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HOUSEHOLD WATER PRICING IN OECD COUNTRIES

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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 — households. It examines current practices and recent trends in domestic water pricing in OECD countries. Other reports in this series deal with water subsidies, and with pricing practices in the agriculture and industry 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 **Paul Herrington**, Department of Economics, University of Leicester, 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.

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HOUSEHOLD WATER PRICING IN OECD COUNTRIES

Introduction

The objectives of this report are two-fold:

- to update *inventory information* about existing water price levels and structures in households in as many OECD countries as possible; and
- to generate *comparative interpretations* of that data.

The study has been restricted to a consideration of the two *piped* water services usually found in the home: (i) provision of potable water supplies; and (ii) provision of wastewater services (i.e. embracing sewerage, sewage treatment, and disposal). Although comprehensive information is not presented regarding the provision of (or charging arrangements for) domestic water services obtained through *direct* abstractions and *direct* discharges (i.e. to septic tanks, cesspits, etc.), some anecdotal information on these subjects *is* presented, and the reader is referred to related publications concerning water pricing practices in both the industry and agriculture sectors (OECD 1999a, and 1999b) for a more extensive discussion of OECD practices in these fields.

The report is organised as follows:

- The next Section describes the context in which household water services are provided in OECD countries. In this respect, "context" is interpreted to include organisational, legal, and accessibility aspects, as well as *per capita* domestic consumption levels and trends. Relevant institutional material from OECD (1999*a*) — henceforth referred to as the *Industry* report — is *not* repeated here, although important legal and institutional changes — both past and planned — which bear directly on tariff issues affecting households are highlighted.
- This is followed by a comprehensive review of: (i) the pricing "principles" underlying tariff designs in various OECD countries; and (ii) the actual charging structures in place for household water supply and wastewater services in those OECD countries for which information was available.
- The extent to which economic and environmental cost recovery practices are actually employed in OECD countries (and thus, the degree of subsidy implied) is then examined. Information concerning taxes, levies, and other fees in Member countries' charging arrangements is also provided, followed by summary data concerning current tariff levels and recent changes.
- The issue of domestic metering across and within countries is then addressed, including policies and practices with regard to both single-family houses and apartments. Recent

evidence about the effects of both tariff structures and prices on total household water demand is also reviewed (i.e. elasticity issues).

- A discussion is then presented concerning the prevalence of "social tariffs" and the results of recent studies enquiries made on "overall affordability" (by relating water charges to household incomes) and on the various methods of providing assistance for groups of (and individual) households who experience difficulties in paying their water bills.
- Country experiences with the pursuit of additional economic and environmental efficiencies (via the development of more complex tariff structures which respond to temporal variations in supplies and demands) are then presented.
- Finally, major trends and issues generated by the study are noted, significant differences in practices among Member countries are explored, and some provisional conclusions are offered.

Approach and methodology

OECD countries are now both more numerous and more heterogeneous than was the case at the time of the 1987 study. It was therefore decided to undertake a more broad-based review of pricing practices here than that which was conducted for the 1987 report (the latter having relied largely on submissions from a relatively small group of OECD countries).

Contacts were sought in each country from: (i) a list of contacts acquired through OECD delegations; and (ii) contacts already working in the area and known to the consultant (i.e. academics, working water professionals, and other consultants).

A three-page brief, setting out the "agenda" for the project, was sent to all contacts who expressed interest in the study during an initial telephone conversation. In many cases, national associations of water supply and wastewater utilities (sometimes two distinct bodies) were in the best position to provide detailed factual information, while consultants and academics were often better able to highlight the underlying socio-economic forces at work, or to offer relevant analyses.

Finally, an extensive review of existing literature was undertaken, including new (and very helpful) country reviews which had been assembled for: (i) two European water price studies undertaken for the German Federal Environment Agency [Ecologic (1996–98) and Ecologic (1997–98)]; and (ii) a study conducted for the European Commission into the application of the Polluter Pays Principle in Cohesion Fund countries (Ecotec, 1996).

Scope

As noted earlier, this study is concerned with the provision of two basic water services to households:

- the piped supply of potable water; and
- the provision of piped wastewater disposal facilities, of which sewerage is a necessary element, and which may or may not lead to sewage treatment before final disposal.

Inevitably, some qualifications had to be made in deciding on the scope of the paper. For example, in some Member countries, there are examples of a piped supply being made available to a standpipe, often in a courtyard around which houses are clustered (e.g. ***Greece, Mexico, Portugal***). No data is available on the prevalence of these systems, or on charges for services provided by them. Second, ownership and/or management (and therefore, provision) of sewerage services in some countries is distinct from that of treatment and disposal. Separate charges may thus be levied (e.g. ***Spain***). Sometimes, there is even a further sub-division of household wastewater services — one involving the separate provision of stormwater (or rainwater) disposal facilities via the drainage of roofs or paved areas associated with the home. This drainage may flow into either the same or a separate sewer system, and the service is normally shared with other customer classes (e.g. highway authorities). Again, a distinct charging system (and, therefore, separate charges) may arise. Where details of such complex systems were available to the study, they have been mentioned, but no systematic attempt has been made here to include them.

The changing context for the pricing of household water services

Recent legal and institutional changes

There is no need to repeat here the detailed legal, institutional, and organisational arrangements for public water supply (PWS) and wastewater services that are so comprehensively described in the *Industry* study. Instead, this section provides only a brief overview of the current situation, highlighting recent and impending changes that either have already had, or are likely to have, direct or indirect implications for household tariffs. National (or supranational) organisational and legal changes with more direct consequences for charging are then dealt with in the next section.

There is an increasing involvement of *private water companies* in service provision, although the precise form this takes varies considerably. What may be termed "full" privatisation (embracing both asset ownership and management) is found in both ***England and Wales*** and in the investor-owned companies of the ***US*** (where private interests are responsible for about one-quarter of the PWS). Full privatisation has also almost been realised in the ***Czech Republic***. Concessions (i.e. the delegation of authority to fully private concerns) is dominant in ***France*** (involving 75 per cent of public water supply, but only about one-third of wastewater services). It is increasing rapidly in ***Spain*** (40 per cent of the population are already served by concessions) and in ***Portugal*** (ten concessions have already been granted), and similar schemes are under active consideration in ***Hungary*** and ***Poland***.

The "optimal" degree of privatisation in water services remains the subject of some debate. On the one hand, significant efficiency gains may be available by using a privatised approach (although the additional costs of regulating the private system on behalf of the public interest should not be ignored in making this calculation). On the other hand, the "natural monopoly" characteristics of water services argue in favour of a stronger public role in the provision of these services.

In ***England and Wales,*** the wholesale privatisation (in 1989) of piped water services provided by the ten Regional Water Authorities has led to: (i) a much more "businesslike" approach in the provision of these services; (ii) several mergers on the PWS side (39 companies have now been reduced to 28, if account is taken of the previous smaller private water supply-only companies); (iii) three large and three "water-only" companies have entered into extensive multi-utility arrangements; and (iv) the first experience with PWS competition — and lower prices — for large industrial water-users.

In ***Australia,*** a similar commercial approach to the "business" of water has been adopted, but so far without private shareholders. In the ***Netherlands,*** mergers and restructuring also continue at a rapid pace - the number of water boards of all kinds has been reduced from 129 (in 1990) to 66 (in 1997). ***Finland*** has seen 21 regional water supply and wastewater systems established since the late 1960s, although small municipal systems still predominate.

Simultaneously, the degree of autonomy enjoyed by water services utilities has been increasing, allowing the utilities great managerial freedom, legal standing, and access to finance. In ***New Zealand,*** nearly all local authorities have established Local Authority Trading Enterprises (LATEs) to take over service provision, while in ***Finland,*** nearly half of all municipalities have established (or are planning to establish) local authority-owned water companies, similar to those which have long existed in ***Germany*** and in parts of ***Austria, Switzerland, France*** and ***Italy.*** In Scotland, the ***UK*** government established three public water authorities in 1995 (with appointed members) to take over the water services supply roles of nine regional and three island councils (which had previously been managed by local authority representatives). These new Authorities are being encouraged to seek private financing for capital investments.

More traditional forms of direct (municipal or supra-municipal) or delegated public management remain the norm in ***Belgium***, ***Denmark***, ***Canada***, ***Greece***, ***Korea***, and ***Sweden,*** and some areas in ***Austria*** and ***Italy*** (although changes may soon occur in Italy — see next section). In ***Ireland, Luxembourg***, and ***Turkey,*** local authorities still appear to be completely responsible for all piped water services. In ***Japan***, local authorities are responsible for *almost* all supplies: communities of more than 5 000 people, amounting to 90 per cent of the total population, receive piped water from 1 949 local authority organisations and 11 privately-owned water companies.

A wide range of recent government Acts, Decrees, Orders and decisions in OECD countries have also had direct consequences for household water charging arrangements and systems.

For example, much of the radical and rapid reforms being experienced in ***Australia*** have been driven by the 1994 Council of Australian Governments (COAG) agreement to implement a Strategic Water Reform Framework. In order to promote more sustainable and efficient natural resource use, a number of deficiencies in the Australian water industry were previously identified. These included charging policies that had often resulted in commercial and industrial users of water services paying more than their fair share of the costs of service provision, of asset refurbishment in rural areas, of service delivery inefficiencies, and of impediments to water being transferred from lower to higher value uses.

To address these shortcomings, the Framework agreed on a number of reforms in relation to charging (Sydney Water, 1998):

- the restructuring of tariffs in line with the principles of "consumption-based" (i.e. volumetric) pricing and full-cost recovery;
- the reduction or elimination of subsidies deemed "inconsistent with efficient and effective service";
- making more transparent all remaining subsidies and cross-subsidies; and
- where service deliverers are required to provide water services to customers or customer classes at less than full cost, the cost should be fully disclosed and (ideally) paid to the service deliverer as a Community Service Obligation (e.g. by the State government which imposes the requirement).

Appropriate economic and regulatory bodies have since been (or are being) established, and independent state regulators have begun to determine medium-term price paths, assessing (*inter alia*) tariff structures and levels.

In the ***US,*** the Safe Drinking Water Act (SDWA, including 1996 Amendments), the enforcement of which is largely delegated to individual States, is often cited as a force driving toward higher prices for water services. Other cost-increasing factors include: (i) the need to replace an ageing infrastructure; (ii) the costs of meeting increasing demands for water; and (iii) the historic under-pricing of water services (use of average historic costs; failure to create adequate replacement funds; deferral of capital improvements; and subsidisation by various levels of government). The US Environment Protection Agency (EPA) has recently pointed out the drinking water affordability implications of the 1996 SDWA Amendments (http://www.epa.gov/OGWDW/ssafford.html#tfb).

In the ***European Union***, realisation of the implementation timetables set by the 1991 EC Urban Waste Water Treatment Directive 91/271/EEC will probably mean sizeable new wastewater costs being added to water bills between now and 2005.

Tariff structures have been more directly affected by recent decisions in France, Belgium, Denmark and Korea. In ***France,*** the January 1992 Water Law attempted, *inter alia*, to reduce water wastage, while promoting improved equity between users. With these objectives in mind, it prohibited the use of "flat fee" tariffs, thereby ruling out *both* entirely non-volumetric schemes (rare in France in any case) *and* tariffs combining a fixed charge (covering a given volume of household consumption per period) with volumetric charging (on the remainder). Departmental *préfets* now have the power to grant derogations on a case-by-case basis (e.g. in very small rural systems where metering may not be cost-effective). The 1992 law also allows two other exceptions: where water is particularly abundant, and in zones where there is a strong seasonal fluctuation in the number of inhabitants. Despite these "let-out" clauses, the result has been a decisive move in France towards one- or two-part tariff systems, without minimum consumption charges.

Belgium has also witnessed major changes in the structure of its water tariffs, most of which have been the result of regional government initiatives. As of January 1997, all households in the Flanders Region (59 per cent of the Belgian population) have been entitled to free access to 15 cubic metres of water per year per person (41 lhd). Further details on this system are provided later. For the moment, it is merely noted that this structure may be breaking completely new ground by imaginatively combining efficiency and equity objectives. The Region of Wallonia (32 per cent of the population) has also initiated tariff reforms. It recently announced the creation of a public company for the management of water, one of the effects of which will be to integrate the costs of sewerage and wastewater treatment with those of water supply. This presents a single price to each consumer — a price which, it may be argued, better reflects the inherent value of the resource.

In ***Denmark,*** a recent government Declaration (No. 525, of 14 June 1996) imposes an obligation on water utilities to ensure that (as of 1 January 1999) all properties connected to the public water supply have a water meter installed. Furthermore, payment for water deliveries must be made via a combination of a fixed charge and a volumetric charge or charges (i.e. utilising at least a two-part tariff).

Korea has also issued the *Comprehensive Water Management Countermeasures* (August 1996) in order to: (i) achieve full cost recovery for water services; (ii) pursue demand management objectives; and (iii) generate extra funds for investment purposes. These measures have already had two significant effects: the widespread abandonment by local authorities of the standard tariff's basic rate (which

amounted to a minimum consumption charge) and a sizeable shift from two-part to increasing block tariffs. Again, further details on these changes are presented later.

In ***Portugal,*** Decree-Laws 379/93 and 319/94 provide a new framework for private companies to be involved in the provision of water services, and prescribe that charges for privatised services must be fixed at "economic levels" [in the case of EPAL[1], prior approval is required from the Ministry of the Environment and Natural Resources (MARN)]. EPAL has become the model for six new water companies which will provide services to more than half the population. Concessions to private companies will also be facilitated by the new legislation, and the first (25 year) concession for water services was awarded to Compagnie Generale des Eaux by the town of Mafra. Ten such concessions now exist. Significant downward pressures on tariff levels are expected to result from these charges.

In ***Italy,*** Law 36/1994 sets out a framework for the reorganisation of the entire Italian water industry. It provides for both vertical and territorial integration of the water cycle (abstraction + PWS + sewerage + treatment + discharge) within "optimal management areas" (OMAs) that the 20 Regions are expected to delineate themselves. Associations of local authorities must then take on responsibility (previously held by 8 000 individual municipalities) for organising water services on an integrated basis. Law 142/1990 further specifies that a variety of organisational forms can be used to discharge this responsibility, including private or public companies, or "contracting out". Under this new system, prices will be set so as to cover full long-run costs (including a reasonable return on investment), with a single charging method for the entire (vertically-integrated) water cycle. However, the actual implementation of this Law — particularly for sewerage — has been slow so far (Massarutto and Messori, 1998).

Share of household consumption in public water services

Table 1 provides an indication of the relative importance of domestic consumption in the public water supply, and access to the two basic piped water services. Data for this table have been drawn from a wide range of sources, including (for sewerage and sewage treatment) the *OECD Environmental Data Compendium 1997* (OECD, 1997*a*).

The share of domestic consumption may be measured in two basic ways: as a proportion of estimated total public water supply consumption (thereby *excluding* unaccounted losses, such as "leakage"), or as a proportion of the public water supply put into the distribution system (and usually measured as water leaving the water treatment works, which *includes* leakage). There is a surprising constancy in the first measure — only one OECD country (***Switzerland***) indicates a consumption rate outside the 59-74 per cent range. The second measure unsurprisingly indicates much more variance — figures range from 31 to 62 per cent — since both "*true*" leakage and leakage *estimates* are known to vary considerably among countries.

1. *Empresas Portuguesa das Aguas Livres* (EPAL) has been responsible for water services in Lisbon since 1867.

Table 1. Population, Relative Size of Domestic Water Consumption, and Household Access to Piped Water Services

	Population (1996) (million)	Domestic water consumption as a proportion of ...			% of population with access to PWS		% of population with access to sewerage and public sewage treatment facilities					
		Total PWS Consumption, excluding leakage (%)	Total water supplied to the public system (%)	Year	Total (%)	Year	Access to sewerage (%)	No treatment (%)	P only (%)	P + S only (%)	P + S + T (%)	Year
Australia	18.289		59[2]	1996			<95 [2]					1996
Austria	8.059						76	1	1	39	35	1995
Belgium	10.157	74	59	1997	98	1997	78			37[3]		1997
Canada	29.955		52	1996	92	1996	89	14	18	24	33	1996
Czech Republic	10.316				86	1997	74			50		1997
Denmark	5.262	66	60	1996	90	1996	87				>18	1996
Finland	5.132	70	60	1997	87[4]	1997	78[4]	0	7		71	1997
France	58.380	70		1994	99	1995	81	4	0	0	77	1994
Germany	81.877	70	61	1994	98	1996	92			>31	>47	1995
Greece	10.465	70[5]		1996	86	1996	70	16	0	0	54	1996
Hungary	10.193	70		1996	97	1996	45	6	20	18	1	1996
Iceland	0.270						90	86	4	0	0	1995
Ireland	3.621	65	31	1994	80	1996	68	32[6]	23[6]	12[6]	1[6]	1995
Italy	57.459	70		1996	98	1987	84	16	3	38	26	1996
Japan	125.823	71	62	1996	96	1996	62	38	0	57	5	1996
Korea	45.545	61		1997	84	1996	56	0	1	56	0	1997
Luxembourg	0.418	70		1997	99	1997	88	0	19	57	11	1995
Mexico	96.582				[1]	1990	65	43	3	19	0	1993
Netherlands	15.494	63	60	1996	100	1996	98	2	0	68	28	1994
New Zealand	3.640											

Table 1. Population, Relative Size of Domestic Water Consumption, and Household Access to Piped Water Services (continued)

	Population (1996) (million)	Domestic water consumption as a proportion of ...			% of population with access to PWS		% of population with access to sewerage and public sewage treatment facilities					
		Total PWS Consumption, excluding leakage (%)	Total water supplied to the public system (%)	Year	Total (%)	Year	Access to sewerage (%)	No treatment (%)	P only (%)	P + S only (%)	P + S+T (%)	Year
Norway	4.370						73	6	15	1	51	1995
Poland	38.618						>41		8	30	4	1995
Portugal	9.935	69		1996	83	1996	55	34	9	11	0	1990
Spain	39.270	71		1994	>90	1996	62	13	11	34	3	1995
Sweden	88.380	73	57	1995	87	1995	86	0	0	5	81	1995
Switzerland	7.085	44	38	1995	100	1995	94	0	0	23	71	1995
Turkey	62.866	70		1997	93(7)	1990	63	50	9	4	0	1995
UK:	58.782				99	1996	96	9	9	64	14	1996
- Eng.&Wales	51.993	63	46	1996	99	1996	96	10	0	0	86	1995
- N. Ireland	1.663				98	1996	83					1996
- Scotland	5.126	59	41	1991	98	1996	94					1996
US	265.557						>71		9	33	30	1990

P = Primary treatment; P+S = Primary + Secondary; P+S+T = Primary +Secondary + Tertiary.

Notes: 1. 94% of the Mexico City Metropolitan Area (15.1 million residents) is serviced with a water connection either directly to the house, or from a common distribution tap in the neighbourhood
2. Applies to 18 urban water utilities supplying a population of 12.55 million with public water supply and 11.91 million with sewerage.
3. Brussels = 0.
4. If the private water supply and sewage systems for individual houses are included, piped water is available in 97% of households and sewerage in 98%.
5. Athens only.
6. Estimates concerning treatment are derived from a breakdown of loads in pollution equivalents (p.e.) for all agglomerations with more than or equal to 2000 p.e., rather than to population. However, the correlation between the two is normally high.
7. 85% in rural areas and 97% in urban areas.

Access

Accessibility figures for basic utility services (like piped water) would normally be expected to be at (or very near) economic limits in advanced economies, thereby showing little change over time. Where these figures fall below 100 per cent, this is mainly due to the presumed inefficiency of linking rural households to existing networks. Thus, only ***Finland***, ***Denmark***, and ***Sweden*** among the "mature" OECD Europe economies exhibit PWS access figures of 90 per cent or less, and all have sizeable rural populations. The four EU Cohesion Fund countries, however, indicate generally lower access rates, ranging from 80 per cent ***(Ireland)*** to over 90 per cent ***(Spain)***.

Access rates to public sewage systems are much more variable (although the data presented in Table 1 for some countries — such as ***Belgium, Japan*** and ***Korea*** — is difficult to interpret). In some cases, sewage access seems to bear surprisingly little relation to PWS access (e.g. ***Hungary, Japan, Poland, Portugal, Spain,*** and ***Turkey***). All four EU Cohesion Fund countries indicate sewage access for 55-70 per cent of their populations — figures similar to those supplied for ***Mexico*** and ***Turkey***. Assuming that economic limits for access have not yet been reached in these countries, significant economic investment would seem to be forecast for them, since the 30-45 per cent of the population remaining to be connected will, of course, be the most costly to add to the system.

Domestic water use in OECD countries (1970–97)

The final element of "context" to be considered is that of average consumption in the public water supply — better expressed on a *per capita* basis than on a per household one for international comparisons (although the latter may be preferable for some analytical and forecasting purposes at the regional and national levels). In any case, it is only on a *per capita* basis that any coherent estimates are currently available. This data has been assembled in Table 2, where it is uniformly presented in terms of litres per head per day (lhd). Inevitably, only a patchy impression emerges, but any potential links between different tariff systems/price levels and the quantity of water demanded by households is worth exploring.

It is immediately clear from Table 2 that, based on recent estimates of *domestic* (but excluding *small business*) consumption, OECD countries can be conveniently divided into four broad groups:

- A "high-use" group at 250 lhd and above (***Canada, United States, Australia*** and ***Japan***). For all of these countries, the evidence is decidedly thin, but in Canada, consumption appears to be declining, and in Japan there is no evidence that average consumption has increased in the 1990s, while in Australia, it may well have not increased over the last 20 years.

- A small group at about 200 lhd (***Italy, Spain, Turkey,*** and ***Sweden***). For the first three of these, this relatively high figure for domestic consumption likely reflects their hot climate (i.e. demands for showering and garden use), whereas in Sweden, evidence collated in an earlier OECD study suggested very high water consumption related to personal washing and dishwasher use (OECD, 1987*a*).

Table 2. Estimates of *Per capita* Household Water Consumption (litres per head per day — lhd)

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
Australia		256[2],[3]	285[4],[5]								268[6]	
Austria			155[8]							162[8]	133-135	
Belgium	72	93	103	108		116				120		122
Canada[1]		255[2]				350			350		326	
Czech Rep.		138[2]	157[5]	165[9]			137			121		113
Denmark				175[9]	165	164	159	155	149	145	139	
Finland			148	155		150					145	
France:												
(HH&SB)		106	109	141		161		157		156		
(HH only)												137
Germany:[10]		133	141	145		144		136	132	132	128	129
(HH&SB)	118											
(HH only)	106	120	127	130		130		122	119	119	115	116
Greece [11]										140		200
Hungary	122	124	133	153	153	140	136	126	119	113	107	102
Ireland									142			
Italy			211					251		249		213
Japan	212	245	244	260	279	279	278	277	278	278		
Korea		62	69	103		160	164	169	181	175	181	183
Luxembourg			177	172	181					169		170
Netherlands				122	130	128	129	125	128	129	130	
New Zealand			170[1]	165[7]								
Norway			154	175								140
Poland			204	214	210					180	158	
Portugal									119			
Spain		145	157	158				210				
Sweden	229	207	196	195	197	195	201	203	199	191		

Table 2. Estimates of *Per capita* Household Water Consumption (litres per head per day — lhd)

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
Switzerland:												
(HH&SB)	270	258	229	259		260				237		
(HH only)				180						158		
Turkey (PWS[12])	105	113	136	159	182					195		
UK:												
• **England & Wales:**												
(Unmetered)												
(Metered)	106	114	122	129	136	137		142	147 131	154 134	149 132	153 141
• **N. Ireland**				136								
• **Scotland**			119[5]			148						
United States		295[2]	305									

HH&SB = Households plus small businesses (category frequently used in presentation of IWSA data); HH only = Households only.

Notes:
1. Source: OECD (1987*b).*
2. Estimate applies to 1977.
3. Estimate for Melbourne.
4. Estimate for Perth.
5. Estimate applies to 1982.
6. Urban domestic water use only.
7. Metered consumption only.
8. HH & SB.
9. Estimate applies to 1987.
10. HH only estimate derived as 90% of HH and SB figure, following discussions with R. Stadtfeld, BGW, Bonn. 1970-85 estimates: Old Länder; 1991-97 estimates: Old and New Länder combined.
11. Athens only.
12. *Per capita* consumption of PWS including 68-70% household use, 23-27% public+commercial+offices, 5-7% industrial.

Other sources used were IWSA (International Water Supply Association) statistics and numerous country submissions covering recent years.

- A large "middle-range" group at 130-180 lhd (***Denmark, Finland, France, Austria, Switzerland, the UK, Norway, Luxembourg, Poland, Netherlands, New Zealand, Korea*** and ***Ireland***). Of the nine countries in this group with sufficient data for an impression to be gained of recent trends, it is interesting to observe that only England and Wales (UK) and Korea show any underlying increase over the past two decades. The former has, in all its regions (including those afflicted by droughts in recent years), very low domestic metering penetration by international standards. In Korea, the probable explanation is very different: until recently that country has experienced rapid economic growth, high subsidies for domestic water services, and (as explained later) a system of minimum charges which has meant that the marginal price of water for many households was zero. Of the other seven countries for which there is a sufficient data, Denmark, Switzerland and Poland all show signs of significant decreases in *per capita* consumption; Finland and Luxembourg reveal slight reductions; while France and the Netherlands reveal no trend at all in the years leading up to the most recent estimates. For Austria, Ireland, Norway, and New Zealand, no impression of trends can be gained from Table 2.
- A "low-use" group at 100-130 lhd (***Czech Republic, Hungary, Portugal, Belgium,*** and ***Germany***). Given the significant economic restructuring which has been occurring in the first two countries in this group (and in Poland as well), it is not surprising to find water use rates declining in these countries during the 1990s. But the presence of Belgium and Germany is more interesting: two "mature" economies, long believed to have had "strong" water economy policies in the home, still seem to have been able to contain or reduce their domestic consumption rates in recent years. Note that it is believed that the low rate of consumption in Belgium is in part a consequence of householders' direct abstractions of groundwater, although the size of this factor is unknown.

With the socio-economic context thus having been established, the report now moves on to consider OECD country tariffs in more detail.

Pricing principles and tariff structures

Objectives of tariff design

More than ten years after the OECD last formally stated the criteria which should inform the design of sensible water service charging systems (OECD, 1987*a*; Chapter II), the list today would probably look not very different. Few would quarrel with the inclusion of the following:

- allocative (economic) efficiency;
- equity;
- financial requirements;
- public health;
- environmental efficiency;
- consumer acceptability and understanding; and
- administrative costs.

On the other hand, two criteria on the 1987 list (energy and employment) would probably be omitted in the late 1990s, not because of any re-evaluation of priorities, but rather because it is generally

now believed that there are better ways of addressing these two issues than by reflecting them in the water pricing system.

Elements of tariff structures

For clarification purposes, this discussion begins with: (i) a definition of the main elements of tariff structures (following the example of Pezzey and Mill, 1998); and (ii) a brief summary of the rationale lying behind this definition. Ideally, these would be accompanied by (iii) an elaboration of the types of economic costs incurred by water utilities in their provision of water services — "customer" costs; "commodity" costs; "capacity" costs; and "common" costs. However, this latter dimension is not explored here. The interested reader is referred instead to OECD (1987*a*; Chapter II.3) for a general theoretical exposition on the matter. Only the actual elements of household water tariffs are indicated here, and a brief comment is offered on each.

A *tariff* is the system of procedures and elements which determines a customer's total water bill (any part of that bill can be called a *charge*, measured in money/time units or money units alone; and any unit price can be called a *rate*, usually measured in money/volume units). Most tariffs are a combination of some or all of the following elements:

- A *connection charge* is a "one-off" and (normally) "up-front" charge for connecting a customer to the public water supply and/or sewage systems. Most OECD countries distinguish between connection charges (non-recurring) and fixed charges (recurring). The economic efficiency criterion suggests that this charge should *not* be used to recover general system development costs. To the extent that the latter are affected in the long-run by the scale of average or peak demands on the system, they are best recovered through a volumetric rate. Although it may be attractive for cash-strapped public (or profit-seeking private) utilities to secure capital contributions through connection charges, the result would likely be the under-pricing of the final service. In the long-run, as domestic water use increasingly takes on (at least in part) the characteristics of a luxury service (power showers, swimming pools, garden use, etc.), under-pricing of the service will provide an environmentally-damaging and economically-misleading signals to consumers.
- A *fixed charge* (sometimes known as a *standing charge* or *flat fee*) is normally either equalised for each customer (e.g. within a given customer class or at a particular geographical location), or linked to some other customer characteristic (e.g. size of supply pipe or meter flow capacity, property value, number of water-using appliances, lot size, etc.). In a metered environment, this charge should not recover more than "ongoing" customer costs which are not directly linked to the volumes of water used (i.e. those associated with a customer continuing to have access to the system, such as meter maintenance and reading, billing, and collection costs).

If a metering (measuring) system is in place, the following elements also occur:

- A *volumetric rate*, which when multiplied by the volume(s) of water consumed in a charging period gives rise to the volumetric charge for that period. Economic efficiency and environmental criteria both suggest that this element should ideally recover all costs which vary with average or peak demands made on the system (in *both* the short- and the long-run). There are several potentially complex issues here, having to do with the "fair" recovery of peak-related costs, but however these issues are resolved, the preference should be to seek recovery of variable costs through volumetric charges, rather than fixed ones. On the other hand, there are two possible reasons for recovering these costs through fixed charges. One is to

reduce *financial risks* for the utility which might derive from its exposure to the volatility of volumetric charges (however, see the discussion of "minimum charges" below). The other arises if the costs of sophisticated meter technology and/or more frequent meter reading (as is necessary for the recording of peak demands) are perceived to be higher than the efficiency gains which derive from their use. In such cases, it may be appropriate to look for *proxies* for the contribution a user should make to peak costs, and one such proxy may be the maximum flow of the consumer's supply pipe per unit period of time. The fixed charge could thus be geared to the potential peak demand that a consumer may make on the system. However, under such circumstances, the fixed charge provides no incentive to reduce peak demands. These issues are addressed in more depth in the 1987 study (OECD, 1987*a*, Chapter III.5).

- A *block* charge, defined by lower and (except for the highest block) upper volumes of consumption per charging level. Different volumetric rates are frequently attached to different blocks. If rates rise or fall consistently as more water is consumed, the schedules are referred to as *increasing-* or *decreasing-block* tariffs, respectively.
- A *minimum charge*, usually imposed to protect the utility's finances, which specifies that a certain minimum volume of the service will be paid for in each period whether or not that amount has, in fact, been consumed.

These, then, are the key elements that constitute a "tariff". Before moving on to consider OECD countries' current tariff structures, however, it is useful to review the main tariff criteria (and, sometimes implicitly, the tariff structure elements) which appear to have the strongest influence on the determination of tariff structures in OECD countries.

Pricing principles

The literature assembled for this study emphasises the need for prices to be based on both "*economic and environmental efficiency"* and "*broad (social) equity"* goals rather more strongly than was the case ten years ago. First, consider efficiency. ***Australian*** documentation, in the form of both the COAG Agreement and data provided by the Sydney Water Corporation (the largest urban water business in that country) stresses the desirability of consumption-based pricing and (more generally) of improving pricing signals in order to move towards sustainable use of the natural resource.

In ***England and Wales,*** the economic regulator (OFWAT) has recently required all water companies to submit estimates (and associated methodologies for computing these estimates) of their long-run marginal costs of providing public water supplies. This has been undertaken with a view to: (i) companies moving towards more efficient pricing of garden-related household water usage; (ii) the achievement of economically-appropriate leakage reduction efforts; and (iii) setting the scene for the regulator's obligation to resolve applications for "inset" appointments. These appointments may result when an existing water company or another enterprise — inevitably a "water broker" — applies to supply an existing large user or (perhaps) a new housing or industrial development at a lower price than the local (monopoly) supplier can offer.

Marginal costs are now also being invoked more often in descriptions of new tariff initiatives. For example, a large utility in the ***US*** — the Los Angeles Department of Water and Power — introduced a radically different tariff structure in 1993 that was designed to be "equitable and promote conservation, water recycling and improved water quality". A Committee on Water Rates set up by the Mayor designed the new structure:

> *... to focus the [rates] increases on those who are consuming more than 175 per cent of the water used by a typical home. Those who consume more than this level will pay a higher rate which is set at the marginal cost of water. (*Mayor's Blue Ribbon Committee on Water Rates, 1992).

Marginal-cost based pricing in ***Japan*** has continued to develop, although the proportion of utilities using increasing-block tariffs has increased only slightly, from 52 per cent in 1978 (OECD, 1987*a*) to 57 per cent in 1998. Documentation supplied from the City of Osaka, for example, confirms the role of marginal costs in fixing the price levels of the higher blocks. In ***Spain***, the example of Barcelona's tariff design is an interesting example of "forward-looking" price-setting (see Box 3 below). In this case, future costs and investments are agreed between the utility company (Aguas de Barcelona) and the local government in a four-year contract (Maestu, undated). In ***Portugal*** too, efficiency concepts continue to evolve: Decree-Law No. 319/94 requires that new privatised water services must be provided at a charge equivalent to the long-term marginal cost (Ecotec, 1996).

Social equity considerations also figure more prominently in several countries today than they did ten years ago. The strong tradition of social tariffs for households, and its expression through increasing-block structures, is stressed in ***Spain***, ***Italy*** and ***Greece***, as well as in recent initiatives in the ***US*** and ***Belgium***. A few examples of social tariffs are also now being reported in ***Hungary***. In ***England and Wales,*** the company leading the way in the switch to domestic metering (Anglian Water) has introduced new tariff structures aimed at meeting "affordability" criteria (more details on this are provided below). More traditional methods of dealing with "economic hardship" (e.g. discounts on charges for certain groups) are also reported for the ***US*** and ***Australia.*** A number of continental Western European submissions to this report, however, maintained that no special help was necessary (or, therefore, available) in those countries, since such problems were insignificant.

The observed shift toward more use of volumetric pricing can be interpreted as a shift toward more equitable allocation of costs because it better reflects actual consumption by individual users. Similarly, the shift toward more use of increasing-block pricing *within* the variable component can be interpreted as an effort to place more of the burden on the highest-income users (i.e. to increase the "progressivity" of the pricing system). Both of these shifts therefore can be seen as moves in the direction of more "social" pricing.

PWS tariff structures in practice

Recent information about household tariff structures used in OECD countries is presented in Tables 3 and 4. Most of the data for Table 3 is expressed in terms of the distribution of *population* (often via numbers of households), sometimes in terms of the distribution of *utilities*, and sometimes in terms of both. The Table 4 data on fixed charges in the public water supply and on wastewater tariffs is much "softer", both because of the sheer complexity of those sets of charging arrangements, and because of the fact that sewerage (S), sewage treatment (ST), and drainage around the home (and associated highways) are sometimes the responsibility of different agencies, each with their own charging schemes. In general, the tariff structures and charge levels for sewerage presented here are quite simplified, as these usually depend on a number of other financing mechanisms as well, such as (annualised) contributions to initial investments in the system as a whole, contributions to or recovery of costs for connecting properties (connection charges), rain water charges, and meter rentals. Note also that no survey work is available concerning the charging systems in place in *apartment blocks*, if (as is usually the case) resident households are not subject to individual meters that are supplied and read by the water supply utility.

Table 3. Public Water Supply: Household Tariff Structures (% of Utilities (U) or Population (P) With a Given Structure)

	Year	Number of utilities in sample	Unit	Flat fee	Constant volumetric rate			Increasing-block schedule			Decreasing-block schedule			Usual number of blocks
					No fixed charge	*Plus fixed charge*	*Plus fixed +min*	*No fixed charge*	*Plus fixed charge*	*Plus fixed +min*	*No fixed charge*	*Plus fixed charge*	*Plus fixed +min*	
Australia	1997	15	P (U)	-	1%(1)	68%(8)	-	-	27%(5)	-	-	4%(1)	-	2
Austria	1993		U	-	-	80%	-	-	20%	-	-	-	-	
Belgium:														
● Flanders	1997		U,P	-	-	-		-	100%	-	-	-	-	2
● Wallonia	1997		U,P	-		<---- 24% ---->		-	76%	-	-	-	-	2
● Brussels	1997		U,P	-	-	100%	-	-	-	-	-	-	-	-
Canada	1996	1452	U	56%		<--- 27% --->			<--- 4% --->			<--- 13% --->		2
Czech Rep.	1998		U,P	-	100%	-	-	-	-	-	-	-	-	-
Denmark	1998		U,P	rural		most								
Finland	1998		U,P	-	-	100%	-	-	-	-	-	-	-	-
France	1990	500	U	2%	5%	46%	47%	-	-	-	-	-	-	-
Germany	1998		U,P	-	-	100%	-	-	-	-	-	-	-	-
Greece	1998	1	U	-	-	-	-	-	-	100%	-	-	-	5
Hungary	1997	268	U	-	95%	-	-	5%	-	-	-	-	-	2
Iceland	1997	1	U	100%	-	-	-	-	-	-	-	-	-	-
Ireland	1998	All domestic water charges have been consolidated into general taxation since 1 January 1997.												
Italy	1998		P	yes	-	-	-	-	100%	-	-	-	-	
Japan	1998	1900	U	-	-	-	42%	-	-	57%	-	-	1%	2-7
Korea	1998		P,U	-	-	-	-		100%	-	-	-	-	6-10
Luxembourg	1997		U	-	-	yes	-	-	y	-	-	Y	-	2-3
Mexico	1996		U	-	-	-	-		<--- 74% --->			<--- 26% --->		
N. Zealand	1998		P	75%	-	25%	-	-	-	-	-	-	-	
Netherlands	1996	28	P(U)	7% (1)	-	90% (25)	-	-	3% (2)	-	-	-	-	2
Norway	1998		P	87%	-	13%	-	-	-	-	-	-	-	-
Poland	1998					most								
Portugal	1996							-	Most					2-5
Spain	1994	389	P(U)	-		<---- 10% (65) ---->			<---- 90% (321) ---->			<---- 0.2% (3) ---->		3
Sweden	1998	288	U		-	100%	-	-	-	-	-	-	-	-
Switzerland	1998		P(U)		-	95% (235)	-	-	5% (1)	-	-	-	-	2
Turkey	1998		P	-	-	-	-		<---- 100% ---->		-	-	-	3
UK:	1998		P	90	-	10%	-	-	-	-	-	-	-	-
● Eng and Wales	1998		P	89	-	11%	-	-	-	-	-	-	-	-
● N. Ireland	1998		P	100	-	-	-	-	-	-	-	-	-	-
● Scotland	1998		P	100	-	0.002%	-	-	-	-	-	-	-	-
US	1997	151	U	2%	1%	<---32% --->		1%	<--30% --->			<--- 34% --->		3

Notes:

Belgium: Antwerp meters high water-users in the residential sector, and offers a choice to other households. In Flanders, following a regional decree which came into force on 1 January 1997, all utilities introduced a free allowance of 15 cubic metres per person per year (about 41 lhd). That is the reason all Flanders utilities are recorded as having an increasing block system. Without the free allowance, only two utilities would be recorded as having an increasing-block system; all the rest would in that case be classified as 'constant volumetric rate plus fixed charge'.

France: Old survey data. Water Law of 1992 ruled out (with some exceptions) a flat fee and constant volume rate + fixed + minimum charge. These categories are now in decline.

Germany: Some water suppliers apply a linear tariff with no fixed element for household consumption.

Greece: Athens only.

Iceland: Reykjavik only.

Italy: A very small fixed charge (meter rent) is applied, and (often) a free minimum allowance as well.

Japan: While Japanese utilities do levy a minimum charge (applicable for the first 10 m^3), they do not levy a fixed charge.

Netherlands: Amsterdam is unmetered; Rotterdam and a few smaller water boards are partly unmetered. Most of these plan to meter all households soon. Two smaller water supply utilities offer metered households a free allowance (30m^3/year and 25m^3/year) before a single volumetric rate begins to operate.

Turkey: Information applies only to urban areas and metropolitan cities (covering 65 per cent of Turkey's population).

England & Wales, Scotland: A choice is offered to all households, except those living in new houses (which are generally metered when they are built) and (i) users of garden sprinklers and swimming pools and (ii) under some water companies, certain other selected groups of high-use houses or households are also compulsorily metered.

Apartments: There is no necessary consistency in the data concerning how individual apartments and apartment buildings are treated in different countries; the best presumption is probably that the percentage figures refer to single-family houses and apartment buildings. However, see Table 14 on metering penetration (below).

Sources: ECOTEC (1996); OECD (1998*b*); and numerous publications and other documents supplied by, and/or relating to, individual countries.

Table 4. Fixed Elements of PWS Tariff Structures and Wastewater Tariff Details for Households

	Determination of Flat Fee (Ff) and/or Fixed Element (Fe) of PWS Tariff	Determination of Sewerage (S) and Sewage Treatment (ST) Charges
Australia	Fe: equal; PV; meter size	64% of pop'n: Fe: equal/PV/meter size/no. of pedestals. 36% of pop'n: constant volum. rate
Austria	"Basic Rate" = Metering charge, varying by pipe size	Varies by water use, or house area
Belgium	Fe: Equal for each house; fixed by utility	Constant volum. rate; fixed at regional level
Canada	Ff: equal; PV; property front; lot size	Flat or (mostly) a given % of PWS charge
Czech Rep.	--	Follows PWS bill
Denmark	Ff: PV; no. of taps; estimated volume Fe: by meter size.	Follows PWS bill; for connection fees, some separate schedules exist for rainwater collection and treatment
Finland	Fe: equal (fixed by utility) Fe: meter size	Follows PWS bill
France	--	Largely (or wholly) volum. rate applied on water supplied
Germany	Fe: equal (fixed by utility)	Follows PWS bill; some separate schedules exist for rainwater collection and treatment
Greece	(Athens) Fe: equal for all households	(Athens) 40% of water bill
Hungary	--	Follows PWS bill
Iceland	(Reykjavik) Ff: fixed charge + rated per m^2 of house	(Reykjavik) Ff = 0.13-0.16% of PV
Ireland	Domestic charges consolidated into general taxation	
Italy	Fe: "insignificant"	Constant volumetric rate on water use
Japan	"Basic Rate" = Minimum charge, varying by pipe size (45.3% of utilities) or equal for all households (41.4% of utilities)	Follows PWS bill, but with more "blocks"
Korea	Fe: pipe diameter	Follows PWS tariff
Luxembourg	--	Fixed & equal: 42% of communes; Fixed *per capita* (3%); Follows PWS (43%); Mixed(12%)
Mexico	--	Based on level of water consumption
Netherlands	Ff: by m^2 of house, number of rooms or garden size. Fe: equal (fixed by utility)	S: fixed per house (by utility). ST: pollution units (PUs): single people = 1PU; other households = 3 PUs
New Zealand	Ff: based on PV; Metered. Fe: equal	Ff: PV; metered; fixed + volumetric
Norway	Area of house	
Poland	--	Follows PWS bill
Portugal	Fe: pipe diameter	S: by PV or quantity of water; ST: by quantity of water
Spain	Fe: size of meter	Fixed charge per house, or volumetric rate
Sweden	Fe: size of meter	Follows PWS bill
Switzerland	Fe: size of meter	
Turkey	Fe: equal for all households (fixed by municipality)	Fixed % of PWS bill
UK:		
• **Eng & Wales**	Unmetered Ff: PV; Metered Fe: equal	Follows PWS; Metered: Fe + (90-100%) of PWS used
• **N. Ireland**	Ff: PV	Ff: PV
• **Scotland**	Ff: PV	Ff: PV
US	Equal for each household, fixed by utility	Nearly all constant volum. rate + fixed or minimum charge

Notes:
- PV = property value, rateable value of property, or some variant.
- Sewerage charges sometimes include rainwater disposal services, but detail on this is often unclear.
- Fixed elements for PWS and wastewater tariffs in some countries include annualised contributions to initial property connection charges.

-- = "not available".

Sources: Ecotec (1996); Ecologic (1996-98); Ecologic (1997-98) and numerous publications or other documents supplied by and/or relating to individual countries, and assembled for this project.

A convenient way of summarising the information in Table 3 is: (i) to categorise each country according to the "thrust" of its tariff *structure(s)*, assessed in terms of their economic and environmental effects; and then (ii) to rank the resulting categories by the *potential* strength of the signal which the structure may transmit to households about the desirability of not wasting piped water supplies, and thus of conserving the resource. For example, the presence of minimum charges and/or a significant fixed element in the tariff "blunts" the conservation message, and thus lowers the potential strength of the signal, other things being equal. Predominantly flat-fee tariffs may lessen the signal's strength even more.

Table 5 shows the results of one attempt to classify countries according to the strength of the "conservation signal" embodied in their tariff *structures.* Note, however, a very important qualification: this table takes no account of the *level* of prices being charged. In particular, no account is taken of the extent to which subsidisation in any given country may be preventing economic and environmental costs from being reflected in charges. Table 5 therefore says nothing about the *overall* conservation signal that is given by combining tariff structures and levels. For example, although Germany employs only a "traditional volumetric" tariff structure, the fact that its prices are actually set so as to recover the full costs of water supply, the *overall* conservation signal given in this country may be stronger than that in a country with a more conservation-oriented tariff structure, but with lower water prices.

Table 5. Household Tariff Structures Ranked by Strength of the Conservation Signal (Late 1990s)

Category	Countries Included	No. of Countries
"Cutting Edge" Conservation Pricing	Korea	1
Conservation or Social Pricing	Belgium, Greece, Japan, Italy, Mexico, Spain, Portugal, Turkey	8
Price times Quantity Volumetric	Czech Republic, Hungary, Poland	3
Traditional Volumetric	Austria, Denmark, Finland, France, Germany, Netherlands, Sweden, Switzerland	8
Mixed volumetric	Australia, Luxembourg, US	3
Mixed (general)	Canada	1
Predominantly Flat-Fee	Iceland, New Zealand, Norway, UK	4
Domestic Water Charges consolidated into general taxation	Ireland	1
		29

Another major problem with any "snapshot" of pricing policies at a particular moment in time (such as the one provided by Table 5) is that it says nothing about the dynamics of the current situation. In now offering more detailed comments about individual countries' tariff structures, some attention is drawn to this "moving picture": where individual countries are coming from and, in some cases, where they are going.

Traditions in the water industry generally die hard, and this is as true of charging arrangements as it is of the industry's intellectual approach to solving water problems. In the ***US*** and ***Canada***, where thousands of municipalities have organised their own water affairs for many years, it is unsurprising that a wide range of different structures has evolved. In addition, water is perceived to be (and frequently is) very cheap in those countries (past subsidies, historic cost accounting, and failure to deal with the effects of externalities have accentuated the effects of strong natural endowments), with the result that tariff structures have been slow to respond to the withdrawal of much government funding in recent years, and sometimes to recognise emerging environmental problems.

Table 6 illustrates some of the reorientation of tariff structures which has taken place in the US over the last 15 years, the *net* effect of which is that about 25 per cent of that country's utilities appear to have switched out of decreasing-block schedules, and into increasing-block ones. However, change is slow — indeed, between late 1995 (when the previous Raftelis Environmental Consulting Group survey was undertaken) and late 1997, the recorded proportion of increasing-block schedules actually *fell* by 1 per cent.

Table 6. Public Water Supply: Domestic Tariff Structures in the United States (1982-97)

	1982[1]	**1987[2]**	**1991[3]**	**1997[4]**
	%	**%**	**%**	**%**
Flat fee:	1	-	3	2
- with seasonal rate	(1)	-		
Uniform volume charge:	35	32	35	33
- no fixed charge	(2)			
- with fixed charge	(7)			
- with minimum charge	(26)			
- with seasonal rate	(-)		(3)	(4)
Decreasing-block:	60	51	45	34
- with fixed charge	(4)			
- with minimum charge	(56)			
Increasing-block:	4	17	17	31
- with fixed charge	(3)			
- with minimum charge	(1)			
- with seasonal rate	(-)			
	100	100	100	100
Number of utilities in sample	(90)	(112)	(145)	(151)

Notes:
1. Lippiatt and Weber (1982).
2. Raftelis (1989).
3. Duke and Montoya (1993).
4. Raftelis Environmental Consulting Group (1998).

Evidence from ***Canada*** is at first sight more puzzling, since the impression (Table 7) is that the flat fee proportion of the total water bill has increased over 1986-1996, whereas in other countries the flat fee approach has generally been decreasing. In part, this is caused by the large number of smaller utilities

that have recently joined the sample (by responding to Environment Canada's occasional rates surveys). But even without these additions — which have a higher propensity not to engage in domestic metering — the tendency prior to 1991 was for more flat fee charging, at the expense of the decreasing-block rate. Over 1991-94, however, the position was reversed: indeed, analysis of municipalities with a population of over 10 000 (responsible for over 85 per cent of Canada's population) indicates that 52 per cent now charge their residential customers by some sort of volumetric system; up 4 per cent since 1991.

Table 7. Public Water Supply: Domestic Tariff Structures in Canada (1986-96)

	1986	1989	1991	1994	1996
Flat fee	47%	53%	61%	58%	56%
Uniform Volume Charge	23%	22%	22%	24%	27%
Increasing-block	2%	2%	3%	4%	4%
Decreasing-block	28%	23%	14%	14%	13%
	100%	100%	100%	100%	100%
Number of utilities in sample:	(591)	(732)	(1416)	(1508)	(1452)

Source: Environment Canada, various publications.

In both the ***UK*** and ***New Zealand*** (see Box 1)**,** progress towards more "rational" pricing structures has also been held back by tradition, as well as by a genuine concern that in any rapid shift to domestic metering (e.g. in the much drier south and east of England), low-income households with children would suffer significant financial hardship. Two large water companies in England — Yorkshire Water and Anglian Water — have recently withdrawn or modified household metering expansion programmes for that reason, and the switch to measured charging in England and Wales now relies on: (i) the obligatory metering of all new houses; (ii) compulsory metering of garden sprinkler and swimming pool users (and, under a few companies, hose-pipe users); and (iii) education, information and (often) free meter installations to promote optional metering programmes which are open to all customers. Anglian Water, serving the driest climate in the UK, expects to have metered over 38 per cent of households by March 1999 (607 000 altogether), up from 2.7 per cent in 1992. Currently, about 3 per cent of households are switching (or being switched) to measured charging each year in England and Wales — a much higher figure than anything that has been experienced in the past.

Australian utilities have employed a wide range of charging systems in the past, but [as already noted in OECD (1987*a*)] once meters had been installed, the existing tariff structures generally provided very large free allowances which ensured that few customers actually entered the tranche where charging on the basis of consumption began. The Australian reforms described earlier have quickened the pace of structural tariff reforms which were already occurring ten years ago. The result has been the virtual abolition of *any* free allowances — let alone *large* ones. Only one of the smaller utilities maintains such an approach. A few utilities have also introduced increasing-block schedules. These changes serve social purposes, as well as generating powerful signals to encourage conservation. It is true that, where these volume-based systems operate, the first tranche is often available at a price well below long-run marginal costs. The important point, however, is that a non-zero price is now being attached to the demands that all households make upon the water systems.

Indeed, most water supply utility revenues in Australia are moving rapidly towards being based on actual usage, rather than on fixed charges. And all of this started from a very low base (often only

about 20 per cent) merely a decade ago. By 1996-97, utilities serving half of Australia's urban population were obtaining 65-80 per cent of their water revenues from usage charges. All others (except for one, with a free allowance of 930 litres per household per day!) were relying on volume charges for at least 50 per cent of their revenues. Six of the twelve utilities for which information was available to this study showed the "usage charge proportion" to have increased by between 10-30 per cent between 1995-96 and 1996-97.

Box 1. Water Pricing in Christchurch, New Zealand

Christchurch City was formed in 1989 from five separate local authorities. The pre-1989 Christchurch City Council area was fully metered, and had a system of consumption-based charging. This system used capital value ratings of houses to establish an initial allocation of water, and then charged by volume for usage above that allocation. Approximately 20 per cent of customers received bills for entering the tranche where volumetric charging occurred. The four other authorities in the new agglomeration had had metering only on their commercial and industrial properties. Residential services were unmetered and payment was made via either a property capital value charge or a uniform charge. Upon amalgamation, the new Council decided to return to capital-value-based rating for all domestic consumption, retaining a volumetric system for the other consumer groups.

Christchurch relies largely on ground water abstractions from the local artesian aquifers. Reports in the 1980s had already drawn attention to the possibility (and undesirable effects) of over-abstraction from these aquifers. In 1991, the new Council therefore resolved to complete the metering of the whole city. It was also decided at that time to delay finalising a decision on the particular tariff system that would be adopted until the installation programme was nearing completion. The metering programme was duly completed in 1996, with $NZ 7 million having been spent on the project. Discussion began in 1995 concerning the details of the preferred charging system to be used.

In September 1996, the City Council resolved that volume-based charging should be recognised as one of the effective means of managing demands, but decided not to proceed to an initial period of optional metering, followed (possibly about five years later) by a volumetric charging system for all consumers.

Instead, the Council decided to continue to implement a variety of other water-saving strategies. In part, this may have been due to a reported *per capita* demand reduction in Christchurch of 13 per cent between 1991 and 1996. This decline was estimated to be due to:

- reductions in commercial use due to the new tariff structures (2 per cent);
- the pricing system giving industry an incentive to switch from the public water supply to direct abstractions from the aquifer (hardly a desirable effect from a resource management perspective) (2 per cent);
- more leakage being discovered with the aid of domestic meters *which, although not being used for charging purposes, continue to be read* (4 per cent);
- new urban development, implying a larger built-up area and therefore less water being required for irrigation (3 per cent); and
- changes in public attitudes caused in part by the installation programme itself and by advising residents — especially large users — of the actual amount of their consumption (2 per cent).

Charging traditions are also well-established in OECD Europe. At one extreme is ***Luxembourg***, with its over 100 communes maintaining an astonishing array of volumetric charging systems, some of them geared to social needs with a sophistication probably unmatched anywhere else in OECD countries (see further discussion below).

At the other end of the scale are two federal countries (***Germany*** and ***Switzerland***), in which the water industry has long propounded a clear set of charging principles. Thus, it has long been argued in both countries that:

- water should be metered;
- water prices should cover all costs;
- tariffs should contain both a basic fee and a volumetric price which would ideally reflect both the fixed and variable costs of the utility. However, this cost structure might be amended for social or conservation reasons; and
- enough revenue should be earned to maintain the system's assets.

There is a strong tradition of subsidiarity in both countries, with recognition of the benefits of local community self-regulation and limited interference by the State. A corollary is a cultural perception of a duty to "pay one's own way", applying equally to individuals, households, and municipalities. As a result, cost recovery levels are high, and metering is widespread. Despite this, the charging principles developed in these two countries do not correspond with the theoretically-ideal balance between the fixed-charge and the volumetric charge components of the pricing structure: according to the criterion of economic efficiency, the *volumetric* part of the tariff should cover any costs that vary with demands on the system (both short- and long-term), while the *fixed* element should be left to cover only those customer-related costs that do not vary, or any others that cannot be accommodated in the variable element. On the contrary, the charging principles in Germany and Switzerland recommend recovering only the *short-run* variable costs in the volumetric portion, and not the *long-run* variable costs.

Since at least 1990, there has been discussion in Germany of the possibility of switching over (as in ***Austria***) to purely quantity-based charges (i.e. no fixed charge). Suggestions have also been made for the introduction of progressive tariff systems (increasing-block) to promote water conservation objectives, again echoing the practice of some Austrian and Swiss utilities. In this respect, it is interesting to note the continuing experience of Zurich, first highlighted in the 1987 study (Box 2 and Table 8).

Box 2. Water Pricing in Zurich, Switzerland

In the 1987 study (OECD, 1987*a*; Chapter III.4), attention was drawn to the unique situation of Zurich: the only water supply utility in Switzerland then administering an increasing-block tariff. In 1975, largely because of local groundwater pollution, the pricing system was radically altered to introduce an excess charge, to be applied only if a consumer had exceeded during the billing period a daily allocation geared to the size of the meter. Thus, a household is "allowed" to consume up to 1000 litres/day at the "basic" price, and other customer classes were given higher specified allowances. For excess volumes consumed, a significantly higher volumetric rate was charged, initially at double the base price, but now believed to be about 40 per cent higher.

Together with important changes in wastewater tariffs in 1968 and 1971, this tariff restructuring was believed to be largely responsible for the reduction in overall consumption which had taken place between 1970 and 1984. Table 8 extends this data to include later years, and further reductions can be observed. The addition of aggregate public water supply figures and estimates for the whole of Switzerland (in part, provided by SGWA) suggests that Zurich's tariff structure continues to exercise a significant influence on the water demands faced by the utility.

Table 8. Zurich PWS Usage and Estimates for Switzerland (1970–1997)

	1970	1976	1984	1994	1997
No. of consumers in "excess tranche"	—	2 913 (7.3%)	1 770 (4.5%)		1 363 (3.7%)
Water consumption in excess (million m^3)	—	2.182 (3.4%)	0.704 (1.1%)		0.500 (0.9%)
Water consumption (million m^3) by:					
• Normal users (0–9999 m^3)	32.3	32.1	31.7		26.5
• Large users ($\geq$ 10000 m^3)	18.4	16.4	15.9		12.7
• Total consumption	50.7	48.5	47.6	41.0	39.2
Population of Switzerland (million)	6.0[1]		6.5	7.0	7.1[1]
Switzerland: PWS *per capita* (litres)	490		490	415	410[1]
Total PWS consumption (million m^3)	1 073[1]		1 163	1 063	1 063[1]

Reduction in PWS Consumption

	1970-94[1]	1970-97[1]
Switzerland	1%	1%
Zurich	19%	23%

Notes: 1. Estimate only.

Source: Wasserversorgung Zurich, personal communication.

Discussion of a possible shift towards "simplistic" volumetric pricing (with no fixed charge element, as already experienced in such eastern European countries as ***Hungary, Poland*** and the ***Czech Republic***) has also found expression in other European countries, and has recently been the subject of active debate in the ***Netherlands***. Here, some local governments have combined water and sewerage charges to present consumers with a single volumetric charge, based on potable water consumption. Trials of the *Waterspoor* are being suggested to encourage even more water saving. Under this law, charges for water supply, sewerage, and water purification would all be levied together, with both water supply and wastewater charges being levied on a volumetric basis. For water supply, the change would not be very significant, since the fixed element is only 5-10 per cent of the present metered bill. On the "dirty water" side, however, the impact of such a change would be considerable. However, it is expected that *Waterspoor* trials will not be held before the year 2000, and then only on a voluntary basis. Moving in a similar direction in the Netherlands is the recent decision by both the Amsterdam and Rotterdam Water Boards (together with Antwerp, the last-remaining "big-city" outposts of unmeasured charging in continental Europe) to complete the individual metering of all households not resident in apartment blocks.

In ***France*** too, both the different components and the totality of the volumetric charge in consumer bills are made clear as a result of an arrêté of July 1996, which lays down in considerable detail the legal content of a water bill. The demise (following the 1992 Water Law) of Type 3 tariffs in France (where the fixed charge "covers" a specified volume of household consumption per billing period), and the parallel increase in the use of Type 4 tariffs (fixed charge + a volumetric rate on all consumption), has led some observers to comment that high service fees ("as high as 90 per cent of water bills") can give municipal officials the scope to introduce tariff schedules with very low volumetric rates. These then

"tend to work against the main goals of the 1992 Water Law" (which seeks to avoid wasteful use of water resources and to promote equity between users) (see Cambon-Grau and Barraqué, 1996). However, Type 4 tariffs have the advantage that *all* water consumption at least attracts a positive marginal price; and the most recent evidence suggests that the fixed elements in household bills are on average only 15 per cent of the total bill (Conso 2000, 1996).

The proposed ***Italian*** scheme for reorganisation of the water supply system was outlined earlier. If implemented, this scheme would build up a single average cost-based volumetric price for the two main water services in each river catchment or "optimal management area" (OMA), with year-to-year increases in "standard costs" being calculated by a complex formula involving assumed productivity growth potential, the inflation rate, and other factors. This would then serve as a benchmark for tariffs and perhaps eventually for the determination of price caps. It could also then be applied to the increasing-block tariff structures which have been used in Italy since the 1975 reforms. The basic principles of the block structure would remain unchanged, with a central block (tariff base) attracting the average cost based price and (as now) an initial subsidised block effectively being financed by a number of more expensive blocks.

The novel part of this scheme is that this increasing-block structure would be extended to sewerage and sewage treatment, both of which are presently charged at *constant* volumetric rates. Thus, overall, the tariff structure for water services would become significantly more progressive.

The prevailing tariff structure in ***Greece*** is motivated primarily by social concerns; hence, there is a reliance on increasing-block tariff structures wherever volumetric charging is available. In addition, in order to address affordability concerns, an upper bound on these tariffs is often applied for families with three or more children. In Athens, the water supply tariff is made up of four elements:

- a fixed charge of GDR 480/month;
- an increasing-block tariff (see Table 9);
- 8 per cent VAT; and
- 18 per cent "tax" for "new projects and meter charges".

Table 9. Domestic Water Tariffs in Two Greek Cities (1988-1995, GRD/ m^3)

Monthly consumption band (m^3)	**1988**	**1991**	**1995**
Athens			
≤5	29[(1)]	48	117
6-20	35[(1)] (+20%)	72 (+50%)	178 (+52%)
21-27	55 (+57%)	200 (+177%)	514 (+189%)
28-35	55 (0%)	280 (+40%)	720 (+40%)
>36	55 (+0%)	350 (+25%)	900 (+25%)
Thessaloniki			
≤5			77
6-15			118 (+53%)
16-30			191 (+62%)
31-50			259 (+36%)
51-100			362 (+40%)
>101			518 (+43%)

Notes: 1. Bands were <6 and 6-20 at that time.
- Figures in brackets give the % increase on the immediately-preceding band rate.
- For Athens, there is a minimum charge for 2 m^3 per month.

In both Athens and Thessaloniki, the crucial step in the increasing-block tariff for household water use occurs at about 20 m^3 per month per household (667 litres/day). At this point, access to cheap water stops (i.e. where households pay less than the price charged to industry) and water becomes more expensive, particularly in Athens (where prices almost triple as compared with the next lower consumption band, and where they are twice the levels paid by industry). As average *per capita* consumption by domestic water users in Athens is estimated at 140 lhd, and assuming scale economies in water use, a household of five should be able to stay in the cheap water tranche, at least during climatically-average periods of the year. As can be seen, water prices between Athens and Thessaloniki differ considerably. Similarly, mean water prices in other major Greek cities also vary, from a low of 88 GRD/m^3 in Orestiada, to a high of 543 GRD/m^3 in Kerkyra.

In ***Turkey***, municipalities in cities and urban areas invariably operate increasing-block tariffs for the household sector. Table 10 shows PWS tariffs in August 1998 for households and other PWS users in two major cities. The billing period is short and price increases are tied to official price indices (the Wholesale Price Index in Ankara and the Consumer Price Index in Istanbul).

Table 10. Domestic Water Tariffs in Two Major Cities in Turkey (August 1998)

	Household water consumption level	Public Water Supply (TRL/ m^3)	Wastewater (TRL/ m^3)
Ankara	0-10 m^3	74 092	37 046
	11-30 m^3	189 865	94 933
	>30 m^3	278 870	139 435
Istanbul	0-10 m^3	66 000	66 000
	10-100 m^3	110 000	110 000
	>100 m^3	371 000	371 000

Notes:
- US$ = 273 300 TRL (August 1998 average).
- Water prices are increased automatically by a factor equal to the monthly increase in Wholesale Price for Ankara and by a factor equal to the monthly increase in the Consumer Price Index for Istanbul.
- The billing period is 1.5 months in Ankara, and 1.0 month in Istanbul.

Increasing-block tariff structures which aim directly at both conservation and social benefits are also prevalent in ***Spain,*** and in Lisbon (***Portugal***), usually with 3-5 blocks being used. Barcelona in particular has pioneered the use of tariffs designed to combine strong incentives to save water with a concern for social justice, and its experiences are illustrated in Box 3.

In ***Belgium,*** the decision in the Region of Flanders to grant each household a free allowance in their water tariff geared to the number of people resident breaks new ground for such a large area (about 6 million people). Until now, the main criticism of introducing a free- or low-price allowance (in support of the "water-is-at-least-in-part-a-basic-right" argument) has been that this allowance had to be associated with the *household* rather than the *person*. The Flanders Region has now moved beyond that point, and the results will be awaited with interest. The organisation of the tariff, which is managed by the local utility, is facilitated through the use of an annual register of the inhabitants of each household. Among the drawbacks of the scheme is the fact that the local water companies now have complex bills to administer (and more questions and complaints as a result). They have also had to find new revenues to replace those lost as a result of the free allowance. On the other hand, equity has clearly been enhanced.

Box 3. Water Pricing in Barcelona, Spain

Catalonia has serious water pollution and water resource problems. In 1983, the Barcelona tariff system was therefore changed from a minimum-charge/no-blocks/no-fixed-charge structure to one with a fixed charge and just two blocks. During a serious drought in 1989, a third block was imposed, starting at 48 m^3/quarter, and with a much higher price, in order to give the bigger domestic users a larger incentive to reduce their consumption. The present domestic tariff structure is illustrated below:

Band	Charge (ptas./m^3)	Proportion of domestic consumers in band(s)
0–18 m^3/quarter	44.10	} 85% (0-48m^3)
18–48 m^3/quarter	89.30	
> 48 m^3/quarter	121.80	15%
Fixed charge per month:		
House type A:		208 ptas.
House types B and C:		547 ptas.
House types D and E:		842 ptas.
House type F:		1 145 ptas.

Two important refinements to this structure serve to enhance equity objectives. First, there is the variation in the fixed charge itself, which depends on the characteristics of the house. Second, for families with more than four people, the limit of the second block is now calculated by multiplying the number of people in the household by 11 m^3. Thus the second block limits are:

Size of household	Second block (m^3/quarter)
1-4	18–48
5	18–55
6	18–66
7	18–77
...	...

Virtually every household is metered (including all apartments individually), and the utility maintains that the tariff was instrumental in reducing *per capita* household consumption from 211 lhd to 193 lhd between 1991 and 1996 (a reduction of 9%).

There has also been an interesting evolution in the household water tariffs used in Antwerp. The 1987 OECD study pointed out that Antwerp's unusual mixed (compulsory and optional) approach to metering domestic consumers — similar in some ways to the approach now being used in ***England and Wales*** — resulted in a balance in favour of unmetered consumption (of 80:20). Ten years later, Antwerp water officials report that this balance is changing, and is now 70:30 — just the result which would be expected as increased incomes generate demands for more of the luxury water-using devices which disqualify consumers from retaining their unmetered status in the city.

In both ***Japan*** and ***Korea***, as in other countries in the Asian region, most utilities use a large number of blocks in their increasing-block tariffs structures (up to 12 in some residential structures in Thailand, for example). In both countries, the "basic rate" system (essentially, a minimum consumption charge which usually covers the first 10 m^3/month for each household) has been applied as a fixed charge base, on which the rest of the tariff edifice is then constructed.

There have been recent debates about the basic rate's future in both countries. For example, faced with the fact that water prices were raising revenues equal to only 77 per cent of the total cost of water provision in Korea as a whole, the government issued the (1996) *Comprehensive Water Management Countermeasures.* Following this move, 59 of the 167 local governments in Korea abandoned the basic rate, and raised the price of water. The official reason given at the time for abandoning minimum consumption charging was to persuade people to be more careful in their use of water.

Finally, an interesting development has recently occurred in ***Ireland.*** In 1978, domestic rates were abolished in that country, and water charges also disappeared. However, in 1983, the *possibility* of separate charges was re-introduced for a number of local services, including water, with local authorities having discretion in the matter. By 1996, domestic water charges had developed in 86 of 88 local authorities — all except Dublin and Limerick. Wastewater charges were also being levied by 31 local authorities. Then, in 1996, a decision was taken to discontinue separate charging for domestic water services, and to recover the costs of these services through the general taxation system. This change took effect on 1 January 1997, and has since been the subject of considerable debate.

Sewerage and sewage treatment tariffs

The second half of Table 4 provides data on current sewerage and sewage treatment charges in OECD countries. These indicate that, for 22 of the 29 OECD countries, revenues for these services are based largely on volumetric charges, as applied to public water supply measurements.

The continuing trend toward more incentive-based charging for the public water supply system therefore generally leads to more *wastewater* revenues being recovered through volumetric charging, which then reinforces the incentives to use the water *supplied* more carefully. This pressure has been further enhanced in various countries, for example:

- in ***Italy,*** the 1996 decision to levy sewerage and sewage treatment charges on 100 per cent of invoiced water, rather than on 80 per cent;
- in ***Belgium***, purely volumetric levies at the regional level on wastewater will soon have completely replaced other more complex (and less direct) mechanisms; and
- possible moves towards the *Waterspoor* in the ***Netherlands***, as discussed earlier.

On the other hand:

- in ***Australia***, only one-third of the urban population pay their sewerage and sewage treatment charges on a volumetric basis, and the volumetric share is typically very small (except in three utilities). However, other water businesses are now considering their position on the whole question of raising wastewater revenues by volumetric charges.

Cost recovery, taxes and charges in practice

Introduction

The main aim of this section is to present information from OECD countries concerning: (i) the *levels* of household charges presently (or recently) in effect; and (ii) their *rate of change* over recent years. Such data complement the earlier discussion about tariff *structures*, and are closely bound up with issues

of economic and environmental efficiency (and therefore, with environmental sustainability). They therefore raise questions concerning *full cost recovery* (FCR), and the *degree of subsidisation* of household water costs. These questions in turn relate to the various *taxes and levies* that are added to (or reflected in) water charges.

It is therefore necessary to begin with a brief discussion of FCR, followed by a description of the various taxes and charges affecting household tariffs. In describing existing tariff levels and rates of change, some additional information (i.e. additional to OECD, 1997*b)* is provided concerning subsidy rates.

Full cost recovery: a taxonomy

The term "full cost recovery" implies the recovery through water charges of all economic and environmental costs associated with the provision of the output under consideration, in this case household water services. Table 11 offers one classification of these costs, together with the various charges, taxes and levies which would normally appear separately on a household water bill. Some of these taxes (e.g. VAT) may occasionally be "justified" as a way of recovering some of the environmental costs that are incurred. In other instances, they may be presented as a method of raising "general" government revenues (e.g. part of a general VAT rate, levied on a whole range of goods and services).

Table 11. Cost and Revenue Classification for Full Cost Recovery Measurement

	Public Water Supply		Wastewater	
Costs				
1. Direct Economic Costs	• Operating Expenditures (Opex) • Capital Expenditures (Capex)	O_p K_p	• Opex • Capex	O_w K_w
2. Related Environmental Costs	• Abstraction Licence Fees (administration) • Abstraction Charges • Scarcity Costs/Rents • Additional Abstractions Costs: Damages	A_a A_c A_s A_d	• Pollution Licence Fees (administration) • Pollution Charges • Additional Pollution Damage (losses to producers or consumers)	P_a P_c P_d
Revenues				
1. Charges/ Tariffs		C_p		C_w
2. Specific Taxes	• On water use	S_p	• On wastewater	S_w
3. General Taxes (VAT, etc.)	• On PWS	T_p	• On wastewater	T_w

Note: Because Table 11 is only intended to help conceptualise FCR, there is no need to be precise about how the various costs and revenues should be measured. It may be helpful, however, to imagine all costs and revenues on an annual basis: any one-off costs (e.g. investments) and revenues (e.g. connection fees) would then be viewed as "annual equivalents". Although A_s is a cost that may be charged, it does not constitute a factor input reward, and thus does not need to be recovered in aggregate. The avoidance of pure "supernormal" profits may be achieved through the use of multi-part tariffs.

In terms of the Table 11 taxonomy, how can FCR be defined? If T_p and T_w are seen as contributing to general revenues, and no cross-subsidisation between different water services is to be tolerated, the FCR requirement is "strong". It is that:

$$C_p + S_p \geq O_p + K_p + A_a + A_c + A_d$$
and $$C_w + S_w \geq O_w + K_w + P_a + P_c + P_d$$

If, however, T_p and T_w are "permitted" to have a role in cost-recovery, then the FCR requirement is "weak", and may be stated as:

$$C_p + S_p + T_p \geq O_p + K_p + A_a + A_c + A_d$$
and $$C_w + S_w + T_w \geq O_w + K_w + P_a + P_c + P_d$$

Because of serious difficulties in placing a monetary evaluation on environmental costs, many of these cannot easily be included *in practice* in the establishment of household charges. *In principle*, however, FCR requires that all such costs be taken into account. As a general objective, therefore, it is useful to include them in this discussion, and then to note some attempts by OECD countries to reflect this type of cost in their tariff systems.

Taxes, levies, etc.

Table 12 illustrates that there is a broad range of practice in the OECD concerning the imposition of taxes and charges, both on the piped household services themselves, and at other stages of the water cycle (with consequent feedback effects on household tariffs).

VAT is the most common type of tax. ***Finland, Sweden***, ***Norway,*** and ***Denmark*** charge VAT on water services at more than 20 per cent. At the other extreme, the ***United Kingdom*** zero-rates water services, while all other EU members have rates between 5 per cent and 10 per cent for piped water supplies (however, half of these countries zero-rate wastewater). The ***Netherlands*** has recently accepted a law that will raise the VAT applied to household water consumption in 1999, up from the low tariff (6 per cent) to the high tariff (17.5 per cent) for water use exceeding 60 guilders per annum per household. In the context of "greening" the tax system, only the first 60 guilders worth of water is considered "essential drinking water", with household water consumption above this level being considered a "luxury good".

The impact of VAT on consumer behaviour (i.e. through incentives to reduce water use) will depend on the possibilities of VAT recovery available. These vary greatly between Member countries, but detailed information on this was not available for this study.

Abstraction charges (A_c) other than administrative permit fees (i.e. A_a, P_a) are found in at least 11 of the 29 OECD countries, while pollution charges (P_c) exist in 8 countries, and are either planned or under discussion in 5 others. Abstraction charges typically vary by category of use, and often, by location (and, therefore sometimes reflect water scarcities). Since they often have a dominant environmental purpose, the proceeds are often placed with environmental agencies, or in environmental funds. The direct economic costs associated with abstraction support works may be recovered through A_c charges (e.g. in ***England and Wales***), or they may have an explicitly environmental purpose (e.g. ***Netherlands***). In the latter case, therefore, by enhancing A_c, A_d-type costs are reduced and cost-recovery is increased.

Table 12. Taxes and Levies in Household Water Tariffs[1]

	Public water supply			Wastewater		
	VAT	Abstraction charge	Other taxes	VAT	Pollution charge	Other taxes
Australia		-		-	-	-
Austria	10%	-		10%	-	
Belgium	6%	✔		0%	✔	
Czech Republic	5%			5%	✔	
Denmark	25%	-	✔ (2)	25%	-	✔ (2)
Finland	22%	-		22%	-	-
France	5.5%	✔	✔ (3)	5.5%	✔	
Germany	7%	✔ (4)	✔ (4)	-	✔	
Greece			8% (5)		-	
Hungary	12%	✔	-	12%	-	-
Ireland	Domestic water charges have been consolidated into the general taxation system.					
Italy	9%	✔		0%		
Japan	5% (6)	✔		5% (6)	-	-
Korea	-	-	-	-	-	-
Luxembourg		-			-	
Mexico		✔				
Netherlands	6%	✔ (7)		0%	✔	
Norway	22%			22%		
Poland		✔			✔	
Portugal	5%	(8)		0%	(8)	
Spain	6%	✔		0%	✔	
Sweden	25%	(9)	(9)	25%	(9)	(9)
Switzerland	0%	-		0%	-	
Turkey	15%	-		15%	(10)	
UK:	0%			0%		
• Eng & Wales		✔	-		(9)	-
• N. Ireland		-	-		(9)	-
• Scotland		-	-		(9)	-

An empty cell implies that data were not available; a cell with a "-" indicates "no charge"; and a cell with a "✔" indicates that a charge is actually levied.

Notes:

1. This table lists taxes and other charges included or reflected in the water bills of domestic consumers. It reflects charges levied in addition to "regular" piped water supply and wastewater charges (e.g. "sewer taxes").
2. Water levy per m^3 and wastewater levy on pollution content of municipal discharge.
3. FNDAE tax is raised to subsidise rural water systems.
4. Abstraction charges are 0-0.6 DM per m^3. There are also administrative fees associated with water abstraction which can amount to a few percent of the water bill.
5. An 8 per cent tax is imposed on the price of water. There is also an 18 per cent charge for "new projects and meter charges", but the precise status of this charge is unclear.
6. 5 per cent consumption tax.
7. Tax on groundwater abstractions only (which represents 60 per cent of PWS, however).
8. Planned.
9. Currently under formal discussion.
10. In metropolitan areas, new rules allow wastewater levies proportional to deviations from standard municipal pollution discharge parameters.

Pollution charges (P_c) generally recover less than the costs of the damages incurred. Only in ***Germany*** has a scheme been developed explicitly to provide incentives to improve the quality of discharges: if consent conditions are not met, charges rise steeply. Again, when P_c is enhanced, the effect is to reduce P_d, or to compensate those who are harmed by the discharges, and overall cost-recovery is thereby enhanced. In addition to the application of pollution charges, compensation payments are also an essential part of the pollution permit procedures in some OECD countries (e.g. ***Finland***).

Other distinctive taxes on water use (S_p) are to be found in ***France*** and ***Denmark***. In France, the tax levied for the *Fonds National Des Adductions d'Eau* (FNDAE) adds about 1 per cent to water bills, and provides funds to supply rural water and wastewater services (effectively financing some K_p and K_w). This is essentially a cross-subsidy between groups of water users (i.e. from non-rural to rural consumers), and is therefore consistent with an aggregate FCR across all water services.

In ***Denmark,*** the water tax of 1 DKr/m^3 introduced in 1994 was increased to its target level of 5 DKr/m^3 in 1998. A new sewage levy (S_w), introduced in January 1997, is part of the same tax reform programme, and is payable on discharges to lakes, watercourses or the sea at a rate which depends on nitrogen, phosphorus, and organic matter content. Among other purposes, proceeds of the levy are used to support smaller waterworks having problems with polluted groundwater (O_p and K_p), increasing overall cost recovery. These two taxes, combined with the high VAT rate in Denmark (25 per cent), serve to raise significantly the costs to households of water consumption. The particular circumstances of Denmark are examined in more detail later.

In ***Sweden,*** there is currently discussion about two new possible taxes or fees: on water use (S_p) and/or on discharges (S_w). After several investigations of these matters, the government proposed in the spring of 1998 that a parliamentary committee develop a tax or fee system for water use. An interesting point here is the potential choice of the PWS as a tax base. The Swedish Board of Agriculture is also leading an enquiry into the development of a fee system for nutrient surpluses (loss of phosphorus and nitrogen to water or air) over nutrient usage as an incentive to reduce pollution.

The ***United Kingdom*** is also currently considering the use of economic instruments for pollution management, and the potential extension of their use in the management of abstractions in England and Wales. The government has recently issued consultation papers discussing the possibility of using pollution charges, of setting abstraction charges with incentive effects in mind, and of permitting the trading of licences. Increases in P_c above zero would, of course, oblige wastewater authorities to increase C_w.

Levels and rates of growth in household tariffs

Table 13 presents (in a common form, and on a common basis) average measures of household charges in OECD countries, using the most recent information available. For this exercise, two alternative types of data have been used: first, the cost of a country's average or typical household bill (for example, by selecting a "typical" annual consumption rate); second, the addition of the average of different utilities' fixed charge elements to the average of their volumetric rates, transforming the former into a "volumetric-equivalent" volumetric rate, by assuming a typical household consumption rate.

These calculations are undertaken in national currencies, separately for PWS and wastewater (where possible) and also for both combined, with account being taken of the relative importance of the fixed charge element in all three cases.

Table 13. Household Tariffs: Levels and Recent Trends

	Water service prices per m^3 (fixed element as % of total, in brackets)							Recent % increase			
	Year	Currency	Measure	PWS	S&ST	Total	US$	Years	Measure	Nominal	Real p.a.
Australia	1996-97	A$	AV-68%	0.95 (36%)	1.11 (96%)	2.06 (69%)	1.64	1995-96	AV	0.7	-0.6
Austria	1997	AS	WAV	12.9	n.a.	n.a.	1.05	n.a.			
Belgium:											
• Flanders	1997	FB	B(120), AV	60.0 (16%)	24.5 (0%)	84.5 (10%)	2.36	)			
• Brussels	1997	FB	B(120), AV	59.6 (11%)	14 (0%)	73.6 (9%)	2.06	)1988-98	“COW”	65	2.7
• Wallonia	1997	FB	B(120), AV	60.5 (13%)	16 (0%)	76.5 (10%)	2.14	)			
Canada	1994	Can$	AB(300)	n.a.	n.a.	1.03 (44%)	0.70	1986-96	AB-PWS	73	2.9
Czech Republic	1997	KCS	AV	12.2(0%)	9.4 (0%)	21.6 (0%)	(0.68)	1990-97	AV	2591	n.a.
Denmark	1995	DKR	B (120) + AV	7.5 (29%)	10.3 (0%)	17.8 (12%)	3.18	1984-95	B, AV	175	6.3
Finland	1998	FMK	WAVE	6.9 (24%)	8.4 (10%)	15.3 (16%)	2.76	1982-98	WAVE	234	3.8
France	1996	FF	WAVE	8.1 (20%)	7.8 (6%)	15.9 (15%)	3.11	1991-96	WAVE	55	7.0
Germany	1997	GDM	B(120)+ AV	2.93 (9%)	n.a.	n.a.	1.69	1992-97	PWS	36	3.8
Greece	1995	GDR	B(204)	188 (22%)	75 (22%)	263 (22%)	1.14	1990-95	AB	114	2.2
Hungary	1997	HFL	AV	73.3 (0%)	52.2 (0%)	125.5 (0%)	0.82	1986-96	AV	3923	18.7
Italy	1996	LIT	AV-65%	783 (4%)	518 (0%)	1301 (2%)	0.84	1992-98	PWS-AV	39	2.0
Japan	1996	YY	WAV	141 (49%)	106	247	2.10	1995-98	AB	2.5	0.3
Korea	1996	W	WAV	201	90	291 (0%)	0.34	1992-96	WAV	45	2.6
Luxembourg	1994	FLUX	WAVE	36.1	n.a.	n.a.	1.01	1990-94	WAVE	42	6.0
Netherlands	1998	DFL	B(120) + AV	2.9 (22%)	3.6 (100%)	6.5 (65%)	3.16	1990-98	PWS	73	4.6
Spain	1994	Ptas	B(200) + AV	97	49	146	1.07	n.a.			
Sweden	1998	SEK	AB(200) + AV	8.3 (32%)	12.4 (32%)	20.7 (32%)	2.60	1991-98	AB(200)	35	1.9
Switzerland	1996	FS	WAVE	1.6	n.a.	n.a.	1.29	n.a.			
Turkey	1998	TRL	B(160)	264000	132000(50%)	396000	1.51	1990-98	WAV	25344	153.1
								1993-98	WAV	2190	-4.1
								1995-98	WAV	332	-24.5
UK:											
• Eng&Wales	1998-9	£	AB(130)	0.86	1.01	1.87	3.11	1994-98	AB	22	2.0
• Scotland	1997-8	£	AB(140)	0.51	0.36	0.88	1.44	1993-97	AB	28	3.4
US	1997	US$	B(345)	0.58	0.67	1.25	1.25	1992- 98	B-PWS	34	2.4

n.a. “not available”

Notes:
- Practices in countries vary considerably in terms of the costs that are included in these tariffs. For example, charges occasionally reflect some of the costs of connecting a property to the public water supply or sewerage system. Also, rainwater collection, treatment and disposal costs are frequently, but not invariably, included in sewerage and sewage treatment charges
- Water abstraction and discharge charges, as well as other water levies, are reflected in tariffs.
- The Japanese consumption tax (5%) is also included; but VAT is excluded.
- High inflation rates in some countries (e.g. Turkey, Hungary and the Czech Republic) reduce the precision of cross-country price comparisons.

Measures used:

AB(x)	Average bill covering flat rate and metered households with an estimated average consumption of x m^3/year.
AV	Unweighted average of volumetric rates.
AV-P	Weighted average of household bills covering P% of population.
A-B	Average household bill, converted to volumetric rate, with consumption changing over time.
B(y)	Average bill when household consumption is y m^3/year.
WAV	Weighted average of volumetric rates.
WAVE	Weighted average of volumetric rates, and of volumetric charge equivalent to average fixed charge.
"COW"	Cost of Water, as defined by sources in the Belgium submission to this study.

The final column in the first part of Table 13 transforms the local currency (combined) volumetric rates into $US equivalents, using average market exchange rates for the relevant year, in order to make comparisons. Note, however, that the usefulness of such an exercise is quite limited. Strictly speaking, the only comparison it permits is from the point of view of a household unit with given financial resources (in $US). Furthermore, it describes the prices of an "average" bundle of water services in different countries, with the average itself varying across countries.

A more appropriate way of comparing volumetric prices in a common currency would be to relate them to a measure of each country's "economic strength" (and therefore, to the average capacity of its citizens to "afford" water services) expressed in the same currency. This approach is developed later.

In the left-hand section of Table 13, it is observed that the fixed charge (non-volumetric) shares of average PWS bills lie between zero (***Austria***, the ***Czech Republic***, and ***Hungary***) and 49 per cent (***Japan***). For wastewater services, the fixed share varies between zero (***Belgium***, ***Czech Republic, Denmark, Hungary*** and ***Italy***) and 100 per cent (***Netherlands*** and — almost — ***Australia***). For combined bills, only three countries definitely show a proportion for fixed charges above 25 per cent: ***Sweden*** (32 per cent), ***Netherlands*** (65 per cent) and ***Australia*** (69 per cent). In each of these countries, however, there are moves underway to change this situation, especially moves towards a higher percentage of the volumetric component in the bill, which would ultimately increase the "force" of the conservation message.

As discussed earlier, ***Sweden*** is considering the introduction of a volumetric tax. Similarly, the possible development of a single volumetric charge — the *Waterspoor* — has already been noted in the ***Netherlands***. However, Table 13 now throws into sharp focus the particular situation which exists in that country. Alone among OECD countries, *all* of a household's wastewater tariff in the Netherlands is at present raised through non-volumetric charges. Interestingly, both economic theory and the pursuit of allocative economic efficiency could help justify the present Dutch policy, since some studies suggest that the long-run marginal cost of sewage services is very small (see Herrington, 1997*b*). However, in practice, the *Waterspoor* proposal is rationalised by the need to move towards FCR, via the reduction of A_d and P_d costs, and this goal is perceived by some to be best pursued by shifting charges into a volumetric basis (note also ***Denmark's*** 1995 rejection of the introduction of an otherwise "rational" two-part wastewater charge — see Box 4). Finally, while 96 per cent of wastewater charges in ***Australia*** are currently derived from non-volumetric elements, the recent COAG reforms (which stress the importance of consumption-based charging) are changing the current political context there, and major urban utilities are known to be re-examining this issue.

It is also useful to think of the situation in dynamic terms. The second section of Table 13 illustrates recent changes in households' average combined bills in a number of countries (only PWS data was available for ***Germany*** and ***Luxembourg***). Consumer Price Index data from the IMF and OECD has been used to convert nominal (money) increases into "real" changes, which have then been expressed on an "annual equivalent" basis.

Denmark's average combined bills increased at 6.3 per cent per annum in real terms over 1984-95. Denmark provides an interesting example of a country that has recently been obliged to start to address water *quality* problems by attempting to manage *quantity* (again, see Box 4).

Box 4. Tariff Levels in Denmark

There is no shortage of water in Denmark. Virtually 100 per cent of the PWS is taken from groundwater sources. These resources, however, are of decreasing quality, and this has been posing serious problems for waterworks in certain regions for several years (e.g. the island of Zeeland).

In the 1980s, water charges in Denmark were perceived to be very low. In 1988, it was noted that in western Europe, only Spain and Italy had lower charges (IWSA, 1988). By 1995, however, Denmark had the highest overall "equivalent-volumetric" rate per cubic metre in all the OECD countries for which data were available (Table 13). Moreover, in that calculation: (i) the new water tax (see earlier discussion) was still only raising 2 DKr/m3; (ii) the sewage levy had not yet been introduced; and (iii) no account was taken of the 25 per cent VAT charge which prevails in Denmark.

An estimate for 1998 should arguably include: (I) the three remaining "tranches" of the water tax (now at 5 DKr/m3); (ii) the full sewage levy (introduced on 1 January 1997); and (iii) 25 per cent VAT charged on both all costs and other levies in the final bill. Even assuming that underlying water supply and wastewater costs have remained the same in nominal terms over 1995–98, a combined average volumetric rate of DKr 27.9/m3 is generated for 1998. At May 1998 exchange rates, this is equivalent to $US 4.13/m3, or 30 per cent higher than any other rate found in Table 13.

The intention of the Danish government to confront households with the full value of the resource was also well illustrated by the Ministry of Environment's report Spildevandsredegørelse 1995 (Statement for Wastewater). In this document:

> *… a possibility for dividing the [sewerage] charges into a fixed and variable part was given attention. The conclusion, however, was that efforts to reduce water consumption could be affected … and therefore the [separation] proposal was not to be recommended.* (Miljoministeriet 1995, p.73) (Kragh, 1998; p.36)

In addition to the tax and "volumetric rate" policies just described, domestic metering has become more widespread in Denmark, and information campaigns to promote water economy have been given prominence. The combined effect of these initiatives can be clearly observed in Table 2, where estimated household consumption is found to have decreased from 175 lhd to 139 lhd over the period 1987-96 — a reduction of 20 per cent.

Table 13 also shows that ***France*** experienced a very large real increase in water charges in the first half of the 1990s, largely due to the impending implementation (1998–2005) of the European Commission's Urban Waste Water Treatment Directive (Cambon-Grau and Berland, 1998). Indeed, over 1991–96, the PWS share of the average increase in the (nominal) water bill rose by 31 per cent, while the wastewater element increased by 90 per cent, according to a government survey covering a sample of 738 communes, and representing over 40 per cent of the French population (Ministère de L'Économie et des Finances, 1996). Simultaneously, it seems, household water consumption was probably stabilising (or even falling slightly in the first half of the 1990s, after increasing through the 1980s (see Table 2).

In ***Turkey,*** while real per annum increases of over 153 per cent have occurred over the period 1990-98, when this is disaggregated, it becomes clear that the real change has been much less in recent years, with an estimated annual *reduction* in prices occurring between 1993 and 1998. *Per capita* household water consumption has therefore continued to increase, despite these changes in water prices.

Hungary's large real price increases (18.7 per cent per annum over the period 1986–96) have been caused mainly by increasing restrictions on the use of central government subsidies in recent years, and the elimination of the automatic price subsidy for all households, a policy which existed until 1992 (Rakosi, 1998). Overall, as charges have increased rapidly, so household water consumption has fallen: from 154-102 lhd over the period 1986 to 1997 (Table 2).

If reliable inflation data were available for the ***Czech Republic***, a similar story of subsidy restriction (certainly true), sizeable increases in real charges (very probable), and *per capita* consumption reductions (18 per cent between 1992–97; see Table 2) could probably be told.

Evidence is available to show that a similar, but less dramatic, pattern also emerged in ***Luxembourg*** over the period 1990–94. Here, PWS charges rose by 6 per cent per annum in real terms, as overall cost recovery rose from 75 per cent to 85 per cent, and reported household consumption fell simultaneously from 181 lhd to 169 lhd between 1990 and 1995.

The picture from this group seems clear: five countries with substantial recent real increases in charges for various reasons (in three of them, subsidy reduction has been the dominant cause) have all been characterised by falling household water consumption. But what of countries with more moderate tariff increases?

Here, the results are more heterogeneous. In the ***US*** (where real prices increased 2.4 per cent over 1992-98), experts continue to find that local water utilities are unable to reverse the historic under-pricing of water services, emphasising the continued:

- use of average costs in rate-making;
- neglect of marginal cost principles;
- failure to create adequate depreciation reserves;
- deferral of necessary capital replacements;
- continuing subsidisation by different levels of government; and
- the politicisation of the rate-making process. (Beecher and Mann, 1997)

In ***England and Wales,*** there has been full cost recovery of *all* direct economic costs for many years now, but the low metering penetration of households (and thus, the frequent absence of any price signals at all) means that underlying domestic consumption continues to increase.

At the other end of the spectrum, the 1997 *Countermeasures* were enacted in ***Korea*** in order to reduce subsidies (overall cost recovery is only 77 per cent of economic costs) and thereby to encourage more rational use of water. In Taegu, the only city for which detailed tariff information is available, the volumetric rate for the first tariff block (up to $10m^3$/month) increased 25 per cent in 1997 over the previously-established (1995) rate, during which period, general inflation was only 10 per cent. It is still too early to assess the success of these measures in terms of their effects on consumption.

Metering, tariff structures, and price levels

Introduction

It is commonly asserted that domestic metering is not a very active political issue in many OECD countries. This is true in the sense that most OECD countries have achieved 100 per cent metering penetration of single-family houses connected to the PWS (Table 14). However, arguments about the impact effects of domestic metering still help to shape water policy in at least three OECD countries (***Ireland, New Zealand,*** and the ***UK*****)**, and a new and wider area of public debate has developed over recent years concerning the metering of individual apartments. Here, costs and benefits are clearly important, and in at least two continental European countries (***Denmark*** and ***Germany***), apartment metering policy is currently undergoing significant change.

This section of the report outlines the present situation concerning domestic metering, and broadly discusses the issue of individual apartment metering. The transparency of water charges and costs for individual consumers, and recent evidence concerning the effects of changes in tariff *structures* and price *levels* on household demands are also examined.

The decision about whether (and when) to adopt a metering approach is based on perceptions about the "optimal" pricing structure. This optimality, in turn, depends on balancing economic, environmental, and social criteria. (In practical terms, e*nvironmental* criteria tend to move in the same policy directions as *economic* ones do — because higher prices for water tend to reduce wastage — so the two are assumed here to be the same).

On the *economic/environmental* side, the main issue is usually whether the costs of installing and administering the metering system are larger than the benefits anticipated in terms of reduced water consumption (reduced infrastructure costs, reduced variability in demand, etc.). This emphasis on the *quantitative* aspects of the metering decision needs to be counter-balanced with a consideration of some of the *qualitative* issues involved. For example, by promoting improved public water infrastructure, metering can make it easier to spread the health benefits associated with improved water quality to a wider segment of the population. Experience in ***Canada***, for example, suggests that when these qualitative aspects are taken into account, they can sometimes push the benefit-cost ratio of metering beyond unity (personal communication, D. Tate).

On the other hand, there are also *economic/environmental* risks associated with metering (e.g. risk of some households connecting illegally or disposing of sewage illegally; risk that reduced waterflows in water pipes may reduce the ability of those pipes to function as they were designed; etc.).

And even where metering may increase the *economic/environmental efficiency* of the water service, it is often regarded as conflicting with *social equity* goals. For one thing, metering may lead to price increases that are regarded as being too regressive in terms of their impacts on certain low-income water users, and therefore be socially-unacceptable. (Note, however, that metering can also *support* social equity goals by making households responsible for only their own actual water consumption). Metering is also generally expected to *decrease* water consumption, whereas it may be in the best interests of certain countries (especially countries currently at earlier stages of development) to encourage *increased* water consumption (as one way of stimulating economic growth).

On the other hand, there is also the argument that social objectives related to water could be more efficiently achieved via other policy approaches besides changing either price structures or price levels (e.g. via changes in income tax policies). To the extent that this is true, it would be inappropriate to emphasise social objectives in deciding whether or not to expand the penetration of metering in the provision of water services.

Thus, a balance must be struck between economic/environmental efficiency and equity objectives when considering the metering option. It is largely for this reason that experiments with "dual" approaches are currently being attempted in some countries, which would protect the low-income, high-use households from excessive price increases, but which would also impose efficiency constraints on "luxury" water uses. These "affordability" issues are discussed in more detail later.

Metering of single-family houses

The first column of Table 14 provides information on metering penetration in single-family houses. There is firm evidence that over two-thirds of OECD Members (20 countries) meter all or nearly all (i.e. $\geq$ 90 per cent) single-family houses. In the ***Netherlands,*** both Amsterdam and Rotterdam, the two largest remaining areas of unmetered charging, are planning to complete their domestic metering activities soon. On the other hand, there are no current plans to alter the unusual tariff policy in Antwerp (***Belgium)*** of obliging high discretionary use households to be metered, and gives all others a choice (a total of about 30 per cent were being charged by meter in early 1998).

In ***Ireland***, a recent government study (Department of Environment, 1996, p. 41) concluded that, given the absence of existing infrastructure and the high costs of putting a metering system in place, universal metering "is not an economic proposal at present".

In ***Norway,*** there is only a very slow spread of domestic metering, and it does not appear to be an issue of much political importance. In both ***New Zealand*** and ***England and Wales***, metering issues have recently been debated, mainly because of their implications for low-income households. (For the current situation in one New Zealand City, see the Christchurch case study discussed previously in Box 1.)

Two water companies in England (Anglian and Yorkshire) have had to withdraw compulsory metering programmes in the last few years, in the face of determined public opposition. OFWAT, the economic regulator of the privatised water companies in England and Wales, is formally opposed to *universal* domestic metering (on cost-benefit grounds), but supports compulsory *selective* metering: (i) where new resources are scarce (and hence expensive); (ii) where households are consuming significant amounts of "discretionary" water (e.g. for luxury use, and especially for garden watering); and (iii) for new homes where the initial installation costs are relatively low. All water companies also offer — with the regulator's approval — a *metering option,* so that those households which use little water have the opportunity of paying a bill that reflects their (small) consumption.

Following the severe drought in 1995, many water companies in southern and eastern England now have expansionary domestic metering programmes underway. Anglian Water, one of the strongest advocates of metering, expects to have 60 per cent of households linked to volumetric charging early in the next decade. Cambridge Water — a smaller water-supply-only company within the Anglian area — plans to meter all of the 25 000+ hose-pipe users by the end of 1999, and expects to reach a 50 per cent metering penetration of its 100 000 households a few years later (Kay, 1998).

Table 14. Metering Penetration in Single-Family Houses and Apartments Connected to the PWS

	Year	Single-family houses	Metering penetration in: Individual apartments[1]	All individual households
Australia	1998	95-100%	"insignificant"[2]	
Austria	1998	100%	"very few"[3]	
Belgium	1997	90%	"many cases"	
Canada	1998	55%	"few"	
Czech Republic	1998	100%		
Denmark	1996	64%	1% in Copenhagen	
Finland	1998	100%	"very low"	
France	1995	100%	>50%	88%
Germany	1997	100%	10-20%	55-60%
Greece[4]	1998	100%	100%	100%
Hungary	1998	100%		
Iceland	1997	0%	0%	0%
Ireland	1998	0%	0%	0%
Italy	1998	90-100%	"many examples"	<30%
Japan	1997	100%	94%	100%
Korea	1998	100%	100%	
Netherlands	1997	93%		
New Zealand	1997	25%		
Norway	1998	"low"	0% or "very low"	10-15%
Poland	1998	100%	0%	"about 10%"
Portugal	1998	100%		
Spain[5]	1998	"nearly 100%"	"nearly 100%"	95%
Sweden	1998	100%	0%	"about a half"
Switzerland	1998	100%	0%	
Turkey[6]	1998	"nearly 100%"	"nearly 100%"	>95%
United Kingdom:				
• Eng. & Wales	1998	12+%	"a few"	11%
• N. Ireland	1997	0%	0%	0%
• Scotland	1997	"near 0%"	"near 0%"	0.002%
United States	1997	90+%		

A blank cell denotes data "not available".

Notes:
1. This applies to *cold* water metering; *hot* water provided in apartments under district heating schemes is normally metered but even here, the practice varies widely.
2. "Insignificant" applies to Sydney only; the situation elsewhere is unknown.
3. It is estimated that "perhaps about 20" apartment buildings in Vienna have individual meters.
4. Athens only.
5. Barcelona only.
6. Ankara only.

Table 15 collates recent evidence on metering effects in OECD countries, with most of the studies relating to single-family houses. These studies, like those listed in the earlier report (OECD, 1987*a*; Table 16), continue to show significant demand reduction effects resulting from domestic metering. Note also the size of the effects on *peak* demands. These are often much greater than those on *average* demands, and raise questions relating to seasonal tariffs (which are explored later).

Table 15. Estimated Water Savings Due to Metering and Charging by Volume (Primarily in Single-family Houses)

CS/ TS	Location	Period	Comparison	Savings due to metering	Reference
TS	Collingwood, Ontario, Canada	1986-90		Summer peak:37%	Anon (1992)
TS	Leavenworth, Washington, USA	1988-91		Summer peak:61%	Anon(1993)
CS	9 metering trial sites, England	1988-92	7000 houses in 9 trial groups and 9 control groups	Average figure: 11.9%	Herrington (1997*a*)
TS	Isle of Wight, England	1988-92	Metered population rose from 1% to 97% in 1992 (50 000 homes)	Annual: 21.3%	DOE (1993)
CS	Metering trial sites, England	1988-92	Peak hr/day/wk/mnth - hot, dry summers - wet summers:	 39% / 27% / 35% / 27% 4% / 15% / 19% / 15%	Herrington (1997*a*)
TS + CS	Mataro, Spain	1983-93	25 694 hh's in 1983 (M:29%) with 39 952 hh's in 1993 (M:90%)	Annual: 35%*	Sanclemente (undated)
CS	Terrassa, Spain	1994-95	23 400 UM hh's and 34 038 M hh's	Annual: 12.7%	Sanclemente (undated)
TS	Barcelona, Spain	early 1990s	2 927 connections switched UM to M	Annual: 12.8%	Sanclemente (undated)
TS	East Anglia, UK	1990s		Annual: 15-20% Summer peak: 25-35%	Edwards (1996)
TS	Portland, USA	1993-94		Annual: 10-12%	Dietz and Ranton (1995)
TS	New York City, USA	1991-95		Annual: 7.4%	Environment Agency (1996)
TS	Oaks Park, Kent, UK	1993-96	61 houses	Annual: 27.5% Summer peak: up to 50%	Mid-Kent (1997)
TS	St. Peters, Kent, UK	1993-96	160 houses	Annual: 14.1% Summer peak: up to 32%	Mid-Kent (1997)

Notes: CS = Cross-sectional study.
TS = Time-series study.
M = Metered.
UM = Unmetered.
* Income effect of +10% in 10 years assumed.

Metering of domestic apartments

The situation in apartment blocks, where most of the population live in a significant number of OECD countries (unfortunately, no precise proportions are available), is much more varied. A limited amount of information is provided in Table 14 (columns 2 and 3), while Table 16 lists the results of the few studies conducted during the last decade that examine the effects of introducing volumetric charges for *individual* apartments. These effects may well include reductions in leakages that are identified during the tariff changeover.

The water being supplied to individual apartment *buildings* is metered in nearly every OECD country. In most cases, the owner, manager, or some other responsible person receives a volumetrically-based water bill. Generally, these charges — together with those applying to wastewater services — are then recovered from tenants (or individual owners) by some criterion (such as m^2 of floor space, number of rooms, number of residents, appliance ownership, etc.).

There are essentially two reasons why pressures may exist for the metering of individual apartments: *equity* and *efficiency*.

Equity concerns arise because, as the real cost of water to households increases (Table 13), non-volumetric charging systems promote more cross-subsidisation of profligate/high water users by economic/low users within any apartment building. In other words, *real* income transfers that may already be perceived to be unfair become even larger. Calls typically follow (from the subsidisers) for the installation of meters. But as long as the water utility recovers its aggregate charges, this equity issue may not be of concern to the utility itself, but may be more of a problem for the apartment block owner. (Note that a *private* company supplying water to its clients would be more likely to take this view than, say, a *municipal* utility, which may be more likely to pursue equity as one of its objectives.)

Table 16. Impacts of Metering Individual Apartments (All Time-series Studies)

		Average Consumption			
Location	**Years**	**Before metering**	**After metering**	**Saving**	**Reference**
Nancy, France: 120-apartment building	1980-82	220m^3/yr.	120m^3/yr.	45%	Roseberg (1994)
Paris, France : 200-apartment building	1986-87	160m^3/yr.	120m^3/yr.	25%	Roseberg (1994)
Rennes, France: 32-apartment building	1987-89	115m^3/yr.	83m^3/yr.	28%	Roseberg (1994)
Copenhagen, Denmark: apartment building	Early 1990s			30-35%	Sanclemente (undated)
Hamburg, Germany				15%	Kraemer and Nowell-Smith* (1997)

Note: * Quoting *Hamburger Wasserwerke*, 28.

Second, consider *efficiency*. Imagine a situation where "in-house" (strictly speaking, "in-apartment") demands are rising (perhaps because of rising incomes), and where there are also significant

local/regional resource constraint problems. In this case, the presence of a single master-meter may have no effect on total demand (the owner allocates the increase in the aggregate bill, and each resident decides that the increase is not his/her fault, but pays the bill anyway). However, the objectives of economic efficiency and environmental sustainability both require a demand-side response in this situation. It may be that the local authority and/or the relevant building code could provide a means of promoting such a response, and thereby overcoming the evident market failure.

Thus, in ***Germany,*** Kraemer and Nowell-Smith (1997) report significant moves since the 1980s to promote the metering of individual apartments, especially in Hamburg, Berlin, and Frankfurt. Two types of initiative are observed. First, the local authority may be the prime mover. In 1985, the City of Hamburg began a programme to install individual meters in all flats, and (from 1987 onwards) all new and renovated apartment buildings in the city have had to have individual meters. By 2004, all households will have their own meters.

Second, on a wider scale, the building codes of the Länder have begun to be amended to provide for the compulsory metering of individual flats in new buildings, as well as (sometimes) the incorporation of individual meters whenever old apartment blocks are being renovated. In Hesse, water abstraction taxes (Table 12) are used to give financial support for retrofitting meters in these situations.

In most other European countries, the policy change is less marked. Thus, in ***Belgium,*** owners or managers of apartment buildings "in many cases" have installed private meters in individual flats, and there is also a (slow) movement towards individual metering by the water companies. In ***France,*** individual metering has always been relatively common. Already in the early 1970s, 50 per cent of apartments were being metered for cold water (see OECD [1987*a*], Table 14), and since 1974, all new housing units have had to be equipped with a meter for each flat. Barraqué and Cambon (1997) explain that this policy originated in the need to measure centrally-generated hot water, with this approach later being extended to include cold water, and eventually being generalised "at the request of managers of large condominiums after increasing dispute between tenants" (*ibid*). However, it should not be assumed that water utilities always read these meters, since they are often beyond legal access. The numbers of meters in apartments have increased in France, since a 1995 survey found that 88 per cent of households are now being metered individually.

In ***Switzerland***, the allocation of water costs within an apartment building is seen as the responsibility of the owner, and there are no plans to take a more pro-active stance. As the price of water has become the subject of increased public debate in ***Italy***, the collective metering of consumption has also given rise to more complaints about cross-subsidisation. Apartment residents normally have the right to ask for their own meter, but they must pay for its installation. The expansion of individual apartment metering is therefore occurring quite slowly.

Sydney Water (***Australia)*** reports that it encourages the implementation of individual metering in apartment blocks, but is content to leave the decision to those responsible for managing the building, since it is usually more cost-effective — presumably viewed from the *water utility's* perspective — to charge for the building as a whole.

The situation in ***Denmark*** highlights the *efficiency* issue mentioned earlier. Recent Danish legislation means that (by 1 January 1999) all *properties* connected to the public water supply must have a meter installed. The duty to commence installation rests with the water utility, although the cost must be met by the individual owner. The metering penetration of single-family houses is therefore expected to increase rapidly. In addition, provision must now be made for the "later" installation of individual meters

in newly-constructed apartment blocks, with a maximum of two feeder-pipes for each apartment (one for cold water, one for hot). What is meant by "later" has yet to be determined. There are no proposals to insist on retrofitting meters in old apartments, but planned legislation will permit water supply utilities to charge directly residents of apartments which have individual meters installed. However, this approach may lead to relatively complicated billing systems, and thus prove difficult to administer.

Denmark's legislative changes at the national level provide the backdrop for a discussion of the situation in Copenhagen, which brings together a number of the issues raised above. Copenhagen has a serious groundwater pollution problem. In addition, Copenhagen's abstractions are threatening to "mine" the groundwater resources, with a consequent adverse effect on wetlands. Of the 288 000 households currently served by the public system, only 5 per cent live in single-family houses (all of which are metered). The other 95 per cent live either in apartments, or in terraced houses (6 400 households in the latter group). Of the 95 per cent of non-single-family-houses, only about 3 100 households (about 1 per cent) have individual meters, and all of these have been fitted as a result of individual choice. The Copenhagen utility therefore faces the problem of "forcing" the scarcity signal through to the 94 per cent of their households who currently do not receive this signal via a price on their water bills.

As a result, the utility has sought to expand the individual metering option, despite the legal restrictions on this option. It is currently investigating the effects of introducing meters at the individual apartment level, with a view to reducing water consumption. The utility is also stressing the financial advantages which may accrue from individual meter installation, but, as yet, without offering the option to its clients of having a free meter installation.

Transparency in water charges

According to the *efficiency* argument presented above, it is preferable from both an economic and an environmental perspective to present consumers with transparent water charges, ideally reflecting the marginal costs of their water usage. The metering of household water usage, and the associated levying of volumetric charges for the water actually consumed, can both help to provide the necessary signals to households of the water quantities they are consuming (and concurrently, the actual costs of this consumption).

Some OECD countries have therefore increased their metering of household water consumption, or devised other policies aimed at enhancing the transparency of water charges in order to achieve demand reduction targets. As discussed above, the plan to reduce *per capita* domestic consumption in Copenhagen (***Denmark***) from 134 lhd in 1995 to a target of 110 lhd by the year 2000 has led the utility to seek to have individual apartment households' water charges made clear to each household, even if these charges are determined under a non-volumetric formulaic system. This is believed to be necessary because water charges in the past have frequently been included with a number of other services — even with the monthly rent — with the result that residents have no idea of the value of the water services they are receiving. Transparent water charges would, it is maintained, "improve our chances for efficient awareness-making, with water saving as our target" (Copenhagen Water Supply, 1998). The important (although implicit) claim being made here is that even if the marginal price of water is zero, awareness of costs can bring about a non-trivial change in consumption behaviour.

However, given the significant costs often associated with implementing water metering and volumetric-charging systems, some countries — particularly those which are not faced with water quality or quantity limitations — have not found the full metering option to be economically-viable. ***Ireland*** has

even preferred to consolidate household water charges into the general taxation system, rather than issue separate water bills.

While some studies have examined the effects of different tariff structures on demand behaviour (see next section), relatively little is yet known about actual consumer behaviour in (non-metered) charging situations involving varying degrees of transparency. Such information is urgently required, in order to better understand the full benefits of any policies designed to increase transparency in the costs of providing water services.

Effects of tariff structures and prices on household demands

Tables 17 and 18 present some recent evidence on the effects on household demands of changes in tariff *structures* and *prices*, respectively. Both Tables should be seen as complementing the information contained in Tables 6 and 7 in the 1987 OECD study (OECD, 1987*a*). Table 17 is largely drawn from a recent paper by Pezzey and Mill (1998).

The results are unsurprising: available evidence supports the theory that increasing domestic water prices, coupled with moves towards volumetric or marginal cost pricing, *do* provide incentives for water conservation by households. The tariff structure effects all have the anticipated sign, although the price elasticity estimates continue to show generally lower values for Europe than for other countries. It should also be noted that the more sophisticated Panel data techniques reflected in this set of estimates give values of the same order of magnitude as those generated by conventional models.

Table 17. Consumption Effects Arising from Tariff Structure Changes

Location	Year(s)	Tariff Before	Tariff After	Consumption Before (lhd)	Saving	Reference
• United Water Co., NY, USA	1981	IB, non-seasonal	Seasonal rate 150% higher		Aver: 20% Peak ratio down from 1.75 to 1.5 (1)	Environment Agency (1996)
• Palm Beach, USA	1983-8	IB and then DB	IB	Aver: 760; Large users > 2500	14% in large user category (2)	Federico (1990)
• Barcelona, Spain	1989-96	2 x IB	3 x IB, with much higher price for 3rd block	211 (1991)	c. 10% (3)	Sanclemente (1998)
• San Antonio, Texas, USA	1994-6	3 x IB + 10% seasonal surcharge	4 x IB + seasonal surcharge	Winter: 252 Summer: 469	Total: 12% to 14% (4) Summer: 22%	Fox (1995)

Notes: 1. Consumption then continued rising at about 1.6% per year.
2. A "pure" price effect.
3. A tariff change occurred in 1989. No consumption estimate was available for 1988 or 1989; the nearest estimate is for 1991. The 1996 estimate was 193 lhd.
4. Revenue-neutral, with small conservation fund raised.

IB = Increasing-block structure.
DB = Decreasing-block structure.

Table 18. Price Elasticities for Public Water Supply

Location	Type of model	Year(s)	Elasticities	Reference
Australia				
• Sydney Water	TS/OLS	1959-60 to 1993-4	AR: –0.13	Warner (1995)
Denmark				
• Copenhagen	TS/OLS		–0.10	Hansen (1996)
France				
• 116 eastern communes	CS-TS/Panel	1988-93	AP, s/r: –0.22 AP, l/r: –0.26 MP, s/r: –0.18	Nauges & Thomas (1998)
• Gironde	CS/OLS		–0.17	Point (1993)
Italy				
• Unknown	CS	Mid- 1990s	–0.24	Critelli (1998)
New Zealand				
• Auckland	TS		–0.08	Law (1986)
• Auckland	CS	1976	–0.20	Law (1986)
• Auckland	CS	1981	–0.24	Law (1986)
• Christchurch	CS/CBS	Late 1980s	–0.29	Welsh (1991)
Korea	TS	1998	-0.29	Kim (1998)
Sweden				
• 282 of 286 Swedish communities	CS-TS/Panel	1980-92	AP,l/r:–0.20 MP,l/r:–0.10	Höglund (1997)
United States				
• Wisconsin	CS/OLS		–0.12	Schafter & David (1985)
• Illinois	CS/SEs		–0.71	Chicoine *et al.* (1986)
• Illinois	CS-TS OLS		–0.48	Chicoine & Ramamurthy (1986)
• Denton, Texas	CS-TS IV,2SLS		IBR: –0.86 DBR: –0.36	Nieswiadomy & Molina (1989)
• Massachusetts	CS		–0.40/–0.45	Stevens, Millan & Willis (1992)
• Santa Barbara, California	CS-TS/2SLS		–0.33	Renwick & Archibald (1997)

Notes:

TS	=	Times series	l/r	=	Long-run
OLS	=	Ordinary least squares	s/r	=	Short-run
CS	=	Cross-sectional	AR	=	Average revenue
Panel	=	Panel data techniques	AP	=	Average price
CBS	=	Contingent behaviour survey	MP	=	Marginal price
SEs	=	Simultaneous equations	IBR	=	Increasing-block rate
IV	=	Instrumental variable	DBR	=	Decreasing-block rate
2SLS	=	Two-stage least squares			

Even with the evidence presented here, a number of uncertainties remain regarding the effects on household demand of changes in water pricing structures and levels. As with most demand functions, it is often only after a certain threshold change in price levels that consumption levels will respond elastically. In addition, increasing prices (and increasing revenues) can sometimes be associated with better infrastructure or water quality. Where this is the case, the higher quality of water and of service provided may actually lead to *increased* consumption, despite the higher price levels. Substitution effects — in terms of self-supply — also need to be considered, and particularly the resulting effects on peak demand.

Social tariffs and affordability

Introduction

In this section, both the "micro" and "macro" aspects of the *affordability* of household water services are examined, with this notion of "affordability" referring to the extent to which some households (or households in general) can afford the water services that they either choose (or are obliged) to purchase (depending on the tariff encountered).

The "micro" issue concentrates on affordability for lower-income groups. The ways in which governments and water utilities have chosen to address this issue can be divided into two broad groups, emphasising either the *tariffs themselves* or *certain individual households.* These can be termed either *tariff solutions* or *target group solutions.* Under the first heading, the "solutions" are to be found either in tariff specification, in tariff amendment, or in tariff innovation. In the second group of "solutions", the focus is on assistance to either individual households or specified groups of households. This assistance may be provided in two ways: via tariff discounts (lower prices) or via income support (higher incomes).

For both groups of solutions, funding may originate from government bodies (local, regional, and national), although the tariff-based approach is more likely in practice to be self-financed by the utility (i.e. through some form of cross-subsidisation). Such cross-subsidisation can and does occur both *from* non-household sectors (e.g. industry and commerce) and also *within* the household sector (i.e. from rich to poor). Similarly, for target-group solutions, price reductions can be funded by the government (although in practice, they too normally involve cross-subsidisation between water consumers instead), and income transfers might originate from the utility itself (although social security is the more usual source).

Note also that the two approaches are not mutually exclusive. A new tariff could be reserved for certain groups of consumers (e.g. those in receipt of social security benefits), or it could be partly geared to some indicator of low income, such as property value or property type.

A focus on the "macro" aspects of affordability is also provided, via a brief examination of two possible indicators of the *overall* affordability of water services for households within a country. Effectively, this means comparing the average (or typical) water bill in a country with some average household's financial strength or "ability to pay".

Tariff-based solutions to affordability problems

Three types of solutions to micro affordability problems can be distinguished, and all are found in OECD countries. They are:

- conventional tariff specification;
- tariff amendment; and
- tariff innovation.

Tariff specification

The term "tariff specification" alludes to the justification frequently offered for referring to increasing-block tariffs as *social tariffs*. Certainly in ***Italy, Greece, Spain, Portugal*** and ***Belgium,*** the familiar increasing-block schedule is often claimed to be advantageous to the relatively poor, granting these consumers the opportunity to buy "early" blocks of water at low (and sometimes very low or even zero) prices. It is not known whether a similar line of argument is responsible for the popularity of such tariffs in many Asian countries (including ***Korea*** and ***Japan***) and its occasional incidence in the ***Netherlands*** and ***Australia***.

Of course, it is not as simple as this in actual practice. Increasing-block schedules do not necessarily reflect large equity gains for the poor. A relatively small "first block" range may simply mean that nearly all households of average size or above are "forced" into higher (and more expensive) blocks, so the consequent welfare distribution may be small, as compared with a uniform volumetric rate (depending on the width of the blocks and the steepness of the rise of the rate). Large poor families may therefore end up in much more expensive blocks, and could pay significantly higher average volumetric rates than smaller (but higher-income) households.

Nevertheless, there *is* an underlying social appeal to such tariff structures, and recognising the significance of one- and two-pensioner households among the emerging poor in a number of developed economies, there is a sizeable reservoir of income redistribution opportunities available via increasing-block tariff systems, as long as the widths and prices of these blocks are carefully chosen.

One general *caveat* is in order, however. This comes into play when a minimum charge is levied which "covers" a relatively large block (rate) of "initial" consumption. Thus, in ***Japan,*** it has been common for utilities to specify a minimum charge covering 10m^3 per month since at least the 1960s, when domestic consumption was even significantly lower than it is today. A similar situation has existed until recently in ***Korea***. In Taegu City, for example, the 1974 minimum charge "paid for" the first 15m^3/month, even though estimated consumption was only 62 lhd, and this meant that only households with *nine or more* people were likely to be facing a non-zero price for water. In 1997, just before the abandonment of the basic rate, only a three-person household (or larger) in Taegu would normally have expected to face a non-zero price at the margin.

The justification for this type of minimum charge is difficult to understand, unless it is seen as a way of recovering customer costs, akin to the fixed element of the familiar two-part tariff. But, if so, it often seems to be too large for that purpose. In general, it would be better to eliminate the minimum charge, thereby removing its potential to dampen conservation "messages", and to replace this charge with a more carefully-sculpted fixed customer charge, aimed specifically at residential households.

Tariff amendment

Amending tariffs is best seen as an attempt to make increasing-block structures more "friendly" to households with below-average incomes, but of average or above-average size. It may be pursued by relating either the fixed charge element or one or more characteristics of the cheap blocks (size, price) to the "needs" of households.

In the Flanders Region of ***Belgium***, as previously discussed, the first 15m^3 per annum per person (equivalent to 41 lhd) in each household has been provided free, since 1 January 1997. This has the virtue of being: (i) small enough to ensure that very few households will face a zero price for their water; (ii) "politically defensible", in that it covers a certain core of basic ("essential") water use in the home; and (iii) "equitable", especially between households of different sizes. It is believed to be the only operational example of such a tariff anywhere in the world, even though a similar schedule has also been proposed for ***England and Wales*** (Herrington, 1996).

In ***Spain,*** two innovations for Barcelona have already been noted: a "blunter" version of the Flanders size-of-household amendment (in this case, extending the width of the *second* block in line with household sizes exceeding five persons), and a progressive variation in the fixed charge, depending on the type of property occupied by the household. Similarly, Madrid and Seville are understood to have introduced new or amended social tariffs in recent years (Sanclemente, 1998).

In ***France***, a new social tariff for domestic water use is currently under study. In addition, it is likely that Article 13 of the Water Law of 3 January 1992 will be modified such that a reduced tariff will be offered to small water consumers in the future.

A further example comes from the ***US***, where the Los Angeles Mayor's Blue Ribbon Committee on Water Rates created a radically different rate schedule between 1992 and 1994. This abolished the old minimum charge; introduced summer *premia* (to increase volumetric prices up to long-run marginal cost levels); and created a two-tier rate structure, in which the size of the first tier is in line with important determinants of what a "responsible" household would be expected to consume. In this way, economic efficiency, equity, and environmental concerns are all addressed (Box 5).

Tariff innovation

In some circumstances, there is no tariff *amendment* which can capture the degree of change required. In this case, completely *new tariffs* may be needed. Examples of such tariff innovations are available from two very different types of water utilities: one from Anglian Water in the ***UK*** (population served: 4 million), and one involving a group of initiatives from the over 100 communes supplying water services in ***Luxembourg*** (average population served: 3 500) (Eurostat, 1997).

In recent years, Anglian Water has chosen to introduce completely new tariffs to meet the concerns of those who object (on social equity grounds) to any sudden shift from flat-fee charges (based essentially on property values) to metering (and the associated volumetric charging that goes with it) which is not accompanied by complete freedom of choice in tariff selection. Opponents were particularly concerned about compulsory metering programmes which Anglian proposed in "resource-stretched" areas. Anglian's reactions to a determined opposition campaign were: (i) to abandon its compulsory programmes other than those centred on new homes and the use of certain high-water-use luxury appliances; and (ii) to introduce a new tariff, termed the *SoLow* rate, which has no standing charge, but which includes a volumetric rate some 25 per cent higher than that in the "normal" tariff. As Table 19 illustrates, a very low-water-use household (a single person household, using 100 l/hh/d), drawing both

water supply and sewerage services from Anglian, would (in 1998-99) save about £20 a year by electing to go onto the SoLow tariff.

Box 5. Los Angeles Tariff Reform in the Early 1990s

The Mayor's Blue Ribbon Committee on Water Rates (1992) initially reported the results of an inquiry into the pre-1992 rate structure. It found serious drawbacks to the "old" system operated by the Los Angeles Department of Water and Power (serving nearly four million people), whose mandate had been to develop a water rate structure that was "equitable and promotes conservation, water recycling, and improved water quality." (*ibid*, p.1)

The main drawbacks were identified as: (i) the "old" structure failed to inform customers of future rising costs; (ii) water shortages, and hence appeals to conserve, were inevitably associated with rate increases (due to the size of short-run fixed costs); (iii) low-income group and "lifeline" assistance was unreasonably restricted to single-family homes (SFHs), whereas needy groups were increasingly locating in multi-family residences (MFRs); (iv) the existence of a fixed minimum monthly charge encouraged waste of the resource; and (v) in order to receive full benefits of water at discounted prices, low-income consumers had to consume more than a certain quantity, which led to water waste.

To remove these disadvantages, the Mayor's Committee, following extensive public hearings in 1994, proposed: (i) the abolition of the minimum charge; (ii) the payment to low-income customers of credits in cash terms (and independent of water usage); and (iii) relating the size of the first tier of water use (at base price) for SFH users to household "needs". These needs were to be determined by lot-size (five categories), temperature zone (three in all), and family size (there would be an extra first-tier allowance for each resident in the household in excess of six). Additionally, an inexplicably small summer premium for all users of first tier water was introduced, ranging between 2 and 4 per cent.

All additional (or second-tier) water for SFH users would be priced at higher levels: in the winter, at a price 37 per cent higher than the first-tier, in the summer (June to October) at a price 72 per cent higher. For MFR consumers, all winter water was priced at first tier-rates (very similar to those for SFHs), but in summer, first-tier usage was fixed at 125 per cent of the average consumption of the preceding winter. Any consumption after that would have a price that was 72 per cent higher. The summer second-tier rate for both SFHs and MFRs was set to reflect the forward-looking unit costs of Los Angeles having to add new supplies (i.e. marginal costs). All these rates and arrangements became effective on 1 June 1995.

[see http://www.ladwp.com/water/rates/index.htm for further details of current rate schedules]

Table 19. Household Metered Charges in Anglian Water (1998-99)
(litres per *household* per day — l/hh/d)

		Normal tariff	SoLow tariff	Plus 4 tariff*
Standing Charge	(£/year)	36.00	-	137.00
Volumetric rate	(£/m^3)	2.12	2.62	1.04
Annual bill:	36.5 m^3/yr. (100 l/hh/d)	113.39	95.56	175.13
	50 m^3/yr. (137 l/hh/d)	142.01	130.90	189.23
	100 m^3/yr. (274 l/hh/d)	248.02	261.80	241.47
	150 m^3/yr. (411 l/hh/d)	354.03	392.70	293.70
	200 m^3/yr. (548 l/hh/d)	460.04	523.60	345.94

Notes: * Consumers receiving social security benefits (Income Support, Job Seekers Allowance or Family Credit) may choose *any* of the three tariffs. All other consumers may choose between *Normal* and *SoLow*.

Although benefiting all households using less than 72 m^3 per annum, the SoLow rate was of no help to households of average- or above-average size, especially those who are unemployed or in low-paid work. Specifically for these groups, therefore, Anglian has introduced for 1998-99 the *Plus 4* rate, combining a high standing charge with a low volumetric rate. Table 19 illustrates that annual savings associated with *Plus 4*, relative to normal tariffs, rise from about £5 to about £115, as consumption rises from 100 to 200 m^3 per annum.

These new tariffs serve two main purposes. First, in a general sense, they demonstrate that the water utility can be responsive to different social contexts (in a country where the complete privatisation of the water industry remains the subject of considerable public debate). Second, by "carving out" new tariff structures, they give real benefits to otherwise disadvantaged consumers. (http:\\anglicanwater.co.uk/customer/charges.html).

In ***Luxembourg***, there are examples of communes charging households increasing-block tariffs, but gearing the widths of the blocks to *the number of people in the household*. Table 20 shows one such example.

Table 20. Variation in Block Size: Luxembourg Commune (1996-97)

Water price in Flux per m^3	Consumption in m^3 per year in households consisting of:						
	1 person	2 persons	3 persons	4 persons	5 persons	6 persons	7 persons
40	≤60	≤100	≤140	≤180	≤220	≤260	≤300
50	61-70	101-120	141-170	181-220	221-270	261-320	301-370
70	> 71	> 121	> 171	> 221	> 271	> 321	> 371

In another commune, the water tariff is gradually reduced, according to the increase in the number of children in the household (Table 21).

Table 21. Volumetric Rate Dependent on Number of Children: Luxembourg Commune (1996-97)

Standard household tariff	38.0 Flux/m^3
Family with 3 children	26.6 Flux/ m^3
Family with 4 children	22.8 Flux/ m^3
Family with 5 or more children	19.0 Flux/ m^3

These socially-driven variations inspire significant differences in basic tariff structures, with 118 communes charging for water at 118 different prices. There are increasing-block, decreasing-block, and constant volumetric rate schedules for water supply; while for sewerage and sewage treatment, a similar variety of arrangements can be found, combining one or more elements of fixed charges (per household, per person or per person-equivalent) and charges per m^3 supplied (with or without different maxima and minima, or only coming into operation with supplies over a certain limit).

What these examples of tariff innovation show is that it is quite possible to design tariffs — with entry being either restricted or unrestricted — which protect the interests of particular well-defined

groups, be they low-income households, large households, households with children, etc. In each case, there will, to the tariff designer who seeks an optimal structure, normally be a trade-off arising from the innovation. But what is lost in efficiency, to be set against the gains in equity, depends very much on the starting-point for the comparison. In Anglian Water, if the "start" is considered to be an unmetered context (and therefore some sort of flat-fee system), the gains from the transition (a positive marginal price, leading to improved economic and environmental signals) have to be set against not only the familiar extra costs of establishing and operating a volumetric charging system, but also against the upset and hardship which may arise from the resulting complex matrix of gains and losses for individual households. Implicitly, Anglian tariff innovators must believe that the extra gains in equity from the introduction of the two "new" tariffs *(*reducing the hardship in many cases) outweigh the more subtle efficiency losses, which may occur because the volumetric rate is not exactly "right" (i.e. perhaps drifting further away from a marginal cost base, such as is presumably true of the very low price attached to the *Plus 4* tariff).

Support for this "implicit" view is provided by the consistently low price elasticities for household use (e.g. as reported in Table 18) and the further argument that the beneficiaries of the restricted *Plus 4* tariff are unlikely, by definition, to have significant luxury uses of water. Their price elasticities are therefore likely to be even lower than those recorded in Table 18 (so long as the volumetric rate is not so high that a substantial *income effect* is generated by the price changes). In Luxembourg as well, the issue of whether the going price is 40, 50 or 70 Flux (Table 20), or anything from 19 to 38 Flux (Table 21), is doubtless considered to be of second-order importance when considered alongside the potential equity gains to be achieved.

Tariff choice

In some circumstances, it is tempting to regard the gains from tariff innovation as resulting not so much from the *introduction* of a new tariff as from the *choice* of alternative tariff structures water users have as a result. In terms of consumer welfare, adding a new tariff, and allowing genuine freedom of choice will always lead to some consumers being better off without others being worse off, so long as the numbers of consumers electing to "join" either one of (say) two tariffs has no feedback effects on the characteristics of the other (e.g. on its volumetric rate). It is precisely the importance of that qualification that has led Anglian Water to restrict entry to its *Plus 4* tariff. If it had not done so, all high-users of water would — rationally — have sought to subscribe to *Plus 4*, and the company would then have had to replace its lost revenue by changing tariffs elsewhere. It is clear that important issues of public relations — and price discrimination — are therefore also bound up with this question.

Two types of choice can in fact be seen in OECD countries. First, the flat-fee/metering choice, which is clearly appropriate where the demand-supply balance in a particular location is such that no case for universal metering can yet be established. Thus in ***England and Wales***, ***Scotland***, and ***Antwerp*** (***Belgium***), such a choice exists. It would also generally enhance equity in other largely flat-fee countries (***Norway*** and ***New Zealand***, for example), since the initial capital costs can (and should) in those situations be at the metering optant's expense, with the extra reading, billing, and collection costs normally being reflected in the fixed charges paid by households.

The other type of choice is the one provided by Anglian Water in its desire to see metering become much more widespread. In public relations terms, this choice has been presented essentially as a measure to smooth out the transition process. A separate question then emerges. Looking ahead, if Anglian arrives — say, in ten years time — at a more-or-less fully-metered situation (it is convenient here to leave aside the question of apartment-metering), would it then be desirable to *maintain* the choice(s)

that were originally on offer? The case for some assistance with water bills for lower-income groups will, it may be assumed, still be strong. Indeed, given recent trends in charges and increasing recognition and recovery of environmental costs, the case may be even stronger.

The ideal would presumably then be a single charging structure that attempted to be fair to all consumers, and here the initiatives made in Flanders, Barcelona and Los Angeles enter into the picture. All these innovations have in common the fact that they represent attempts to improve the equity attributes of increasing-block tariffs. All incorporate changes in either the sizes ("widths") of one or other of the initial blocks in the structure, or in the fixed charge, according to perceived household "needs". They are therefore important "models" for steady-state fully-metered residential scenarios.

Target group solutions to affordability problems

Examples exist in OECD countries of both price (rate) reductions and income supplements (or "cashback") schemes being used to assist low-income households.

For example, Sydney Water (***Australia*****)** reports a wide range of "residential safety nets" to help consumers experiencing financial difficulties in the transition to consumption-based charging (Roberts, 1998). The main components of this system are:

- a Pensioner Rebate scheme, funded by the New South Wales government, which also decides the eligibility criteria for concession. Under the scheme, pensioners are given a 50 per cent discount on the availability (fixed) charge on their property, with no discount on water usage.
- a Payments Assistance scheme whereby customers experiencing genuine hardship may apply for a rebate on their current water bills (usually this amounts to an $A25 voucher).
- a Kidney Dialysis Program, whereby free water allowances are granted to customers requiring the use of Continuous Flow Home Dialysis (400kl/year), Continuous Ambulatory Peritoneal Dialysis (12kl/year) or Recycled Water Dialysis (12kl/year).

A ceiling of $A2 million per year exists for hardship relief — about 0.2 per cent of Sydney Water's total income. In other Australian utilities in the past, rebates of up to 50 per cent on all water and wastewater charges had been granted to holders of a variety of concession cards (Herrington, 1997*a*).

There are also numerous examples in the ***US*** of disabled and low-income households receiving a wide variety of assistance, including rebates based on income, percentage discounts on water bills for certain groups, waivers of the fixed charge, and fixed allowances (or credits) on each bill. Most of this assistance is funded by individual utilities, although occasionally local authorities and voluntary community organisations (using donated funds) are also involved. In 1997, in the latest survey of US water rate characteristics (Raftelis Environmental Consulting Group, 1998), only 4 per cent of surveyed utilities offered discounts for low-volume consumers and 9 per cent offered discounts for low-income consumers. 28 per cent of utilities offered "other" (unspecified) forms of assistance.

Beecher, writing in a US context (Beecher, 1994), claims that there are actually many more options available for utilities to offer assistance than is generally realised. These include financial counselling, forgiveness of arrears, payment discounts, income-based payments, lifeline rates, targeted conservation, disconnection moratoria, and flow restrictions.

At the same time, it should be recorded that submissions to this report relating to several western European countries suggested that there were no significant affordability problems in those countries. This is at least the impression conveyed by information provided by the ***Netherlands***, ***Norway,*** and ***Sweden***.

In Eastern Europe, however, the reverse is true, especially in ***Hungary***, where some subsidies from the central government budget are "earmarked" for those utilities with the highest-cost local water and wastewater supplies (Rakosi, 1998).

Measures of aggregate affordability

In the absence of detailed information about the distribution of household water charges, "aggregate affordability" involves relating some measure of average charges to either average household incomes, or (failing that) to average household *aggregate* expenditures.

Two attempts have been made here to devise relevant series data across OECD countries. The first builds on the results of the latest (1996) IWSA household water bill survey (IWSA, 1997). Every two years since 1992, this survey has established, in a number of cities in each of the participating IWSA members, the average *public water supply* bill (measured in ECUs) of a given household: two adults and two children, using 200 m^3 of potable water per annum (therefore, an average of 137 lhd), and living in a single family house with certain characteristics, defined in order to specify the charges required by some local utilities (lot size, number of rooms, number of taps, etc. [see Achtienribbe, Homer, Papp and Wiederkehr (1992) for further details]. Note that no account is taken of wastewater charges in these IWSA surveys, unlike the entries in the other three columns in Table 22.

This "cost of 200m^3 per year" series, which excludes VAT and other consumption/sales taxes, may then be related to an indicator of purchasing power in each country. The only such indicator easily available for a broad range of countries is the one used by IWSA itself: GDP *per capita* (in 1996 ECUs). Column 1 of Table 22 therefore divides the average bill for each country (for a household of four) by the GDP *per capita* for the same year, in order to generate a rough indicator of average family public water supply expenditures *in relation to average ability to pay*. Note that the resulting quotients have been multiplied by 100, for ease of interpretation.

Because of the crudeness of *GDP per capita* as a surrogate for "ability-to-pay" (and also because of the scaling factor of 100), the *absolute* magnitude of the resulting series is irrelevant. However, the series is still of some interest, since it provides a rough indicator of *relative* average affordability across the OECD. Table 22 offers a ranking for the calculated (column (1)) statistics, with a fairly clear-cut division of the countries into five groups. *High* values of the indicator suggest higher PWS charges relative to *GDP per capita*, and therefore relatively *low* average affordability (especially ***Hungary***, the ***Czech Republic*** and ***Portugal***). At the other end of the spectrum, low figures imply *high* average affordability (***Italy, Norway, Korea, US***, and ***Iceland***).

Comparison of the column (1) statistics with the current water prices (in $US) derived earlier in Table 13 demonstrates that:

- very low prices in international terms (e.g. ***Hungary, Portugal***, and the ***Czech Republic***) are sometimes associated with water supply charges being very high relative to income (GDP) *per capita*.

- some of the countries with the highest water supply charges in international terms (e.g. ***Denmark, France, England and Wales*** and ***Sweden***) do not necessarily reveal water charges that are high in proportion to income *per capita*.

Table 22. Measures of Overall (Average) Affordability of Water Charges

	PWS charges for an average family of four, relative to GDP and based on IWSA data (1996)	Average water charges as proportion of household incomes (Y) or expenditures (E) (1997/8)	Water charges as proportion of household incomes	
			Existing water tariffs	Full cost recovery
Hungary	3.62	>3%[1] (Y) -		
Portugal	2.25	1.6%(Y)	0.5%	2.8%
Czech Republic	2.17			
Germany*	1.32[2]	1.0%(Y)	1.0%	1.2%
Luxembourg	1.30	1-1.5%(Y) 1.6%(Y)		
Netherlands	1.13			
Austria	1.13	1-1.3%(Y)		
France	1.12		1.1%	1.5%
Belgium	1.09			
England & Wales	1.05	1.3%[3] (Y)	1.2%	1.3%
Canada	1.05			
Spain	1.02	1.0%[4] (Y)	0.4%	1.6%
Finland	0.97			
Switzerland	0.94			
Turkey	(0.87)[5]	1.2-1.7%(Y)		
Australia	0.79			
Denmark	0.68		0.8%	0.9%
Japan	0.60	0.7% (E)		
Sweden	0.59			
Iceland	0.47			
U.S.	0.46	0.8%[6] (Y)		
Norway	0.45			
Italy	0.43			
Korea*	(0.43)[5]	0.6% (E)	0.6%	0.9%
Greece			0.4%	2.1%
Ireland			0.3%	1.9%

In column (1), wastewater charges are excluded; the definition of "water charges" in column (2) varies slightly between countries; in columns (3) and (4), water charges are defined to include the provision of piped water supplies and the collection, treatment, and disposal of wastewater.

(*) Some of the data for columns (3) and (4) for Germany and Korea was supplied by experts from these countries.

Notes:
1. Figure exceeds 3% in many regions in low-income category.
2. Germany does not take part in the IWSA water bill survey. Similar calculations have therefore been undertaken, using the German average PWS charges figure per cubic metre from the Ecologic study (1996-98). Although this figure is calculated in a manner consistent with the IWSA study, it is still considered to be rather high, partly because the data used in the calculation are not strictly comparable.
3. Figures range from 0.9% (Thames Water) to 1.9% (South West Water).
4. Barcelona only (which has relatively high charges within Spain).
5. As calculated by country experts.
6. Figures for individual utilities ranged from 0.3% to 1.7% of median household incomes.

Sources:
Col. (1) is calculated from data in IWSA (1997), following the procedure explained in the text.
Col. (2) derived from country submissions to this study.
Col. (3) from Ecotec (1996), Final Report, Table 5.12*a*, date of "existing" is unknown.
Col. (4) is from Ecotec (1996), Final Report, Table 5.12*b*.

In column (2), the (relatively few) results of enquiries made of all countries for the present study are reported. These percentages apply to *all* water charges, and are reassuringly consistent with the rankings indicated in column (1). Column (3) presents similar statistics collected by Ecotec (1996) for its

recent study of the application of the Polluter Pays Principle in EU Cohesion Fund countries (***Greece, Ireland, Portugal*** and ***Spain***), and from other country submissions to this study. The years to which these data apply are unclear in the Ecotec report, which may explain some of the inconsistencies observed (i.e. for ***Spain*** and ***Portugal***). What is most noticeable, however, are the relatively low figures for the four Cohesion Fund countries.

The data in column (4) — also from the Ecotec (1996) study and from country submissions — have been included in order to show what average water charges estimates would be, as a proportion of average household incomes, if: (i) water services were to be provided for the first time to a "greenfield" site in a hypothetical urban area (with primary and secondary wastewater treatment); and (ii) there were to be full cost recovery of all direct economic costs, both operating and capital. As expected, very large increases in the incidence of water charges for Cohesion Fund countries are indicated, while the more mature water economies would experience only marginal price increases, reflecting the relatively low subsidies presently in effect.

Temporal tariff structures

Introduction

Household water demands are not evenly spread over time. Like agricultural users, households tend to demand more water in hot and dry conditions. Other, non-climatic, factors and habits also drive peaks over shorter time periods: within-the-*day* and, to a limited degree, within-the-*week*. Engineers, economists, and environmentalists all have reason to be interested in such temporal variations, since large costs will be faced by water utilities if supply systems are to be constructed, maintained, and operated at a scale which can satisfy whatever peak flows may ultimately be demanded.

If charging systems could be designed and operated so as to either even out demand patterns or simply price some of the more luxurious peak demands out of existence, then suppliers could reduce the capacity of their systems and so save resources, reduce customer bills, and reduce demands made upon the environment. Analysis to date has been concentrated on peak-hour, peak-day, peak-week, and peak-month demands, as well as on average demands in especially hot and dry years, and over longer dry periods. Over all these time periods, pricing may in principle "compete" with storage as a way of reconciling supplies and demands. Least-cost planning then provides the appropriate intellectual framework in which to establish the most economically and environmentally efficient solutions (more storage, more demand management through extra tariff sophistication, or some combination of these approaches). Alongside these factors, the criteria of equity, technical feasibility, consumer understanding and acceptability, and risk all need to be considered before final decisions on tariff structures are made.

In practice, it has been found that tariff policies may have the most to offer in the temporal dimension in *time-of-day* and *seasonal* pricing. Other peak demands — for example, peak-day and peak-week — tend to be best handled within general volumetric charging or seasonal tariffs, rather than being granted their own extension of temporal tariffication.

Time-of-day tariffs

Time-of-day tariffs smooth regular and irregular diurnal household peaks (normally in the mornings and early evenings), by shifting demands or removing them altogether. However, no permanent operational examples of such tariffs in the household sector have emerged in the course of enquiries undertaken for this study.

In the ***UK***, small-scale site metering trials for 1988–92 (mixing cross-sectional and time-series analytical methods by comparing demands in "trial" and "control" areas over a period of four years) introduced time-of-day tariffs in two areas, but in both cases problems arose in interpreting results (DOE, 1988; DOE, 1990; and DOE,1993).

In the Lee Valley Water Company (Brookmans Park trial), a complex time-of-day tariff for water supply only was designed with a peak rate, occupying three hours in each of the morning and the evening, and augmented by a seasonal factor, so the peak rate was 95 per cent higher than the off-peak rate in summer, and 66 per cent higher in winter. However, the tariff was abandoned after being used for one year (1989-90), in favour of a constant volumetric rate. Together with the fact that recorded water consumption in the control area in the year before the tariff was introduced (1988–89) was abnormally (and unaccountably) low, this meant that no significance could be attached to the results.

The second trial, in Wessex Water Company (Broadstone), compared 358 "affluent suburban properties" in the trial group with 625 similar houses in the control group. Here, the trial was sustained for all three charging years (1989–90 to 1991–92), and the peak rate was defined for a three-hour period each evening throughout the year, the price at this time being 77 per cent higher than that for the rest of the day. This was for water supply only; sewerage and sewage treatment were again charged according to a single volumetric rate, with no temporal variation.

Peak-hour and peak-day demands were found to be significantly affected by metering in the first two years of charging, with peak-hour demands falling in "trial" households by an average of 17 per cent, and peak-day demands by 23 per cent, as compared with what would have been expected in an unmetered situation (calculated by observing what happened in "control" households). However: (i) these percentages may have been influenced by very cold weather (and therefore by "bursts", generating peak demands over which households had no control); and (ii) the apparent peak-day effect is no greater than that reported (on average) for *all* the trial areas, including nine without any time-of-day tariffs. Furthermore, in the third year of charging in Broadstone, daily and hourly peaks actually rose *more* in the trial than in the control area (Water Research Centre, 1994).

Clearly, more searching trials of time-of-day tariffs in a domestic context will be required before any reliable assessments of the demand effects can be made. Once such assessments are available, it would then be necessary to evaluate the extra costs and benefits generated by a time-of-day tariff being grafted onto an already-metered residential community, as compared with no such tariff being added on. The usual concerns of economic and environmental efficiency, equity, consumer acceptability, and risk would then each have to be examined.

Seasonal tariffs

Very few examples of the regular use of seasonal tariffs in OECD countries have been reported. Those applying to the household sector are all from the ***US***. While a 1982 survey of nearly 100 US utilities showed only one example of a seasonal component to a residential public water supply tariff structure, in 1991 a larger survey showed seven utilities out of 121 in that category (5.7 per cent; and the same figures, exactly, for wastewater tariffs). By 1997, the water supply proportion had increased to ten utilities out of 121 (6.6 per cent) with, unaccountably, none revealing seasonal wastewater tariffs (references: 1982 and 1997 — see Table 6, above; 1991 data from Markus (1993)).

These figures suggest some growth in the interest in seasonal tariffs in the 1980s. This may have been prompted by a number of US utility experiences, with seasonal charging over the 1974–78 period only being reported in literature a few years later (1978–82) [these were also summarised in the 1987 OECD study (OECD (1987*a*), Table 7]. During the 1990s, however, there has been no evidence of any further growth in the use of seasonal rates.

The seasonal element in tariff structures is normally characterised by higher volumetric rates during the summer months. In Portland, Maine, however, it is the *fixed* charge that is increased — from $7.61/month in November–March to $120/month in April–October, with no apparent change in the *volumetric* rate (Raftelis Environmental Consulting Group, 1998). This is a huge summer premium; it appears that the part of Portland's utility infrastructure associated with summer demands has been erroneously counted as giving rise to a fixed customer cost, with the result that the incentive to reduce water use in the summer is no greater than that in the winter.

No new analyses of seasonal tariffs have recently been reported, so no update of the earlier OECD discussion of this topic (OECD (1987*a*), pp. 59–62) has been possible. However, three of the small-scale metering trials in ***England and Wales*** previously referred to (DOE, 1993) incorporate seasonal tariffs. In one of these, the results were not reliable enough to be trusted (Brookman's Park), but in the other two, seasonal charging continued for the full three years of the "charging" part of the trial period. These were based in the Southern Water Company (at Chandler's Ford, where 602 trial homes were compared with 280 control properties), and in East Worcestershire Water (1 100 trial and 600 control houses).

In both cases, a small annual fixed charge was imposed, together with: (i) (in *winter*) a low volumetric rate applying to all consumption; and (ii) (in *summer*) the same low rate applying to the *base* load (defined as being equal to the previous winter's consumption) plus a summer premium rate applied to all consumption in excess of the base load. In both trials, the summer premium tariff was fixed at just over 60 per cent in excess of the base tariff. In Table 23, the estimated average effects of domestic metering on summer and winter demands are separately distinguished for: (i) the two trials of seasonal tariffs described above; (ii) the seven of the other nine trials in England and Wales for which a summer/winter distinction could be made. It is seen that the impact of metering in summer is significantly more marked in those trials which included summer premium rates (Water Research Centre, 1994).

Table 23. Estimated Average Metering Effects by Season in UK Metering Trials

	6 summer months	6 winter months
Two seasonal tariff trials	-21.1%	-7.5%
Seven non-seasonal tariff trials	-10.5%	-6.4%
All nine trials areas	-12.9%	-6.6%

Also in England and Wales, two of the smaller water companies have recently introduced seasonal elements into their *industrial* tariffs. For 1998, Bournemouth and West Hampshire Water announced summer volumetric rates (for June, July and August) that are 42 per cent, 59 per cent and 94 per cent higher than those in effect for the other nine months of the year for customers in three different size groupings in the company's "large user" tariff system. Tendring Hundred has also fixed summer tariffs for the same three months at 44 per cent above those for the rest of the year, for *all* its industrial consumers (Office of Water Services, 1998). Both companies are believed to be considering the extension of seasonal tariffs to the residential sector over the next few years.

Automatic meter reading technology

Central to the economics of the decision whether or not to extend metering to include temporal tariffs are: (i) the capital and operating costs of the extra metering equipment required; and (ii) an evaluation of the extra demand savings generated. Only (i) is considered here, since (ii) is typically covered in any routine cost-benefit analyses.

The main temporal tariff requirements are: (i) multi-rate tariff units (MTUs), which accumulate consumption totals for different time periods (e.g. specified peak and non-peak hours each day, weekends, and weekdays) and perhaps (ii) more frequent reading of orthodox meters. Time-of-day tariffs require (i) and possibly (ii), but seasonal tariffs only need the latter (if reading frequency has to be increased to record the seasonal variation).

MTUs are well-established and are not discussed further here, but meter-reading technology is developing fast. Traditional "notebook" manual reading is now commonly being replaced with hand-held data loggers, which record readings by eye. Beyond that, the simplest form of automatic meter reading (AMR) has the meter reader using a hand-held electronic probe to pick up the reading from a touchpad — either part of, or wired to, a water meter. The use of *remote* reading devices is rare, however. These devices use radio signals in which readings are transmitted and then retrieved either by vehicles driving by metered properties ("drive-by" technology, claimed to be operational at speeds of up to 80 km/hour), or at fixed remote billing centres, usually via a mast on a high building with radio signal ranges in urban centres of up to 500 metres (McCann, 1998).

In January 1998, 32 000 meters in ***Spain*** (Barcelona), 350 in the ***UK*** (Anglican Water Company), 5 000 in ***Canada*** (Fredericton NB and Moncton NB) and 145 000 in 25 ***US*** utilities were recorded as being involved in AMR trials and installations (AMRA, 1998). A further 1.6 million meters were planned to be included in those 29 locations in future years.

Trials and installations of AMR with multi-tariff units have not yet been reported, so it may be presumed that the benefits of AMR in facilitating temporal tariffs will first become apparent with seasonal tariffs. Time-of-day tariffs in a residential setting would therefore not be expected to become viable in economic terms for some considerable time yet. More generally, because of the rapid development of AMR technology, there is a lack of consensus concerning the economic viability of its less simple forms. Thus, some water companies in ***England and Wales*** believe that the economic case for drive-by technology or billing-centre remote reading cannot yet be made, because of the very high capital and operating costs of the sophisticated equipment required. Other companies are currently experimenting with walk-by meter reading on a large scale, with the stated aim of moving on to automatic reading by a remote centre (McCann, *ibid).*

Conclusions

Most OECD countries are making progress domestic water pricing systems that better reflect the marginal social costs of service provision, and encouraging economic efficiency and more sustainable use of water resources. A number of innovative policies for addressing social equity issues in water pricing have also been developed in recent years. Thus, there seems to be a general movement away from the pricing of water services solely to generate revenues, and towards the use of tariffs to achieve a wider range of economic, environmental, and social objectives. Awareness also seems to be growing about which particular elements of water price structures (connection charges, volumetric and fixed charges, etc.) can be used to best achieve particular policy objectives. However, the specific paths taken by individual countries toward these goals differ, largely as a result of differences in their prevailing water supply situations, and in their cultural and political contexts. Despite these variations, some general trends can be identified.

Institutional context

Public water supply/disposal institutions have been undergoing significant reforms over the period covered by this study. In many situations, there has been a shift in the role of governments, away from being the "provider", and toward being the "regulator" of water services. This has also often been accompanied by an increased role for the private sector, but most countries have so far opted for the "concession" model (where the private sector participates in managing some services, but the public sector retains ownership control over the system). Complete private sector ownership of water supply systems is not widely encountered, and may not be desirable in many situations because of the natural monopoly characteristics of water services.

Price structures

Given the widely differing demands on water supply/disposal systems, and the different institutional and cultural frameworks within which pricing policies have to operate, it is not surprising that there continues to be considerable variation in pricing structures across the OECD. The range of household water charging structures in place in Member countries extends from increasing-block structures, to various other forms of volumetric system, to predominantly flat-fee tariff structures, and even to the recovery of water service costs via the general taxation system.

Overall, there has been a general movement in many countries away from decreasing-block and flat-fee pricing structures for the domestic sector, and towards either uniform volumetric or increasing-block tariff systems. Most countries also now use two-part tariffs (i.e. with fixed and volumetric components), with the volumetric portion making up at least 75 per cent of the total water bill. These shifts will eventually lead to the better reflection of marginal costs in water prices, and thus, towards better incentives for water conservation.

Policies aimed at improving the affordability of water services are also increasingly better-targeted to the groups most in need. Thus, rather than applying across-the-board subsidies to water consumption, or large free initial water consumption allowances, a number of countries have developed innovative tariff structures offering separate tariffs to specific low-income consumer groups.

As the real costs of water provision and disposal rise, the cost-benefit balance of the possible metering of individual households (even apartments) moves towards increased metering, on both economic and environmental grounds. In addition, the metering of individual household water

consumption may also be desirable on equity grounds, as it allows for volumetric charging which reflects the costs of the water actually consumed by each household. Thus, there have been continued increases in the penetration of water metering in OECD countries over the last decade, with nearly two-thirds of Member countries now metering over 90 per cent of single-family households. Several countries are also expanding their metering of individual apartments.

Price levels

Water supply and sewage disposal prices have generally increased in OECD countries over the last decade, and significantly so in a few countries. Of the 18 countries for which enough data was available for this study, all but one exhibited real per annum increases in household water prices in recent years, and six actually experienced average rates of real price increase of 6 per cent or more per annum.

There has also been increased attention to charging for wastewater disposal on the basis of the treatment costs actually faced by service providers. In addition to general increases in sewerage and sewage disposal charges, some countries are also shifting towards recovering wastewater charges through volumetric charging, and separately from water supply.

OECD countries exhibit a wide range of practices concerning the application of water taxes and charges. VAT is the most common tax applied, with rates sometimes exceeding 20 per cent. Abstraction charges are levied on households in at least eleven OECD countries, and are under discussion in one other, while pollution charges are in place in seven countries, and under discussion in a few others. An assortment of other taxes and charges — some with specific environmental purposes — are also levied on household water services.

Full cost recovery and subsidies

There is a growing acceptance of the need for "full cost recovery" in the provision of household water services. Most OECD countries have already adopted (or are in the process of adopting) "full cost recovery" as an operating principle in the management of their public water supply systems. However, definitions of exactly which costs should be included under this principle of "full cost recovery" vary.

The spread of full cost recovery principles has been accompanied by significant reductions in total subsidies, and in cross-subsidies between user groups. Even where subsidies still exist, there is now much more emphasis on the need to make these subsidies transparent, and to better-target them to their intended purposes. The reduction of subsidies to the users of water services not only enhances cost recovery objectives, but is also likely to lead to a higher quality and stability of service over the long-term.

Multiple objectives

The above-noted trends reflect a growing tendency to seek to simultaneously incorporate economic, environmental and social objectives in water pricing practices. For example, the increasingly common use of volumetric pricing structures can improve *economic efficiency*, through the better reflection of marginal costs in water prices. It can also encourage *water conservation*, through the levying of a positive cost on each unit of water used, and it can enhance *equity* goals through charging each consumer according to their actual consumption level. Similarly, reducing subsidies and increasing water prices can lead to financial stability for the water services provider, as well as encouraging water conservation among consumers. The use of increasing-block volumetric tariffs can also promote conservation objectives, while contributing to the affordability of basic water services for low-income households.

Data collection and transparency

Although considerable information on water price levels and structures in OECD Member countries was assembled for this study, in many cases, comparable data was not always available. As a result, it is difficult to establish clear trends or current practices within individual countries, or across the OECD as a whole. Such information can inform the design of better-targeted water pricing policies. Member countries and the OECD could both help to overcome some of these data deficiencies, as well as increasing the transparency of their water pricing practices more generally, by:

- periodically reviewing household water tariff structures, taxes and charges, and price levels charged in Member countries;

- monitoring on a regular basis any specific price-related initiatives taken by Member countries in the pursuit of water resource conservation and/or social equity/affordability goals;

- regularly consolidating available data on household access to piped water supplies, sewage and sewerage treatment, and water consumption levels in Member countries; and

- undertaking periodic reviews of households demand responses to changes in water pricing levels and different tariff structures.

REFERENCES

ACHTTIENRIBBE, G., V. HOMER, E. PAPP AND W. WIEDERKEHR (1992). "International Comparison of Drinking Water Prices". *Aqua.* Vol. 41, no. 6, pp. 360-363.

AKYAR, H. (1998). *Personal communication*. September.

AMRA (AUTOMATIC METER READING ASSOCIATION) (1998). *Trials and Installations '98 Report.* Northbrook, Illinois.

ANON (1992). "Canadian Water Utility Makes Successful Switch to Metering". *Water Engineering and Management.* Vol. 139, March, pp. 20-26.

ANON (1993). "Water Meters at Work: System-Wide Metering Helps Solve Shortage Problems". *Water Engineering and Management.* Vol. 140, no. 6, pp. 31.

BARRAQUE, B. AND S. CAMBON (1997). "Appendix B: France". In: *Water Research Centre* (1997). *Op. cit.*

BEECHER, J.A. (1994). "Water Affordability and Alternatives to Service Disconnection". *Journal of the American Water Works Association.* Vol. 86, no. 10, pp. 61-65.

BEECHER, J.A. AND P.C. MANN (1997). "Real Water Rates on the Rise." *Public Utilities Fortnightly.* Volume 135, no. 14, pp. 42-46.

CAMBON-GRAU, S. AND B. BARRAQUÉ (1996). "Comparing Water Prices in Europe — France". In ECOLOGIC (1996-98). *Op. cit.*

BARRETT, A., J. LAWLOR AND S. SCOTT (1997). *The Fiscal System and the Polluter Pays Principle*. Ashgate: Avebury, Aldershot, Hampshire.

CAMBON-GRAU, S. AND J-M. BERLAND (1998). "Sewerage Charges in France". In ECOLOGIC (1997-98). *Op. cit.*

CHICOINE, D.L., S.C. DELLER AND G. RAMAMURTHY (1986), "Water Demand Estimation Under Block Rate Pricing: A Simultaneous Equation Approach". *Water Resources Research.* Vol. 22, no. 6, 859-863.

CHICOINE, D.L. AND G. RAMAMURTHY (1986). "Evidence on the Specification of Price in the Study of Domestic Water demand". *Land Economics.* Vol. 62, no. 1, 26-32.

CONSO 2000 (1996). *EAU: Résultats de l'enquête.* CONSO 2000. Mimeo.

COPENHAGEN WATER SUPPLY (1998). *Personal communication from Svend Madsen*. May.

CRITELLI, A. (1998). Elasticity Estimate Calculated From Equations Contained in *Personal communication* from A. Massarutto, Universita di Udine. May.

DEPARTMENT OF THE ENVIRONMENT (1996). *The Financing of Local Government in Ireland,* Department opf the Environment: Dublin.

DIETZ, C. AND J. RANTON (1995). "Targetted Programming for Low-income Households". Paper 10C-3, presented to *Conser 96 Conference*. American Water Works Association: Denver.

DOE (DEPARTMENT OF THE ENVIRONMENT) (1988). *National Metering Trials. Interim Report No. 1,* Department of the Environment: London.

DOE (DEPARTMENT OF THE ENVIRONMENT) (1990). *National Metering Trials. Second Interim Report*, Department of the Environment: London.

DOE (DEPARTMENT OF THE ENVIRONMENT) (1993). *Water Metering Trials: Final Report.* Department of the Environment: London.

DUKE, E.M. AND A.C. MONTOYA (1993). "Trends in Water Pricing: Results of Ernst & Young's National Rate Surveys". *Journal of the American Water Works Association.* Vol. 85, no. 5, 55–61.

ECOLOGIC (1996–98). *Country Case Studies on Water Pricing and English Summary.* Report prepared for UFOPLAN Research Plan 102/04/427, on contract to the German Federal Environment Agency: Berlin. Various mimeo reports.

ECOLOGIC (1997–98). *Country Case Studies on Sewerage Pricing.* Report prepared on contract to the German Federal Environment Agency: Berlin. Various mimeo reports.

ECOTEC (1996). *The Application of the Polluter Pays Principle in Cohesion Fund Countries (Annexes 1 to 4).* Ecotec Research and Consulting Limited: Birmingham and Brussels.

EDWARDS, K. (1996). "The Role of Leakage Control and Metering in Effective Demand Management". Paper delivered at *Water '96: Investing in the Future* conference, London.

ENVIRONMENT AGENCY (1996). *Water Conservation Planning: USA Case Studies Project Final Report,* Amy Vickers & Associates, Inc: Boston.

EUROSTAT (1997). *Water Prices in the 15 Member States of the EU -- Pilot Study of Luxembourg.* Joint Eurostat/EFTA Sub-Group on Water Statistics. Statistical Office of the European Communities.

FEDERICO, K. (1990). "Experience in Mandating Water Conservation Pricing in Palm Beach County". In BLOOME, M.W. (ED.). *Rate Structures to Promote Conservation: Conference Proceedings,* Delaware River Basin Commission and New York City Water Board.

FOX, T.P. (1995). "Analysis, Design and Implementation of a Conservation Rate Structure". Paper 2F-1 delivered at *Conserve '96* Conference, American Water Works Association: Denver.

HANSEN, L.G. (1996). "Water and Energy Price Impacts on Residential Water Demand in Copenhagen". *Land Economics*. Vol. 72, no. 1, 66-79.

HERRINGTON, P.R. (1994). "The Economics of Water Conservation, Metering and Tariffs". Financial Times European Water Conference, March 1994: London.

HERRINGTON, P.R. (1997*a*). "Pricing Water Properly". In T. O'RIORDAN (1997). *Ecotaxation.* Earthscan: London.

HERRINGTON, P.R. (1997*b*). "Long-Run Marginal Cost Estimates in the Public Water Supply in England and Wales". Appendix C in HILLS, B., M. HUBY AND P. KENWAY: *Fair and Sustainable: Paying for Water.* New Policy Institute: London.

HOGLUND, L. (1997). "Estimation of Household Demand for Water in Sweden and its Implications for a Potential Tax on Water Use". *Studies in Environmental Economics and Development.* 1997:12. Department of Economics, Gothenburg University: Gothenburg.

IWSA (INTERNATIONAL WATER SUPPLY ASSOCIATION) (1988). International Water Statistics. IWSA: Zurich.

IWSA (INTERNATIONAL WATER SUPPLY ASSOCIATION) (1997). International Statistics for Water Supply. IWSA: Vienna.

KAY, S. (1998). *Personal Communication.* 20 February.

KIM, T.Y. (1998). "Water Pricing Policy for the Optimal Management of Water Resources" (in Korean).

KRAEMER, R.A. AND H. NOWELL-SMITH (1997). "Appendix C: Germany". In: *Water Research Centre* (1997). *Op. cit.*

KRAGH, P. (1998). "Sewerage Charges and the Cost of Sewerage Services in Denmark". In ECOLOGIC (1997-98). *Op. cit.*

LAW, G.R. (1986). "Water Use in Urban Auckland, New Zealand". Paper presented at the National Workshop on Urban Water Management: Perth, Western Australia.

LIPPIATT, B.C. AND S.F. WEBER (1982). "Water Rates and Residential Water Conservation". *Journal of the American Water Works Association.* Vol. 74, no.6.

MAESTU, J. (UNDATED). "Water Prices in Spain". In ECOLOGIC (1997-98). *Op. cit.*

MARKUS, E. (1993). *Personal communication.* 3 February. Ernst & Young: New York.

MASSARUTTO, A. AND L. MESSORI (1998). "Sewerage Charges in Italy". In ECOLOGIC (1997-98). *Op. cit.*

MAYOR'S BLUE RIBBON COMMITTEE ON WATER RATES (1992). *City of Los Angeles — Proposed Water Rates*. Mayor's Blue Ribbon Committee: Los Angeles.

McCANN, B. (1998). "Metering on the Move". *Water*, No. 7, 22 May, 10-11.

MID-KENT (1997). Meter Pilot Project Report 1. Mid-Kent Water PLC: Snodland, UK.

MINISTERE DE L'ECONOMIE ET DES FINANCES (1996). *Enquete sur le prix de l'eau 1991-1996.* Service Public 2000: Paris.

NAUGES, C. AND A. THOMAS (1998). "Efficient Estimation of Residential Water Demand with Panel Data". Paper presented at EAERE annual meeting, Venice, June. Universite des Sciences Sociales de Toulouse: Toulouse.

NIESWIADOMY, M.L. AND D.J. MOLINA (1989). "Comparing Residential Water Demand Estimates Under Decreasing and Increasing Block Rates Using Household Data". *Land Economics*. Vol. 65, No. 3, 281-289.

NIJS, R. (1998). *Personal Communication.* Vlaamse Mantschappij Voor Watervoorziening.

OECD (1987*a*). *Pricing of Water Services*. OECD: Paris.

OECD (1987*b). Improved Water Demand Management: State of the Art Report.* Document ENV/NRM/87.2/REV1. OECD: Paris.

OECD (1997*a*). *OECD Environmental Data Compendium 1997.* OECD: Paris.

OECD (1997*b*). *Water Subsidies and the Environment.* Document OCDE/GD(97)220. OECD: Paris.

OECD (1998). *Water Management: Performance and Challenges in OECD Countries.* OECD: Paris.

OECD (1999*a). Industrial Water Pricing in OECD Countries.* OECD: Paris.

OECD (1999*b*). *Agricultural Water Pricing in OECD Countries.* OECD: Paris.

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

OFFICE OF WATER SERVICES (1998). *1998-99 Report on Tariff Structure and Charges.* Office of Water Services: Birmingham.

PEZZEY, J.C.V. AND G.A. MILL (1998). *A Review of Tariffs for Public Water Supply*. A Report to the Environment Agency, National Water Demand Management Centre: Worthing, West Sussex.

POINT, P. (1993). "Partage de la ressource en eau et demande d'alimentation en eau potable". *Revue Economique*, 4, 849-862.

RAFTELIS, G.A. (1989). *The Arthur Young Guide to Water and Wastewater Finance and Pricing.* Lewis Publishers: Chelsea, Michigan.

RAFTELIS ENVIRONMENTAL CONSULTING GROUP, INC. (1998). *Water and Wastewater Rate Survey*. Raftelis Environmental Consulting Group, Inc.: Charlotte, North Carolina.

RAKOSI, J. (1998). *Personal communication*. May. OKO Rt., Hungary.

RENWICK, M. AND S. ARCHIBALD (1997). "Demand-Side Management Policies for Residential Water Use: Who Bears the Conservation Burden". University of Minnesota.

ROBERTS, M. (1998). *Personal communication*. May. Sydney Water Corporation

ROSEBERG, P. (1994). *Water and Wastewater International*. February.

SANCLEMENTE, C. (1998). *Personal communication.* 20 May.

SANCLEMENTE (Undated). *Influence of Metering on Water Consumption.*

SCHEFTER, J.E. AND E.L. DAVID (1985). "Estimating Residential Water Demand Under Multi-Part Tariffs Using Aggregate Data". *Land Economics*. Vol. 61, no. 3, 272-280.

STEVENS, T.H., J. MILLER AND C. WILLIS (1992). "Effect of Price Structure on Residential Water Demand". *Water Resources Bulletin*. Vol. 28, no. 4, 681-685.

SWARCENSZTAJN, J., DGRNE BELGIUM (1998). *Personal communication.*

SYDNEY WATER (1998). *Submission to the Independent Pricing and Regulatory Tribunal of New South Wales Review of 1996 Medium Term Price Path Determination for Sydney Water Corporation.* Sydney Water Corporation: Sydney.

VLAAMSE MILIEUMAATSCHAPPIJ (FLEMISH ENVIRONMENT AGENCY) (1998). *International Milieubeleid:* Erembodegem.

WARNER, R. (1995). *Water Pricing and the Marginal Cost of Water*. Sydney Water Corporation: Sydney.

WATER RESEARCH CENTRE (1994). *The Effects of Metered Charging on Customer Demand for Water from 1 April 1989 to 31 March 1993*. Report UC 2072. Water Research Centre: Swindon.

WATER RESEARCH CENTRE (1997*). International Comparison of the Demand for Water*. Office of Water Services: Birmingham.

WELSH, C. (1991). "A Contingent Valuation Study of Consumers' Willingness to Pay for Water: An Approach to Conserving Christchurch's Groundwater Resource". Thesis submitted for M.Sc. degree, Lincoln University.

OTHER PUBLISHED DATA SOURCES

ASOCIACÍON ESPAÑOLA DE ABASTECIMIENTOS DE AGUA Y SANEAMIENTO (1996). *Suministo de Agua Potable y Saneamiento en Espana, IV Encuesta Nacional de Abastecimiento, Saneamiento y Depuracion, 1994.* Madrid.

GLOWNY URZAD STATYSTYCZNY (CENTRAL STATISTICAL OFFICE) (VARIOUS YEARS). *Rocznik Statystyczny (Statistical Yearbook for Poland).* Warsaw.

JAPAN LAND AGENCY (1998). *Water Resources of Japan.*

JAPAN MINISTRIES OF HEALTH AND WELFARE, AGRICULTURE, FORESTRY AND FISHERIES AND CONSTRUCTION (1998). *Outlines of Sewage Treatment Facilities.*

JAPAN WATER WORKS ASSOCIATION (1990-97). *Water Supply Manuals.*

JAPAN WATER WORKS ASSOCIATION (1996). *Water Statistics Manual.*

JAPAN WATER WORKS ASSOCIATION (1998). *General Aspects of Water Supply (Revised).*

JAPAN WATER WORKS ASSOCIATION (1998). *Survey on Water Tariff.*

JAPAN WATER WORKS ASSOCIATION (1998). *Water Utilities Data Book for the World.* Tokyo.

OFFICE OF WATER SERVICES (1998). *1998-99 Report on Tariff Structure and Charges*. Birmingham.

VERENIGING VAN EXPLOITANTEN VAN WATERLEIDINGBEDRIJVEN IN NEDERLAND (VEWIN) (1997). *Waterleidingstatistiek 1996*. Rijswijk.

VESI JA VIEMARILAITOSYHDISTYS (Finnish Water and Waste Water Works Association) (1998). *VV-Maksut 1.2.98 Jasenlaitokset* . Helsinki.

WATER SERVICES ASSOCIATION (1997). *Waterfacts '97.* London.

WATER SERVICES ASSOCIATION OF AUSTRALIA (1998). *The Australian Urban Water Industry: WSAA Facts '97*. Melbourne.

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