | 0.74     | 1.00     | 1.80     |
| Province: Bialostockie     | Bialystok           | 0.87     | 0.85     | 1.00     | 0.98     |
|                            | Bielsk Podlaski     | 0.80     | 1.30     | 1.10     | 1.30     |
|                            | Czarna Bialostocka  | 0.98     | 1.29     | 1.05     | 1.29     |
|                            | Dabrowa Bialostocka | 0.95     | 0.69     | 0.95     | 1.06     |
|                            | Hajnowka            | 0.68     | 0.59     | 0.68     | 0.59     |
|                            | Lapy                | 0.73     | 0.72     | 0.80     | 0.95     |
|                            | Sokolka             | 1.00     | 1.25     | 1.30     | 1.65     |
|                            | Suprasl             | 0.88     | 0.90     |          |          |
| Province: Bielskie         | Andrychow           | 0.91     | 0.91     | 1.87     | 1.12     |
|                            | Bielsko-Biala       | 0.68     | 0.66     | 2.44     | 1.99     |
|                            | Chelmek             | 1.50     | 0.66     | 1.91     | 1.24     |
|                            | Makow Podhalanski   | 1.20     | 0.60     | 2.10     | 0.10     |
|                            | Oswiecim            | 1.00     | 0.70     |          |          |
|                            | Sucha Beskidzka     | 1.05     | 0.85     | 1.30     | 1.15     |
|                            | Ustron              | 1.51     | 1.52     | 1.70     | 1.65     |
|                            | Zator               | 1.22     | 0.65     | 3.06     | 1.54     |
|                            | Zywiec              | 0.79     | 0.63     | 1.50     | 1.90     |
| Province: Bydgoskie        | Barcin              | 1.10     | 1.10     | 1.10     | 1.10     |
|                            | Chojnice            | 0.75     | 0.90     | 1.00     | 1.45     |
|                            | Czeladz             | 1.50     | 0.90     | 1.50     | 1.60     |
|                            | Inowroclaw          | 0.90     | 0.60     | 1.74     | 0.86     |
|                            | Janikowo            | 0.87     | 0.93     | 0.87     | 0.93     |
|                            | Mogilno             | 0.75     | 0.75     | 1.23     | 1.35     |
|                            | Naklo n/Notecia     | 0.96     | 0.85     | 1.50     | 1.10     |
|                            | Pakosc              | 0.80     | 0.75     | 1.10     | 1.10     |
|                            | Sepolno Krajenskie  | 0.90     | 1.30     | 0.90     | 1.30     |
|                            | Strzelno            | 0.80     | 0.80     | 1.10     | 1.00     |
|                            | Szubin              | 1.00     | 1.25     | 1.00     | 1.25     |
|                            | Tuchola             | 0.90     | 1.26     | 1.17     | 1.56     |
| Province: Chelmskie        | Chelm               | 1.02     | 0.82     | 1.48     | 1.64     |
| Province: Ciechanowskie    | Ciechanow           | 0.90     | 1.35     | 0.90     | 1.35     |
| Province: Czestochowskie   | Czestochowa         | 1.12     | 0.75     | 1.42     | 0.89     |
|                            | Dobrodzien          | 0.85     | 0.25     | 1.85     | 0.42     |
|                            | Zarki               | 1.00     |          | 1.00     |          |
| Province: Elblaskie        | Braniewo            | 1.32     | 0.68     |          |          |
|                            | Dzierzgon           | 1.20     | 1.05     | 1.20     | 1.05     |
|                            | Krynica Morska      | 1.10     | 1.10     |          |          |

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area            | Town                | Domestic |          | Industry |          |
|--------------------------|---------------------|----------|----------|----------|----------|
|                          |                     | Water    | Sewerage | Water    | Sewerage |
| Province: Gdanski        | Kwidzyn             | 1.23     | 1.10     | 1.48     | 1.10     |
|                          | Malbork             | 0.75     | 0.64     | 1.25     | 1.06     |
|                          | Miloradz            | 0.75     |          | 1.35     |          |
|                          | Orneta              | 0.90     | 0.90     | 1.10     | 1.40     |
|                          | Paslek              | 1.20     | 1.10     | 1.80     | 2.20     |
|                          | Pieniezno           | 1.10     | 1.10     | 1.10     | 2.00     |
|                          | Prabuty             | 1.40     | 1.40     | 1.50     | 1.50     |
|                          | Stare Pole          | 1.25     | 1.00     |          |          |
|                          | Gdansk              | 1.07     | 1.03     | 1.36     | 1.34     |
|                          | Gdynia              | 1.05     | 1.25     | 1.50     | 1.50     |
|                          | Kartuzy             | 0.90     | 1.05     | 1.10     | 1.45     |
|                          | Koscierzyna         | 0.90     | 1.10     | 0.90     | 2.30     |
|                          | Starogard Gdanski   | 0.90     | 0.95     | 0.90     | 0.95     |
|                          | Wladyslawowo        | 1.01     | 1.36     | 1.26     | 1.69     |
| Province: Gorzowskie     | Drezdenko           | 0.98     | 0.98     | 0.98     | 1.72     |
|                          | Gorzow Wielkopolski | 1.11     | 1.11     | 1.33     | 1.33     |
|                          | Kostrzyn            | 0.81     | 0.72     | 0.86     | 0.78     |
|                          | Lubniewice          | 0.69     | 1.20     | 0.87     | 1.78     |
| Province: Jeleniogorskie | Boleslawiec         | 1.08     | 0.68     | 1.68     | 1.28     |
|                          | Jelenia Gora        | 1.10     | 0.80     | 1.80     | 1.50     |
|                          | Kamienna Gora       | 0.88     | 0.56     | 1.60     | 1.03     |
|                          | Luban               | 0.75     | 0.45     |          |          |
|                          | Zgorzelec           | 0.85     | 0.58     | 1.66     | 1.00     |
| Province: Kaliskie       | Jarocin             | 1.00     | 1.00     | 1.00     | 1.00     |
|                          | Kalisz              | 0.73     | 0.37     | 1.09     | 0.79     |
|                          | Kepno               | 0.95     | 0.90     | 1.20     | 1.20     |
|                          | Krotoszyn           | 0.80     | 0.75     | 1.30     | 1.45     |
|                          | Odolanow            | 0.75     | 0.60     | 1.25     | 1.20     |
|                          | Ostrow Wielkoposki  | 0.75     | 0.60     | 1.00     | 0.95     |
|                          | Ostrzeszow          | 1.00     | 1.07     | 1.70     | 1.51     |
|                          | Pleszew             | 0.85     | 0.95     | 1.26     | 1.44     |
| Province: Katowickie     | Bedzin              | 1.51     | 1.07     | 1.51     | 1.20     |
|                          | Byfom               | 1.75     | 0.90     | 1.75     | 1.20     |
|                          | Chorzow             | 1.50     | 1.00     |          |          |
|                          | Chrzanow            | 1.50     | 1.00     | 1.90     | 1.40     |
|                          | Dabrowa Gornicza    | 1.29     | 0.91     | 1.43     | 1.30     |
|                          | Gliwice             | 1.25     | 0.72     | 1.25     | 1.40     |
|                          | Jastrzebie Zdroj    | 1.50     | 0.90     | 1.50     | 1.20     |
|                          | Jaworzno            | 1.32     | 1.33     | 2.54     | 2.66     |
|                          | Katowice            | 0.68     |          | 1.00     |          |
|                          | Katowice            | 1.51     | 0.76     | 1.51     | 1.48     |
|                          | Kety                | 1.31     | 0.77     |          |          |
|                          | Olkusz              | 1.40     | 0.75     | 1.40     | 0.75     |

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area          | Town                    | Domestic |          | Industry |          |
|------------------------|-------------------------|----------|----------|----------|----------|
|                        |                         | Water    | Sewerage | Water    | Sewerage |
| Province: Kieleckie    | Raciborz                | 1.11     | 0.80     | 1.86     | 1.30     |
|                        | Ruda Slaska             | 1.95     | 0.65     | 1.95     | 0.65     |
|                        | Rybnik                  | 1.50     | 0.70     | 1.50     | 1.10     |
|                        | Sosnowiec               | 1.30     | 0.56     | 1.30     | 1.35     |
|                        | Sosnicowice             | 0.90     |          | 1.20     |          |
|                        | Tarnowskie Gory         | 1.40     | 1.10     | 1.40     | 1.40     |
|                        | Tychy                   | 1.35     | 0.60     | 1.35     | 1.37     |
|                        | Wodzislaw Slaski        | 1.80     | 0.95     | 1.80     | 1.90     |
|                        | Zabrze                  | 1.15     | 0.80     | 1.15     | 0.95     |
|                        | Zawiercie               | 1.30     | 0.75     | 1.30     | 1.20     |
|                        | Busko-zdroj             | 0.82     | 0.95     | 1.44     | 1.52     |
|                        | Kielce                  | 0.50     | 0.57     | 1.40     | 1.20     |
|                        | Ostrowiec Swietokrzuski | 0.78     | 0.66     | 1.44     | 1.34     |
|                        | Pinczow                 | 0.70     | 0.64     | 1.00     | 0.75     |
|                        | Skarzysko-Kamienna      | 0.80     | 0.40     |          |          |
| Province: Koninskie    | Starachowice            | 0.70     | 0.36     | 1.40     | 1.10     |
|                        | Staporkow               | 1.00     | 0.85     | 2.60     | 2.10     |
|                        | Kolo                    | 0.84     | 0.59     | 1.44     |          |
|                        | Konin                   | 1.10     | 1.19     | 2.95     | 1.82     |
|                        | Konin                   | 1.11     | 0.90     | 1.38     |          |
| Province: Koszalin     | Slupca                  | 1.00     | 0.89     | 1.53     | 1.11     |
|                        | Witkowo                 | 0.90     | 1.00     | 0.96     | 1.00     |
|                        | Bialogard               | 0.76     | 0.83     | 1.00     | 0.98     |
|                        | Darlowo                 | 0.88     | 0.79     | 0.88     | 0.79     |
|                        | Kolobrzeg               | 0.70     | 0.70     | 1.00     | 1.58     |
|                        | Koszalin                | 0.72     | 0.66     | 0.99     | 0.66     |
|                        | Polczyn Zdroj           | 1.00     | 0.80     | 1.00     | 1.50     |
|                        | Szczecinek              | 0.88     | 1.30     |          |          |
| Province: Krakowski    | Zlocieniec              | 0.69     | 0.64     | 0.84     | 0.64     |
|                        | Krakow                  | 1.19     | 0.79     | 2.12     | 1.33     |
|                        | Skawina                 | 1.05     | 0.55     | 1.85     | 2.40     |
|                        | Wieliczka               | 1.00     | 1.00     | 2.00     | 2.00     |
| Province: Krosnienskie | Brzozow                 | 0.80     | 0.60     | 1.60     | 1.20     |
|                        | Jaslo                   | 0.70     | 0.70     | 1.40     | 1.55     |
|                        | Krosno                  | 0.95     | 0.65     |          |          |
|                        | Ustrzyki Dolne          | 1.31     | 1.06     | 2.62     | 2.18     |
| Province: Legnickie    | Glogow                  | 1.03     | 1.08     | 2.48     | 1.25     |
|                        | Legnica                 | 1.04     | 0.68     | 1.58     | 1.90     |
|                        | Lubin                   | 1.10     | 0.65     |          |          |
|                        | Polkowice               | 1.05     | 1.17     | 2.74     | 2.17     |
| Province: Leszczynskie | Gostyn                  | 1.02     | 0.45     | 1.02     | 1.12     |
|                        | Leszno                  | 1.28     | 1.36     | 1.66     | 1.36     |
|                        | Rawicz                  | 1.00     | 1.00     | 1.20     | 1.30     |

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area          | Town               | Domestic |          | Industry |          |
|------------------------|--------------------|----------|----------|----------|----------|
|                        |                    | Water    | Sewerage | Water    | Sewerage |
| Province: Lubuskie     | Wschowa            | 1.05     | 1.25     | 1.25     |          |
|                        | Debno Lubuskie     | 0.82     | 1.08     | 1.50     | 2.50     |
|                        | Kazimierz Dolny    | 0.92     | 1.10     |          |          |
|                        | Lubartow           | 0.70     | 0.94     | 1.03     | 1.28     |
|                        | Lublin             | 0.69     | 0.51     | 2.14     | 2.45     |
|                        | Leczna             | 1.15     | 1.35     | 1.97     | 1.35     |
|                        | Pulawy             | 0.70     | 1.10     | 1.40     | 1.65     |
| Province: Lomzynskie   | Swidnik            | 0.78     | 1.19     | 1.75     | 1.32     |
|                        | Jedwabne           | 0.90     | 1.08     | 0.90     | 1.08     |
|                        | Lomza              | 1.05     | 0.93     | 1.12     | 1.16     |
| Province: Lodzkie      | Aleksandrow Lodski | 1.00     | 0.64     | 1.00     | 1.60     |
|                        | Andrespol          | 0.96     |          | 1.45     |          |
|                        | Konstantynow       | 0.80     | 0.65     | 1.20     | 1.01     |
|                        | Lodz               | 0.78     | 0.60     |          |          |
| Province: Nowosadeckie | Gorlice            | 0.89     | 0.48     | 1.50     | 0.76     |
|                        | Krynica            | 0.97     | 0.75     |          |          |
|                        | Nowy Sacz          | 0.93     | 0.82     | 0.93     | 0.82     |
|                        | Nowy Targ          | 1.40     | 1.40     |          |          |
|                        | Rabka              | 1.55     | 0.54     |          |          |
|                        | Zakopane           | 0.75     | 1.35     |          |          |
| Province: Olsztynskie  | Bartoszyce         | 0.61     | 0.88     | 0.88     | 0.88     |
|                        | Biskupiec          | 0.78     | 0.78     | 1.75     | 2.38     |
|                        | Ilawa              | 0.62     | 1.13     | 0.89     | 1.31     |
|                        | Ketrzyn            | 0.80     | 0.44     | 1.30     | 1.39     |
|                        | Lidzbark Warminski | 0.81     | 0.52     | 1.47     | 1.47     |
|                        | Morag              | 0.80     | 0.65     | 1.30     | 1.38     |
|                        | Mragowo            | 0.60     | 1.00     |          |          |
|                        | Nidzica            | 0.57     | 1.09     | 0.91     | 2.86     |
|                        | Olsztyn            | 0.85     | 0.80     | 1.70     | 1.40     |
|                        | Olsztynek          | 0.60     | 0.65     | 0.90     | 1.20     |
| Province: Opolskie     | Baborow            | 1.10     |          | 1.40     |          |
|                        | Brzeg              | 1.08     | 0.49     | 1.76     | 0.94     |
|                        | Głubczyce          | 0.83     | 0.36     | 1.72     | 1.09     |
|                        | Grodkow            | 0.85     | 0.70     | 1.70     | 1.70     |
|                        | Kedzierzyn Kozle   | 0.68     | 0.48     | 1.12     | 0.85     |
|                        | Kietrz             | 1.09     | 1.15     | 1.25     | 1.65     |
|                        | Kluczbork          | 0.70     | 0.90     | 1.33     | 2.45     |
|                        | Namyslow           | 0.80     | 0.90     | 1.25     | 2.50     |
|                        | Opole              | 0.82     | 0.62     | 1.68     | 1.20     |
|                        | Prudnik            | 0.70     | 0.70     | 1.50     | 1.50     |
| Province: Ostroleckie  | Makow Mazowiecki   | 0.74     | 1.00     | 1.10     | 1.36     |
|                        | Ostroleka          | 1.04     | 1.14     |          |          |
|                        | Ostrow Mazowiecka  | 0.80     | 0.60     | 0.80     | 0.90     |

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area          | Town                 | Domestic |          | Industry |          |
|------------------------|----------------------|----------|----------|----------|----------|
|                        |                      | Water    | Sewerage | Water    | Sewerage |
| Province: Pilskie      | Przasnysz            | 0.67     | 0.65     | 1.05     | 0.90     |
|                        | Chodzież             | 0.97     | 0.86     | 1.15     | 1.15     |
|                        | Czarnków             | 0.80     | 1.31     | 1.35     | 2.30     |
|                        | Krzyż Wielkopolski   | 0.86     | 0.86     | 1.15     | 1.15     |
|                        | Pila                 | 0.82     | 1.03     | 0.94     | 2.30     |
|                        | Pila-Leszków         |          | 0.59     |          |          |
|                        | Trzcianka            | 0.71     | 0.71     | 1.23     | 1.23     |
|                        | Wągrowiec            | 0.90     | 1.20     | 1.20     | 1.60     |
|                        | Wronki               | 1.18     | 1.12     | 1.72     | 1.52     |
|                        | Wyrzysk              | 0.90     | 1.00     | 1.44     | 1.51     |
|                        | Złotów               |          |          | 1.54     | 1.80     |
| Province: Piotrkowskie | Bełchatów            | 0.81     | 0.81     | 0.81     | 0.81     |
|                        | Piotrków Trybunalski | 0.82     | 0.82     | 1.25     | 1.25     |
|                        | Tomaszów Mazowiecki  | 0.85     | 0.50     | 1.20     | 1.08     |
| Province: Płockie      | Krosniewice          | 1.00     | 1.10     |          |          |
|                        | Kutno                | 1.03     | 1.46     |          |          |
|                        | Płock                | 1.45     | 0.60     |          |          |
|                        | Sierpc               | 1.07     | 0.93     | 1.19     | 2.31     |
|                        | Zychlin              | 0.96     | 0.84     | 1.44     | 1.31     |
| Province: Poznańskie   | Gniezno              | 1.20     | 1.20     | 1.20     | 1.20     |
|                        | Nowy Tomysł          | 1.24     | 1.81     | 1.24     | 1.81     |
|                        | Pobiedziska          | 1.02     | 1.76     |          |          |
|                        | Poznań               | 1.13     | 1.13     | 1.13     | 1.13     |
|                        | Srem                 | 1.25     | 1.05     | 1.25     | 1.05     |
|                        | Sroda Wielkopolska   | 1.30     | 1.20     | 1.30     | 1.20     |
|                        | Wrzesnia             | 1.30     | 1.30     | 1.30     | 1.30     |
|                        | Przemysł             | 0.97     | 0.73     | 1.27     | 1.33     |
| Province: Przemyskie   |                      |          |          |          |          |
| Province: Radomskie    | Białobrzegi          | 0.90     | 1.10     |          |          |
|                        | Radom                | 0.70     | 0.60     |          |          |
| Province: Rzeszowskie  | Kolbuszowa           | 1.30     | 0.60     | 1.85     | 0.95     |
|                        | Mielec               | 1.20     | 0.70     | 2.40     | 1.60     |
|                        | Rzeszów              | 0.87     | 0.63     | 1.55     | 0.90     |
| Province: Siedleckie   | Garwolin             | 1.50     | 1.50     | 1.80     | 1.80     |
|                        | Luków                | 0.85     | 0.85     |          |          |
|                        | Minsk Mazowiecki     | 1.22     | 1.11     | 1.98     | 1.89     |
|                        | Siedlce              | 0.95     | 0.90     | 0.95     | 1.50     |
|                        | Sokołów Podlaski     | 0.94     | 0.93     | 1.24     | 1.52     |
|                        | Wedrow               | 0.80     | 1.10     | 0.80     | 1.60     |
|                        | Lask                 | 1.00     | 1.00     | 1.32     | 1.29     |
|                        | Sieradz              | 1.02     | 0.86     | 1.23     | 0.88     |
| Province: Sieradzkie   | Warta                | 1.00     | 1.30     | 1.80     | 1.80     |
|                        | Wielun               | 1.10     | 1.30     | 1.60     | 1.70     |
|                        | Lowicz               | 0.90     | 0.90     | 1.32     | 1.80     |
|                        |                      |          |          |          |          |

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area            | Town                 | Domestic |          | Industry |          |
|--------------------------|----------------------|----------|----------|----------|----------|
|                          |                      | Water    | Sewerage | Water    | Sewerage |
| Province: Slupskie       | Skierniewice         | 1.10     | 1.10     |          |          |
|                          | Bytow                | 0.80     | 1.08     | 1.00     | 1.65     |
|                          | Lebork               | 0.58     | 0.92     | 0.65     | 1.30     |
|                          | Leba                 |          | 1.71     |          | 5.14     |
|                          | Przechlewo           | 0.80     | 1.35     | 0.80     | 1.35     |
|                          | Slupsk               | 0.58     | 0.79     | 0.70     | 0.95     |
|                          | Ustka                | 0.61     | 1.05     | 0.87     | 1.17     |
| Province: Suwalskie      | Elk                  | 0.72     | 1.03     | 1.20     | 1.23     |
|                          | Olecko               | 0.76     | 1.29     | 0.93     | 1.45     |
|                          | Pisz                 | 0.77     | 0.98     |          |          |
| Province: Szczecinskie   | Gryfino              | 0.90     | 1.00     | 0.90     | 1.00     |
|                          | Lobez                | 0.82     | 1.22     | 0.82     | 1.22     |
|                          | Miedzyzdroje         | 0.71     | 0.80     | 0.92     | 1.04     |
|                          | Nowogard             | 0.80     | 1.00     | 0.80     | 1.00     |
|                          | Police               | 0.93     | 0.42     | 0.93     | 0.42     |
|                          | Stargard Szczecinski | 0.72     | 0.83     | 1.20     | 1.00     |
|                          | Szczecin             | 0.93     | 0.60     | 1.26     | 0.84     |
|                          | Swinouiscie          | 1.05     | 0.95     |          |          |
| Province: Tarnobrzekskie | Nowa Deba            | 1.10     | 0.80     | 2.15     | 1.80     |
|                          | Sandomierz           | 0.90     | 0.73     | 1.20     | 0.97     |
|                          | Stalowa Wola         | 0.56     | 0.72     | 1.17     | 1.82     |
|                          | Tarnobrzeg           | 1.40     | 0.58     | 1.70     | 0.58     |
| Province: Tarnowskie     | Bochnia              | 1.12     | 1.02     | 1.34     | 1.51     |
|                          | Brzenica 401 A       | 1.10     |          | 1.40     |          |
|                          | Dabrowa Tarnowska    | 1.60     | 1.57     | 2.13     | 1.57     |
|                          | Nowy Wisnicz 16      | 1.20     | 1.20     |          |          |
|                          | Siedliska            | 1.30     | 0.90     | 1.80     | 1.79     |
|                          | Tarnow               | 0.69     | 1.08     | 1.04     | 1.18     |
|                          |                      |          |          |          |          |
| Province: Torunskie      | Brodnica             | 0.76     | 0.95     | 1.10     | 1.30     |
|                          | Chelmza              | 0.80     | 1.40     | 1.35     | 1.80     |
|                          | Golub Dobrzyn        | 0.85     | 0.85     | 2.10     | 2.30     |
|                          | Grudziadz            | 0.85     | 0.85     | 0.85     | 1.70     |
|                          | Kowalewo Pomorskie   | 1.00     | 1.00     | 1.70     | 2.20     |
|                          | Torun                | 0.65     | 0.39     | 0.95     | 0.67     |
|                          |                      |          |          |          |          |
| Province: Walbrzyskie    | Dzierzoniow          | 1.20     | 0.70     | 1.74     | 1.10     |
|                          | Nowa Ruda            | 1.28     | 0.71     | 2.23     | 0.71     |
|                          | Polancia Zdrok       | 0.95     | 1.06     | 1.20     | 1.35     |
|                          | Strzegom             | 0.84     | 0.59     | 1.81     | 1.16     |
|                          | Swidnica             | 0.81     | 0.67     | 1.94     | 1.69     |
|                          | Walbrzych            | 1.40     | 0.70     | 2.20     | 1.45     |
|                          | Zabkowice Slaskie    | 0.95     | 0.60     | 2.00     | 1.60     |
|                          | Zebice               | 0.85     | 0.80     | 1.66     | 1.45     |
| Province: Warszawskie    | Grodzisk Mazowiecki  | 0.87     | 0.68     | 1.14     | 0.91     |

**Table 22.5. Prices of Water and Sewerage Services (1996/97) (Zl/m<sup>3</sup>)**

| Province/Area            | Town                 | Domestic |          | Industry |          |
|--------------------------|----------------------|----------|----------|----------|----------|
|                          |                      | Water    | Sewerage | Water    | Sewerage |
|                          | Nowy Dwor Mazowiecki | 0.89     | 1.08     | 1.00     | 1.45     |
|                          | Otwock               | 0.82     | 0.86     | 1.47     | 1.84     |
|                          | Piaseczno            | 1.10     | 0.80     | 1.16     | 1.80     |
|                          | Strzyzow             | 0.96     | 0.96     | 1.80     | 2.16     |
|                          | Wieruszoe            | 1.10     | 1.50     | 2.12     | 1.50     |
|                          | Wolomin              | 1.00     | 0.95     |          |          |
| Province: Wloclawskie    | Aleksandrow Kujawski | 0.75     | 0.90     | 1.50     | 1.70     |
|                          | Cechocinek           | 0.63     | 0.64     | 1.23     | 1.27     |
|                          | Wroclawek            | 0.80     | 1.05     | 0.95     | 1.25     |
| Province: Zamojskie      | Bilgoraj             | 0.82     | 0.89     | 1.16     | 1.69     |
|                          | Hrubieszow           | 0.90     | 1.20     | 0.90     | 1.20     |
|                          | Zamosc               | 0.95     | 1.55     | 1.12     | 1.57     |
| Province: Zielonogorskie | Kozuchow             | 0.80     | 0.30     | 0.80     | 0.30     |
|                          | Krosno Odrzanskie    | 0.72     | 0.37     |          |          |
|                          | Nowa Sol             | 0.97     | 1.16     | 0.97     | 2.17     |
|                          | Sulechow             | 0.88     | 0.45     | 0.88     | 0.45     |
|                          | Swiebodzin           | 1.00     | 1.35     | 1.57     | 1.35     |
|                          | Wolsztyn             | 0.87     | 1.33     | 1.02     | 1.33     |
|                          | Zielona Gora         | 1.00     | 0.60     | 1.30     | 0.72     |
|                          | Zagan                | 0.85     | 0.50     | 1.15     | 0.80     |
|                          | Zary                 | 0.85     | 0.92     | 1.10     | 1.10     |

## REFERENCES

CENTRAL STATISTICAL OFFICE OF POLAND (1996). *“Environment Protection 1996”*. Warsaw.

OECD (1995). *Environmental Performance Reviews: Poland*. OECD: Paris.

WODOCIUGI POLSKE. Communication with Mrs Izba Gospodarcza.

## PORTUGAL

### Context for industrial water uses

#### *Institutional arrangements*

Until 1994, the supply of water and wastewater treatment services was the exclusive responsibility of local municipalities, who were closely involved in the management of these services. The private sector was almost totally excluded from the sector. There were only a handful of inter-communal groupings, due to the fact that municipalities in Portugal are, in comparison with some other countries, large and relatively limited in number (305). The only autonomous public water company in the country was EPAL (*Empresas Portuguesa das Aguas Livres, SA*), which has been responsible for water services in Lisbon since 1867.

*IPE-Aguas de Portugal* (IPE-AdP), a state-owned company, was created in 1993 to develop inter-municipal water catchment areas and wastewater treatment areas, in order to improve the level of water and wastewater services.<sup>36</sup> Under the guidance of the Ministry of Environment, six companies were created by IPE-AdP, in association with the municipalities, to be managed on the basis of a concession system. EPAL, the model for these new regional companies, then became a major element of IPE-AdP's portfolio.<sup>37</sup> The decree-law 379/93 provides a regulatory framework for private companies to be involved in the provision of water and sewerage services, and privatisation is now seriously under consideration in order to allow investments and service quality improvements required by the European Union.

#### *Relative importance of industrial water use*

Portugal has relatively abundant water resources, albeit unequally distributed across the country. Industrial and energy production uses together account for 36 per cent of total abstractions, but account for a large share of non-consumptive uses (Table 23.1). Irrigation abstractions are by far the most dominant. Of the total 8 600 million m<sup>3</sup> of water abstracted each year, only 3 700 million m<sup>3</sup> are effectively consumed.

---

36. IPE-AdP is a subsidiary of the public investment company, IPE (*Investimentos e Participações Empresariais*).

37. The six new companies are the following: *Aguas do Cávado*, *Aguas do Douro e Paiva*, *Simria*, *Sanest*, *Aguas do Barlavento Algarvio*, *Aguas do Sotavento Algarvio*. They cover more than half of the Portuguese population, and involve 56 municipalities for water supply and 14 municipalities for wastewater services.

**Table 23.1. Annual Water Abstractions by Type of User (1991)**

| Type of user      | Million m <sup>3</sup> | %   |
|-------------------|------------------------|-----|
| Public supply     | 400                    | 5   |
| Irrigation        | 5 100                  | 59  |
| Industry          | 1 100                  | 13  |
| Energy production | 2 000                  | 23  |
| Total             | 8 600                  | 100 |

Source: Ministério do Ambiente e Recursos Naturais (1991).

### ***Water sources for industry***

Large industrial concerns have their own water sources and supply systems, as is the case for 99 per cent of the paper industry. Smaller industrial concerns are connected to the public water supply system. In the case of manufacturing industries, about 60 per cent of water uses are drawn from direct abstractions and 40 per cent from the public network. The percentage of direct abstractions varies from one sector to the other (Table 23.2). Direct abstractions are mostly taken from groundwater sources.

### ***Types of industrial water uses***

Data for 1987 indicate that the manufacturing sector accounted for the majority of industrial water uses (93 per cent), while extractive industry accounted for only 7 per cent. Within manufacturing, textiles represented the largest (45 per cent) users of industrial water, followed by the paper and publishing industries with 7.5 per cent.

**Table 23.2. Industrial Water Consumption by Sector (Thousand m<sup>3</sup>, 1987)**

| Sector               | Direct abstraction | %    | Public supply | %    | Total use | %of total industrial consumption |
|----------------------|--------------------|------|---------------|------|-----------|----------------------------------|
| Textiles and Leather | 115 402            | 33   | 234 164       | 67   | 349 566   | 44.9                             |
| Paper and publishing | 196 902            | 99   | 1 520         | 1    | 198 422   | 25.5                             |
| Raw metallurgy       | 50 299             | 86   | 8 188         | 14   | 58 487    | 7.5                              |
| Food and beverages   | 39 365             | 77   | 11 758        | 23   | 51 123    | 6.6                              |
| Chemical             | 11 707             | 33   | 23 768        | 67   | 35 475    | 4.6                              |
| Mining products      | 16 166             | 62   | 9 909         | 38   | 26 075    | 3.3                              |
| Metallurgy           | 2 349              | 38   | 3 832         | 62   | 6 189     | 0.8                              |
| Total manufacturing  | 432 658            | 60   | 293 864       | 40   | 726 522   | 93.2                             |
| Extractive industry  | n.a.               | n.a. | n.a.          | n.a. | n.a.      | 6.8                              |

Source: Direcção General de Recursos Naturais, "A Utilização da Água em Portugal" (1992); INE (1987) Estatísticas Industriais, Vol. I e II; and MESS (1987). Departamento de Estatística.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Water prices are determined by each company and by individual municipalities. Prices must be approved by the municipal assembly. Tariff structures for non-domestic users (which generally include industrial and agricultural users) are generally different from those for domestic users. Water is usually metered, and charges are based on volumes consumed, using (in general) an increasing-block tariff

structure, combined with a fixed charge (*quota de serviço*) which varies according to meter size. The limits of the blocks are determined independently by each municipality. The only exception is Lisbon, where water services managed by EPAL apply a single-block (flat volumetric rate) tariff structure for non-domestic customers. For EPAL, prices are negotiated each year with the Direction General of Competition and Prices in the Ministry of Economy.

### ***Sewerage and trade effluent charges***

Wastewater collection and treatment costs are charged either through an additional payment for each cubic meter of water supplied, or through a charge paid as part of the general municipal tax, as a function of the price of the property. However, the proportion of users connected to a sewerage network in Portugal represents one of the lowest in the EU.

A charge for trade effluent discharge, based on pollution content, is currently being implemented. The intention is that regional delegations for the environment would collect pollution charges, based on the loads being discharged.

### ***Abstraction charges***

Portugal agreed on the introduction of abstraction charges in 1993, on the basis of the “user pays principle”. Licensed uses of water are to be subject to the payment of a charge which depends on the volume of water, the relative scarcity of the resource and the economic value of water for each specific sector. This new legislation should have come into force in 1995, with the imposition of charges to be phased in gradually over five 20 per cent annual increases (i.e. up to 100 per cent of its value) up to 1999. Revenue from these charges will be used to finance improvements to the river basins. As of the end of 1997, however, no abstraction charges had actually been levied. The issue of the registration of abstractors has considerably slowed down the introduction of these charges.

## **Price levels and trends**

### ***Water from public supply system***

Prices vary considerably from one water system to the other. Overall, water services appear to be sold below cost, such that the systems are heavily subsidised. In the Lisbon district, prices for industrial users are higher than those applied in the rest of the country. Data for water prices applied to businesses was recently collected through a questionnaire sent to 270 municipalities, with average values determined for this survey presented in Table 23.3.

**Table 23.3. Water Tariffs for Non-domestic Consumers (1995)**

|                  | Minimum Charge (Esc.) | Monthly consumption in m <sup>3</sup> (Esc. per m <sup>3</sup> ) |       |       |       |       |         |
|------------------|-----------------------|------------------------------------------------------------------|-------|-------|-------|-------|---------|
|                  |                       | 5                                                                | 10    | 20    | 50    | 100   | 500     |
| Average          | 262.1                 | 141.2                                                            | 122.4 | 118.5 | 130.4 | 145.0 | 166.7   |
| Weighted average | 409.1                 | 222.6                                                            | 189.7 | 179.9 | 181.8 | 192.7 | 212.4   |
| Minimum value    | 30.0                  | 13.0                                                             | 10.0  | 5.0   | 2.0   | 1.0   | 0.2     |
| Maximum value    | 1 850.0               | 630.0                                                            | 445.0 | 352.5 | 447.0 | 723.5 | 1 252.0 |

Source: A survey of 270 Portuguese municipalities, EPAL.

***Sewerage and trade effluent charges***

Information on sewerage prices is incomplete, with only two data points available. The municipality of Oeiras charges industrial users 36 escudos per m<sup>3</sup> of water billed. In the City of Lisbon, the sewerage charge has a two-block structure, with a fixed charge and a volumetric charge that depends on the volume of water consumed. In 1997, industrial users paid the municipality of Lisbon, an average of 657 escudos per month and 85 escudos per m<sup>3</sup> of water billed.

***Direct abstraction or self-treatment***

Abstraction charges are not yet levied.

Detailed data were available for industrial water prices in 36 district capitals in 1995, and are presented in Table 23.4.

**Table 23.4. Water Tariffs for Non-Domestic Customers in 36 District Capitals (1997)**

| District               | Consumer Type         | Structure (m <sup>3</sup> ) | Tariff (Escudos) |
|------------------------|-----------------------|-----------------------------|------------------|
| Sobral de Monte Agraco | Commerce and Industry | One block                   | 200.00           |
| Alenquer               | Commerce and Industry | 0-50                        | 149.00           |
|                        |                       | >50                         | 179.00           |
| Amadora                | Commerce and Industry | 0-15                        | 281.00           |
|                        |                       | >150                        | 380.00           |
| Arruda dos Vinhos      | Commerce and Industry | 0-50                        | 205.00           |
|                        |                       | >50                         | 365.00           |
| Aveiro                 | Commerce and Industry | 0-50                        | 160.00           |
|                        |                       | >50                         | 230.00           |
| Azambuja               | Commerce and Industry | 0-50                        | 124.00           |
|                        |                       | >50                         | 176.00           |
| Beja                   | Companies             | One block                   | 235.00           |
| Braga                  | Commerce and Industry | 0-30                        | 107.50           |
|                        |                       | >30                         | 148.00           |
| Braganca               | Commerce and Industry | 0-50                        | 155.00           |
|                        |                       | 51-100                      | 300.00           |
|                        |                       | >100                        | 400.00           |
| Cascais                | Commerce and Industry | 0-5                         | 83.00            |
|                        |                       | 6-200                       | 255.00           |
|                        |                       | >200                        | 351.00           |
| Castelo Branco         | Commerce and Industry | One block                   | 185.00           |
| Coimbra                | Commerce and Industry | One block                   | 130.00           |
| Constancia             | Commerce and Industry | 0-50                        | 120.00           |
|                        |                       | 51-100                      | 260.00           |
|                        |                       | >100                        | 375.00           |
| Entroncamento          | Commerce and Industry | One block                   | 97.00            |
| Evora                  | Commerce and Industry | 0-100                       | 137.50           |
|                        |                       | >100                        | 145.00           |
| Faro                   | Industry              | 0-10                        | 54.00            |
|                        |                       | 11-50                       | 114.00           |
|                        |                       | >50                         | 157.00           |
| Guarda                 | Industry              | 0-5                         | 100.00           |
|                        |                       | 6-15                        | 90.00            |
|                        |                       | >15                         | 80.00            |
| Leiria                 | Commerce and Industry | 0-100                       | 119.00           |
|                        |                       | 101-1000                    | 159.00           |
|                        |                       | >1000                       | 246.00           |
| Lisboa                 | Commerce and Industry | One block                   | 181.70           |
| Loures                 | Commerce and Industry | 0-150                       | 258.00           |
|                        |                       | >150                        | 347.00           |
| Mafra                  | Commerce and Industry | One block                   | 275.00           |
| Oeiras                 | Commerce and Industry | 0-150                       | 281.00           |
|                        |                       | >150                        | 380.00           |
| Portalegre             | Commerce and Industry | 0-50                        | 153.00           |
|                        |                       | 50-500                      | 168.00           |
|                        |                       | >200                        | 218.00           |
| Porto                  | Commerce and Industry | 0-50                        | 270.00           |
|                        |                       | 50-200                      | 301.00           |
|                        |                       | >200                        | 334.00           |
| Santarem               | Commerce and Industry | One block                   | 218.00           |
| Setubal                | Commerce and Industry | 0-50                        | 167.50           |
|                        |                       | >50                         | 260.00           |
| Sintra                 | Commerce and Industry | 0-150                       | 267.00           |
|                        |                       | >150                        | 368.00           |
| Sobral de Monte Agraco | Commerce and Industry | >150                        | 368.00           |
|                        |                       | 0-50                        | 205.00           |
|                        |                       | >50                         | 365.00           |
| Tomar                  | Commerce and Industry | 0-15                        | 180.00           |
| Torres Novas           | Commerce and Industry | >15                         | 275.00           |

**Table 23.4. Water Tariffs for Non-Domestic Customers in 36 District Capitals (1997)**

| District               | Consumer Type         | Structure (m <sup>3</sup> ) | Tariff (Escudos) |
|------------------------|-----------------------|-----------------------------|------------------|
| Torres Vedras          | Commerce and Industry | 0-20                        | 256.00           |
|                        |                       | >20                         | 297.00           |
| Viana do Castelo       | Commerce and Industry | <5                          | 140.00           |
|                        |                       | >5                          | 207.00           |
| Vila Franca de Xira    | Commerce and Industry | 0-150                       | 268.00           |
|                        |                       | >150                        | 362.00           |
| Vila Nova de Barquinha | Commerce and Industry | One block                   | 75.00            |
| Vila Real              | Commerce and Industry | One block                   | 140.00           |
| Viseau                 | Commerce and Industry | 0-10                        | 148.00           |
|                        |                       | >10                         | 224.00           |

Source: Associação Portuguesa dos distribuidores de Água.

## REFERENCES

ASSOCIAÇÃO PORTUGUESA DOS DISTRIBUIDORES DE ÁGUA.

MINISTÉRIO DO AMBIENTE E RECURSOS NATURAIS (1991). “Livro branco sobre o estado do ambiente em Portugal” (April).

IPE-AGUAS DE PORTUGAL. Communication with Mr Ramos Motta.

## SPAIN

### Context for industrial water uses

#### *Institutional arrangements*

Municipalities are responsible for the distribution of water and for sewerage services. There are 8 050 municipalities across Spain, with only municipalities in urban areas forming inter-communal groupings in order to rationalise services. Given the importance of inter-regional water transfers, there are also a number of aqueducts which are either under the responsibility of autonomous regions (17 *autonomías*) or the national government. The delegation of services to private companies is rapidly increasing, since municipalities generally lack the investment capacity required to develop new infrastructure. Public management of services remains the norm, however, with 72 per cent of water volumes delivered via public facilities.

For the purposes of water resource management, Spain is organised along the lines of river basins, with 9 River Basin Agencies (*Confederaciones hidrográficas*): Norte, Sur, Duero, Tajo, Guadiana, Guadalquivir, Segura, Júcar and Ebro. These River Basin Agencies finance themselves through four charges for water and sewerage services according to the 1985 water law: the occupation charge (*canon de ocupación*); the flow regulation charge (*canon de regulación*); the irrigation tariff (*tarifa de utilización*); and the effluent charge (*canon de vertido*). Further details are given below.

#### *Relative importance of industrial water use*

Agricultural requirements exert the strongest sectoral pressure on scarce water resources, as shown in Table 24.1. A new law (to complement the 1985 Law) is currently under discussion that would allow the use of economic instruments (water markets) to encourage a more efficient use of water resources.

**Table 24.1. Water Abstractions by Sector**

| <b>Sector</b>    | <b>Million m<sup>3</sup></b> | <b>%</b> |
|------------------|------------------------------|----------|
| Agriculture      | 240                          | 64       |
| Public supply    | 43                           | 11       |
| Industry         | 22                           | 6        |
| Power production | 71                           | 19       |
| Total            | 376                          | 100      |

Source: Barraqué (1995).

***Water sources for industry***

No data was obtained for this study on water sources for industry in general, or on the largest industrial water users.

**Pricing principles*****Pricing structure for water from the public supply system***

By law, prices charged for water and wastewater services are initially set by the relevant administration in charge (municipalities, even in the case of a concession, or River Basin Agencies), and are then presented to the Price Commission of the regional governments for approval.

Tariffs charged by service providers (municipalities, or private companies) are theoretically intended to recover all the costs of providing the water services. The price of water is not related to the full economic cost of its provision, however, since it is based only on the cost of providing the infrastructure and equipment used to supply customers.

**Table 24.2. Summary of Tariff Setting Principles**

| <b>Tariff components</b>    | <b>Number of municipalities</b> |
|-----------------------------|---------------------------------|
| Service payment             | 261                             |
| Minimum consumption tariff  | 15                              |
| Block tariffs               | 268                             |
| One block                   | 47                              |
| Two blocks                  | 174                             |
| Three blocks                | 20                              |
| Four blocks                 | 25                              |
| Increasing tariffs          | 209                             |
| Decreasing tariffs          | 2                               |
| Single tariffs              | 73                              |
| Wastewater treatment tariff | 200                             |
| Wastewater treatment tax    | 61                              |

*Source: AEAS (1994).*

The use of block-tariffs has recently increased in Spain, with two-block tariff structures being the most common. Increasing-block tariffs are far more common than decreasing-block tariffs, indicating a commitment to conservation objectives.

***Sewerage and trade effluent charges***

Two types of charges are levied for wastewater discharge and treatment: a tariff paid to municipalities for the service provided, and a levy paid to the River Basin Agencies as an environmental tax.

The “service provider” charge is further divided into two components: a charge for the operation and maintenance of the municipal sewage network (*tasa de alcantarillado*) which is raised by the local administration; and a charge for wastewater treatment services (*canon de saneamiento*) which is regulated by regional governments (and sometimes levied by them as well). These charges are used to recover the

costs of providing wastewater services, and they are allocated between types of users. Thus, industrial users always pay a surcharge above domestic charges, according to the pollution content of the discharges made by each industry.

Since the enactment of the 1985 water law, effluent charges (*canon de vertido*) have also been levied by the River Basin Agencies to encourage the internalisation of pollution costs, and as a financing instrument to fund new sewage treatment works. For industry, charges are based on the pollution content of the effluent, measured in “population-equivalents”.

### ***Abstraction and discharge charges***

In Spain, water belongs to the public domain, and it is necessary to obtain a permit for water abstraction. Terms for granting abstraction licences and the basic structure of abstraction tariffs are set under national laws and regulations. Due to relative resource scarcities, and as set out in the 1985 Water Law, water is allocated according to the following usage priorities:

1. Domestic use
2. Irrigation and agrarian uses
3. Industrial uses for hydroelectricity generation
4. Other industrial uses
5. Fish farming
6. Recreational uses
7. Navigation and water transport
8. Other uses

This system of priorities ensures that those who hold a concession right for domestic water use have a right which will almost certainly be fulfilled every year, while those who hold rights for industrial uses, fish farming, recreation or navigation will have a progressively lower chance of receiving the water they need. Moving down the list of priorities, the conversion of rights into actual usage becomes more and more uncertain.

Once an abstraction licence has been granted, charges — called occupation charges (*canon de ocupación*) — are levied on water abstractions by the River Basin Agencies for the use of public resources. The charge is related to the expected use of the resources, as declared in applications for abstraction permits. The charges are then set so as to reflect the benefits expected to be extracted by each activity from the use of the resources. Industrial users are charged by volume used and electricity companies by kWh, while agricultural water users are charged by the hectare. Using available conversion factors to calculate all charges using a common unit indicates that charge levels vary according to the type of use.<sup>38</sup>

In addition, River Basin Agencies levy two charges for the management of water resources:

---

38. Different River Basin Agencies have different conversion factors, making comparisons between them quite difficult.

- flow regulation charges (*canon de regulación*), aimed at distributing the investment, operating and maintenance costs of existing infrastructure between different of users (i.e. municipalities, farmers, direct industrial users); and
- water use charges (*tarifa de utilización*), intended principally to cover the costs of irrigation waterworks and the administrative costs of River Basin Agencies.

These tariffs are calculated independently by each basin authority for each user, and vary according to the infrastructure they use, and the share of operation and maintenance costs which is attributable to this use. For industrial users, these charges are levied on a per cubic meter basis, according to the water abstraction permit.

## Price levels and trends

### *Water from public supply system*

Only summary data on water prices — which depend on the volumes consumed — was available for this study. This data is provided in Table 24.3.

**Table 24.3. Average Prices (pesetas , 1992-1994)**

| Average prices           | 1992   | 1994   |
|--------------------------|--------|--------|
| 1 m <sup>3</sup>         | 109    | 145    |
| 100 m <sup>3</sup> Total | 11 270 | 16 847 |
| 400 m <sup>3</sup> Total | 43 389 | 58 160 |

Source: AEAS (1994).

### *Sewerage and trade effluent charges*

No data on sewerage and trade effluent charges was available for this study.

### *Direct abstraction or self-treatment*

**Table 24.4. Average Resource Development Tariffs Charged by River Basin Agencies**

|                        | Charge to irrigation associations | Charges to municipal suppliers | Charges to hydroelectricity companies |
|------------------------|-----------------------------------|--------------------------------|---------------------------------------|
| Pesetas/m <sup>3</sup> | 1.00                              | 0.48                           | 0.1                                   |

Source: AEAS (1994).

## REFERENCE

AEAS (ASOCIACIÓN ESPAÑOLA DE ABASTECIMIENTOS DE AGUA Y SANEAMIENTO) (1994).  
 “Suministro de Agua Potable y Saneamiento en España”.

## SWEDEN

### Context for industrial water use

#### *Institutional arrangements*

Water and sewerage services are under the responsibility of 288 “communes” across Sweden. The municipalities own the municipal water and sewage facilities, and run these services under the oversight of regional services.

#### *Relative importance of industrial water use*

Total water use in Sweden is given in Table 25.1. Given that industrial users utilise about 10 per cent of municipal supplies, industrial consumption can be estimated at 55 per cent of total water consumption in Sweden.

**Table 25.1. Water Use by Sector (1995)**

| <b>Water user</b>     | <b>Million m<sup>3</sup></b> | <b>%</b> |
|-----------------------|------------------------------|----------|
| Municipal supply      | 937                          | 31.8     |
| Rural domestic supply | 90                           | 3.0      |
| Industries            | 1 537                        | 52.3     |
| Agriculture           | 377                          | 12.8     |
| Total                 | 2 941                        | 100      |

*Source:* Swedish Water and Wastewater Association (approximate figures).

#### *Water sources for industry*

Table 25.2 indicates that the majority of industrial water use is supplied through direct abstractions. However, direct industrial abstractions have decreased by about 10 per cent since 1983. There has simultaneously been a decline in industrial water use from the community system, from 170 m<sup>3</sup> million in 1972 down to around 95 million in 1997, but the decrease over the last 10 years has been relatively small.

**Table 25.2. Industrial Abstractions, Excluding Nuclear Power Plants (1995, Rounded Figures)**

| Source of water                    | Consumption (m <sup>3</sup> million) |             |
|------------------------------------|--------------------------------------|-------------|
| Municipal system                   | 94                                   | 4.2%        |
| Groundwater (direct abstraction)   | 37                                   | 1.6%        |
| Surface water (direct abstraction) | 1 500                                | 67.2%       |
| Sea water                          | 600                                  | 26.8%       |
| <b>Total</b>                       | <b>2 231</b>                         | <b>100%</b> |

Source: Swedish Statistics.

### ***Types of industrial water use***

The largest quantities of industrial water are used for cooling purposes (about 53 per cent of total industrial use, although some of this water is not ‘consumed’, but is available for reuse), and for manufacturing processes (about 47 per cent). The largest industrial user categories are indicated in Table 25.3.

**Table 25.3. Largest Industrial Water Consumers (1995)**

| Industry category         | Million m <sup>3</sup> | % of total industry |
|---------------------------|------------------------|---------------------|
| Pulp and paper            | 981                    | 60                  |
| Chemical                  | 217                    | 13                  |
| Iron and steel            | 167                    | 10                  |
| Electricity, gas and heat | 76                     | 5                   |
| Others                    | 205                    | 12                  |
| <b>Total</b>              | <b>1 646</b>           | <b>100</b>          |

Source: Swedish Statistics.

## **Pricing principles**

### ***Price structure for water from the public supply system***

A two-part tariff structure is generally used for water from the public supply system, comprised of a standing charge and a volumetric charge. The standing charge is a fixed (annual) charge, and depends on factors such as the size of the industrial estate or the size of the water meter. Nearly all water users are metered, and the volumetric charge for industry is often similar to that paid by households. The value-added tax levied on water use is 25 per cent.

Large users with big water meters tend to pay a small fixed charge relative to the volumetric charge. Overall, the volumetric charge for large industrial users (i.e. those using more than 1 m<sup>3</sup>/h) accounts for more than 90 per cent of the total price of water charged to these users.

Seasonal variations in charges are prohibited by law. Industrial users can get a discount if they only use water for cooling purposes and do not release it into the public sewer system. They can also pay for the drinking water part of the tariff separately (about 40 per cent of total price).

### ***Trade effluent charges***

Water prices also include sewerage and sewage treatment. Industrial users have to pay extra sewerage charges that are calculated as a function of trade effluent loads.

Some 90 ‘communes’ in Sweden have special agreements with industries that discharge water of lower quality than household sewage. These industrial customers have to pay an extra charge for effluent discharges: particularly, for BOD, phosphorus and nitrogen.

### ***Abstraction charges***

There are no abstraction fees (since water is seen as being relatively abundant), but large groundwater abstractions must be legally authorised by the “Water Board of Justice”. This is a court with judges specialised in the Water and Sewage Act, the Water Act, and other environmental laws concerning water. Their jurisdiction includes (among other things) assigning permission to an industry, municipality, or even to a private person to extract a specified quantity — generally large — of water per time unit from an aquifer.

### **Price levels and trends**

#### ***Water from public supply system***

No detailed information was available for this study on industrial water prices. However, some median values were available (Table 25.4).

**Table 25.4. Industrial Prices in Sweden (Median Values, 1997)**

| Type of industry      | Consumption                 | Prices (SEK/m <sup>3</sup> excluding VAT) |
|-----------------------|-----------------------------|-------------------------------------------|
| Small industrial user | 200 m <sup>3</sup> per year | 18                                        |
| Large industrial user | 1 m <sup>3</sup> per hour   | 13                                        |

*Source:* Swedish Water and Wastewater Association.

These median values cover 286 different data points. Prices within these vary by as much as 50 per cent across the country. These variations are mainly due to the fact that the Swedish Water and Sewage Act prevents a ‘commune’ from making a profit on the supply of water and sewage services. Thus, price variations are mainly due to differences in abstraction costs, together with the fact that a small ‘commune’ will have a relatively high cost per person of providing water services compared with a large ‘commune’. They can also be due to the fact that “communes” are allowed to subsidise water prices through tax revenues.

Between 1985 and 1997, water prices increased by 11 per cent in real terms. Water subsidies fell by 11 per cent (down to 5 per cent today) over the same period, such that net prices have remained more or less stable.

### ***Sewerage prices***

Prices included in Table 25.4 include wastewater charges. The costs of drinking water services represent roughly 40 per cent of the total, with the costs of wastewater services making up the remaining 60 per cent. It is estimated that SEK 11 of the water prices levied on small industrial users corresponds to the cost of sewerage services, while this figure is SEK 8 for the large industrial users (VAT excluded).

In 1985, trade effluent charges for industrial users (VAT excluded) was SEK 1 per kilogramme of suspended solids (SS) and organic matter. The charge for total phosphorus (P) was higher, at SEK 20 per kilogramme. Only 80 “communes” of 284 impose this type of charges.

No data on trade effluent charges has been collected since 1985.

### ***Abstraction charges***

As yet, there are generally no abstraction charges in Sweden. The cost to industry of direct water abstractions is much lower than if they buy it from the community, depending on such cost factors as the quantity produced, capital costs, the cost of labour, the length of mains required, raw water quality, and purification and sewage treatment needs. For instance, for cooling water from a “clean” source, and where no purification or sewage treatment is needed, the cost will be minimal, and can be estimated at SEK 0.5 per cubic meter (pump, pipe and electricity).

## **REFERENCES**

SWEDISH STATISTICS.

SWEDISH WATER AND WASTEWATER ASSOCIATION (VAV). Communication with Mr. Mats Larsson.

## SWITZERLAND

### Context for industrial water uses

#### *Institutional arrangements*

Water supply services are under the responsibility of municipalities in Switzerland. In the cantons of Basle and Geneva, attempts are being made to form entities at the cantonal level. In the agglomeration areas of Basle, Berne, Geneva and Zurich, a supra-regional system overlays the groupings of water supply companies. In total, there are 236 water utilities in Switzerland. Water services are often part of an “umbrella” municipal utility, in charge of electricity and gas services as well as water services. There are no private companies, but management principles in use are often inspired by the private sector.

#### *Relative importance of industrial water use*

Industrial users receive about 20 per cent of publicly-supplied water. In addition, they use about 46 per cent of total direct water abstractions. In total, water use by industry accounts for approximately 60 per cent of the total water used in Switzerland.

**Table 26.1. Public Water Supply by Type of User (1995)**

| Type of user                    | Million m <sup>3</sup> | %          |
|---------------------------------|------------------------|------------|
| Households and small businesses | 610.6                  | 57.20      |
| Business and industry           | 217.5                  | 20.40      |
| Public services and fountains   | 71.1                   | 6.60       |
| Consumption by water utilities  | 20.1                   | 1.90       |
| Leakage                         | 148.2                  | 13.90      |
| <b>Total</b>                    | <b>1 067.50</b>        | <b>100</b> |

*Source:* Swiss Agency for the Environment, Forest and Landscape.

#### *Water sources for industry*

About 30 per cent of water for industry comes from the public supply network, with the remainder coming from direct abstractions.

#### *Types of industrial water uses*

No information was obtained for this study on major industrial users.

## **Pricing principles**

### ***Pricing structure for water from the public supply system***

Water consumption is usually metered. Charges are meant to be sufficient to cover costs. Tariffs are generally composed of a fixed element and a volumetric element, which can be either increasing or decreasing with the level of consumption. The average water price in Switzerland is Sfr 1.50, but prices can vary between a range between Sfr 0.60 and Sfr 3.00. Sewerage service charges are based on the volume of freshwater consumed, and are paid through a local tax whose revenues go to the municipalities.

## **REFERENCES**

GAS- WASSER - ABWASSER (1982). "Survey of the Structure of the Water Supply in Switzerland".

GIACASSO, P. (1991). "Le financement et le coût du secteur de l'eau en Suisse". In VALIRON, F. (1991). *Coût et prix de l'alimentation en eau et de l'assainissement*.

SERVICES INDUSTRIELS DE GENÈVE. Communication with Mr. Pierre Giacasso.

SWISS AGENCY FOR THE ENVIRONMENT, FORESTS AND LANDSCAPE. Communication with Mr. Jlona Mendez.

## TURKEY

### Context for industrial water uses

#### *Institutional arrangements*

According to the Constitution, control over both surface and groundwater resources (with the exception of some privately-owned springs) is under the responsibility of the State. Responsibility for the development, management, protection and conservation of water resources is divided between several ministries, state agencies, local administrations and municipalities. Water supply is under the responsibility of municipalities, which are controlled by the Ministry of Public Works and Settlements through the Bank of Provinces (*Iller Bankası*). This Bank provides infrastructure projects on a “turn-key” basis to municipalities, provides credit for financing these projects and technical assistance for construction, in particular for towns below 100 000 population. For large towns, the State Hydraulic Works (under the Ministry of Energy and Natural Resources) are responsible, through its control on inland water resources development.

Both governmental and non-governmental organisations (municipalities, administrations, utility agencies, irrigation co-operatives, water user associations, etc.) are involved in the operation and maintenance of water projects. The four main executive level organisations responsible for the development of water resources are the general directorates of State Hydraulic Works (DSI) and of Rural Services (GDRS), the Bank of Provinces (Iller Bank), and the Electric Works Investigation Administration (EIEI).

In Turkey, by law, the principal institution authorised to plan, develop, and manage all aspects of water resources is the DSI. The development, management, and conservation of groundwater resources (except mineral and geothermal waters) also fall exclusively under the responsibility of DSI. GDRS is responsible for the construction of rural roads, small reservoirs and small-scale irrigation schemes, and for supplying drinking water to rural communities. The Bank of Provinces is responsible for the development of urban plans, water supply and sewerage for municipalities, and for the provision of loans to municipalities for the construction of urban infrastructure. EIEI is responsible for surveys on electrical power, and for the rational use and conservation of electricity.

The Ministry of Environment, which was established as an under-secretariat in 1978 (elevated to Ministry status in 1991) is responsible for setting policies, principles and rules for water pollution control and for co-ordination and inspection activities relating to environmental aspects of water resources.

#### *Relative importance of industrial water use*

Agriculture is the dominant water-using sector in Turkey, while industry accounts for only approximately 10 per cent of the total water consumed (Table 27.1). In 1997, total water abstraction was approximately 35.55 km<sup>3</sup>, and almost 27.20 km<sup>3</sup> of this was utilised by the agricultural sector.

**Table 27.1. Annual Water Consumption by Major Sectors (1997)**

| <b>Sector</b> | <b>Total consumption (km<sup>3</sup>/a)</b> | <b>% of total withdrawals</b> |
|---------------|---------------------------------------------|-------------------------------|
| Agriculture   | 27.20                                       | 76.5                          |
| Public supply | 4.65                                        | 13.1                          |
| Industry      | 3.70                                        | 10.4                          |

***Water sources for industry***

About 81 per cent of water used by industry comes from direct abstractions, and 19 per cent from public supply. In 1997, the share of industrial water coming from surface waters was 86 per cent with the rest being drawn from groundwaters (14 per cent).

***Types of industrial water uses***

The food and drinks industry (including beet sugar production) is the dominant industrial water user in the manufacturing sector (28 per cent), followed by textiles (17 per cent), pulp and paper (14 per cent), steel and iron (10 per cent), mining (8 per cent), chemical (7 per cent), and finally, oil and petroleum (4 per cent).

**Pricing principles*****Pricing structure for water from the public supply system***

Prices of water and sewerage services are determined by the municipalities, if the user is connected to the municipal network. Water tariffs for industrial water coming from the public distribution systems are generally charged on a flat volumetric basis, with the rate being set by the municipalities. There is also a fixed charge for meter rent fee and distribution network maintenance.

***Sewerage and trade effluent charges***

Sewerage charges are identified independently in water bills, and are calculated as a proportion of the volume of water used. This charge was equal to 50 per cent and 100 per cent of the public water supply charges in Ankara and Istanbul, respectively. In addition, a charge is applied for wastewater disposal to the municipal sewerage system. Load charges for “extra strength” effluents are also applied in some municipalities. These municipalities may also ask industry to pre-treat effluents to a certain standard in order to meet the constraints of the public wastewater treatment process.

***Abstraction and discharge charges***

Concessional water rights, allocations, and long-term licenses are widely used to control direct abstractions from surface waters. No abstraction charges are applied for surface waters. The development, management and conservation of groundwater resources fall exclusively under that responsibility of DSI according to the Groundwater Law, No. 167. Under this Law, all groundwater allocations and abstractions are licensed and monitored by DSI, and revenues from groundwater abstraction charges (including charges to industry) are paid into the States’ general budgets.

Discharge charges are levied by the State according to the 1988 Water Pollution Control Regulation. The release of industrial effluents are controlled and enforced under the Water Pollution Control Regulation (1988), which basically follows the Polluter Pays Principle.

### **Price levels and trends**

In Ankara, industrial water supply and waste water charges are billed in the same invoice, and are levied for a 1.5 month period. As of August 1998, industrial water prices and waste water charges were US\$ 1.74/m<sup>3</sup> and US\$ 0.87/m<sup>3</sup> respectively (US\$ 1 = TL 272.000).

In Istanbul, as of August 1998, industrial water prices and waste water charges were US\$ 1.61/m<sup>3</sup> and US\$ 1.61/m<sup>3</sup> respectively.

### **REFERENCES**

- KULELI, SERAP. "Institutional and Legal Framework of the Water Sector in Turkey". Ministry of Environment, General Directorate for Environmental Protection.
- STATE HYDRAULIC WORKS (DSI). Communication with Mr. Hasan AKYAR, Deputy Head, Water and Sewerage Department.

## UK (ENGLAND & WALES)

### Context for industrial water uses

#### *Institutional arrangements*

Since privatisation in 1989, water and sewerage services in England and Wales have been provided by private-sector water companies, each of which has a regional monopoly. There are ten water and sewerage companies, and about twenty water-only companies. Recently, the prospect of competition between alternative suppliers has been introduced for very large water users (those consuming more than 250 000 m<sup>3</sup> of water per year).

The prices and service quality of all companies are regulated by the Office of Water Services (Ofwat), by means of a limit on the average increase in charges in any year, and through the monitoring of specified levels of service. This limit is applied to a “tariff basket” of charges for water and sewerage services (including trade effluent charges), covering both business customers and households.<sup>39</sup>

Charges may increase each year according to the inflation index, plus a “K” factor, set every five years at a level deemed to be sufficient by Ofwat to enable each company to finance its services, and to meet its legal obligations. As of the last review of K factors in 1994-95, these factors were generally positive (implying price increases in real terms), partly reflecting the level of investments needed to comply with existing European Union Directives.

Each company is responsible for its own charging structures, and these vary between companies depending on local circumstances and historical legacies. Charges are required to be broadly cost-reflective. According to Condition E of each company’s licence, Ofwat must ensure that there is “no undue discrimination or preference” in a company’s water and sewerage charges. Water abstraction charges are levied by the environmental regulator, the Environment Agency (EA). Abstraction charges are presently set to recover the EA’s costs, rather than serving as a measure of the economic costs of abstraction.

#### *Relative importance of industrial water use*

Extraction by the electricity industry accounts for nearly half of all abstractions in England and Wales. Much of this water is returned to source after being used for cooling (non-consumptive use). The relative importance of this and other uses is shown in Table 28.1. It is evident that the relative shares changed little over the period 1991-95. Industrial and power production uses together account for about 60 per cent of total water use.

---

39. There are currently proposals by the regulator to take the very largest users (those consuming greater than 250 000 m<sup>3</sup> of water per year) out of the (regulated) tariff basket.

**Table 28.1. Total Water Abstractions by Purpose (1991-95)**

| <b>Water abstraction (Ml/day)</b> | <b>1991</b>   |             | <b>1995</b>   |             |
|-----------------------------------|---------------|-------------|---------------|-------------|
| Public water supply               | 17 562        | 30%         | 17 346        | 31%         |
| Electricity supply industry       | 30 359        | 51%         | 25 805        | 46%         |
| Other industry                    | 5 469         | 9%          | 7 513         | 13.5%       |
| Other purposes*                   | 5 806         | 10%         | 5 306         | 9.5%        |
| <b>Total</b>                      | <b>59 196</b> | <b>100%</b> | <b>55 970</b> | <b>100%</b> |

*Note:* \* "Other purposes" include agriculture, fish farming, spray irrigation, and domestic water self-supply.

*Source:* Environment Agency.

### ***Water sources for industry***

About 76 per cent of water directly abstracted by industry is sourced from surface water, with the remaining 24 per cent coming from groundwater. For electricity supply, close to 100 per cent is abstracted from surface waters.<sup>40</sup> On the basis of an estimate that industrial consumers purchase around 25 per cent of public water supply (high estimate, based on supply to metered customers), direct abstractions by industry (excluding power production) account for about 64 per cent of industrial water use. With power production, direct abstractions account for 87 per cent of the total.

### ***Types of industrial uses***

No data was available for this study.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

Water charges for industrial users are generally made up of two components: a fixed (standing) charge, based on the size of the supply pipe; and a variable charge which varies according to the level of consumption. Most business customers (75 per cent) are metered,<sup>41</sup> non-metered business customers are those occupying quasi-domestic premises, such as small shops or small hotels. Additional charges are levied to cover the costs of providing new mains water supplies, or connections to public sewers.

Partly in response to the prospect of competition for such customers, most water companies have introduced "large user tariffs" to better reflect the lower costs actually imposed by large users on the water supply system. Thus, in April 1997, 20 of the 29 water supply companies offered a special tariff for large users. These discounts reflect, for example, the cost-savings that result if a large user does not make use of the local distribution network.

40. DoE (1996), Digest of Environmental Statistics.

41. Water Facts (1996).

### ***Sewerage and trade effluent charges***

Sewerage charges for metered users are based on the volume of water delivered, less a small allowance (typically 5 per cent) for water not discharged to the sewer. Sewerage charges also contain elements for surface drainage (run-off from properties) and highway drainage (run-off from roads and pavements).

Businesses which discharge trade effluent into a public sewerage system are charged for the treatment given on a volumetric basis, modified by factors which relate to its strength (according to the “Mogden formula”, which may change slightly from one water company to another). This formula apportions a cost to each stage of the treatment process, and takes into account the ways in which a particular firm’s effluent differs from the “average” composition of sewage in the region. Charges are determined by the elements of reception, conveyance, treatment and disposal associated with the trade effluent. Charges are averaged across regions, and are therefore unlikely to reflect costs incurred at any one treatment works.

The Mogden formula is:  $C = R + V + (O_t / O_s) B + (S_t / S_s) S$ , where:

C= Charge;

R = reception or conveyance;

V = additional volume charge if there is biological treatment;

B= biological oxidation of settled sewage;

$O_t$  = settled COD strength of the effluent (mg/l);

$O_s$  = COD (mg/l) of average strength settled sewage;

$S_t$  = total suspended solids of the effluent (mg/l);

$S_s$  = total suspended solids (mg/l) of average strength crude sewage; and,

S = treatment of disposal or primary sludge.

Businesses are not obliged to use the public system — they may undertake part of the treatment themselves (“self-treatment”).

### ***Abstraction charges***

Under the *Water Resources Act 1991*, the Environment Agency is responsible for administering a system of abstraction licensing for both surface water and groundwater.

All abstractions in excess of 20m<sup>3</sup> a day require a licence, which normally states: the source of supply; the means of abstraction; the amount of water that can be abstracted; the timing of abstractions over the year; specified water uses; the land where the water can be used; the duration of the licence; the conditions to protect other interests and the water environment; and how abstraction levels are to be measured and records kept.

Annual abstraction charges are based on the amount of water the user is authorised to abstract, not what is actually used in practice. There are two kinds of charges: an application charge (fixed at £100 in 1996/97) and an annual charge (set at a minimum of £25 annually).

The annual charge is calculated as follows:  $V \times A \times B \times C \times SUC$ , where:

V= annual licensed volume (in '000 cubic metres)

A= source factor

B= season factor

C= loss factor

SUC= standard unit charge for 10 different regions

The factors used for the calculation are indicated in Table 28.2:

**Table 28.2. Charge Factors for Abstraction Charges**

| Factor        | Categories                | Coefficient |
|---------------|---------------------------|-------------|
| Source Factor | Unsupported (groundwater) | 1.0         |
|               | Supported (surface water) | 3.0         |
|               | Tidal                     | 0.2         |
| Season Factor | Summer                    | 1.6         |
|               | Winter                    | 0.16        |
|               | All Year                  | 1.0         |
| Loss Factor   | High loss                 | 1.0         |
|               | Medium loss               | 0.6         |
|               | Low loss                  | 0.03        |
|               | Very low loss             | 0.003       |

Source: Environment Agency.

The development of a regulatory framework to facilitate competition in water supply has focused attention on the system of water allocation. The Department of the Environment has recently begun a review of the feasibility of introducing economic instruments to the system of water allocation. Issues under consideration seem likely to include abstraction charges aimed at reflecting economic costs to a greater extent than they currently do, as well as the potential role that transferable forms of entitlement might play in this allocation.

### **Discharge charges**

There are no discharge charges as such, but discharges are required to meet "consent levels" set by the Environmental Agency. Two administrative fees are charged to cover the costs of issuing and monitoring consents and authorisation conditions: an application charge (payable on application for a new or revised consent) and an annual charge, based on the volume and the content of the effluent, as well as the type of receiving waters.

If industrial discharges do not meet these requirements, they have to be treated by a public sewerage company, and hence, to be subjected to the trade effluent charges (see earlier discussion). The Department of Environment Transport and Regions (DETR) has recently launched a review of possibilities for charging for discharges (including economic instruments).

## Price levels and trends

### *Water from public supply system*

Standard water prices by the water companies of England and Wales are presented in Table 28.3. Prices vary from one region to the other, mainly due to cost variations.

On average, and due to Ofwat's non-discrimination principle, prices for industrial users have usually been set on a basis comparable to that used for metered household customers.<sup>42</sup> The standing charge for the smallest pipe size is equal to households' standing charge, as is the volumetric.

As mentioned earlier, this can be modified when special tariffs for large users are introduced. Table 28.4 provides some examples of large-user tariffs currently being offered by water and sewerage companies.

### *Sewerage and trade effluent charges*

Sewerage charges are levied by water companies for collecting, treating, and disposing of sewage, and for covering the costs of the transportation network. These are independent of the strength of the effluent involved. In addition, water and sewerage companies can impose a trade effluent charge, which reflects the strength of the effluent discharged by industrial users into the public sewers.

Standard sewerage charges and typical bills are shown in Table 28.5, and information on trade effluent charges is provided in Table 28.6.

Table 28.6 also indicates the value attached to various characteristics of the effluent discharged to a public sewer. These factors are combined according to the Mogden formula, discussed earlier. Some companies use more detailed factors, which are explained in the key to Table 28.6.

### *Direct abstraction or treatment*

The standard unit charge (SUC) varies from one region to another. In 1996/97, the SUC varied between £6.51/m<sup>3</sup> in Yorkshire and £16.71/m<sup>3</sup> in Northumbria, with an average of £10.73/m<sup>3</sup>. The regions for the application of abstraction charges differ from the Environment Agency's current organisational boundaries. Standard unit charges for the 10 relevant regions are indicated in Table 28.7.

---

42. In England and Wales, the majority of household customers are not metered, but water companies must try to reach an equivalence between metered and non-metered customers.

Table 28.3. Standard Water Tariffs (1997/98)

|                           | Standing charges (£) |        |          | Volumetric<br>Charge | Annual Bill (£) |            |            |
|---------------------------|----------------------|--------|----------|----------------------|-----------------|------------|------------|
|                           | 12mm                 | 50mm   | 150mm    |                      | Business<br>1   | Business 2 | Business 3 |
|                           | (1/2")               | (2")   | (6")     |                      | 1997-98         | 1997-98    | 1997-98    |
| Water & sewage companies  |                      |        |          |                      |                 |            |            |
| Anglian                   | -                    | -      | -        | -                    | 104             | 713        | 135 416    |
| Dwr Cymru <sup>1</sup>    | 23.00                | 248.00 | 750.00   | 79.00                | 102             | 1 038      | 158 750    |
| North West <sup>1</sup>   | 34.00                | 117.00 | 1 380.00 | 61.50                | 96              | 732        | 124 380    |
| Northumbrian:             |                      |        |          |                      |                 |            |            |
| Northumbrian              | 24.00                | 504.00 | 5 301.00 | 55.83                | 80              | 1 062      | 116 961    |
| North East                | 24.00                | 486.00 | 5 301.00 | 53.06                | 77              | 1 017      | 111 421    |
| Severn Trent <sup>1</sup> | 27.00                | 94.92  | 650.76   | 67.99                | 95              | 775        | 136 631    |
| South West <sup>1</sup>   | 18.60                | 225.00 | 1 200.00 | 81.38                | 100             | 1 039      | 163 960    |
| Southern                  | 24.40                | 457.00 | 3 400.00 | 58.40                | 83              | 1 041      | 120 200    |
| Thames                    | 19.00                | 304.00 | 1 000.00 | 53.62                | 73              | 840        | 108 240    |
| Wessex                    | 24.00                | 300.00 | 1 000.00 | 77.76                | 102             | 1 078      | 156 520    |
| Yorkshire                 | 23.00                | 196.00 | 662.00   | 69.80                | 93              | 894        | 140 262    |
| Water-only companies      |                      |        |          |                      |                 |            |            |
| Bournemouth & W Hampshire | 18.00                | 227.00 | 1 764.00 | 56.68                | 75              | 794        | 115 124    |
| Bristol                   | 21.00                | 120.00 | 600.00   | 59.60                | 81              | 716        | 119 800    |
| Cambridge                 | 22.80                | 200.00 | 4 600.00 | 57.20                | 80              | 772        | 119 000    |
| Chester                   | 23.00                | 454.00 | 2 150.00 | 54.27                | 77              | 997        | 110 690    |
| Cholderton                | 20.00                | -      | -        | 76.40                | 96              | -          | -          |
| Essex & Suffolk           | 22.50                | 270.00 | 1 850.00 |                      |                 |            |            |
| Essex                     |                      |        |          | 61.08                | 84              | 881        | 124 010    |
| Suffolk                   |                      |        |          | 84.36                | 107             | 1 114      | 170 570    |
| Folkestone & Dover        | 23.80                | 491.40 | -        | 65.00                | 89              | 141        | 132 951    |
| Hartlepool                | 24.00                | 24.00  | 24.00    | 38.50                | 63              | 409        | 77 024     |
| Mid Kent                  | 19.20                | 96.00  | 252.00   | 68.34                | 88              | 779        | 136 932    |
| Mid Southern              | 19.50                | 380.00 | 3 300.00 | 59.53                | 79              | 975        | 122 360    |
| North Surrey              | 19.50                | 515.00 | 4 026.00 | 62.11                | 82              | 1 136      | 128 246    |
| Portsmouth <sup>2</sup>   | 22.00                | 262.00 | 2 401.00 | 41.20                | 63              | 674        | 84 801     |
| South East                | 19.50                | 581.00 | 5 086.00 |                      |                 |            |            |
| Eastbourne                |                      |        |          | 104.24               | 124             | 1 623      | 213 566    |
| Mid Sussex                |                      |        |          | 109.15               | 129             | 1 673      | 223 386    |
| West Kent                 |                      |        |          | 86.00                | 106             | 1 447      | 178 206    |
| South Staffs              | 14.50                | 132.06 | 305.16   | 52.82                | 67              | 660        | 105 945    |
| Sutton & East Surrey      |                      |        |          |                      |                 |            |            |
| East Surrey               | 24.00                | 384.00 | 3 456.00 | 81.00                | 105             | 1 194      | 165 456    |
| Sutton                    | 24.00                | 384.00 | -        | 50.00                | 74              | 884        | 100 024    |
| Tendering Hundred         | 23.00                | 360.00 | 900.00   | 98.50                | 122             | 1 345      | 197 900    |
| Three Valleys             | 25.00                | 224.00 | 1 773.00 | 54.69                | 80              | 771        | 111 153    |
| Wrexham                   | 23.00                | 617.52 | n.a.     | 68.36                | 91              | 1 301      | 138 145    |
| York                      | 22.40                | 56.00  | n.a.     | 48.60                | 71              | 542        |            |

Notes: 1 Average bills given for these companies do not take account of customer rebates paid in 1996-97 and 1997-98.

Annual bills are calculated for the following types of businesses:

**Business 1**

Small business  
15mm (1/2") supply pipe  
100m<sup>3</sup> water used per year.

**Business 2**

Commercial building, e.g.. hotel  
50mm (2") supply pipe  
1 000m<sup>3</sup> water used per year.

**Business 3**

Major manufacturer 150mm (6") supply pipe  
200 000m<sup>3</sup> water used per year  
Bill calculated on standard tariff structures and do not take account of large user tariffs.

Source: Ofwat 1997-98 Report on tariff structure and charges - Tables D3 and D5.

**Table 28.4. Large User Water and Sewerage Tariffs (1997/98)**

|                                     |              | Breakdown point | Fixed charge | Volumetric Charge |            | % bill saving for customer using 300MI |
|-------------------------------------|--------------|-----------------|--------------|-------------------|------------|----------------------------------------|
|                                     |              | MI              | £/year       | Standard p/m3     | Lower p/m3 |                                        |
| <b>Water and Sewerage Companies</b> |              |                 |              |                   |            |                                        |
| Anglian <sup>1</sup>                |              |                 |              |                   |            |                                        |
| water                               | Orange       | 0.5             | 46           | 67.69             | 65.63      | 3                                      |
|                                     | Blue         | 5               | 250          | 67.69             | 61.64      | 9                                      |
|                                     | Industrial   | 50              | 7 920        | 67.69             | 46.25      | 28                                     |
| Sewerage                            | Orange       | 0.5             | 45           | 92.90             | 91.04      | 2                                      |
|                                     | Blue         | 5               | 300          | 92.90             | 86.45      | 7                                      |
|                                     | Industrial   | 50              | 4 240        | 92.90             | 79.37      | 13                                     |
| Dwr Cymru                           |              | 250             | 60 250       | 79.00             | 55.30      | 5                                      |
| North West                          |              | 250             | 46 000 2     | 61.50             | 43.10      | 5                                      |
| Northumbrian:                       |              |                 |              |                   |            |                                        |
|                                     | Northumbrian | 267             | 35 000 2     | 55.83             | 42.71      | 3                                      |
|                                     | North East   | 338             | 35 000 2     | 53.06             | 42.71      |                                        |
| Severn Trent                        |              | 250             | 50 175       | 67.99             | 47.92      | 5                                      |
| South West                          |              |                 |              |                   |            |                                        |
| water                               |              | 150             | 33 400 2     | 81.38             | 59.11      | 14                                     |
| sewerage                            |              | 150             | 33 400 2     | 148.65            | 127.49     | 7                                      |
| Thames                              |              | 94              | 10 000 2     | 53.62             | 42.90      | 14                                     |
| Wessex                              |              |                 |              |                   |            |                                        |
| Band 1                              |              | 50              | 200          | 77.76             | 68.29 3    | 10                                     |
| Band 2                              |              | 100             | 200          | 77.76             | 51.96 3    | 22                                     |
| Band 3                              |              | 150             | 200          | 77.76             | 42.09 3    | 23                                     |
| Yorkshire                           |              |                 |              |                   |            |                                        |
| water                               |              | 50              | Standard     | 69.80             | 68.30 3    |                                        |
|                                     |              | 250             | Standard     | 69.80             | 49.40 3    | 6                                      |
|                                     |              | 3 000           | Standard     | 69.80             | 40.00 3    |                                        |
| sewerage                            |              | 50              | Standard     | 86.07             | 85.22 3    |                                        |
|                                     |              | 250             | Standard     | 86.07             | 60.23 3    | 6                                      |
| <b>Water-only Companies</b>         |              |                 |              |                   |            |                                        |
| Bristol                             |              |                 |              |                   |            |                                        |
| Band 2                              |              | 100             | 5 450        | 59.60             | 48.20      |                                        |
| Band 3                              |              | 250             | 12 950       | 59.60             | 45.20      | 17                                     |
| Band 4                              |              | 500             | 27 450       | 59.60             | 42.30      |                                        |
| Cambridge                           |              | 150             | Standard     | 57.20             | 40.20      | 29                                     |
| Essex & Suffolk:                    |              |                 |              |                   |            |                                        |
| Essex                               |              |                 |              |                   |            |                                        |
| Band 1                              |              | 100             | 18 390 2     | 61.08             | 42.68      | 20                                     |
| Band 2                              |              | 1 000           | 18 390 2     | 61.08             | 39.51 3    |                                        |
| Suffolk                             |              |                 |              |                   |            |                                        |
| Band 1                              |              | 100             | 25.450 2     | 84.36             | 58.93      | 20                                     |
| Band 2                              |              | 1 000           | 25.450 2     | 84.36             | 54.62 3    |                                        |
| Folkestone & Dover                  |              | 150             | Standard     | 65.00             | 59.20      | 9                                      |
| North Surrey                        |              | 100             | Standard     | 62.11             | 39.80 3    | 23                                     |
| South Staffordshire                 |              | 250             | 31 245       | 52.82             | 40.72      | 3                                      |
| Sutton & East Surrey:               |              |                 |              |                   |            |                                        |
| East Surrey                         |              | 250             | Standard     | 81.00             | 59.00      | 27                                     |
| Tendering Hundred                   |              |                 |              |                   |            |                                        |
| Band 1 Jun, Jul, Aug                |              | 25              | 6 000        | 98.50             | 96.20      |                                        |
| Band 1 other months                 |              |                 |              |                   | 71.40      |                                        |
| Band 2 Jun, Jul, Aug                |              | 50              | 12 000       | 98.50             | 80.00      |                                        |

|                      | Breakdown point | Fixed charge | Volumetric Charge |            | % bill saving for customer using 300MI |
|----------------------|-----------------|--------------|-------------------|------------|----------------------------------------|
|                      | MI              | £/year       | Standard p/m3     | Lower p/m3 |                                        |
| Band 2 other months  |                 |              |                   | 59.20      |                                        |
| Band 3 Jun, Jul, Aug | 100             | 20 000       | 98.50             | 68.30      |                                        |
| Band 3 other months  |                 |              |                   | 59.90      | 37                                     |
| Three Valleys        | 100             | Standard     | 54.69             | 40.00 3    | 18                                     |
| Wrexham              | 250             | 26 075       | 68.36             | 54.69      | 3                                      |
| York                 | 50              | Standard     | 48.60             | 41.45 3    | 12                                     |

- Notes:**
1. Anglian has a choice of tariffs for non-household customers: Streamline Green, Orange, Blue and Industrial. The breakdown points for 'Orange', 'Blue' and 'Industrial' are provided for guidance only. Customers must assess the most beneficial option for them. Choosing the Streamline Industrial tariff also entitles customers to be charged at industrial trade effluent charges.
  2. Fixed charge is supplementary to the normal standing charge based on meter size.
  3. Lower, volumetric charge applies to all volume after break-even point.

**Source:** 1997-98 Report on tariff structure and charges - Table 25

**Table 28.5. Standard Sewerage Tariffs (1997/98)**

|                        | Meter size |        |           | Volumetric charge | RV charge | Annual bill (£)    |                    |                    |
|------------------------|------------|--------|-----------|-------------------|-----------|--------------------|--------------------|--------------------|
|                        | (1/2")     | (2")   | (6")      | p/m3              | p/ERV     | Business 1 1997-98 | Business 2 1997-98 | Business 3 1997-98 |
| Anglian1               | -          | -      | -         | -                 | -         | 128                | 964                | 152 954            |
| Dwr Cymru*             | 11.00      | 29.00  | 412.00    | 100.86            |           | 112                | 1 038              | 147 861            |
| North West*            | 3.00       | 167.00 | 1, 204.00 | 57.60             | 33.20     | 393                | 7 383              | 113 485            |
| Northumbrian           | -          | -      | -         | 39.93             | 27.80     | 318                | 5 959              | 136 698            |
| Severn Trent (Zone 4)* | -          | -      | -         | 60.83             | 18.57     | 247                | 4 322              | 122 133            |
| South West*            | 9.00       | 330.00 | 1 200.00  | 148.65            |           | 158                | 1 817              | 289 498            |
| Southern               | 34.00      | 580.00 | 3 924.00  | 81.23             |           | 115                | 1 392              | 168 081            |
| Thames                 | 38.00      | 608.00 | 5 472.00  | 44.74             |           | 83                 | 1 055              | 108 450            |
| Wessex                 | 36.00      | 700.00 | 6 000.00  | 79.81             |           | 116                | 1 498              | 142 157            |
| Yorkshire              | 18.00      | 140.00 | 466.00    | 86.07             |           | 104                | 1 001              | 145 664            |

- Notes:**
- \* Average bills given for these companies do not take account of customer rebates paid in 1996-97 and 1997-98.
  1. Anglian has a series of four optional tariffs for non-household customers, each of which consists of a fixed charge and a volumetric charge, with no standing charge based on meter size.

The following businesses were used to calculate typical annual sewerage bills:

| Business 1                       | Business 2                       | Business 3                                                                                                                                       |
|----------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Small business                   | Commercial building, e.g. hotel  | Major manufacturer                                                                                                                               |
| £1 000 rateable value            | £20 000 rateable value           | £30 000 rateable value                                                                                                                           |
| 15mm (1/2") supply pipe          | 50mm (2") supply pipe            | 150mm (6") supply pipe                                                                                                                           |
| 100m3 water used per year.       | 1 000m3 water used per year.     | 200 000m3 water used per year.                                                                                                                   |
| All sewage is domestic strength. | All sewage is domestic strength. | 60 000m3 domestic strength sewage;<br>140 000m3 trade effluent discharged to sewer<br>at 750 chemical oxygen demand and 350<br>suspended solids. |

**Source:** 1997 Water Facts and 1997-98 Ofwat report on tariff structure and charges - Tables D4 and D6.

**Table 28.6. Standard Trade Effluent Tariffs (1997-98)**

|                         | Min.<br>charge | Charge factors |           |            |           |            |            |            |            | Annual bills |        |
|-------------------------|----------------|----------------|-----------|------------|-----------|------------|------------|------------|------------|--------------|--------|
|                         | £              | R<br>p/m3      | V<br>p/m3 | Bv<br>p/m3 | M<br>p/m3 | B'<br>p/kg | S'<br>p/kg | Os<br>mg/l | Ss<br>mg/l | Bill 1       | Bill 2 |
| Anglian -standard       | 125.00         | 11.42          | 17.88     | 3.45       | 9.58      | 38.66      | 21.88      | 456        | 383        |              |        |
| Industrial <sup>1</sup> |                | 10.06          | 15.74     | 3.05       | 8.44      | 34.06      | 19.27      | 456        | 383        | 7 565        | 2 353  |
| Dwr Cymru               | 107.00         | 13.00          | 7.57      | 3.03       | 11.21     | 34.90      | 35.20      | 500        | 350        | 7 303        | 2 057  |
| North West              | 108.00         | 10.80          | 8.60      | 1.20       | 8.10      | 24.16      | 27.66      | 364        | 235        | 5 433        | 1 687  |
| Northumbrian            | 253.00         | 20.44          | 10.03     | -          | -         | 39.51      | 41.34      | 386        | 187        | 8 529        | 2 539  |
| Severn Trent            | 110.42         | 15.98          | 15.07     | -          | -         | 25.70      | 19.61      | 351        | 343        | 5 746        | 2 104  |
| South West              | 124.80         | 33.45          | 30.83     | -          | -         | 72.98      | 66.30      | 744        | 489        | 15 652       | 4 938  |
| Southern                | 135.00         | 21.16          | 15.45     | 2.49       | 2.72      | 45.08      | 27.24      | 452        | 512        | 8 952        | 2 814  |
| Thames                  | 72.00          | 6.74           | 8.29      | -          | -         | 20.35      | 49.54      | 445        | 336        | 6 897        | 1 788  |
| Wessex                  | 170.00         | 19.50          | 12.60     | -          | -         | 25.62      | 33.53      | 802        | 313        | 6 484        | 2 364  |
| Yorkshire               | 200.00         | 17.46          | 20.06     | -          | -         | 21.77      | 37.08      | 931        | 336        | 6451         | 2650   |

Note: 1. Choosing the Industrial tariff entitles Anglian's customers to be charged as industrial trade effluent charges.

**Key**

Bv - additional volume charge if there is biological treatment

M - treatment and disposal where effluent goes to a sea outfall (M for marine)

B' - B/Os, i.e. B corrected for average regional strength

S' - S/Ss, i.e. S corrected for average regional strength

**Bill 1:** 5,000 m<sup>3</sup> of High Strength Effluent, calculated according to the Mogden formula, where effluent characteristics are:

volume (m<sup>3</sup>) 5 000

COD (MG/l) 2 000

SS (mg/l) 1 000

Charge = (R + V + Bv)\* 5 000 + B\*2\*5 000 + S\*1\*5 000

**Bill 2:** 5 000 m<sup>3</sup> of Low Strength Effluent, calculated according to the Mogden formula, where effluent characteristics are:

volume (m<sup>3</sup>) 5 000

COD (MG/l) 200

SS (mg/l) 300

Charge = (R + V + Bv)\* 5 000 + B\*0.2\*5 000 + S\*0.3\*5 000

Sources: Water Facts, and Ofwat 1997-98 Report on tariff structure and charges - Tables 22 and 23.

**Table 28.7 Standard Unit Charge by Region for Abstraction Charges (1996/97)**

| Region      | SUC (£/1 000m <sup>3</sup> ) |
|-------------|------------------------------|
| Anglian     | 14.09                        |
| Northumbria | 16.71                        |
| North West  | 8.12                         |
| Midlands    | 9.36                         |
| Southern    | 10.57                        |
| South West  | 13.05                        |
| Thames      | 8.03                         |
| Welsh       | 7.77                         |
| Wessex      | 13.05                        |
| Yorkshire   | 6.51                         |

Source: Environment Agency, Annual abstraction charges, 1996/97.

## REFERENCES

ENVIRONMENT AGENCY (1997). *The Environment in Your Pocket*.

ENVIRONMENT AGENCY (1996a). *The Environment of England and Wales, A Snapshot*. (April): Bristol.

ENVIRONMENT AGENCY (1996b). *Annual Abstraction Charges (1996-1997)*: Bristol.

OFFICE OF WATER SERVICES (1997). "1997-98 Report on Tariff Structure and Charges" (May): Birmingham.

WATER SERVICES ASSOCIATION (1996). "*Water Facts*": London.

## UNITED STATES

### Context for industrial water uses

#### *Institutional arrangements*

In the US, there are more than 50 000 water systems. About half of these systems are owned by government entities (usually municipalities), which also run the majority of wastewater systems. The rest are nearly equally divided between privately-owned systems and auxiliary systems owned by homeowners' associations (such as those found in mobile home parks). The financial and operating characteristics of water systems vary substantially, according to their size.

Publicly-owned utilities' pricing policies are not regulated, and they can experiment with various systems of rate-setting. They typically use a "cash-needs" method of rate-setting, primarily aimed at keeping the utility viable. Privately-owned utilities tend to be regulated by the State Public Utility Commissions (10 000 systems fall under this jurisdiction), which regulate all investor-owned utilities in a given State. These regulatory commissions have the power to fix prices and price structures in a way that imitates the conditions that companies would face in a competitive market. Due to several factors (particularly criticism of publicly-owned utilities' management and fiscal policy changes that have reduced the sources of finance for new investment by public utilities), there is a trend towards the privatisation of water systems. In the long run, this trend could also have an impact on the pricing policies adopted by utilities.

#### *Relative importance of industrial water use*

Industry uses water from two main sources: public supply and self-supply.<sup>43</sup> Industrial use from public supply water systems accounts for 13 per cent of total water use from the public supply (in comparison, commercial use accounts for 15 per cent, and thermo-electric power use for less than 1 per cent). However, nearly 95 per cent of 1990 industrial water use was based on direct abstractions, which accounted for 7 per cent of total out-stream use in the US, and are particularly prevalent in rural areas. Together with thermoelectric power production, industrial use accounts for 56 per cent of total out-stream water use. More water is extracted by thermoelectric power production than by any other category.

Self-supplied water used by industry declined by 37 per cent from 1970 to 1990, while water used by the thermoelectric industry increased by 15 per cent, and total out-stream use increased by 8 per cent (Table 29.1).<sup>44</sup>

---

43. In the US, public supply is considered to be the supply of water through water systems that furnish at least 25 people, or that have a minimum of 15 connections.

44. No data were available for industrial use from the public supply system in 1970.

**Table 29.1. Estimated Use of Water in the United States (million gallons per day)**

| Type of user                              | 1970           |            | 1990           |            |
|-------------------------------------------|----------------|------------|----------------|------------|
|                                           | Mgal/day       | %          | Mgal/day       | %          |
| Total public supply                       | 27 000         | 7          | 38 500         | 9          |
| Industrial use from public supply         | n.a.           | n.a.       | 5 005          | 1          |
| Thermoelectric power from public supply   | n.a.           | n.a.       | 770            | 0          |
| Rural (domestic self-supplied, livestock) | 4 500          | 1          | 7 890          | 2          |
| Irrigation                                | 130 000        | 34         | 137 000        | 34         |
| Thermoelectric power                      | 170 000        | 45         | 195 000        | 48         |
| Other industrial use                      | 47 000         | 12         | 29 900         | 7          |
| <b>Total out-stream use</b>               | <b>378 500</b> | <b>100</b> | <b>408 290</b> | <b>100</b> |

Source: U.S. Geological Survey (1993).

### ***Water sources for industry***

Surface water was the source of about 82 per cent of self-supplied industrial withdrawals in 1990, with groundwater accounting for about 18 per cent.<sup>45</sup>

### ***Types of industrial water uses***

In the US, major water-using industries include steel, chemical and allied products, paper and allied products, and petroleum refining. The Great Lakes region and the south (Texas, Louisiana) had the largest abstractions for industrial purposes, as did Pennsylvania, where industrial abstractions ranged from 1 500 to 2 600 million gallons per day. Consumptive use accounted for only 15 per cent of water abstracted for industrial purposes, with the rest being returned to the flow.

### **Pricing principles**

#### ***Pricing structure for water from the public supply system***

For investor-owned water companies, the guiding principle used for setting the *level* of prices is the cost-of-service standard: rates should recover no more, but no less either, than the actual cost of providing the services. When setting rates, the regulatory commission will first determine the total revenues to which the company is entitled for providing the water services. Individual prices for each part of the service are then calculated from the total revenue figure, such that the total required revenue is generated with the most efficient pricing structure possible.

Regarding price *structures*, almost all water networks meter customer consumption and charge in relation to the volume of water that is consumed. Various price structures have been adopted, with the choice of rate structure usually reflecting supply availability and other regional differences. Price structures for industrial users are often different from those used for household customers for the same utility.

45. US Geological Survey (1993).

Historically, flat fees were used for non-metered customers and declining-block rate structures for metered accounts. Declining-block rates, in which the price of one unit of water declines with the volume consumed, were predicated on the belief that economies of scale and demand patterns warranted such a structure. However, the use of declining-block rates waned during the 1980s, and has been banned entirely in Massachusetts. Water utilities have increasingly opted for uniform rates or (in some cases) increasing-block rates, often aimed at water conservation objectives. For the same reason, rates based on marginal (or incremental) costs have been increasingly popular as have seasonal rates, aimed at smoothing peak demands, usually with a winter (low) rate and a summer (higher) rate.

Increasing-block rates hurt large users most, which are also penalised by the introduction of discounts for low-income customers. In regions with the largest industrial bases, such as the Mid-West, where resources are plentiful, increasing-block structures have faced considerable resistance and they are less prevalent than in the rest of the country. It is in those regions which are confronted by the most severe drought conditions, such as the West, that increasing-block tariffs have been most popular, including for industrial users.

A number of municipalities have adopted innovative rate structures, for example:

- Los Angeles, California has adopted a seasonal increasing-block rate structure (two usage blocks) with rates being adjusted for “average prior use” for industrial users.
- Phoenix, Arizona has adopted a seasonal uniform rate structure, based on long-term marginal cost.
- Las Vegas, Nevada has an increasing-block structure (four usage blocks), with the highest block defined as an “excess-use charge”.
- Johnson County, Kansas has an increasing-block structure (two usage blocks), with a “peak demand” rate.

With the introduction of increasing-block tariffs, it can be expected that large users will become more proactive in the rate-setting process, which might lead to legal challenges. In an increasing number of cases, large customers try to negotiate special rates that will not have such a big impact on their bills. As a result, the burden might fall more heavily on smaller industrial customers. Another innovation is the introduction of different rate structures for each customer class. This can help reduce the impacts on some large users’ bills, while also helping to achieve socio-economic objectives.

Communities vary widely in the use of connection charges and system development fees. Many utilities charge a higher price for customers served outside of municipal boundaries. This can add to the monthly water charges.

### ***Sewerage and trade effluent charges***

Tariff structures for wastewater services are less sophisticated than those for water services, with more rates based on uniform structure, and with no seasonal volume adjustment. Some utilities have retained decreasing-block structures, while others have introduced increasing-block structures, with up to 10 blocks (Boston, MA).

Since the passage of the *Federal Water Pollution Act (1972)*, sewerage charges have been introduced in a growing number of water networks, with surcharges being imposed for strength characteristics. These surcharges typically apply to the following categories:

- TSS: total suspended solids;
- BOD/COD: biological or chemical oxygen demand;
- Monitoring surcharges;
- Laboratory testing surcharges;
- Other: surcharges for phosphorus, oil and grease, ammonia, nitrogen, septage and other purposes.

### ***Abstraction and discharge charges***

Regulation of water abstractions for surface water varies widely from one State to another. Doctrines for the establishment of water rights have been developed through a succession of court cases, before being enshrined in states' legislation.

For surface water, eastern ("humid") states generally abide by the *riparian* doctrine, while the western ("arid") states typically follow the rules of *prior appropriation*, defined as follows:

- According to the *riparian* doctrine, the right to take water depends on ownership of a land bordering a surface water body. There is usually no mention of a specific volume of water or rate of water flow to be maintained.
- According to the *appropriation* doctrine, existing water users have stronger rights than late-comers. This doctrine rests on two principles: priority (which matches supply and demand as no further use is allowed), and beneficial use (which favours the most efficient use). The administrative permit system was a major development, since it provides for efficient enforcement of rights. Many States have developed permit programmes which require the reporting of industrial withdrawals and return flows.

In terms of resource fees, it is unlikely that States will start imposing a resource charge for the abstraction of surface water, since this has rarely been proposed in the United States. However, there have been some initiatives at the State level to charge for groundwater, in order to limit the over use of this resource. For instance, the Arizona's Groundwater Management Act of 1980 imposed water pumping taxes which were expected to increase over time. Other States in the West have imposed this type of charge, but mainly to cover the costs of engineering, administration, and water losses.

### **Price levels and trends**

#### ***Water from public supply system***

During the 1980s, water prices increased sharply across the US, in some cases by a factor of two or three. Further price increases are expected, in order to meet the requirements of the *Safe Drinking Water Act*.

Information on price levels for this study was obtained through the survey of water rates published by Raftelis Environmental Consulting Group (1996). In this survey, data is arranged by system size, using 3 categories based on the size of the water system, ranging from large systems (group A) to systems serving a small number of customers (group C). The data was collected during the summer and

autumn of 1995, for sample cities in 46 States. The survey encompasses 139 water utilities and 112 wastewater utilities. The monthly charges shown in Table 29.2 include service charges and volume charges, based on different consumption levels and different pipe sizes.

Table 29.2 illustrates average monthly water charges for the various customer groups, and compares bills for industry and households for 142 water distribution systems across the US. This shows that standing (fixed) charges and/or decreasing-block tariff structures are still prevalent, since prices for industrials are proportionally lower than those for domestic customers. Prices in larger systems (Group A) tend to be lower than in the smallest ones (Group C).

**Table 29.2. Water Charges (Average 1995 US\$)**

| System                 | MONTHLY WATER CHARGES                |                                        |                                 |                                               |                                                |
|------------------------|--------------------------------------|----------------------------------------|---------------------------------|-----------------------------------------------|------------------------------------------------|
|                        | 5/8-Inch Meter                       | 2-Inch Meter                           |                                 | 4-Inch Meter                                  | 8-Inch Meter                                   |
|                        | Residential<br>500 CF<br>(3 740 Gal) | Commercial<br>3 000 CF<br>(22 440 Gal) | Commercial/<br>Light Industrial | Industrial<br>1 000 000 CF<br>(7 480 000 Gal) | Industrial<br>1 500 000 CF<br>(11 220,000 Gal) |
|                        |                                      |                                        | 50 000 CF<br>(374 000 Gal)      |                                               |                                                |
| <b>ALL SYSTEMS</b>     |                                      |                                        |                                 |                                               |                                                |
| Average                | 9.39                                 | 39.47                                  | 557.02                          | 9 979.26                                      | 15 031.03                                      |
| Mean                   | 8.76                                 | 36.22                                  | 529.69                          | 8 886.04                                      | 13 201.85                                      |
| Number of Systems      | 142                                  | 142                                    | 142                             | 141                                           | 134                                            |
| <b>GROUP A SYSTEMS</b> |                                      |                                        |                                 |                                               |                                                |
| Average                | 8.06                                 | 33.62                                  | 503.34                          | 8 799.05                                      | 14 510.74                                      |
| Mean                   | 8.19                                 | 34.21                                  | 486.82                          | 7 926.97                                      | 12 964.79                                      |
| Number of Systems      | 34                                   | 34                                     | 34                              | 34                                            | 33                                             |
| <b>GROUP B SYSTEMS</b> |                                      |                                        |                                 |                                               |                                                |
| Average                | 9.97                                 | 42.74                                  | 564.31                          | 9 866.10                                      | 14 510.74                                      |
| Mean                   | 9.43                                 | 34.80                                  | 530.92                          | 8 747.06                                      | 12 964.79                                      |
| Number of Systems      | 61                                   | 61                                     | 61                              | 61                                            | 60                                             |
| <b>GROUP C SYSTEMS</b> |                                      |                                        |                                 |                                               |                                                |
| Average                | 9.60                                 | 39.30                                  | 11 001.67                       | 11 001.67                                     | 17 078.75                                      |
| Mean                   | 9.00                                 | 38.73                                  | 10 292.34                       | 10 292.34                                     | 16 507.00                                      |
| Number of Systems      | 47                                   | 47                                     | 46                              | 46                                            | 41                                             |

*Note:* Summary statistics include district rates and exclude peak-season rates.

*Source:* 1996 Raftelis Environmental Consulting Group, Inc

### ***Sewerage and trade effluent charges***

Table 29.3 provides average monthly wastewater charges for 110 wastewater systems across the US. For a given pipe size, charges are considerably higher for business consumers than they are for households. Prices tend to be higher in smaller systems.

### ***Direct abstraction or self-treatment***

There are no data on abstraction charges, or on the price of direct abstraction and treatment for industries which are self-supplied.

**Further tables**

Table 29.4 provides more detailed information on water and wastewater charges for 139 water utilities and 112 wastewater systems. They also show which systems have waste-water surcharges for the treatment of specific trade effluents and special contract rates for large users.

**Table 29.3. Wastewater Charges (1995 US\$)**

| System                 | Monthly Wastewater Charges           |                                                       |                                                               |                                               |                                                |
|------------------------|--------------------------------------|-------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|
|                        | 5/8-Inch Meter                       | 2-Inch Meter                                          | 4-Inch Meter                                                  | 8-Inch Meter                                  |                                                |
|                        | Residential<br>500 CF<br>(3 740 Gal) | Non-manuf./<br>Commercial<br>3 000 CF<br>(22 440 Gal) | Commercial/<br>Light Industrial<br>50 000 CF<br>(374 000 Gal) | Industrial<br>1 000 000 CF<br>(7 480 000 Gal) | Industrial<br>1 500 000 CF<br>(11 220 000 Gal) |
| <b>ALL SYSTEMS</b>     |                                      |                                                       |                                                               |                                               |                                                |
| Average                | 11.08                                | 49.57                                                 | 768.27                                                        | 14 968.65                                     | 22 746.67                                      |
| Mean                   | 10.66                                | 45.34                                                 | 649.02                                                        | 12 543.79                                     | 19 376.00                                      |
| Number of Systems      | 110                                  | 107                                                   | 105                                                           | 103                                           | 101                                            |
| <b>GROUP A SYSTEMS</b> |                                      |                                                       |                                                               |                                               |                                                |
| Average                | 10.67                                | 49.25                                                 | 759.73                                                        | 14 805.66                                     | 22 784.97                                      |
| Mean                   | 10.66                                | 42.53                                                 | 645.73                                                        | 12 525.35                                     | 19 176.25                                      |
| Number of Systems      | 28                                   | 27                                                    | 26                                                            | 26                                            | 26                                             |
| <b>GROUP B SYSTEMS</b> |                                      |                                                       |                                                               |                                               |                                                |
| Average                | 10.82                                | 48.85                                                 | 757.27                                                        | 14 583.42                                     | 21 736.88                                      |
| Mean                   | 9.88                                 | 43.47                                                 | 653.73                                                        | 12 464.50                                     | 18 600.00                                      |
| Number of Systems      | 42                                   | 42                                                    | 42                                                            | 41                                            | 41                                             |
| <b>GROUP C SYSTEMS</b> |                                      |                                                       |                                                               |                                               |                                                |
| Average                | 11.64                                | 50.58                                                 | 786.75                                                        | 15 525.09                                     | 23 935.06                                      |
| Mean                   | 10.81                                | 49.14                                                 | 657.50                                                        | 13 034.00                                     | 20 031.45                                      |
| Number of Systems      | 40                                   | 38                                                    | 37                                                            | 36                                            | 34                                             |

*Note:* Summary statistics exclude partial charges (eg, collection only charges). The number of systems indicates the size of the sample for which data were available.

*Source:* 1996 Raftelis Environmental Consulting Group, Inc.

**Table 29.4(a)**  
**Summary of Charges Paid by Industrial Customers for**  
**Water and Wastewater Services in the US (1996)**  
**Group A Systems**

| System             | System Ownership |            | Rate structure*                           | Applicable Season                    | Monthly water charge          |                                  |                                  | Rate structure | Seasonal Volume Adjustment | Wastewater services<br>Monthly waste-water charges |                                  |                                  | Waste-water surcharges |         |                       | Both Special Contract Rates |
|--------------------|------------------|------------|-------------------------------------------|--------------------------------------|-------------------------------|----------------------------------|----------------------------------|----------------|----------------------------|----------------------------------------------------|----------------------------------|----------------------------------|------------------------|---------|-----------------------|-----------------------------|
|                    |                  |            |                                           |                                      | 2-Inch Meter                  | 4-inch Meter                     | 8-inch Meter                     |                |                            | 2-Inch Meter                                       | 4-inch Meter                     | 8-inch Meter                     | TSS                    | BOD/COD | Monitoring Laboratory |                             |
|                    | Water            | Wastewater |                                           |                                      | Light Industrial<br>50,000 CF | Light Industrial<br>1,000,000 CF | Light Industrial<br>1,500,000 CF |                |                            | Light Industrial<br>50,000 CF                      | Light Industrial<br>1,000,000 CF | Light Industrial<br>1,500,000 CF |                        |         |                       |                             |
| New York, NY       | City             | City       | Uniform                                   | All year                             | 505.00                        | 10,100.00                        | 15,150.00                        | Uniform        | No                         | 802.95                                             | 16,059.00                        | 24,088.50                        |                        |         |                       | No                          |
| Detroit, MI        | City             | City       | DB (3)                                    | All year                             | 309.05                        | 5,576.68                         | 8,413.13                         | Uniform        | No                         | 448.72                                             | 8,489.76                         | 12,776.00                        | S                      | S       |                       | Yes                         |
| Los Angeles, CA    | City             | City       | IB (2) (adjusted to average prior use)    | Jun 1 to Oct 31                      | 855.00                        | 17,100.00                        | 25,650.00                        | Uniform        | No                         | 1,016.50                                           | 20,330.00                        | 30,495.00                        | S                      | S       | S                     | Yes                         |
| Miami, FL          | City             | City       | IB (5), Seasonal                          | May 1 to Oct 31                      | 644.94                        | 12,993.28                        | 19,492.40                        | IB (2)         | No                         | 915.87                                             | 18,289.47                        | 27,433.47                        | S                      | S       |                       | Yes                         |
| Las Vegas, NV      | District         | City       | IB (4), Excess use                        | Nov 1 to Apr 30<br>All year          | 870.67<br>651.94              | 17,540.93<br>14,149.48           | 26,314.74<br>21,391.50           | Flat           | No                         | Varies                                             | Varies                           | Varies                           | S                      | S       | S                     | No                          |
| Phoenix, AZ        | City             | City       | Uniform, Seasonal (4)                     | Oct 1 to May 31<br>Jun 1 to Sep 30   | 488.57<br>720.21              | 9,722.21<br>14,513.85            | 14,579.91<br>21,771.55           | Uniform by     | Yes                        | 400.37                                             | 10,904.12                        | 16,355.62                        | S                      | S       | S                     | No                          |
| Denver, CO         | City             | NR         | Uniform, Seasonal (whlsle. only)          | All year                             | 328.40                        | 6,454.90                         | 9,696.98                         | N / A          | N / A                      | N / A                                              | N / A                            | N / A                            |                        |         |                       | No                          |
| Philadelphia, PA   | City             | City       | DB (4)                                    | All year                             | 485.07                        | 8,343.47                         | 12,504.14                        | Uniform        | No                         | 642.44                                             | 12,543.79                        | 18,897.48                        | S                      | S       |                       | Yes                         |
| Dallas, TX         | City             | City       | IB (2)                                    | All year                             | 494.54                        | 9,775.40                         | 14,732.60                        | Uniform        | No                         | 578.38                                             | 11,521.62                        | 17,281.22                        | S                      | S       | S                     | No                          |
| Baltimore, MD      | City             | City       | DB (3)                                    | All year                             | 199.28                        | 3,400.78                         | 5,085.78                         | Uniform        | No                         | 585.50                                             | 11,710.00                        | 17,565.00                        | S                      | S       |                       | No                          |
| San Diego, CA      | City             | City       | Uniform                                   | All year                             | 741.34                        | 14,498.74                        | 21,971.22                        | Uniform        | No                         | 1,111.34                                           | 21,898.70                        | 39,221.22                        |                        |         |                       | No                          |
| Oakland, CA        | District         | City       | Uniform                                   | All year                             | 799.58                        | 15,653.14                        | 23,561.71                        | Uniform        | No                         | 505.37                                             | 10,005.37                        | 20,005.37                        |                        |         | S                     | No                          |
| San Antonio, TX    | City             | City       | IB (2)                                    | Nov 1 to Jun 30<br>Jul 1 to Oct 31   | 283.51<br>303.71              | 5,548.56<br>5,898.63             | 8,398.48<br>8,920.59             | Uniform        | No                         | 561.06                                             | 11,141.89                        | 16,710.75                        | S                      | S       | S                     | No                          |
| Honolulu, HI       | City             | NR         | Uniform                                   | All year                             | 695.60                        | 13,841.70                        | 20,760.70                        | IB (2)         | No                         | 931.26                                             | 18,625.20                        | 27,937.80                        |                        |         |                       | S                           |
| Seattle, WA        | City             | City       | Uniform<br>Seasonal                       | Sep 16 to May 14<br>May 15 to Sep 15 | 277.50<br>674.50              | 5,330.00<br>13,270.00            | 8,065.00<br>19,975.00            | Uniform        | No                         | 1,865.00                                           | 37,300.00                        | 55,950.00                        |                        |         |                       | S                           |
| St. Louis, MO      | Private          | NR         | Uniform                                   | All year                             | 641.66                        | 6,678.73                         | 10,059.31                        | N / A          | N / A                      | N / A                                              | N / A                            | N / A                            |                        |         |                       | Yes                         |
| Memphis, TN        | City             | City       | DB (6)                                    | All year                             | 362.12                        | 4,387.31                         | 6,550.31                         | Uniform        | No                         | 581.60                                             | 7,046.45                         | 10,520.44                        |                        |         |                       | Yes                         |
| Milwaukee, WI      | City             | District   | DB (4)                                    | All year                             | 453.35                        | 5,717.35                         | 8,256.33                         | Uniform        | No                         | 419.11                                             | 8,230.61                         | 12,378.74                        | S                      | S       | S                     | No                          |
| Indianapolis, IN   | Private          | City       | DB (5)                                    | All year                             | 555.33                        | 6,241.56                         | No 8" Service                    | Uniform        | No                         | N / A                                              | N / A                            | N / A                            |                        |         |                       | No                          |
| Tacoma, WA         | City             | City       | Uniform,<br>Seasonal (re & whlsls)        | Oct 1 to May 31<br>Jun 1 to Sep 30   | 381.52<br>381.52              | 6,626.00<br>6,626.00             | 10,255.20<br>10,255.20           | Uniform        | Yes                        | Varies                                             | Varies                           | Varies                           | S                      | S       |                       | Yes                         |
| Cincinnati, OH     | City             | City       | DB (3), Seasonal (political subdiv. only) | All year                             | 480.64                        | 8,403.94                         | 12,533.24                        | DB (2)         | Yes                        | 670.65                                             | 12,506.90                        | 19,039.90                        |                        |         |                       | Yes                         |
| Columbus, OH       | City             | City       | DB (5)                                    | All year                             | 419.39                        | 6,730.34                         | 9,774.07                         | Uniform        | No                         | 816.21                                             | 16,117.86                        | 24,171.36                        | S                      | S       | S                     | No                          |
| Louisville, KY     | City             | District   | IB-DB (7)                                 | All year                             | 590.97                        | 9,144.41                         | 13,143.71                        | N / A          | N / A                      | N / A                                              | N / A                            | N / A                            |                        |         |                       | No                          |
| Portland, OR       | City             | City       | IB (3)                                    | All year                             | 453.70                        | 8,752.97                         | 13,213.50                        | Uniform        | No                         | 1,160.62                                           | 23,029.62                        | 34,539.62                        | S                      | S       |                       | Yes                         |
| Albuquerque, NM    | City             | City       | Seasonal                                  | Nov 1 to Mar 31<br>Apr 1 to Oct 31   | 384.20<br>408.14              | 7,245.44<br>8,596.16             | 12,529.85<br>12,529.85           | Uniform        | Yes                        | 383.35                                             | 7,000.49                         | 13,750.56                        | S                      | S       |                       | Yes                         |
| Baton Rouge, LA    | Private          | City       | DB (5)                                    | All year                             | 379.65                        | 4,606.45                         | 7,105.95                         | Uniform        | No                         | 511.56                                             | 10,201.56                        | 15,301.56                        | S                      | S       |                       | No                          |
| Tulsa, OK          | City             | City       | Uniform                                   | All year                             | 568.48                        | 7,510.46                         | 11,286.18                        | Uniform        | No                         | 649.06                                             | 12,873.83                        | 19,312.60                        | S                      | S       | S                     | No                          |
| Sacramento, CA     | City             | City       | Uniform                                   | All year                             | 255.75                        | 5,115.00                         | 7,672.50                         | Uniform        | No                         | 159.85 (a)                                         | 3,197.00 (a)                     | 4,795.50 (a)                     |                        |         |                       | Yes                         |
| Austin, TX         | City             | City       | Uniform                                   | All year                             | 843.33                        | 15,952.42                        | 23,953.27                        | Uniform        | No                         | 1,406.50                                           | 23,416.40                        | 35,122.60                        | S                      | S       | S                     | Yes                         |
| Atlanta, GA        | City             | City       | DB (2)                                    | All year                             | 825.00                        | 12,900.00                        | 19,150.00                        | Uniform        | No                         | 975.00                                             | 19,500.00                        | 29,250.00                        |                        |         |                       | S                           |
| Birmingham, AL     | Cooperative      | City       | DB (5)                                    | All year                             | 567.23                        | 10,778.26                        | 15,773.82                        | Uniform        | No                         | 790.00                                             | 15,800.00                        | 23,700.00                        |                        |         |                       | No                          |
| Salt Lake City, UT | City             | City       | Seasonal                                  | Oct 1 to May 31<br>Jun 1 to Sep 30   | 210.55<br>314.50              | 3,867.40<br>5,966.35             | 5,919.120<br>9,068.05            | Uniform        | Yes                        | 400.00                                             | 8,000.00                         | 12,000.00                        | S                      | S       |                       | No                          |
| Omaha, NE          | District         | NR         | Uniform<br>Seasonal                       | Oct 1 to Apr 30<br>May 1 to Sep 30   | 294.00<br>370.50              | 5,769.00<br>5,769.00             | 8,482.00<br>8,482.00             | N / A          | N / A                      | N / A                                              | N / A                            | N / A                            |                        |         |                       | No                          |
| Fort Worth, TX     | City             | City       | DB (2)                                    | All year                             | 687.30                        | 10,254.20                        | 18,173.35                        | Uniform        | Yes                        | 624.50                                             | 12,404.50                        | 18,604.50                        | S                      | S       | S                     | No                          |

\* DB: decreasing block structure (number of blocks)

IB: increasing block structure (number of blocks)

**Table 29.4(b)**  
**Summary of Charges Paid by Industrial Customers for**  
**Water and Wastewater Services in the US (1996)**  
**Group B Systems**

| System              | System Ownership |                | Rate structure*                   | Applicable Season                  | Monthly water charge |                       |                        | Rate structure | Seasonal Volume Adjustment | Wastewater services |              |               | Waste-water surcharges |         |                       |        | Both Special Contract Rates |
|---------------------|------------------|----------------|-----------------------------------|------------------------------------|----------------------|-----------------------|------------------------|----------------|----------------------------|---------------------|--------------|---------------|------------------------|---------|-----------------------|--------|-----------------------------|
|                     | Water            | Wastewater     |                                   |                                    | 2-Inch Meter         | 4-inch Meter          | 8-inch Meter           |                |                            | 2-Inch Meter        | 4-inch Meter | 8-inch Meter  | TSS                    | BOD/COD | Monitoring Laboratory | Others |                             |
|                     |                  |                |                                   |                                    |                      |                       |                        |                |                            |                     |              |               |                        |         |                       |        |                             |
| Toledo, OH          | City             | City           | DB (4)                            | All year                           | 316.90               | 5,176.30              | 7,197.30               | Uniform        | Yes                        | 599.47              | 11,719.28    | 17,636.30     | S                      | S       | S                     |        | No                          |
| Baltimore Cnty, MD  | Country          | Country        | DB (99)                           | All year                           | 391.06               | 7,581.48              | 10,173.83              | Uniform        | No                         | 850.00              | 17,000.00    | 25,500.00     |                        |         |                       | S      | Yes                         |
| Charlotte, NC       | City             | City           | Uniform                           | All year                           | 471.45               | 9,401.45              | 14,101.45              | Uniform        | No                         | 761.45              | 15,201.45    | 22,801.45     | S                      | S       |                       | S      | No                          |
| Boston, MA          | District         | District       | IB (10)                           | All year                           | 1,007.84             | 20,304.25             | 30,464.25              | IB (10)        | No                         | 1,812.31            | 37,510.52    | 56,335.52     |                        |         |                       |        | No                          |
| Norfolk, VA         | City             | City           | Uniform                           | All year                           | 1,025.00             | 20,500.00             | 30,750.00              | DB (3)         | No                         | 547.77 (a)          | 8,632.56 (a) | 12,832.56 (a) |                        |         |                       |        | Yes                         |
| Mesa, AZ            | City             | City           | IB (2)                            | All year                           | 492.24               | 9,500.74              | 14,361.40              | Uniform        | Yes                        | 631.95              | Varies       | Varies        | S                      | S       | S                     |        | No                          |
| Tampa, FL           | City             | City           | IB (2)                            | All year                           | 450.00               | 900.00                | 1,350.00               | Uniform        | No                         | 1,140.00            | 22,800.00    | 34,200.00     | S                      | S       |                       |        | No                          |
| Hartford, CT        | District         | District       | Uniform                           | All year                           | 586.14               | 11,564.64             | 17,314.64              | Uniform        | No                         | 0.00 (b)            | 12,200.00    | 18,300.00     | S                      | S       |                       |        | Yes                         |
| Wichita, KS         | City             | City           | IB (3)                            | All year                           | 217.97               | 4,273.09              | 6,395.40               | Uniform        | No                         | 444.60              | 8,758.62     | 13,134.42     |                        |         |                       |        | Yes                         |
| Orlando, FL         | City             | City           | Uniform                           | All year                           | 244.31               | 4,791.24              | 7,203.36               | Uniform        | No                         | 1,447.38            | 28,947.60    | 43,421.40     | S                      | S       | S                     |        | Yes                         |
| Shreveport, LA      | City             | City           | Uniform                           | All year                           | 532.62               | 9,453.20              | 14,220.50              | Uniform        | Yes                        | 675.50              | 13,466.30    | 20,198.30     | S                      | S       |                       |        | Yes                         |
| Reno, NV            | Private          | NR             | IB (2)                            | All year                           | 782.68               | 15,573.00             | 23,463.00              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | Yes                         |
| LA (Sub. Water)     | Private          | NA             | Uniform & IB (varies by district) | All year                           | 441.53               | 8,044.89              | 12,303.83              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
|                     |                  |                |                                   |                                    | 575.40               | 10,653.44             | 16,249.14              |                |                            |                     |              |               |                        |         |                       |        |                             |
| Riverside, CA       | City             | City           | Seasonal                          | Oct 1 to May 31<br>Jun 1 to Sep 30 | 287.69<br>367.89     | 5,444.30<br>7,048.30  | 8,263.00<br>10,669.88  | Uniform        | N/A                        | 528.50              | Varies       | Varies        |                        |         |                       |        | No                          |
| Little Rock, AR     | City             | City           | DB (5)                            | All year                           | 317.87               | 3,168.15              | 4,684.21               | Uniform        | No                         | 675.55              | 13,164.22    | 19,778.45     | S                      | S       |                       |        | No                          |
| Alton-Cairo, IL     | Private          | NR             | DB (4)                            | All year                           | 638.80               | 9,231.10              | 13,936.10              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Rochester, NY       | City             | City           | IB (3)                            | All year                           | 697.52               | 10,630.86             | 15,962.08              | Uniform        | No                         | 561.00              | 11,220.00    | 16,830.00     | S                      |         |                       |        | No                          |
| Greenville, SC      | District         | District       | DB (3)                            | All year                           | 216.42               | 4,151.30              | 6,804.83               | Uniform        | Yes                        | 966.18              | 20,201.00    | 30,299.00     | S                      | S       | S                     | S      | Yes                         |
| Arlington, TX       | City             | City           | Uniform                           | All year                           | 842.05               | 16,241.35             | 24,698.45              | Uniform        | No                         | 895.10              | 17,656.60    | 26,659.55     | S                      | S       | S                     | S      | No                          |
| Amarillo, TX        | City             | City           | Uniform                           | All year                           | 399.52               | 7,781.62              | 11,718.77              | Uniform        | No                         | 373.72              | 7,412.75     | 11,145.16     | S                      | S       |                       |        | Yes                         |
| Charleston, SC      | City             | City           | DB (3)                            | All year                           | 330.73               | 6,260.34              | 9,457.34               | DB (3)         | No                         | 1,568.77            | 31,113.77    | 46,663.77     |                        |         |                       |        | Yes                         |
| Johnson Cnty, KS    | District         | Country        | Excess use                        | All year                           | 874.40               | 16,936.80             | No 8" Service          | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Lexington, KY       | Private          | City           | Uniform                           | All year                           | 758.69               | 12,035.44             | 18,301.26              | Uniform        | Yes                        | 900.00              | 18,000.00    | 27,000.00     | S                      | S       |                       | S      | No                          |
| Alameda Cnty, CA    | District         | NR             | Uniform                           | All year                           | 330.10               | 6,273.00              | 9,448.85               | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Mobile, AL          | City             | City           | DB (8)                            | All year                           | 576.26               | 11,531.04             | 13,022.30              | DB (8)         | No                         | 1,010.10            | 20,206.08    | 24,366.30     | S                      | S       | S                     | S      | Yes                         |
| Des Moines, IA      | City             | City           | IB (3)                            | All year                           | 645.85               | 8,210.53              | 12,175.53              | Uniform        | No                         | 845.31              | 16,833.81    | 25,248.81     |                        |         |                       |        | No                          |
| Charleston Area, WV | Private          | City           | DB (5)                            | All year                           | 1,068.12             | 17,366.54             | 24,762.60              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Corpus Christi, TX  | City             | City           | DB (5)                            | All year                           | 528.45               | 7,673.40              | 11,724.73              | DB (2)         | No                         | 584.65              | 10,731.00    | 16,863.00     | S                      | S       |                       |        | No                          |
| Scranton, PA        | Private          | NR             | DB (3)                            | All year                           | 1,248.23             | 21,626.20             | 31,922.66              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Boise, ID           | Private          | NR             | Seasonal                          | Oct 1 to Apr 30<br>May 1 to Sep 30 | 422.53<br>523.98     | 8,144.04<br>10,164.04 | 12,291.92<br>15,321.92 | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Pittsburgh, PA      | District         | NR             | Uniform                           | All year                           | 128.15               | 23,547.00             | 35,364.00              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | Yes                         |
| Lincoln, NE         | City             | City           | IB (2)                            | All year                           | 546.20               | 7,532.00              | 11,378.00              | Uniform        | Yes                        | 485.50              | 9,582.00     | 14,453.00     |                        |         | S                     |        | No                          |
| Raleigh, NC         | City             | City           | DB (2)                            | All year                           | 525.80               | 7,186.43              | 10,720.86              | Uniform        | No                         | 466.58              | 9,301.58     | 13,951.58     | S                      | S       |                       |        | No                          |
| Akron, OH           | City             | City           | DB (3)                            | All year                           | 823.66               | 12,257.86             | 16,457.86              | Uniform        | No                         | 980.37              | 24,711.37    | 37,066.37     | S                      | S       |                       |        | No                          |
| Chattanooga, TN     | Private          | NR             | DB (6)                            | All year                           | 849.44               | 10,227.26             | 16,655.34              | DB (4)         | No                         | 1,033.48            | 12,464.50    | 17,877.50     |                        |         |                       |        | Yes                         |
| Greensboro, NC      | City             | City           | DB (2)                            | All year                           | 314.00               | 3,829.00              | 5,679.00               | Uniform        | No                         | 460.00              | 9,200.00     | 13,800.00     | S                      | S       |                       |        | Yes                         |
| Virginia Beach, VA  | City             | City, District | Uniform                           | All year                           | 1,381.70             | 27,350.00             | 41,105.00              | Uniform        | No                         | 43.30 (a)           | 142.00 (a)   | 662.00 (a)    |                        |         |                       |        | No                          |
| Wyoming, MI         | City             | City           | DB (2)                            | All year                           | 297.33               | 5,176.00              | 7,830.00               | Uniform        | No                         | 342.33              | 6,740.00     | 10,183.33     | S                      | S       |                       | S      | Yes                         |
| Madison, WI         | City             | NR             | DB (2)                            | All year                           | 271.17               | 4,946.50              | 7,454.17               | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Garland, TX         | City             | City           | DB (4)                            | All year                           | 541.46               | 10,621.60             | 15,932.40              | Uniform        | No                         | 602.90              | 11,972.50    | 17,956.00     |                        |         |                       | S      | Yes                         |
| St. Petersburg, FL  | City             | City           | Uniform                           | All year                           | 568.70               | 10,829.81             | 16,576.14              | Uniform        | No                         | 732.59              | 14,058.50    | 21,449.89     |                        |         |                       |        | Yes                         |
| Knoxville, TN       | City             | City           | DB (5)                            | All year                           | 808.90               | 9,487.90              | 13,467.90              | DB (5)         | No                         | 1,129.76            | 17,144.76    | 24,961.76     |                        |         |                       |        | Yes                         |
| Canton, OH          | City             | City           | DB (5)                            | All year                           | 342.76               | 4,435.76              | 6,300.76               | Uniform        | No                         | 556.35              | 11,101.35    | 16,651.35     | S                      | S       |                       | S      | NR                          |
| New Orleans, LA     | Cooperative      | Cooperative    | DB (3)                            | All year                           | 707.10               | 11,097.80             | 16,488.60              | Uniform        | No                         | 495.74              | 9,520.80     | 14,417.20     | S                      | S       |                       | S      | NR                          |
| Tallahassee, FL     | City             | City           | Uniform                           | All year                           | 461.33               | 9,130.73              | 13,693.56              | Uniform        | No                         | 1,069.52            | 20,256.40    | 30,741.60     | S                      | S       | S                     |        | No                          |
| Topeka, KS          | City             | City           | Uniform                           | All year                           | 428.90               | 8,606.28              | 12,907.28              | Uniform        | No                         | 759.59              | 15,113.71    | 22,668.51     | S                      | S       |                       |        | Yes                         |
| Abilene, TX         | City             | City           | IB                                | All year                           | 530.92               | 9,021.40              | 13,604.40              | Uniform        | No                         | 313.04              | 6,133.60     | 9,200.40      | S                      | S       | S                     | S      | No                          |
| Evansville, IN      | City             | City           | DB (4)                            | All year                           | 362.08               | 4,202.97              | 6,167.12               | DB (6)         | No                         | 524.89              | 8,578.68     | 12,816.08     | S                      | S       |                       |        | No                          |
| Augusta, GA         | City             | City           | Uniform                           | All year                           | 309.20               | 5,994.00              | 8,986.00               | Uniform        | No                         | 331.90              | 6,372.00     | 9,551.00      | S                      | S       |                       | S      | Yes                         |
| Provo, UT           | City             | City           | Uniform                           | All year                           | 203.69               | 3,529.44              | 5,327.29               | Uniform        | No                         | 264.55              | 5,204.55     | 7,804.55      | S                      | S       |                       | S      | Yes                         |
| Nashville, TN       | City             | City           | Uniform                           | All year                           | 1,211.10             | 18,369.90             | 27,369.51              | Uniform        | Yes                        | 1,698.02            | 26,319.26    | 39,171.46     | S                      | S       |                       |        | Yes                         |
| LA (Cal-American)   | Private          | NA             | Uniform, District                 | All year                           | 451.20               | 8,183.00              | 12,476.00              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
|                     |                  |                |                                   |                                    | 570.80               | 10,575.00             | 16,064.00              |                |                            |                     |              |               |                        |         |                       |        |                             |
|                     |                  |                |                                   |                                    | 935.55               | 17,870.00             | 27,006.50              |                |                            |                     |              |               |                        |         |                       |        |                             |
| Springfield, IL     | City             | NR             | IB-DB (3)                         | All year                           | 532.86               | 8,747.06              | 13,190.20              | IB (2)         | No                         | 354.80              | 6,677.50     | 10,055.00     | S                      | S       | S                     | S      | Yes                         |
| Champ-Urbana, IL    | Private          | District       | DB (4)                            | All year                           | 541.10               | 8,266.80              | 12,461.55              | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Stockton, CA        | City             | city           | DB (2)                            | All year                           | 330.08               | 5,500.89              | 8,310.87               | Uniform        | No                         | 629.00              | 12,400.00    | 18,600.00     | S                      | S       | S                     | S      | No                          |
| Peoria, IL          | Private          | NR             | DB (4)                            | All year                           | 539.46               | 6,384.86              | 9,747.86               | N/A            | N/A                        | N/A                 | N/A          | N/A           |                        |         |                       |        | No                          |
| Wilmington, DE      | City             | city           | Uniform                           | All year                           | 864.96               | 13,545.56             | 20,385.38              | Uniform        | No                         | 1,159.04            | 18,151.04    | 27,316.41     |                        |         |                       |        | Yes                         |
| Lawton, OK          | City             | city           | DB (8)                            | All year                           | 325.06               | 4,934.82              | 7,403.22               | Uniform        | No                         | 143.96              | 2,773.18     | 4,156.98      | S                      | S       | S                     | S      | Yes                         |

\* DB: decreasing block structure (number of blocks)

IB: increasing block structure (number of blocks)

**Table 29.4(c)**  
**Summary of Charges Paid by Industrial Customers for**  
**Water and Wastewater Services in the US (1996)**  
**Group C Systems**

| System              | System Ownership |             | Rate structure* | Applicable Season | Wastewater services<br>Monthly waste-water charges |                                               |                                               | Rate structure              | Seasonal Volume Adjustment | Monthly waste-water charges                |                                               |                                               | Waste-water surcharges |         |                       |        | Both Special Contract Rates |
|---------------------|------------------|-------------|-----------------|-------------------|----------------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------|----------------------------|--------------------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------|---------|-----------------------|--------|-----------------------------|
|                     | Water            | Wastewater  |                 |                   | 2-Inch Meter Light Industrial<br>50,000 CF         | 4-inch Meter Light Industrial<br>1,000,000 CF | 8-inch Meter Light Industrial<br>1,500,000 CF |                             |                            | 2-Inch Meter Light Industrial<br>50,000 CF | 4-inch Meter Light Industrial<br>1,000,000 CF | 8-inch Meter Light Industrial<br>1,500,000 CF | TSS                    | BOD/COD | Monitoring Laboratory | Others |                             |
| Lafayette, LA       | City             | City        | Uniform         | All year          | 426.42                                             | 8,125.40                                      | 12,357.00                                     | Uniform                     | No                         | 603.66                                     | 11,902.20                                     | 17,848.80                                     | S                      | S       | S                     | S      | No                          |
| Ventura, CA         | City             | City        | Uniform         | All year          | 880.30                                             | 17,279.45                                     | 26,062.50                                     | Uniform, IB (2) by customer | No                         | Varies                                     | Varies                                        | Varies                                        | S                      | S       |                       |        | No                          |
| Beaumont, TX        | City             | City        | Uniform         | All year          | 600.19                                             | 11,909.15                                     | 17,881.69                                     | Uniform                     | Yes                        | 547.80                                     | 10,800.57                                     | 16,220.58                                     | S                      | S       |                       |        | NR                          |
| Manchester, NH      | City             | NR          | DB (2)          | All year          | 379.88                                             | 6,570.71                                      | 9,883.75                                      | N / A                       | N / A                      | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | Yes                         |
| Las Cruces, NM      | City             | City        | IB (4)          | All year          | 44.05                                              | 8,886.04                                      | 13,336.64                                     | Uniform                     | No                         | 387.93                                     | 7,231.01                                      | 10,823.63                                     | S                      | S       |                       |        | No                          |
| Allentown, PA       | City             | City        | Uniform         | All year          | 593.97                                             | 11,587.19                                     | 17,547.37                                     | Uniform                     | No                         | 462.43                                     | 9,138.38                                      | 13,736.40                                     | S                      | S       |                       | S      | No                          |
| Battle Creek, MI    | City             | City        | Uniform         | All year          | 393.50                                             | 7,491.13                                      | 11,437.50                                     | Uniform                     | No                         | 1,069.90                                   | 21,319.00                                     | 32,006.00                                     | S                      | S       |                       |        | Yes                         |
| San Jose, CA        | City             | NR          | Uniform, Zonal  | All year          | 707.00                                             | 13,598.00                                     | 20,425.00                                     | N / A                       | N / A                      | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | No                          |
| Jericho, NY         | District         | NR          | IB (4)          | All year          | 523.97                                             | 10,827.67                                     | 16,250.67                                     | N / A                       | N / A                      | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | No                          |
| Cheyenne, WY        | City             | City        | Uniform         | All year          | 690.68                                             | 13,663.60                                     | 20,505.40                                     | Uniform                     | No                         | 473.50                                     | 9,364.85                                      | 14,058.00                                     |                        |         |                       |        | No                          |
| Port Arthur, TX     | City             | City        | IB (2)          | All year          | 917.50                                             | 18,333.20                                     | 27,510.60                                     | Uniform                     | No                         | 844.00                                     | 16,832.50                                     | 25,247.50                                     |                        |         |                       |        | Yes                         |
| Anniston, AL        | Cooperative      | Cooperative | DB (7)          | All year          | 400.20                                             | 5,395.20                                      | 7,895.20                                      | Uniform                     | No                         | 185.40                                     | 3,605.40                                      | 5,405.40                                      | S                      | S       |                       |        | No                          |
| Rochester, MN       | City             | City        | Uniform         | All year          | 252.13                                             | 4,634.47                                      | 7,106.73                                      | Uniform                     | No                         | 510.87                                     | 10,689.07                                     | 15,754.07                                     | S                      | S       | S                     | S      | No                          |
| Anchorage, AK       | City             | City        | Flat            | All year          | 1,012.06                                           | 19,810.40                                     | 29,807.60                                     | Flat, Uniform               | No                         | 841.02                                     | 20,801.40                                     | 31,198.60                                     |                        |         |                       | S      | Yes                         |
| Norman, OK          | City             | City        | DB (3)          | All year          | 372.30                                             | 7,211.20                                      | 11,109.80                                     | Uniform                     | No                         | 346.65                                     | 6,884.40                                      | 10,325.20                                     | S                      | S       | S                     | S      | No                          |
| High Point, NC      | City             | City        | DB (4)          | All year          | 568.56                                             | 9,526.31                                      | 14,207.86                                     | Uniform                     | No                         | 799.16                                     | 15,533.65                                     | 23,429.59                                     | S                      | S       | S                     | S      | Yes                         |
| Milpitas, CA        | City             | City        | Uniform         | All year          | 689.82                                             | 13,633.31                                     | 20,446.60                                     | Uniform                     | No                         | Varies by industry                         | Varies                                        | Varies                                        | S                      | S       |                       | S      | No                          |
| Mansfield, OH       | City             | City        | IB (5)          | All year          | 966.32                                             | 17,331.32                                     | 25,381.32                                     | Uniform                     | No                         | 855.80                                     | 17,100.80                                     | 25,650.80                                     | S                      | S       | S                     | S      | Yes                         |
| Ridgewood, NJ       | City             | NR          | Uniform         | All year          | 714.20                                             | 13,673.00                                     | No 8" Service                                 | N / A                       | N / A                      | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | No                          |
| Carson City, NV     | City             | City        | IB (3)          | All year          | 578.96                                             | 11,299.99                                     | 17,022.49                                     | Uniform                     | Yes                        | 685.18                                     | 13,618.10                                     | 20,424.90                                     | S                      | S       |                       | S      | Yes                         |
| Victoria, TX        | City             | City        | Uniform         | All year          | 514.65                                             | No 4" Service                                 | No 8" Service                                 | Uniform                     | No                         | 533.42                                     | No 4" Service                                 | No 8" Service                                 | S                      | S       |                       |        | NR                          |
| College Station, TX | City             | City        | Uniform         | All year          | 783.50                                             | 15,414.40                                     | No 8" Service                                 | Uniform                     | No                         | 766.07                                     | 15,190.99                                     | 22,783.45                                     | S                      | S       |                       | S      | No                          |
| Bismarck, ND        | City             | City        | Uniform         | All year          | 1,100.00                                           | 22,000.00                                     | 33,000.00                                     | Per contract                | No                         | 1,085.00                                   | 21,700.00                                     | 32,550.00                                     | S                      | S       |                       |        | No                          |
| Chapel Hill, NC     | District         | District    | Uniform         | All year          | 905.24                                             | 17,417.55                                     | 26,347.65                                     | Uniform                     | No                         | 809.34                                     | 15,841.15                                     | 23,856.70                                     | S                      | S       |                       | S      | No                          |
| Eau Claire, WI      | City             | City        | DB (3)          | All year          | 418.95                                             | 7,240.65                                      | 9,852.25                                      | Uniform                     | Yes                        | 930.00                                     | 18,600.00                                     | 27,900.00                                     | S                      | S       |                       |        | NR                          |
| Lorain, OH          | City             | City        | DB (4)          | All year          | 626.10                                             | 1,224.60                                      | 1,871.60                                      | Uniform                     | No                         | 814.50                                     | 1,638.00                                      | 2,510.00                                      | S                      | S       |                       | S      | Yes                         |
| Gresham, OR         | City             | City        | Uniform         | All year          | 290.86                                             | 5,417.56                                      | 8,271.99                                      | Uniform                     | No                         | Varies                                     | Varies                                        | Varies                                        | S                      | S       |                       |        | No                          |
| Aberdeen, WA        | City             | City        | DB (5)          | All year          | 438.65                                             | 7,468.65                                      | 11,168.65                                     | Uniform                     | No                         | 1,047.60                                   | 20,997.60                                     | 31,497.60                                     |                        |         |                       |        | NR                          |
| Salina, KS          | City             | City        | DB (4)          | All year          | 686.22                                             | 13,161.35                                     | 19,843.22                                     | Uniform                     | Yes                        | 876.63                                     | 17,501.63                                     | 26,251.63                                     |                        |         |                       |        | No                          |
| Massapequa, NY      | District         | NR          | Uniform         | All year          | 32.40                                              | 943.00                                        | No 8" Service                                 | N / A                       | N / A                      | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | No                          |
| Juneau, AK          | City             | City        | Uniform         | All year          | 660.50                                             | 13,096.00                                     | 19,641.00                                     | Uniform                     | No                         | 1,882.50                                   | 37,412.50                                     | 56,122.50                                     |                        |         |                       |        | No                          |
| Helena, MT          | City             | City        | Uniform         | All year          | 850.00                                             | 17,000.00                                     | 25,500.00                                     | Uniform                     | No                         | 401.42                                     | 7,944.42                                      | 11,914.42                                     |                        |         |                       |        | No                          |
| Pekin, IL           | Private          | NR          | DB (4)          | All year          | 368.10                                             | 4,808.10                                      | 7,257.10                                      | N / A                       | N / A                      | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | No                          |
| Port St. Lucie, FL  | City             | City        | IB (2)          | All year          | 1,109.33                                           | 22,133.19                                     | 33,174.92                                     | Uniform                     | No                         | 2,545.45                                   | 49,146.47                                     | 94,232.60                                     |                        |         |                       | S      | No                          |
| Salem, MA           | District         | District    | Uniform         | All year          | 950.00                                             | 19,000.00                                     | 28,500.00                                     | IB (2)                      | No                         | 2,005.00                                   | 45,000.00                                     | 67,250.00                                     |                        |         |                       |        | No                          |
| Concord, NH         | Private          | City        | DB (5)          | All year          | 756.55                                             | 9,757.00                                      | 16,507.00                                     | Uniform                     | No                         | 1,170.00                                   | 23,400.00                                     | 35,100.00                                     |                        |         |                       |        | No                          |
| Carson, CA          | City             | NR          | DB (2)          | All year          | 703.00                                             | 13,185.00                                     | 19,590.00                                     | N / A                       | No                         | N / A                                      | N / A                                         | N / A                                         |                        |         |                       |        | NR                          |
| Pierre, SD          | City             | City        | Flat            | All year          | 325.00                                             | 6,500.00                                      | 9,750.00                                      | Uniform                     | No                         | 374.50                                     | 7,499.50                                      | 1,249.50                                      |                        |         |                       |        | NR                          |
| Alice, TX           | City             | City        | IB (3)          | All year          | 658.10                                             | 13,093.60                                     | 19,638.60                                     | Uniform                     | No                         | 251.45                                     | 4,870.35                                      | 7,301.35                                      |                        |         |                       |        | No                          |
| Monroe, NC          | City             | City        | Uniform         | NR                | 366.30                                             | 6,416.00                                      | No 8" Service                                 | Uniform                     | NR                         | 583.75                                     | 10,579.75                                     | No 8" Service                                 | S                      | S       | S                     | S      | No                          |
| Ottawa, IL          | City             | City        | DB (2)          | All year          | 351.00                                             | 6,706.00                                      | 10,356.00                                     | Uniform                     | No                         | 357.00                                     | 7,162.00                                      | 10,652.00                                     | S                      | S       |                       |        | No                          |
| Sun Prairie, WI     | City             | City        | DB (3)          | All year          | 232.89                                             | 4,150.89                                      | No 8" Service                                 | Uniform                     | No                         | 635.60                                     | 12,525.09                                     | No 8" Service                                 | S                      | S       |                       | S      | No                          |
| Peru, IN            | City             | City        | DB (6)          | All year          | 514.02                                             | 7,193.90                                      | 10,709.50                                     | DB (5)                      | No                         | 537.37                                     | 9,633.05                                      | 14,420.25                                     |                        |         | S                     | S      | No                          |
| Whitefish Bay, WI   | City             | District    | Uniform         | All year          | 355.00                                             | 7,020.00                                      | 10,525.00                                     | Uniform                     | No                         | 541.55                                     | 10,801.55                                     | 16,201.55                                     |                        |         |                       |        | No                          |
| Robbinsdale, MN     | City             | District    | Uniform         | All year          | 487.20                                             | 9,725.00                                      | 14,586.00                                     | Uniform                     | Yes                        | 657.50                                     | 13,093.00                                     | 19,638.00                                     |                        |         |                       |        | No                          |
| W Carrollton, OH    | City             | City        | DB (4)          | All year          | 535.50                                             | 8,399.00                                      | 12,729.00                                     | DB (2)                      | Yes                        | 642.30                                     | 12,975.00                                     | 19,376.00                                     |                        |         |                       |        | NR                          |
| N Tonawanda, NY     | City             | NR          | IB (2)          | All year          | 830.00                                             | 16,818.50                                     | 25,233.50                                     | Uniform                     | No                         | 1,028.50                                   | 20,570.00                                     | 30,855.00                                     |                        |         |                       |        | No                          |

\* DB: decreasing block structure (number of blocks)

IB: increasing block structure (number of blocks)

## REFERENCES

- BEECHER , JANICE A. AND PATRICK C.MANN (1991). *Cost Allocation and Rate Design for Water Utilities*. American Water Works Association, Research Foundation (March).
- DUKE, ELLEN M. AND ANGELA C. MONTOYA (1993), "Trends in Water Pricing: Results of Ernst & Young's National Rate Surveys". *Journal AWWA* (May).
- MCLAMB, DAVID W. (1978). *Industrial Demand for City-supplied Water and Waste Treatment*". North Carolina State University, PhD Thesis.
- RAFTELIS ENVIRONMENTAL CONSULTING GROUP (1996). *1996 Water and Wastewater Rate Survey*.
- RUSSELL, DAVID F. AND CHRISTOPHER P.N. WOODCOCK (1992). "What Will Water Rates Be Like in the 1990s?" *Journal AWWA* (September).
- US GEOLOGICAL SURVEY (1993). *Estimated Use of Water in the United States in 1990*. U.S. Department of the Interior: United States Government Printing Office.



## **RELATED OECD PUBLICATIONS**

### **Water Pricing: Current Practices and Recent Trends**

The price of water is a key determinant of both the economic efficiency and the environmental effectiveness of water services. This book summarises *current practices and recent trends* in water pricing practices for the household, agriculture, and industrial sectors in OECD countries. It addresses pricing issues related to the full range of water services, including public supplies, sewage treatment and disposal, abstraction and discharge fees, and cost recovery. It also outlines recent developments in institutional arrangements related to water pricing, and briefly considers questions concerning the affordability of water services and the responsiveness of water demands to changes in price levels. Its broad coverage of issues, sectors, and countries makes it a unique overview of trends in the water pricing field.

**FORTHCOMING** ISBN 92-64-17079-0 (Mid-1999)

### **Water Management**

#### **Performance and Challenges in OECD Countries**

This book examines the progress made in water management in OECD countries in the light of the objectives of Agenda 21. It presents the experience of the OECD programme of environmental performance reviews and focuses on issues of sustainable use of water resources, pollution control and water economics. Environmental performance reviews of Australia, Austria, Belarus, Bulgaria, Canada, Finland, France, Germany, Iceland, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, the United Kingdom and the United States have already been published.

(97 1998 06 1P1) ISBN 92-64-16078-7 March 1998 36 Pages 5 Tables 41 Charts  
FF 55 US\$9 DM 16 £6 ¥1150

### **Environmental Indicators**

#### **Towards Sustainable Development**

Interest in sustainable development and awareness of the international dimension of environmental problems, have stimulated governments to track and chart environmental progress and its links with economic conditions and trends. This publication presents leading environmental indicators from the OECD Core Set and thus contributes to measuring environmental performance and progress towards sustainable development. Organised by issues such as climate change, air pollution, biodiversity, waste or water resources, this book provides essential information for all those interested in sustainable development.

(97 1998 03 1P1) ISBN 92-64-16080-9 July 1998 132 Pages 32 Tables 420 Charts  
FF 155 US\$26 DM 46 £16 ¥3300

### **Improving the Environment through Reducing Subsidies**

#### **Part I: Summary and Conclusions - Part II: Analysis and Overview of Studies**

Substantial amounts of money continue to be spent in OECD Member countries on measures to support agricultural, energy, transportation and industrial activities. Many of these support measures encourage the emission of environmentally-harmful pollutants, the generation of waste, and the excessive use of natural resources, and constitute a large drain on government budgets. Although the effects of a given support measure on the environment will be determined by a number of different factors, this publication finds that releasing market forces through support removal and increasing the effectiveness and efficiency of regulations can lead to significant environmental benefits. The book develops an analytical framework which enables policy makers to identify those support measures whose removal is most likely to lead to "win-win" benefits. It also offers recommendations to implementing reductions in environmentally-harmful subsidies -- especially those that run counter to environmental objectives that are shared by OECD Member countries -- and to overcome the often exaggerated fear of a loss in competitiveness.

(97 1998 09 1P1) ISBN 92-64-16091-4 April 1998 168 Pages 19 Tables 24 Charts  
FF 180 US\$30 DM 54 £18 ¥3850

## 5 EASY WAYS TO ORDER

|                        |                                                                                                               |                                                                                                                                                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. By post</b>      | <b>In the rest of the world</b><br>OECD Paris Centre<br>2, rue André-Pascal<br>75775 Paris Cedex 16<br>France | <b>In the United States</b><br>OECD WASHINGTON CENTER, 2001 L Street NW Suite 650, Washington DC 20036-4922 USA<br>Tel: (202) 785-6323, Toll-Free Number for Orders: (800) 456-6323, Fax: (202) 785-0350<br>E-mail: washington.contact@oecd.org, Internet: www.oecdwash.org |
| <b>2. By Telephone</b> | (33-1) 45 24 81 67                                                                                            | <b>In Austria, Germany and Switzerland</b><br>OECD BONN CENTRE, August-Babel-Allee 6, D-53175 Bonn<br>Tel: (49-228) 959 1215, Fax: (49-228) 959 1218<br>E-mail: bonn.contact@oecd.org, Internet: www.oecd.org/bonn                                                          |
| <b>3. By Fax</b>       | (33-1) 49 10 42 76                                                                                            |                                                                                                                                                                                                                                                                             |
| <b>4. By E-mail</b>    | sales@oecd.org                                                                                                | <b>In Asia</b><br>OECD TOKYO CENTRE, Landic Akasaka Bldg, 2-3-4 Akasaka, Minato-ku, Tokyo 107-0052<br>Tel: (81-3) 3586 2016, Fax: (81-3) 3584 7929<br>E-mail: center@oecdtokyo.org, Internet: www.oecdtokyo.org                                                             |
| <b>5. By Internet</b>  | www.oecd.org/publications<br>(secure payment with credit card)                                                | <b>In Latin America</b><br>OECD MEXICO CENTRE, Edificio INFOTEC, Av. San Fernando No. 37, Col. Toriello Guerra<br>Tlalpan C.P. 14050, Mexico D.F.<br>Tel: (52-5) 528 10 38, Fax: (52-5) 606 13 07<br>E-mail: mexico.contact@oecd.org, Internet: rtn.net.mx/ocde/            |

For the fastest service, fax your order to  
your nearest OECD Centre

## Yes! Please send me the following OECD publications

|                                |               |         |
|--------------------------------|---------------|---------|
| (Prof./Dr./Mr./Ms.) First name |               | Surname |
| Organisation                   |               |         |
| Address                        |               |         |
|                                |               |         |
| City                           | Post/Zip Code | Country |
| Tel.                           | Fax           | E-mail  |

### Choose your books and the correct price option

#### Water Pricing: Current Practices and Recent Trends

\_\_\_\_\_ English ISBN 92-64-17079-0 Please contact me as soon as this publication is available  
 \_\_\_\_\_ French ISBN 92-64-27079-5 Please contact me as soon as this publication is available

#### Water Management: Performances and Challenges

\_\_\_\_\_ English ISBN 92-64-16078-7 FF 55 US\$ 9 DM 16 £ 6 ¥ 1 150  
 \_\_\_\_\_ French ISBN 92-64-26078-1

#### Environmental Indicators : Towards Sustainable Development

\_\_\_\_\_ English ISBN 92-64-16080-9 FF 155 US\$ 26 DM 46 £ 16 ¥ 3 300  
 \_\_\_\_\_ French ISBN 92-64-26080-9

#### Improving the Environment through Reducing Subsidies

\_\_\_\_\_ English ISBN 92-64-16091-4 FF 180 US\$ 30 DM 54 £ 18 ¥ 3 850  
 \_\_\_\_\_ French ISBN 92-64-26091-9

#### Enter method of payment

\_\_\_\_\_ Cheque/Eurocheque enclosed (please make payable to OECD)  
 \_\_\_\_\_ Please invoice me. Purchase order no. \_\_\_\_\_ **Total** \_\_\_\_\_  
 \_\_\_\_\_ Please charge my credit card: AMEX / VISA / MASTERCARD

Card Number \_\_\_\_\_ Expiry Date \_\_\_\_\_

Today's date \_\_\_\_\_ Signature \_\_\_\_\_

**Post, fax or e-mail to your nearest OECD Centre or use the website: [www.oecd.org/publications](http://www.oecd.org/publications)**