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

17-Jun-2002

English text only

ENVIRONMENT DIRECTORATE
ENVIRONMENT POLICY COMMITTEE

ENV/EPOC/WPNEP(2001)15/FINAL
Unclassified

Working Party on National Environmental Policy

SECTOR CASE STUDIES SERIES

HOUSEHOLD ENERGY & WATER CONSUMPTION AND WASTE GENERATION: TRENDS, ENVIRONMENTAL IMPACTS AND POLICY RESPONSES

For more information, please contact Adriana Zacarias Farah, Environment Directorate, National Policies Division, tel. +33 (0) 1 45 24 13 80, fax. +33 (0) 1 45 24 78 76,
e-mail adriana.farah@oecd.org

JT00128448

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FOREWORD

This document is the OECD Secretariat's summary report for the sector case study on Household Energy and Water Consumption and Waste Generation. It is part of the sector case studies series of the OECD 1999-2001 OECD Programme of Work on Sustainable Consumption. The report traces household energy and water consumption and waste generation trends and related environmental impacts in OECD countries, and particularly in Germany, Mexico and the Netherlands. It identifies the driving forces behind household consumption patterns, and analyses some policy responses for reducing environmental impacts that have been implemented in some OECD countries. The report concludes with some policy recommendations for promoting sustainable household consumption.

The OECD Secretariat expresses its thanks and appreciation to the Mireya Vilar Compte, Valeria Guarneros, Kristina Jannerbo and Mariela Ibañez (Instituto Tecnológico Autonómo de México - ITAM); to Sylvia Lorek, Joachim Spangenberg and Sandra Striewski (Sustainable Europe Research Institute - SERI), and to Aad Correljé, Judith E.M. Klostermann and Stephan Slingerland (Erasmus Center for Sustainable Development & Management), and to Elaine Geyer-Allely. This Synthesis Report has been prepared by Adriana Zacarías Farah. The report was submitted to the Working Party on National Environmental Policy (WPNEP). It is published under the responsibility of the Secretary-General of the OECD.

The OECD Programme on Sustainable Consumption

The OECD 1999-2001 Work Programme on Sustainable Consumption provided new data and analysis to help OECD Member countries reduce the environmental impacts from household consumption patterns. The Programme combined empirical studies of consumption trends in OECD Member countries with conceptual and policy analysis. Programme elements included: development of an economic conceptual framework to set out boundaries of analysis and policy to influence household decisions; sector case studies documenting trends, environmental impacts, and policy options in five key areas of household decision-making; policy case studies to deepen analysis of policy instruments that influence household consumption of final goods and services; and refinement of a body of indicators to assess progress towards more sustainable consumption patterns. The results of these 8 elements of work are published separately and drawn together in a Synthesis Report (see below). For more information contact the OECD Environment Directorate: www.oecd.org/env/consumption.

OECD Environment Directorate 1999-2001 Programme on Sustainable Consumption **PUBLICATIONS AND UNCLASSIFIED DOCUMENTS**	
Towards Sustainable Household Consumption? Trends and Policies in OECD Countries ***Synthesis Report of the 1999-2001 Programme on Sustainable Consumption***	OECD 2002
Conceptual Analysis *Towards Sustainable Consumption: An Economic Conceptual Framework*	 ENV/EPOC/WPNEP(2001)12/FINAL
Sector Case Studies *Household Food Consumption: Trends, Environmental Impacts and Policy Responses* *Household Tourism Travel: Trends, Environmental Impacts and Policy Responses* *Household Energy and Water Consumption and Waste Generation: Trends, Environmental Impacts and Policy Responses*	 ENV/EPOC/WPNEP(2001)13/FINAL ENV/EPOC/WPNEP(2001)14/FINAL ENV/EPOC/WPNEP(2001)15/FINAL
Policy Case Studies *Information and Consumer Decision-making for Sustainable Consumption* *Participatory Decision-making for Sustainable Consumption* *Policies to Promote Sustainable Consumption: An Overview*	 ENV/EPOC/WPNEP(2001)16/FINAL ENV/EPOC/WPNEP(2001)17/FINAL ENV/EPOC/WPNEP(2001)18/FINAL

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EXECUTIVE SUMMARY

Household energy use, water consumption and waste generation are three areas of household activity that are particularly important for the environment. This *Sector Case Study on Household Energy and Water Consumption and Waste Generation* analyses the consumption patterns, trends in these areas and their related environmental impacts in OECD countries in general, and particularly in Germany, Mexico and the Netherlands. The Report also identifies and analyses some policies that have been implemented in some countries to promote sustainable consumption patterns.

Although environmental pressures of individual households are sometimes minor compared to environmental impacts from the industrial and public sectors, the combined impact of many households is an important contributor to a number of environmental problems, including air and water pollution, energy consumption and waste generation. Moreover, in areas like household energy use and waste generation, material and energy efficiency gains have been outweighed by the absolute increase in the volume of goods and services that are consumed and discarded. These consumption trends are projected to continue to grow to 2020 and with them environmental pressure and degradation (*e.g.* air pollution, GHG emission, waste generation, water depletion, etc.).

This study analyses the driving forces shaping energy and water consumption and waste generation patterns. There are several key driving forces behind consumption, including, for example, economic growth and growing per capita disposable income, lifestyles, demographic trends and cultural values. Combined with other influences on consumption patterns, such as existing technology and infrastructure, the policy framework in place, available products, environmental awareness and information, all these driving forces help determine the environmental intensity of consumption patterns. Understanding the drivers behind consumption provides new insight for the design and implementation of more effective policies for sustainable consumption. It also helps to determine the relative emphasis that should be given to different types of instruments (economic, regulatory or social).

To analyse consumption patterns, the report uses *the system of provision framework*, analysing consumption as an active process, with actors seeking certain lifestyles, and constructing their identity by selective consumption and practices. Within this framework, consumers are defined as *co-actors* who interact, shape and are shaped by the way in which systems of production are designed. In this light, it becomes clear that by the way governments design and transform energy, water and waste systems can either enable or obstruct household behaviour towards sustainable consumption.

The analyses of household energy consumption shows that residential energy demand continues to grow, although at a slower rate than in the past and despite efficiency gains for many household energy end uses. The environmental impacts of increased household energy consumption will depend on future approaches to residential and space heating and energy efficiency improvements achieved via building standards, product modification as well as on changes in household behaviour. The main drivers behind household energy consumption trends are economic growth, more space heating per capita, and the increasing ownership of electronic appliances. Some policies to promote sustainable consumption have been implemented such as taxes, energy efficiency schemes (standards, labels, information and savings), and some incentives to promote the production and demand of renewable energy.

In the area of household water consumption, the main driving forces of water consumption are economic and demographic growth, as well as changes in lifestyles that are more water intense. On the other hand, technological innovations (water efficient appliances and devices) and responsible household water use patterns have helped to reduce water consumption. Some governments have design a policy package with a mix of policy instruments to move towards sustainable water consumption (*e.g.* water pricing and metering, stricter environmental regulation, taxes, diffusion of technology, information and environmental education), some OECD countries have succeeded in de-coupling economic growth from water consumption. However, in other countries water subsidies are still one of the main obstacles for the efficient and sustainable use and management of water.

Household waste is a priority area of concern; the generation of household waste is growing and is projected to increase further to 2020. Waste represents an inefficient use of both material and energy resources. It is also a source of pollution and land degradation when treated inappropriately. The main drivers of household waste generation are economic growth and consumption patterns. To date, it has not been possible to de-couple waste generation from economic growth. On the other hand, waste management has improved significantly in OECD countries (recycling rates have grown rapidly). Major efforts are needed, however, especially in preventing the generation of waste, a task that implies changes in production patterns, distribution systems, and consumption patterns.

The study concludes with policy recommendations on integrated policy approaches to reduce environmental impacts from household consumption, looking at the whole system of provision of goods and services and not only at consumption patterns. There are many policy options to influence consumption patterns underlining the importance of applying combinations of instruments to reflect the fact that different driving forces act simultaneously on consumer decisions. The analysis suggests that government policies to promote sustainable household consumption need to be well-targeted to the different economic actor, and require as well a multi-stakeholder approach. In many cases, this implies a combination of instruments. For example in the case of waste management an integrated policy will require relevant changes on both the production and consumption side. On the production side, incentives to reduce packaging and make available “green products” (less packaging, biodegradable or refillable) are needed. Integrated product policy (IPP) and extended producer responsibility (EPR) schemes as well as eco-design, de-materialisation and industrial initiatives to move from products to services are all positive developments in this direction. Using well targeted economic instruments (deposit-return schemes and applying taxes on disposable products) will also be important. On the consumer side it is also important to provide the required infrastructure for recycling schemes, information and environmental awareness, as well as to support and improve voluntary initiatives.

Governments could play a more active role in facilitating household action than they currently do. In particular, governments will need to clarify objectives for household action, and provide consumers with a consistent set of signals (prices and information); use packages of instruments to address different influences on consumption; ensure integrated, cross-sector policies, use complementary measures where some policies are likely to have unaccepted environmental impacts (land-use, infrastructure, etc.); use an integrated approach that addresses environmental impacts throughout the lifecycle of products or services and, promote and support voluntary initiatives by private sector and civic organisations. These policies will enable households to move towards sustainable lifestyles.

CHAPTER ONE. INTRODUCTION

Households affect the environment through both their day-to-day decisions on what goods and services to buy and the use they make of them, and their decisions on what kind of dwelling to have, whether to recycle their waste, and how much energy and water to consume. Although the environmental pressures of individual households are sometimes minor compared to environmental impacts from the industrial and public sectors, the combined impact of many households is an important contributor to a number of environmental problems, including air and water pollution, energy consumption and waste generation. Moreover, in areas like household energy use and waste generation, material and energy efficiency gains have been outweighed by the absolute increase in the volume of goods and services that are consumed and discarded. These consumption trends are projected to continue to grow to 2020 and with them environmental pressure and degradation (OECD, 2001*a*).

Household energy use, water consumption and waste generation are three areas of household activity that are particularly important for the environment. The OECD *Sector Case Study on Household Energy and Water Consumption and Waste Generation* analyses the trends in these areas and their related environmental impacts in OECD countries in general, and particularly in Germany, Mexico and the Netherlands. The Report's main objectives are to:

- document trends on energy and water consumption and waste generation patterns at the household level in OECD countries and particularly in Germany, Mexico and the Netherlands.
- discuss the impacts of these consumption patterns on the environment (energy and water consumption, material flows, water quality), using indicators for evaluating those impacts.
- describe the driving forces shaping energy and water consumption and waste generation patterns, and
- identify and suggest integrated policy approaches to reduce environmental impacts from household consumption.

Methodology and Framework

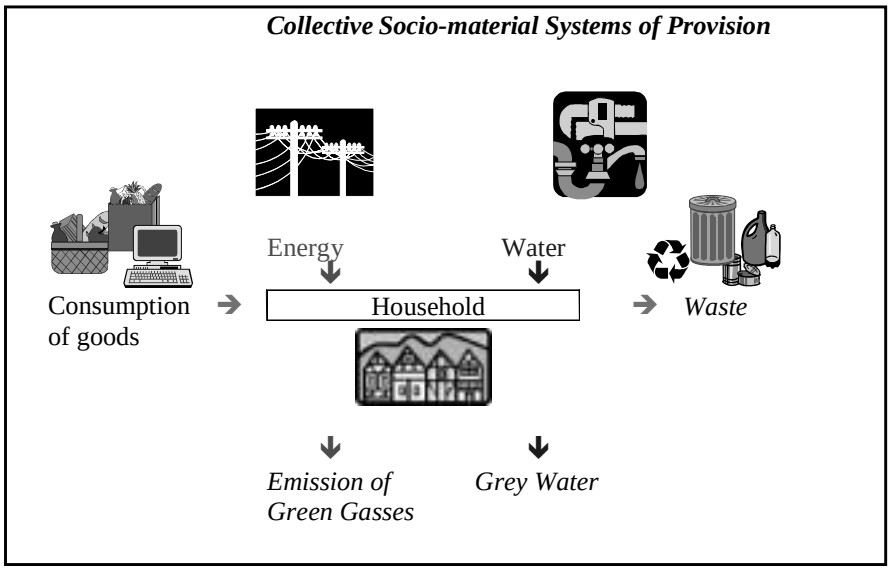
The OECD Secretariat conducted in-house research and data collection on general OECD trends. This was complemented by three national studies on household consumption patterns in Germany, Mexico, and the Netherlands. These studies allow a comparison of consumption in different geographical locations and different levels of economic development, which may help to understand different levels of energy and water consumption and waste generation. The national case studies were developed following a common set of research questions (see Annex 1).

To analyse the key forces shaping consumption patterns, the report uses the system of provision framework. The systems of provision approach analyses consumption as an active process, with actors seeking certain lifestyles, and constructing their identity by selective consumption and practices. The "systems of provision" is defined as the chain that unites particular systems of production with particular systems of consumption, focusing on the dynamics of the different actors (producers, distributors, retailers as well as consumers). In this manner, consumers are defined as *co-actors* who interact, shape and are shaped by the way in which systems of production are designed (Spaargaren and van Vliet, 1999). In this light, it becomes clear that by the way governments design and transform energy, water and waste systems can either enable or obstruct household behaviour towards sustainable consumption (Figure 1).

The *systems of provision* framework for understanding consumption patterns stresses the importance of exploring the mechanisms that shape everyday practices related to commodities and services

and the extent to which they can be seen to support or impede sustainable consumption behaviour. In this light, household consumption is not just the sum of individual behavioural patterns, each consciously motivated and evaluated by the actor. Instead, household consumption is a whole set of behavioural practices that are common to other households (*e.g.* bathing, washing, food-preparing, gardening). They are social practices carried out by applying sets of rules and shared norms. They are also connected to production and distribution systems (technological and infrastructure network) that enable certain lifestyles and that connect consumers to one another (Chappells, *et al*., 2000).

Figure 1



Consumers' beliefs, norms and values regarding (environmentally friendly) action are therefore not assumed to exist in a social vacuum but in a context. The (relative) power of the actor to change the course of actions is specific for a certain context too, depending on the resources that are implied in the reproduction of social practices (Spaargaren and Van Vliet, 2000). In other words, domestic consumption cannot be treated in isolation from the sphere of industrial production, systems of provision and waste management systems.

Water and energy consumption and waste management (recycling, collection) can be viewed within the context of social practices of households rather than as separate and individual behaviour. This has important implications for policies to influence household consumption. For instance, it would be unrealistic to assume that directing policy instruments and measures uniquely towards consumers could prevent or reduce the environmental impacts of household consumption (*e.g.* the ineffectiveness of environmental education alone to influence patterns). It is equally unrealistic, however, to lean on strategies which aim at only a technological restructuring of the collective social-material system without working with household practices. De-coupling environmental pressure from energy use, water consumption and waste generation will require an integrated effort addressing consumption and production, including encouraging more efficient resource use and addressing consumer demand dynamics. The system of provision framework also suggests that the government policies to promote sustainable household consumption need to be well-targeted to the different economic actors. And, in many cases, need to include a combination of instruments (economic, regulatory and social) as well as strategies that

provide consistent signals and environmentally friendly consumption options to promote efficiency gains and resource saving behaviour.

Structure of the document

Chapter 2 analyses household energy consumption. Section 2.2 shows that household energy demand continues to grow, although at a slower rate than in the past and despite efficiency gains for many household energy end uses. It stresses that the environmental impacts of increased household energy consumption will depend on future approaches to residential and space heating and energy efficiency improvements achieved via building standards, product modification as well as on changes in household behaviour. Section 2.3 identifies the main drivers behind household energy consumption trends including economic growth, more space heating per capita, and the increasing ownership of electronic appliances. Section 2.4 analyses policies on household energy consumption, such as taxes, the promotion of energy efficiency (standards, labels, information and savings), and the importance of accelerating the production and demand of renewable energy.

Chapter 3 studies household water consumption. Section 3.2 shows that water consumption has stabilised or declined in some OECD countries (Germany and the Netherlands), but in others it continues to grow (Mexico). Section 3.3 studies the main drivers of water consumption, which are economic and demographic growth, as well as changes in lifestyles that are more water intense. On the other hand, technological innovations (water efficient appliances and devices) and responsible household water use patterns have helped to reduce water consumption. Section 3.4 analyses policy responses to promote sustainable water consumption. Some governments have applied different policies towards sustainable water consumption and management (*e.g.* stricter environmental regulation, taxes, diffusion of technology, information and environmental education) and have succeeded in de-coupling economic growth from water consumption. However, in other countries water subsidies are still one of the main obstacles for the efficient and sustainable use and management of water.

Chapter 4 focuses on household waste generation. Section 4.2 explains why household waste is a priority area of concern; the generation of household waste is growing and is projected to increase further to 2020. Waste represents an inefficient use of both material and energy resources. It is also a source of pollution and land degradation when treated inappropriately. Section 4.3 analyses the main drivers of household waste generation (economic growth and consumption patterns) and recycling. It highlights the importance of providing the optimal recycling infrastructure to households as well as raising environmental awareness. Section 4.3 analyses the policy responses for waste prevention and management. To date, it has not been possible to de-couple waste generation from economic growth. Major efforts are needed especially in preventing the generation of waste, a task that implies changes in production patterns, distribution systems, and consumption patterns. The study on waste also shows the importance of Extended Producer Responsibility (EPR) and Integrated Product Policy (IPP) for waste management, and how waste fees and taxes are key elements for a more environmentally sound waste management.

CHAPTER TWO. HOUSEHOLD ENERGY CONSUMPTION

2.1 Introduction

OECD countries are the largest energy-consumers and the largest net energy importers. Energy use in OECD countries grew by 36% from 1973 to 1998. By 2020 it is expected to grow by a further 35% and 51% world-wide, with a related increase in CO_2 emissions. After transport, residential energy use is the most rapidly growing area of demand globally.

The share of OECD countries in total world energy consumption is projected to fall from 35% in 1995 to 32% in 2020. Compared with recent trends in energy demand, these figures represent a decline in the energy intensity of the economy both for OECD regions and world-wide, indicating that some de-coupling of energy use from economic activity is taking place[1]. However, per capita energy use is still increasing and is expected to continue to increase to 2020 in both OECD countries and world-wide. Energy related CO_2 emissions in 2010 will still be significantly higher than required to meet commitments under the Kyoto Protocol (IEA, 2000; OECD, 2001*a*).[2]

Household energy consumption is a sector with increasing energy use and with a potential contribution in energy saving and in reducing CO_2 emissions. Household energy use affects the environment primarily through the burning of fossil fuels either directly or in the generation of electricity. As emissions are a consequence of the choice of technologies and fuel use in the power sector, households often do not have much influence over emissions. However, their decisions to reduce their energy consumption by changing behaviours and choosing energy efficient electric appliances could contribute to reducing environmental impacts. Moreover, the recent provision of "green" power gives a small number of consumers a choice in selecting the source of energy for electricity. The greater involvement of consumers in the choice for their systems of energy supply and energy-efficient appliances may produce an increase in "consumer leverage".

This chapter analyses household energy consumption. Section 2.2 describes energy consumption by sectors and the relative importance of household energy consumption. It explores the trends of household energy consumption and describes their environmental impacts. Section 2.3 explores the main driving forces behind household energy consumption. Section 2.4 analyses the different policy responses towards sustainable household energy consumption. Section 2.5 presents some policy recommendations.

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1. The World-energy intensity - primary energy demand per unit of real GDP - is expected to decline between 1997 and 2020 by 1.1% a year, equal to the historical rate since 1971 (IEA,2000).

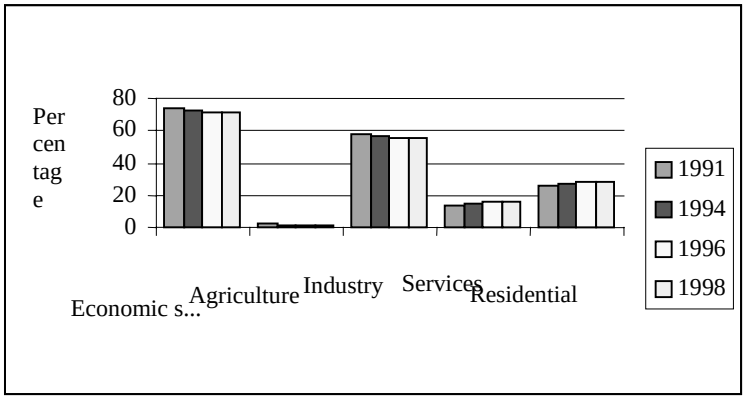
2. Despite commitments by Annex 1 countries to reduce emissions, the release of total greenhouse gases in OECD countries is expected to continue to increase to 2020, with emissions from non-OECD countries rapidly gaining pace. Under current policies, OECD countries are likely to increase greenhouse gas emissions by approximately 25% to 2020, fair from the overall Kyoto Protocol target at 5% reduction from 1990 levels to 2008-2012.

2.2 Energy consumption trends and their environmental impacts

2.2.1 Energy consumption by sectors

During the 1970s, industry was the major energy consumer using 38%. Transport energy used increased from 25% in 1971 to 33% in 1997, and is projected to reach 37% by 2020. Household energy consumption, is the second growing sector, after transport, and is expected to continue to grow. This is illustrated, for example, in Germany where household energy consumption increased 9.4% during the 1990s, whereas the share of energy use by the economic sector, agriculture and industry decreased (Figure 2), and in Mexico household electricity demand increased 6% during the 1990s (Secretaría de Energía, 2000*a*).

Figure 2. Primary Energy Consumption by Sectors in Germany

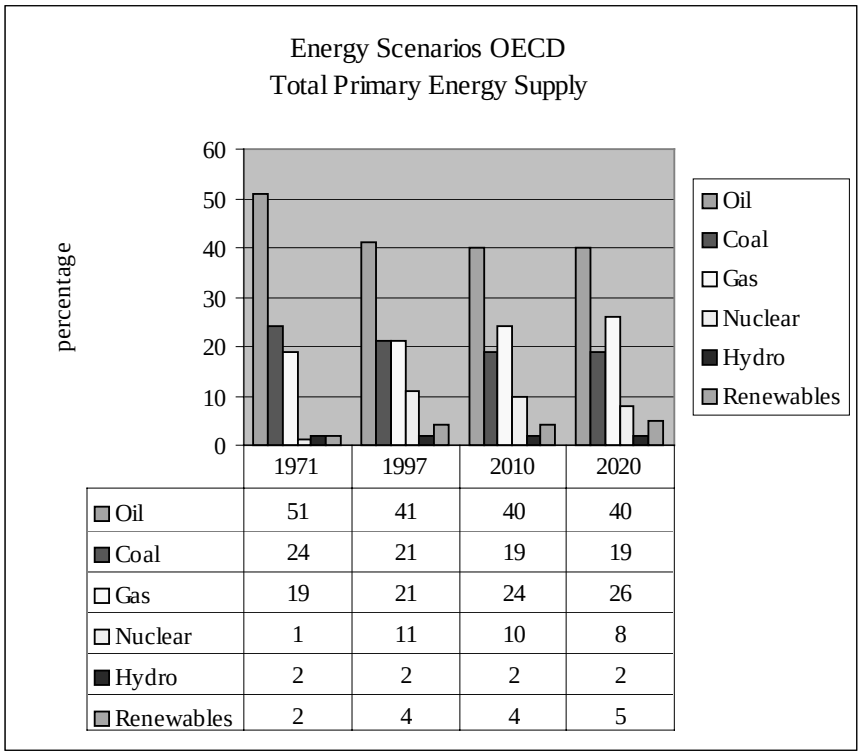


Source: Germany Federal Statistic Office, 1999.

2.2.2 Different sources of energy

There are many different sources of energy in OECD countries (Figure 3). The IEA 2000 scenarios project that between 1997 and 2020 the share of coal will continue to fall, mainly due to coal's replacement by gas in power generation, while the share of nuclear power is expected to drop from 11% to 8%. Natural gas will make up most of these losses. Fossil fuels will account for 85% of the OECD region primary energy mix by 2020. Non-hydro renewables (green energy) are expected to grow steadily, but will still only reach 5% (IEA, 2000). Within OECD Europe, nuclear power is absent from the fuel mix in half of the countries, but accounts for a major share of electricity output in others-notably France, Sweden and Belgium.

Figure 3. Energy Scenarios OECD



	1971	1997	2010	2020
Oil	51	41	40	40
Coal	24	21	19	19
Gas	19	21	24	26
Nuclear	1	11	10	8
Hydro	2	2	2	2
Renewables	2	4	4	5

Source: IEA. World Energy Outlook, 2000.

2.2.3 Energy efficiency

Total primary energy supply (TPES)[3], per capita consumption, and efficiency rates vary significantly among OECD countries. Total primary energy supply per capita, for instance, is much higher in Germany and the Netherlands than in Mexico, but so is energy efficiency. Differences are remarkable in the USA, where electricity consumption is 13 388 kWh per capita and electricity consumption /GDP is 0.51 (Table 1). In per capita terms, Mexico's energy use and pollutant emissions are low compared to most OECD countries. Notwithstanding, energy intensity (energy use per unit of GDP) is increasing in Mexico at the same time that it is decreasing for the OECD as a whole (OECD, 1998).

3. Total Primary Energy Supply (TPES) is the energy content of different energy sources as they are offered by nature before they are transformed for use. TPES is made up of domestic production plus imports and minus exports, international marine bunkers, and stock changes.

Table 1. Key Energy Indicators in 1998

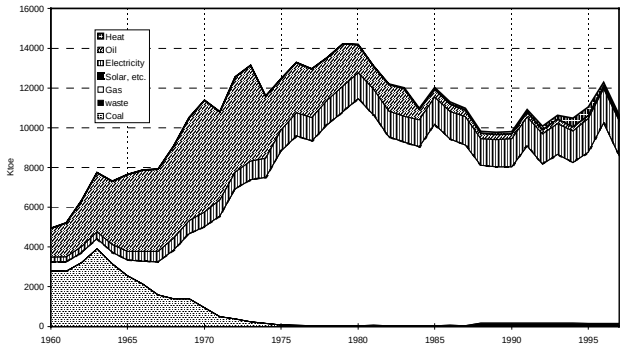
	Germany	Netherlands	Mexico	USA	OECD
Population (million)	82	16	96	269	1101
GDP (Billion 1990 US Dollar)	1834	349	334	7044	20656
Total Primary Energy Supply (Mtoe)	345	74	148	2182	5097
TPES/Population (toe per capita)	4	4.7	1.6	8.1	4.6
TPES/GDP (toe per 000 US dollar)	0.18	0.21	0.44	0.31	0.25
Electricity Consumption/population (kWh per capita)	6482	6310	1644	13388	7751
Electricity Consumption/GDP (kWh per US dollar)	0.28	0.28	0.47	0.51	0.38

Source: IEA, Statistical Files, 1998.

2.2.4 Households energy consumption

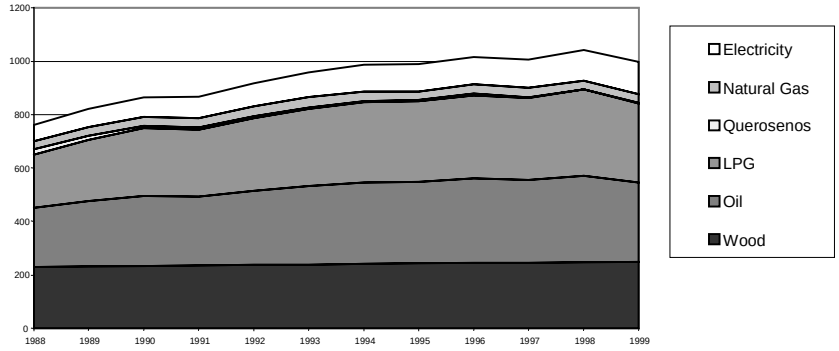
Household (residential) energy consumption accounts for 15% to 25% of the national energy use (OECD, 2001*a*). It represents 29% of the final energy consumption in Germany, 20% in the Netherlands and 17% in Mexico. OECD households use energy mainly as gas, electricity and wood. Electricity at the same time can be generated by nuclear power, coal, hydropower and other types of renewables (solar and wind power). However, there are significant differences among countries (very often related to the level of economic growth). In the Netherlands, as many other OECD countries, natural gas and electricity are the main sources for household energy supply (Figure 4). On the other hand, in Mexico, liquefied petroleum gas (LPG) and wood (especially in rural areas) are the principal energy sources for cooking and water heating, whereas electricity is the main use for lighting and cooling (Villar, *et al.*, 2001). The main obstacle for increasing the use of natural gas is the lack of infrastructure for its distribution. The use of wood is a signal of the lack of alternative sources of energy and the deficiency of the *energy systems of provision* in poor-rural households (Figure 5).

Figure 4. Structure of Residential Energy Use by Type of End-use Energy in the Netherlands (in Ktoe)



Source: IEA Energy Balances 2000.

Figure 5. Structure of Residential Energy Use by Type of End-use Energy in Mexico (Ktoe)

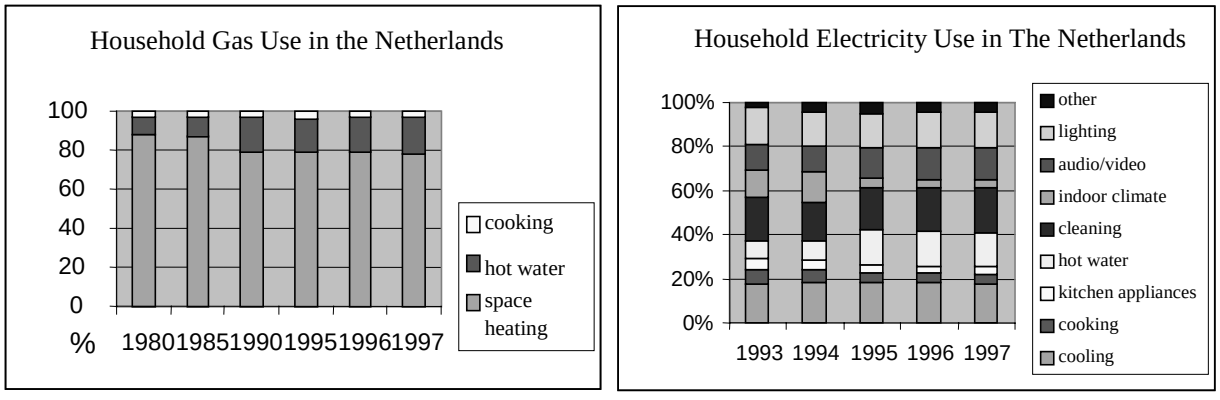


Source: Secretaria de Energía, Mexico, 2000.

Energy Use within Households

The main household energy uses are for space heating, followed by water heating and in small proportions lighting and cooking. In the Netherlands, natural gas became the fuel of choice for cooking, hot water supply and central heating in the early 1960s. From the 1980s onwards, natural gas consumption per household began to fall in absolute terms, as a consequence of the introduction of more efficient boilers and the improved insulation of houses (Figure 6a and 6b). In contrast, the demand for electricity for lighting and powering a growing number of appliances, has continuously grown. The appliances marketed in the Netherlands have become substantially more energy efficient in recent years, but this has not offset the growing intensity of use (scale effect) (Correljé, *et al*., 2001).

Figure 6a and 6b

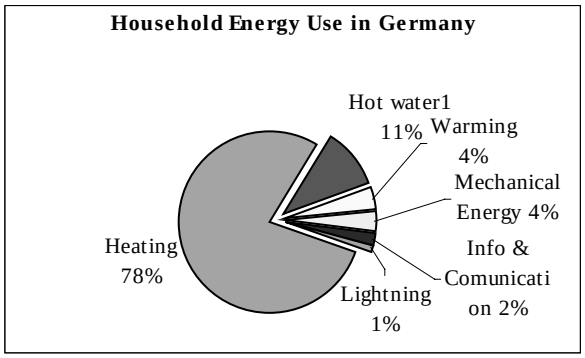


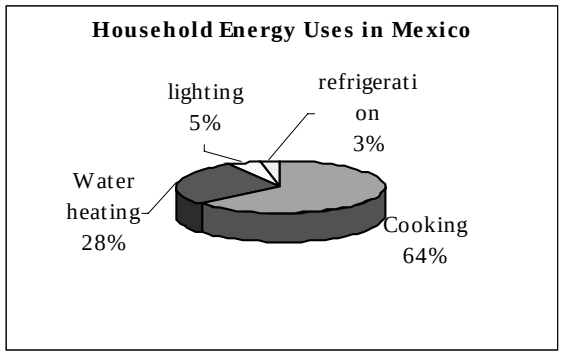
Source: Energieverslag Nederland 1994-1997, ECN, Peten, 1995-1998.

In Germany nearly 80% of household energy is used for heating (Figure 7). In Mexico, household energy use is quite different, mainly due the favourable climate conditions that do not require so

much energy use for heating. It is estimated that 61% of energy used is for cooking, 27% water heating, 5% lighting and 3% cooling (Figure 8).

Figure 7 **Figure 8**





Source: Germany: Vereinigung Deutscher Elektrizitätswerke, Frankfurt; AK Nutzenenergiebilanzen, 1998. Mexico: Masera*, et al.*, 1993.

Note: In Germany, hot water includes hot water for washing machines, dishwashers. Engines are categorised under mechanical energy. Warming refers to cooking, ironing, tumbling etc.

Households are increasing their energy consumption through greater use of electrical goods, more home floor space per capita, and higher levels of cooling and heating comfort. Per capita demand for energy and for electricity in particular, is projected to increase substantially in all OECD regions, with the highest relative increases (approximately 200%) expected in Central and Eastern Europe (OECD, 2001*a*).

2.2.5 Environmental impacts of household energy consumption

Household often do not have a direct influence over energy emissions, but an indirect influence through their energy use. They could reduce their impacts by deciding to reduce their energy consumption by energy saving behaviour and choosing energy efficient electric appliances. Nearly every kind of energy production causes negative effects for the environment. The use of nuclear energy creates radioactive waste with serious problems of safe storage. The burning of fossil fuels – coal, mineral oil and gas – leads to emissions of CO_2, and NO_X, which play a serious role in global warming. The use coal and wood as main sources of household energy is a significant source of emission of SO_2 and NO_x.

Air pollution and human induced climate change are the most pressing environmental problems arising from energy generation and use. Fuel combustion is the major source of air pollution across OECD countries, with subsequent impacts on human health and on ecosystems. Regional and global impacts on ecosystems include acid rain through SO_x and NO_x emissions, and climate change through increased atmospheric concentrations of greenhouse gases, as well as other environmental problems (*e.g.* tropospheric ozone and particulates). CO_2 emissions in OECD countries are expected to increase 33% between 1995 and 2020 (1% per annum) (OECD, 2001*a*).

Some countries, however, have succeed in reducing their emissions. In Germany, for example, NO_X emissions decreased 33% over the 1990s. The main area of reduction was traffic and to a smaller extent power plants. Household NO_X emissions were stable. Total CO_2 emissions also decreased by about 15% in Germany over the same period, although emissions from traffic and households increased by 16% and 6% respectively (Table 2).

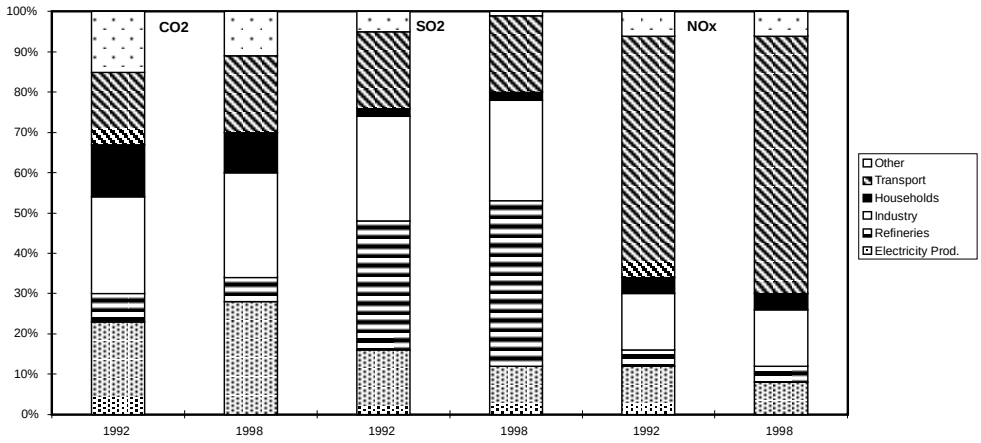
Table 2. Reduction of CO_2 (in Mt) in Germany, 1990-1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Industry	28	25	25	25	27	26	25	25	25	-
Street traffic	150	154	160	164	161	165	165	166	168	-
Other traffic	22	20	18	18	19	18	17	17	18	-
Households	128	131	123	134	138	139	146	141	136	-
Small businesses	76	74	65	62	56	58	67	54	52	-
Industrial burning	213	184	168	158	159	158	153	154	148	-
Power and heating plants	397	369	368	356	354	349	351	336	339	-
Total	1014	977	927	917	904	903	924	891	886	859

Source: Federal Environment Agency, cited from BMW, 2000.

In the Netherlands, absolute amounts of SO_2 and NO_x emitted have been stable over the past ten years while relative shares have shifted (Figure 9). This is a consequence of a strong reduction in the overall emissions of SO_2 in industry and power generation over the 1980s. The share of NO_x emitted by households is relatively small and also difficult to reduce. Overall CO_2 emissions fell in the Netherlands as a result of increased efficiency of gas heating.

Figure 9. Netherlands: Direct Emissions from Energy Use by Sector 1992 and 1999 (Shares)



Source: Energieverslag Nederland 1997", Energie Centrum Nederland (ECN), Petten, 1998.

Water pollution is another environmental impact of electricity generation. An important emerging trend in many OECD countries is the growing use of freshwater resources for cooling purposes in electricity production. Over 50% of freshwater abstractions in at least eight OECD countries are used for cooling in electrical power generation (OECD, 1999). This trend is expected to increase by almost 100% world-wide from 1995 to 2020 (OECD, 2001*a*). While water used for cooling is generally returned to the source, it often has a higher temperature than when it was abstracted. Thermal pollution of waterways can lead to oxygen depletion in freshwater ecosystems, and is for that reason regulated in most OECD countries, usually through siting permits. Pollution of water and soil from energy use also occurs directly through leaking oil tanks and indirectly through acidic deposition caused by air emissions of NO_x and SO_x. This has led to severe effects on lakes and rivers and on forests in some regions, with damage to freshwater fish, other fauna, and habitats (OECD, 2000).

Nuclear energy produces waste that carries unique risks in relation to its transport and disposal, as it can remain highly radioactive for thousands of years. Furthermore, there is a threat of accidental releases of radioactive material from nuclear power generation facilities. While many OECD countries have agreed that isolation of nuclear waste in stable geological structures is the most appropriate option, implementation of this policy has been slow for political reasons.[4] In addition, there is no consensus on whether waste disposed in such a manner should be retrievable - in case another method of storage is subsequently preferred – or irretrievable, so as to minimise the risk that the storage facility could turn into an illegal source of nuclear materials (OECD, 2001*a*).

2.3 Energy consumption drivers

Many factors influence household energy demand such as economic factors, climate conditions, socio-demographic characteristics (including cultural aspects), technology, energy suppliers, living situations among others. Economic growth, demographic changes and technology have the strongest influence, and some times work in opposite directions. Rising incomes have enabled consumers to purchase more electronic appliances and larger houses. At the same time, family size has decreased, so per capita dwelling area has increased. Larger dwelling areas lead to greater energy demand for space heating/cooling, hot water, as well as for more electronic appliances. These trends are driving a greater demand for energy and water. On the other hand, technological improvements (energy-efficiency) in household heating systems, in electrical appliances and the increased of households equipped with energy conserving technologies (*e.g.* double-glazing and insulation) have helped to reduce household energy consumption. Moreover, in many countries, households now have better access to reliable information (*e.g.* household energy audits, energy efficiency labels) on their energy use, which could motivate energy savings (OECD, 2001*a*). Despite the energy gains, household energy consumption is still increasing.

2.3.1 Economic drivers: rising household income

Economic growth and disposable income are the most important determinants of energy consumption. Estimated income elasticity for energy consumption is 0.1 to 0.4, which implies that a 1% increase in income leads to an increase in energy consumption of 0.1 to 0.4% (Fuchs and Lorek, 2001). Energy prices are another moderate driving force. Energy is a "necessity" with a comparatively inelastic demand. Empirically observed, price elasticities generally range from -0.2 to -0.1, indicating that higher prices only cause a moderate reduction in demand. Besides energy prices, the availability of credit (*e.g.* difficulties of financing investments in dwelling improvements), ownership structures, and spending patterns are important determinants of household energy consumption.

2.3.2 Increasing electric appliances ownership

Perhaps the most important trend in energy consumption over the last few decades has been the rapid increase in the share of energy from electricity, which has almost doubled in OECD countries since 1975. This is partly the result of increased growth in the electricity-intense residential and commercial sectors. Rising income – in combination with relatively stable or falling prices for appliances - has led to a significant expansion in electric appliances ownership for which there is no realistic alternative fuel source (Table 3 and Figure 10). This reflects the wide range of uses of electricity, its flexibility, safety and cost (OECD, 2001*a*).

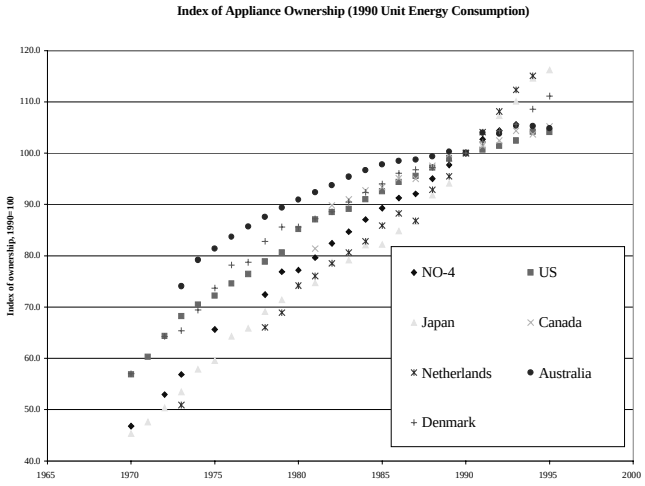
4. The first installation for high-level nuclear waste storage is not expected before 2010 (IEA, 2000c).

Table 3. Household Appliance Ownership for Selected OECD Countries 1973-1997 (units per 100 households)

		Refrigerators & combination units	Freezers	Clothes washers	Clothes dryers	Dish-washers	Air conditioners
US	1973	100	34	70	38	25	47
	1997	115	36	79	55	50	86
JAPAN	1973	104	na	101	na	na	15
	1997	120	na	107	23	na	191
UK	1973	73	8	68	4	3	Na
	1997	104	42	92	51	21	Na
DENMARK	1973	97	42	41	1	6	Na
	1997	107	65	72	30	35	Na
NORWAY	1973	89	57	72	15	3	Na
	1997	141	92	92	35	47	Na

Source: IEA, 2000, in OECD Environmental Outlook, 2001.

Figure 10. Household Appliance Ownership for Selected OECD Countries



Source: IEA, Internal database, 1999.

Lifestyle changes, (*e.g.* working hours, need to save time, expanding leisure activities, perception of cleanliness, etc) have lead to greater mechanisation in the home. Households today both own more appliances and use them more often. "Product innovation systems" theory[5] explains this trend as a process by which new products and appliances enter households, help change lifestyles and routines, and then themselves become part of those routines. Over time products that were once considered as luxuries become necessities[6] (*e.g.* washing machines, dish washers, microwaves, mobiles, etc.). The household

5. See Villager, Wüstenhagen, and Meyer (2000), Jenseits der Öko-Nische (Birkäuser Verlag, Basel).

6. Mika Pantzar (2000), Do Commodities Reproduce themselves through human beings? Man vs. nature vs. technology: problems and new conceptualisations (see www.comp.lancs.ac.uk/sociology/esf/papers.htm).

appliances that consume more energy are water boilers, freezers, stoves, refrigerators and dryers (Table 4). Hence, it has been a priority to increase the energy efficiency of these appliances.

Table 4. Household Electricity Consumption of Different Appliances

Appliance	Appliance share of electricity consumption in one household (%)
Water boiler	35,5
Freezer	10,9
Stove	9,8
Refrigerator (with freezing compartment)	9,2
Dryer	7,0
Dish washer	5,6
Washing machine	4,5
TV (first and second)	4,3
Video recorder	3,5
PC	2,9
Printer	1,6
Microwave	1,5
Electric kettle	1,0

Source: Böttcher – Tiedemann,1996.

2.3.3 Appliances in standby-power

Recently, more attention has been given to the energy consumption of household appliances in *standby* power. Studies have shown that standby power is responsible for 3 to 13% of household total electricity (20 to 60 watts per home) in developed countries.[7] Standby power accounts for 1.5% of OECD countries' total residential electricity consumption, while power generation to support standby modes produces almost 1% (68 million tonnes) of CO_2 emissions from the electricity sector of those countries (IEA, 2001). Standby power consumption is growing faster as more appliances are used per household. In the Netherlands, stand-by accounts for between 10% and 15% of total electricity consumption in domestic households (Correljé, *et al.*, 2001), and in Germany 14%. An average German household with an average number of appliances wastes 400 kWh or 77 Euro a year by keeping appliances on stand-by instead of turning them off. In France, the average annual household consumption of standby power mode is 235 kWh/year, representing 7% of the total electricity consumption (excluding electricity for space and water hearing). (IEA, 2001). Appliances with high stand-by consumption (over 5 W/h per year) are: PCs including monitors (35W), hot water boilers (25W); matrix printers (16W), laser printers (13,8W) (ESSH, 2000 in Lorek, *et al.*, 2001).

2.3.4 Technological change

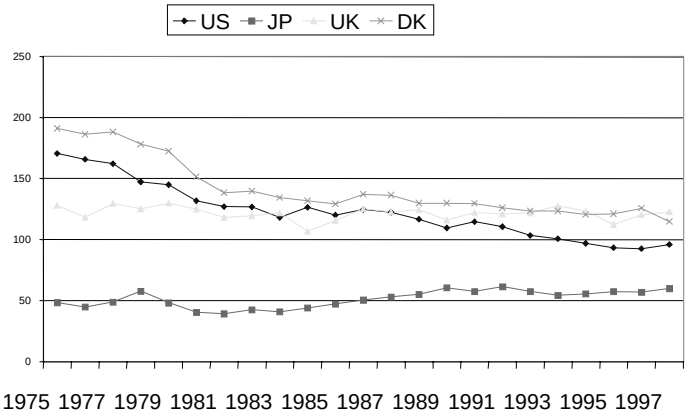
In many areas, new technological breakthroughs have recently occurred or are expected in the period up to 2020. These include new energy technologies that can contribute to increasing energy efficiency and reduce pressures on the environment. In some countries the energy efficiency of appliances has increased, partly due to an active government policy to create standards and labels for energy efficiency for consumer durables (Table 5). In many OECD countries, progress has also been made in reducing household energy use for heating through the use of better insulation and other technologies

7. A Video-cassette recorder (VCRs) in the United States consumes more energy when is in the standby mode than when actively recording or playing. For more information see IEA (2001), Things that Go Blip in the Night. Standby Power and How to Limit it.

(double glazing) (Figure 11). In the Netherlands, for instance, from the 1990s, natural gas consumption in households began to fall as a consequence of the introduction of more efficient boilers and the improved insulation of houses. Currently, energy consumption in new houses is about 60% less of that in a home from the 1960s.

Technological improvements, however, have not been sufficient to offset the increased penetration and use of appliances. In the Netherlands, for example, although the energy efficiency of refrigerators improved from 450 kWh/app to 342 kWh/app between the mid 1970s and mid-1990s, ownership increased from 88% to 112%, with similar trends for washing machines (Table 5). In Germany, efficiency gains have been made in several areas (freezers, dishwashers, cooks, etc) but combined with ownership levels, the overall trend is towards increasing energy demand.

Figure 11. Space Heat Intensity (adjusted to similar climate) in kJ/m2-dd



Source: IEA, Internal data base, 1999.

Table 5. Ownership and Energy Consumption of Appliances

	1973			1996		
Appliance	Penetration (%)	Efficiency (kWh/app)	Energy Use per hh (kWh)	Penetration (%)	Efficiency (kWh/app)	Energy Use per hh (kWh)
Fridge	88	450	396	112	342	382
Freezer	17	800	136	56	380	212
Dishwasher	4	900	36	25	303	76
Clothes Washer	85	450	83	98	231	225
Wash dryer	5	700	35	52	542	279
Water Boiler	16	1750	280	18	1352	238
CV-system	30	500	150	77	283	216
Television	96	175	168	166	100	166

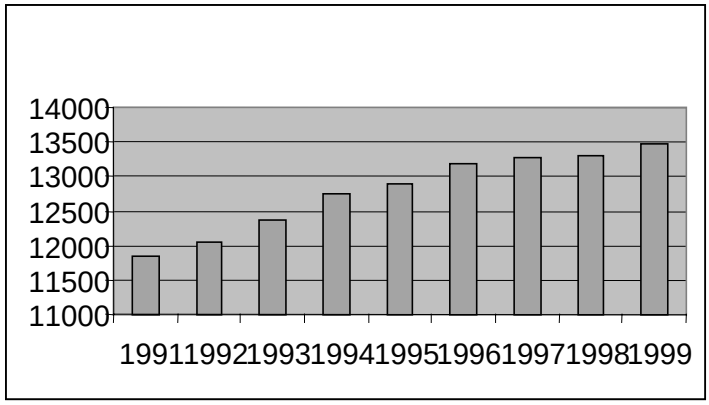
Source: Energieverslag Nederland 1997, ECN, Petten, 1998.

Recent studies highlight the decline of prices for electronic goods (stereos, TV, dishwashers, computers, etc.) as another important driver in the increase of electronic appliance ownership and, thus, the increase of energy demand. The analysis of the acquisition and use of electronics at the household level, shows some preliminary patterns: a) a decline in the fixed costs of electronic appliances significantly correlates with an increase in the rate of penetration; and b) there is only a weak relationship between variable (mostly energy) costs and frequency/intensity of use of appliances. This suggests that policies to reduce energy demand should promote an increase in the production/use of sustainable energy and an increase in the price of energy-intensive appliances relative to that of energy efficient equipment (Van Swighem *et al.*, 2000, in Correlié, *et al.*, 2001).

2.3.5 Socio-demographic drivers

Among the socio-demographic variables, the increase in the number of households and increasing number of single member households are drivers for more energy use, more water consumption and waste generation. Single member households are increasing in all OECD countries. In the 1990s alone, for instance, the number of single person households rose by 31% in the Netherlands (Figure 12), 14% in Germany, and 12% in Mexico. Many factors contribute to single household increase: individualisation, divorce, economic growth, a greater number elderly living on their own, as well as an increasing number of wealthy young people living on their own earlier and staying alone longer, before starting a family. A single member household consumes 20% more energy than a two-member household (Table 6).

Figure 12. Single Households in Germany (1991-1999)



Source: Federal Statistic Office, 2000.

Table 6. Average Household Electricity Consumption in kWh

Person in the household	Average electricity consumption per household	Average electricity consumption per person in the household
1	1730	1730
2	2930	1465
3	3750	1250
4	4290	1070

Source: VDEW (1998).

Dwelling characteristics are another important set of determinants of direct energy consumption by households. Particularly, per capita floor space, dwelling type and age, and the structural surroundings of the dwelling. In addition, construction characteristics such as the presence of insulation, and other governmental building regulations have been found to be significant (Lorek and Fuchs, 2001; OECD, 2001*h*).

Summary of household energy consumption drivers

Household energy demand is expected to continue to rise with no major reductions in the short- to medium-term. In the Reference Scenario, electricity demand by households is projected to increase substantially in all OECD regions. The environmental impacts of increased household energy consumption will depend on future approaches to residential space and water heating (*e.g.* small-scale co-generation, decentralised energy production in the residential sector, use of green energy), energy efficiency improvements achieved via building standards, technology and product modification, as well as in changing household behaviour. Table 7 summarises the main drivers on household energy use.

Table 7. Main Drivers of Household Energy Use

Drivers	Household Behaviour	Effect on Energy Use
Larger dwelling are	Greater demand for space heating/cooling, appliances, lighting and hot water.	+
Per capita disposable income	More electric appliances (Fridge, washing, machine, TV, microwave, WC, shower, bath, washing machine, swimming pool, garden and lawn care.	+
(together with environmental awareness or economic incentives)	Purchases of more water efficient technologies and appliances.	-
Changes in Lifestyles	Rising "comfort" levels: more number and more frequent use of electronic appliances.	+
(together with environmental awareness or economic incentives)	Energy saving behaviour and purchase of energy efficient appliances.	-
Technology	Improvements on energy efficiency (space heating and appliances) have helped to dampen the effects of scale increases.	-
Regulation on house construction	Insulation, double glazing, use of natural light.	-
Environmental Information and Awareness	Energy efficiency labels. Sustainable energy use, willingness to pay for green energy.	-
Socio-demographic changes	Population growth, and especially more single-member households.	+

2.4 Policy to promote sustainable household energy consumption

Energy markets within the OECD and around the world are being rapidly reformed. After decades of structural immobility in electricity supply, governments are allowing market forces to play an increasing role in the operation of supply systems and the allocation of investment in new generation capacity. The new framework is characterised by the introduction of competition in electricity generation

and end-user supply, new access to electricity networks and a redefinition of the regulatory function of governments (IEA, 1999*a*).

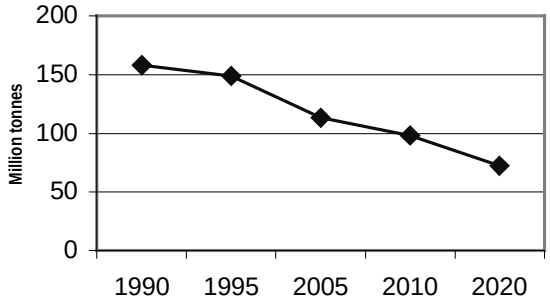
Market liberalisation and increased competition in the energy markets is contributing to lower energy prices which could increase energy demand. The main driver for environmental objectives in the new energy context in OECD countries will be to meet agreed targets for reducing greenhouse gas emissions. Unlike emissions of "conventional" air pollutants, there are no economically viable end-of-pipe controls available as yet for emissions of CO_2, so the challenge is large. In order to reduce the environmental impacts of energy use, energy policies will be needed for strengthening demand-side management (to reduce growth in overall energy demand), encouraging the development and uptake of low emission and energy efficient technologies; and ensuring a higher share of low-emission energy sources in the fuel mix. These objectives can be met under the new competitive market conditions, but it is crucial that they be included in liberalisation efforts at the beginning of the process (IEA, 1999*b*).

This section presents some policy responses to promote sustainable household energy consumption such as climate protection policies in Germany and the Netherlands, ecological tax reform, programmes to substitute high-emission energy fuels for low-emission energy sources, energy efficiency measures (standards, eco-labels, information) and the promotion of "green" energy.

2.4.1 Climate protection policies

The need to reduce greenhouse gas emissions has driven a number of countries to address household consumption patterns through climate protection policies. The German government has targeted a general 25% reduction of carbon dioxide emissions by 2005 compared with 1990 levels (BMU, 2000-Climate Protection Programme). Corresponding reduction targets for households were established at 13-20 million tonnes (Mio t) of CO_2 from buildings and a further 5 Mio t from private households. In one reduction scenario, household CO_2 emissions could drop from 158 Mio t in 1990 to 72 Mio t in 2020 (Figure 13).

Figure 13. Germany: Scenario of Household CO_2 Emissions (1990-2020)



Source: BMU, 2000.

In order to reach the objectives defined in this scenario, the German Climate Protection Programme provides for a package of regulatory, economic instruments, voluntary agreements and incentives to technological innovation that have been co-ordinated across sectors:

- a cross-sector ecological tax reform (1999-2003) to increase energy prices to stimulate reduced energy intensity and improved resource productivity in general. Higher energy prices are judged to be necessary to achieve existing energy savings potential, and to develop renewable energies;

- an energy saving Ordinance, expected to be in force in the beginning of 2002, combining regulations for insulation and efficient heating systems (CO_2 emissions reduction target of 4 Mio t);

- subsidies to motivate household use of green energy and implementation of energy efficient systems (CO_2 emissions reduction target of 4-7 Mio t); and

- information measures directed at electricity consumption (particularly stand-by mode) of electrical and electronic appliances in households and offices, voluntary agreements, and legislation on energy consumption labelling (CO_2 emissions reduction target of 5 Mio t). In addition, the programme foresees additional measures without specific reduction targets, such as greater market penetration of calorific boilers, small district heating power stations, fuel cells, connections to district heating supply systems, measurement and control technology, and energy efficient household appliances (BMU, 2000 in Lorek *et al.*, 2001).

In line with the liberalisation of the energy sector in the Netherlands, Dutch energy policy is relying increasingly on market instruments. Specific user categories are also still approached through traditional covenants and benchmarking agreements, but the new approach is more strongly directed to energy users, and consumers are seen as occupying a dominant position in a "demand driven" liberalised market.

As in Germany, the Dutch government is using a combination of economic instruments (taxes on fossil fuel, tax rebates on sustainable energy use or production) and regulated efficiency standards to stimulate the development of sustainable energy supply and technology. Where demand-side oriented policies are not sufficient, subsidies to technology development and basic R&D activities are used to enhance "policy-induced efficiency improvements" (Correljé, *et al.*, 2001). The Dutch Energy Conservation Action Programme (1999-2002) aims to increase the rate of energy efficiency improvements from 1.6% to 2.0% per annum.

2.4.2 Energy taxes and ecological tax reform

In the last decade, market liberalisation and increased competition in energy markets has contributed to lower energy prices and increased energy demand in many OECD countries. The trend is for further liberalisation of energy markets with expected price cuts in OECD countries in the coming years. It is against this background of falling prices (market signals working in the opposite direction) that environmentally related taxes may be introduced or modified. Although energy demand is relatively inelastic, a price elasticity significantly different from zero indicates that price increases can substantially reduce the demand for energy. As a response, several OECD countries have introduced or increased the use of environmentally related taxes during the 1990s, as part of a trend towards green tax reform. Environmental taxes provide direct incentives for consumers or producers to alter their choices which

negatively impact the environment,. Environmentally related taxes could have a significant impact on reducing energy demand, especially in the long run (OECD, 2001*f*). However further analysis is required to measure their potential impact on household energy consumption.

The environmental effectiveness of a tax can be measured as the extent to which the tax delivers a reduction in pollution or actual emissions. The effect of a tax on the quantitative reduction of emissions depends on the response of the polluter to the price incentive. The own-price elasticities estimated for energy sources are generally fairly low, albeit significantly different from zero. Increasing tax rates on relatively demand-inelastic demanded goods will reduce consumption, however the environmental impact will in general be fairly modest in the short-term, whilst tax revenues will increase. In the long-term energy price elasticities are generally larger (the users are given the incentive to change technologies or adjust), therefore the environmental effectiveness of the tax will increase if the tax is planned for the long term. Evaluations of the environmental effectiveness of environmentally related taxation are not routinely carried out, perhaps in part because it is often difficult to isolate the impact of the tax alone from other elements of a policy package on consumption/production. A lack of data on emissions and the means to measure the longer-term impacts of taxes on technological change also complicates the measuring of environmental effectiveness (OECD, 2001*f*).

In 1999 Germany initiated its Ecological Tax Reform, which consists in progressively raising energy taxes without increasing the overall tax burden. The first step was to raise the fuel tax (by DM 0.06 per litre of petrol or diesel, DM 0.04 per litre of fuel oil) and to introduce an electricity tax (DM 0.02 per kWh. Levied on the producer, these taxes are passed on to consumers, and will be increased annually until 2003. Electricity generated from renewable energy sources is exempt from the eco-tax, and electricity used by local public transport enjoys a 50% tax reduction (OECD, 2001*d*). The new energy tax is subject to two types of exemptions: one for coal and nuclear energy and the other for industry and agriculture, which pay only 20% of the standard tax rate. The new tax reform will also be used to subsidise renewable energy (DM 200 million per year) and public transport. The ecological tax also includes an increase for petrol and gasoline of DM 0.06 per litre each year from 2000 to 2003 and DM 0.05 per kWh for electricity (Table 8).

Table 8. Development of Taxes Due to Ecological Tax Reform

		Tax			Taxes from ecological tax reform & mineral oil tax		
Energy carrier		Up to 31.03.1999	From 01.04.1999	From 01.01.2000	From 01.01.2001	From 01.01.2002	From 01.01.2003
Petrol	Pf/l	62	68	74	80	86	91
Gasoline	Pf/l	98	104	110	116	122	128
Heating oil	Pf/l	8	12	12	12	12	12
Natural gas	Pf/kWh	0,36	0,68	0,68	0,68	0,68	0,68
Electricity	Pf/kWh	0	2	2,5	3	3,5	4

Source: Federal Environment Agency, 2000.

By gradually increasing the energy tax, and applying a zero-tariff for renewables, the government intends to give a stimulus to reduce fossil fuel use and increase sustainable energy use. The Dutch government through its *Environmental Action Plan* (Milieu Actieplan, MAP), has also introduced an energy tax on energy. As of 1st of January 2001, small-scale consumers were paying over one-third more for their energy through a tax levied on gas and electricity. This tax is passed from producers to consumers, and depends on energy consumption levels (Table 9). Most of the extra revenues from the tax are to be

redistributed to taxpayers through reductions in wage and income taxes, but a portion will be redistributed through tax incentives for energy conservation measures as of 2001. With the introduction of this tax, the price of domestic electricity has gone up by 15% (Correljé, *et al.*, 2001). In the future, the Dutch cabinet is planning is to reduce the difference in costs and price between renewable and fossil energy options by means of fiscal instruments, including taxes as well as tax rebates, to promote renewable energy production and consumption.

Table 9. Natural Gas Tax Rates (in cents per cubic metre, excl. VAT)

Category cubic metre	0-800	800-5000	5000-170000	170000-1 million	Over 1 million
1996	0	3,18	3,18	0	0
1997	0	6,36	6,36	0	0
1998	0	9,53	9,53	0	0
1999	0	15,78	10,24	0,71	0
2000	0	20,82	11,44	1,54	0
2001	26.50	26,50	12,38	2,30	0

Source: Central Planning Bureau (www.cpb.nl).

The reform of energy subsidies can have environmental as well as direct economic benefits. Revenues in OECD countries from environmentally related taxes amounted to 7% of total OECD tax revenues, or 2.5% of GDP in 1997. These taxes are heavily concentrated on motor fuels and vehicles, contributing to more than 90% of the total revenues (OECD, 2002).

Sometimes, however, taxes set on competing products (*e.g.* different fuel sources) are set such that the more polluting option is taxed less, rather than more. Thus, OECD countries impose no or low taxes on coal or coke, even though their combustion results in much higher emissions of carbon, sulphur, and particulate matter than more heavily-taxed alternatives such as natural gas. Similarly, most countries have imposed much higher taxes on petrol than on diesel, although from an environmental perspective, diesel has traditionally been more polluting than petrol, particularly in terms of small particulates. Furthermore, most of the environmental taxes applied in OECD countries fall on consumers, while producers – particularly large energy-intensive industries – receive significant exemptions and tax rebates (OECD, 2002).

On the other hand, energy subsidies need to be addressed in any regulatory reform programme which seeks to meet environmental objectives. In many OECD countries, economic development strategy has long been based on low energy prices to promote industrial development, subsidise transport, and keep inflation under control. Many OECD countries committed to reducing their subsidies to energy production or fuel (such as coal), or to reducing and changing the structure of their support in some sectors (*e.g.* to agriculture) to reduce the negative effects on trade, the economy, and the environment. Progress, however, has been slow (OECD, 2002). Subsidies for energy production in OECD countries, intended mainly to protect domestic producers and maintain employment in these industries, are estimated to be around US$20 billion per year. A third of these energy subsidies support coal production, although coal subsidies in OECD countries fell by 55% between 1991 and 2000 (IEA, 2001, in OECD, 2002).[8] Subsidised production is expected to decline further over the next few years, as several OECD countries plan to phase out their remaining subsidies.

In 2002 the Mexican government introduced reforms to residential electricity rates subsidies. Households consuming between 280 and 500 kilowatts per hour (kWh) bimonthly will face a gradual and differentiated reduction in their electricity rate subsidy, while the subsidy has been eliminated for those

8. Calculated using producer subsidy equivalents.

households that consume more than 500 kWh. Low-consumption households (less than 280 kWh) are not affected. These consumers represent 75% of the population. The reduction in residential electricity subsidies is expected to amount to 5 billion pesos (629 million Euro) (Mexican Ministry of Finance, 2002). A financial support programme will be implemented in order to encourage the acquisition of more efficient refrigeration, air conditioning, and insulating equipment for consumers who live in regions with extreme climate.

2.4.3 Promoting energy efficiency: standards, eco-labels and information

Another mechanism for meeting environmental objectives is the use of energy efficiency programmes. Three important instruments for promoting energy efficiency gains have been the introduction of energy efficiency standards to improve consumer appliances on the market, energy labelling to provide consumers with comparable information on appliance performance, and environmental information and awareness to promote household energy efficiency (and energy savings).

In Mexico, the 1992 Federal Metrology and Standardisation Law made the application of energy efficiency standards obligatory. By the end of 1996, 11 such standards had been developed for various household devices, including water pumping systems, water heaters, boilers, lighting systems and thermal insulation materials. With these standards, it is expected that electricity consumption will be reduced by 10% by 2005 (OECD, 1998*a*). Research indicates that energy efficiency standards can be particularly effective in overcoming market barriers to investment in energy efficient equipment (IEA, 2000*a*).

Energy-efficiency labels for appliances and equipment are used in many OECD countries, and the range of appliances to which they are being applied is expanding. The EU Energy Labelling Framework Directive (92/75/EEC) makes labelling compulsory for refrigerators and freezers, dishwashers, light bulbs, washing machines, dryers, and combined washing machines and dryers. The Directive is implemented in Dutch law via the Energy Conservation (Appliances) Act. Energy labels are in preparation for a number of appliances covered in the Framework Directive, including boilers and hot water appliances. A second generation of labels is in preparation for refrigerators, freezers and washing machines.

Energy labels can have an impact on consumer decision-making, particularly in the purchase of large, high-cost electronic appliances (refrigerators/freezers, washing machines, televisions, computers etc.), for which consumers often seek more complete comparative information between products. However, while more consumers give greater consideration to energy efficiency when they are choosing electrical appliances, it is not a prime decision criteria. Questions also remain about the clarity of energy labels and the ability of the average consumer to translate the information on labels into meaningful decision-making criteria, for instance to compare up-front purchase price and long-run operational costs. Retail sale staff are ideally placed to facilitate consumer decision-making by explaining energy labels, but they are not always well informed or motivated and may not volunteer information the consumer has not requested.[9]

The design and standards of buildings/houses are potential sources of energy savings (approx. 20% of energy use). It is therefore crucial to improve the energy efficiency of buildings, which generally means reducing the quantity of energy[10] required to satisfy requirements from owners and users in terms of internal environment and services. Various design elements affect energy efficiency, from very basic

9. See Background paper on Information and Consumer Decision Making for Sustainable Consumption. (www.oecd.org/env/consumption)

10. Usually not includes renewable energy.

elements such as the orientation and shape of the building structure (which influence the heat gain from daylight), to detailed elements such as the method of sealing joints between building components. There are three basic principles in the design of an energy efficient building. The first is to minimise the energy demand for the operation of equipment by optimising the design of building envelopes. The second is to install energy efficient equipment. The third is to maximise the use of renewable energy technologies and sources[11] (OECD, 2001).

There have been some national, regional and local initiatives by governments, the private sector and NGOs to provide information on environmentally friendly energy consumption (*e.g.* energy saving campaigns). Unfortunately, the environmental effectiveness of general awareness raising and information efforts is difficult to measure, although some campaigns use feed back mechanism to calculate, for example, CO_2 reductions, related to their activities.

In Germany, as in many other OECD countries, there is still a large gap between environmental awareness and environmental actions. While most people describe themselves as environmentally aware, most still have not changed unsustainable energy consumption behaviour (*e.g.* open windows with heating on, not reducing heat temperature when they leave the flat). The implementation gap can also be observed in the case of new appliances. More than 80% of Germans claim to consider energy consumption when they are going to buy new equipment, but 60% of households argue that the additional cost of efficient appliances have to pay off in the long run (often the economic or private benefits of buying eco-efficient appliances are not clear) (Kuckartz, 2000). As a result more emphasis needs to be given to behavioural changes.

2.4.4 Substituting high-emission energy sources for low-emission energy sources

Energy is considered to be one of the most heavily subsidised sectors in the OECD area. Subsidies to the entire energy sector have been estimated as being an order of magnitude higher than other sectors (*e.g.* water, food), with the bulk of support going towards nuclear, coal and oil production, often for purposes of maintaining regional employment (de Moor and Calamai, 1998, in OECD, 2001*a*). Subsidies to specific fuels lead to an economically inefficient energy supply level and mix, and discourage new fuel or technological developments that could reduce negative environmental effects. In OECD countries, the reform of environmentally damaging subsidies – particularly those that are tied to the use of more polluting fuels (*e.g.* fossil fuels, especially coal in Germany and Spain) or to energy production or consumption – could contribute to meeting Kyoto targets for greenhouse gas emission reductions and national environmental targets (OECD, 2001*a*).

In Mexico the main energy policy for households have focused on substituting high polluting energy for less polluting types of energy. Since the 1950s the government has promoted a policy to replace wood for LPG. One of the main strategies was the substitution of wood-stoves for gas-stoves. The reason of promoting LPG and not natural gas was the lack of infrastructure. Likewise, there is a programme on solar energy for rural communities and promotion of renewable energy generation.

11. For further information on sustainable building see *Design of Sustainable Building Policies: Scope for Improvement and Barriers*, OECD 2001, General distribution document [ENV/EPOC/WPNEP(2001)5/REV1].

2.4.5 Promotion of renewable energy

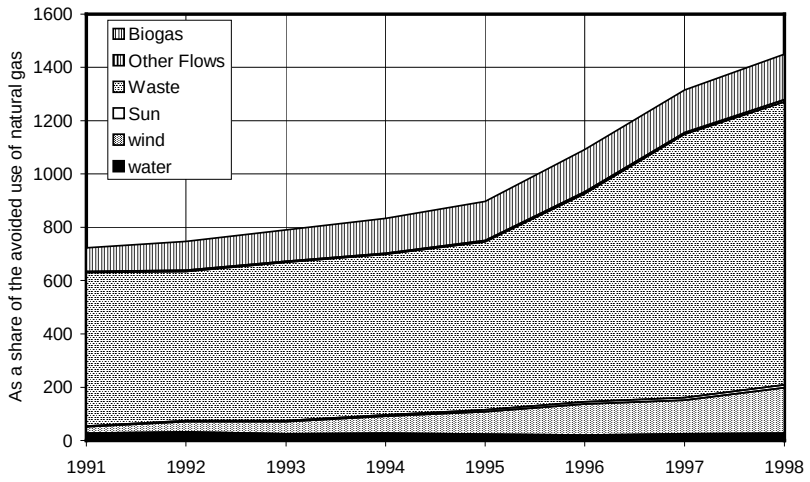
Different schemes have been developed by OECD governments to promote the production and consumption of renewable energy and stimulate the green power market. Germany, for instance, has established a minimum premium to operators of renewable power plants for each kilowatt hour of electricity input into the public grid [13 to 15 pfennig for electricity generated by water, 17.8 pfennig per kilowatt hour (kWh) from wind, up to 20 pfennig bio mass and DM 0.99 per kWh for solar power fed into the grid]. This makes investment in renewable energy systems more attractive (Staiß, 2000). Hydropower increased from 3.4% of power generation in 1991 to 4.3% in 1999 while wind power increased from 2.9 to 4.1%. Germany is now the world's largest producer of wind power. Nonetheless, renewable energy sources account only for a marginal portion of primary energy and electricity generation (2% and 5%, respectively). As a result, the government has targets to expand the use of renewable energy sources to 10% of electricity produced by renewable energy sources by 2010 and 50% by 2050 (OECD, 2001*d*).

The current federal programme for promoting renewable energy includes the so-called "***100 000 Roof Program***" which promotes the installation of 100 000 photovoltaic plants by the end of 2002. In addition Germany's Länder spent 1.7 Billion DM on the promotion of renewable energy. Private programs also exist, such as those supported by regional energy suppliers or nation-wide initiative "Solar 2000". Households have welcomed these programs. From 1999 to the end of 2000, for instance, the Program to Promote the Use of Renewable Energy, received over 113 000 applications for financial promotion, the majority of which were for solar energy plants or a combination of solar energy and energy efficiency home modernisation (Lorek *et al.*, 2001).

Sustainable energy use is seen as one of the most important activities towards environmental behaviour in Germany. The use of "green energy" is becoming a symbol of environmental awareness or "green identity"; visible solar energy or photovoltaic panels, for example, can give prestige to their owners (Lorek, *et al.*, 2001). As a result, a majority of the population (56%) support the ecological tax reform to (higher energy taxes) to stimulate green energy consumption and energy savings.

In the Netherlands the "third White Paper on Energy" includes a 10% target for the contribution of renewable energy to the energy supply by the year 2020. This has been a strong catalyst for the marketing and demand for green energy and the demand. Recently local energy supply systems are being promoted, involving heat pumps, co-generation, photovoltaic systems, and biomass fueled systems. Dutch climate policy offers special support and subsidy programmes for green energy. Waste incineration, wind power and biogas have been introduced in Dutch electricity supply (Figure 14).

Figure 14. Dutch Supply of Sustainable Energy in Terms of Avoided Use of Natural Gas, by Type

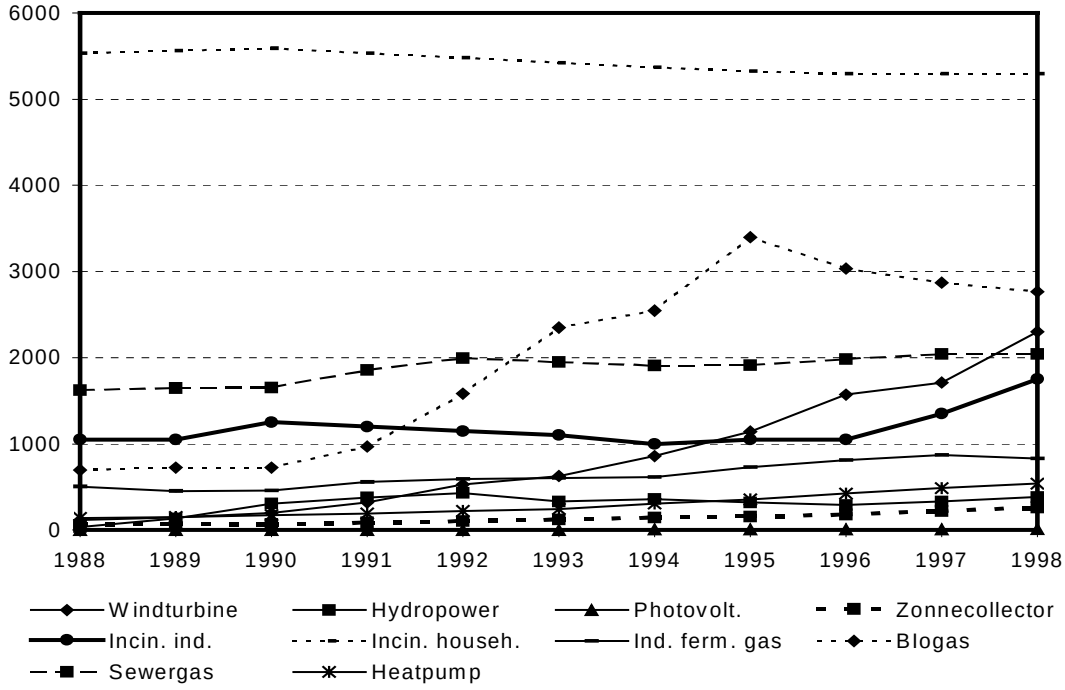


Source: CBS Statline

The growth of green energy, however, has been slow, partly because of the economic factors, including differences in fixed and/or variable production costs between fossil and non-fossil fuels for electricity production. Nevertheless, there are other factors that have pushed electricity suppliers to seek recourse to import green power from abroad. These problems include:

- Siting aspects, like the NIMBY-phenomenon (Not in My Backyard) and local resistance;
- Difficulties in obtaining back-up power supply from the grid;
- Difficulties in achieving a connection permit to sell power produced in excess to local requirements;
- The fact that the tariff structure for transmission and distribution often restrains the use of decentralised, or non-continuous, power production (like wind and water driven turbines);
- Other environmental and safety legislation that impede the use of alternative gasses.

Figure 15. Supply of Sustainable Energy in the Netherlands (Petajoules)



Source: CBS Statline.

In Mexico, the installed capacity of solar power generation was 9.2 MW in 1994. Pilot projects are operating in several parts of the country. The photovoltaic rural electrification programme, aimed at providing energy to 40 000 households, is one of the most world's ambitious. Wind power generated about 5.7 GW of electricity in 1995; most of the installed capacity is in South of Mexico (Oaxaca). It is expected that greater use will be made of solar and wind power in the future.

2.5 Conclusions

In OECD countries, there have been rapid increases in both energy production and consumption since the 1980s, although the energy intensity of the economy has been declining. This pattern seems likely to continue, with energy use in OECD countries projected to grow by another 35% to 2020, while world-wide it is expected to increase by 51%. Household energy main uses are for space heating, water warming and cooking. The main drivers on household energy consumption are economic growth, increasing ownership of electric appliances, more single member households and larger dwellings.

Household often do not have much influence over energy emissions, except by deciding to reduce their energy consumption by energy saving behaviour and choosing energy efficient electric appliances. With the increasing liberalisation of energy markets and the supply of green energy, consumer information and decision-making are likely to become more important tools for promoting sustainable

energy consumption. The greater involvement of consumers in the choice for their systems of energy supply and energy-efficient appliances may produce an increase in "consumer leverage".

Energy is one area of household consumption that has received significant, if sporadic, public attention. It is also one of the areas where information and standards have been most vigorously developed to influence consumer behaviour, and where they have had an impact. However, past and projected trends in household energy demand in OECD countries clearly shows that additional measures to promote energy savings and efficiency will be needed in the future. This will require a combination of supply-side efficiency gains and shifts to less polluting energy sources - to accelerate the use of natural gas, renewables and other low emission technologies, and to quicken the pace of improvements of conversion efficiency for fossil fuel use in the power sector – and policies aimed at consumer demand management to improve efficiency, moderate the demand for energy services, and promote the purchase of “green” energy (OECD, 2001). Governments need to accelerate measures to increase energy efficiency through more or higher energy standards, voluntary programmes and fiscal incentives, giving special attention to measures that are justified economically, regardless of any direct environmental benefits.

The implementation of national strategies to progressively reduce the rate of growth in emissions of greenhouse gases is a necessary policy to strengthen current efforts to improve energy efficiency and conservation, as it has been observed in several OECD countries such as Australia, Belgium, Canada, Denmark, Finland, France, Germany, the Netherlands, the United Kingdom among others.[12] The use of economic instruments and the Ecological Tax Reform seem to be significant initiatives for energy efficiency. Nevertheless, more analysis of the impact of taxes on household energy consumption is required. On the other hand, the reform of the energy sector must also review subsidies and cross-subsidies. Subsidies should be removed and/or stress the importance of energy efficiency and energy savings. This is not to say that governments should avoid all forms of subsidies, but that they should consider very carefully the mechanism for subsidisation, having first clearly identified the policy reason for it and eliminate those that do not support clearly defined objectives. They should also consider the potential conflict between different objectives (IEA, 1999*b*).

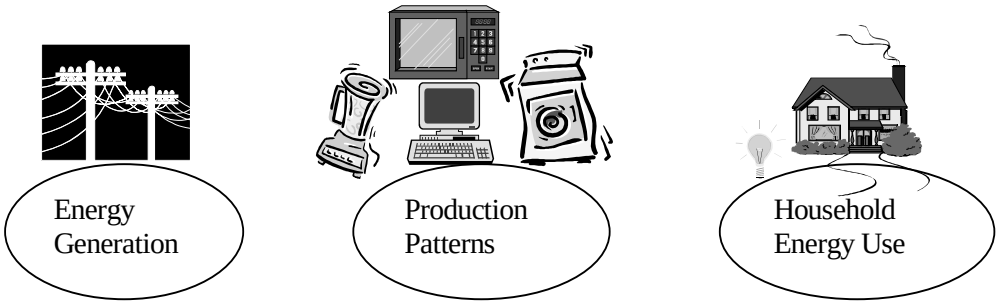
The liberalisation of the energy sector represents both a challenge and an opportunity for promoting sustainable energy consumption. Market liberalisation critically shifts decision making from the state to the market and, often for the first time, gives consumers a choice. Currently, in some countries, notably Switzerland, the Netherlands and Germany, households have now the option to buy “green” energy. IEA analysis shows that consumers in some countries are willing to pay for environmental protection through premium for buying green energy (IEA, 1999*a*). However, making the most of this option requires better provision of clear and accurate information to households. Governments also have an important role in ensuring an effective market is established including transparency and competition in generation and end user choice. They will also need to address market entry barriers to energy generators, and, especially, internalise the environmental externalities generated by energy production and consumption. Environmental regulation should be redesigned to fit this new framework, and modified towards more transparent and incentive-based systems, rather than a matter of command and control (IEA, 1999*b*).

On the other hand, with the increasing liberalisation of energy markets, supplier characteristics are likely to become more important in shaping consumers energy choices. This applies, in particular, to new options for consumers to choose between renewable and non-renewable energy sources. Many different companies, brands and labels have emerged on the energy market, and with them some confusion has been generated. Hence, major efforts are needed to provide clear and accurate information to promote both green energy and energy saving behaviour (*e.g.* insulation, purchasing energy efficient appliances).

12. Too see the specific national strategies for climate change see IEA (2001), *Dealing with Climate Change*.

Figure 16 presents the package of policies that government can use to promote sustainable household energy use.

Figure 16: Government Policies for Sustainable Energy Use



Economic Instruments
* Taxes on fossil fuels.
* Incentives for energy substitution.
* Incentives for renewable energy fuels.

Regulation &Policy
* National Climate Protection Policy.
* Target for green energy generation.

* Programmes for substitution of high emission energy fuels for low-emission fuels.

Economic Instruments
* Taxes on energy use.

Technological Innovation
* Energy efficiency
* Dematerialisation
* Eco-design.
* Support to R&D

Regulatory
* Energy efficiency standards and labels

Social instruments
* Labels,
* Support voluntary initiatives.

Economic Instruments
* Ecological Tax Reform
* Subsidies on *green* energy demand
* Taxes on energy

Regulatory Instruments
* Building codes.
* House insulation

Technology & infrastructure
* Green Energy supply (*e.g.* 1000,000 Roof Programme)
***** Provision of energy efficient appliances.

Social Tools
* Information campaigns on energy savings and climate change.
*Energy efficiency labels

CHAPTER THREE. HOUSEHOLD WATER CONSUMPTION

3.1 Introduction

OECD countries are the largest users of water, consuming three times more than an average person in East Asia, Latin America, Africa or India. In the OECD area, total freshwater abstractions have risen by over 4% since 1980, and are expected to rise by a further 12% by 2020. World-wide water use has increased significantly over the last few decades, in part because of increasing population pressures, but also due to significant increases in per capita water use related to economic growth and lifestyle changes. Over the last 50 years there has been a four-fold increase in global water use, while the total world population roughly doubled during the same period. Future global water withdrawals are projected to increase by about 30-35% between 1995-2020 (OECD, 2001*a*).

There has been a slight de-coupling of water consumption from economic growth in some OECD countries mainly due to technological improvements. However, while per capita water abstraction has declined in many OECD countries, the net effect of growth of population levels has resulted in an increase in total water abstractions. Only nine OECD countries – primarily in Europe - reduced total water abstraction between 1980 and 1997 (OECD, 2001*a*). The residential sector is a small water consumer (8% of total freshwater withdraws), however its trends and environmental impacts deserve some attention.

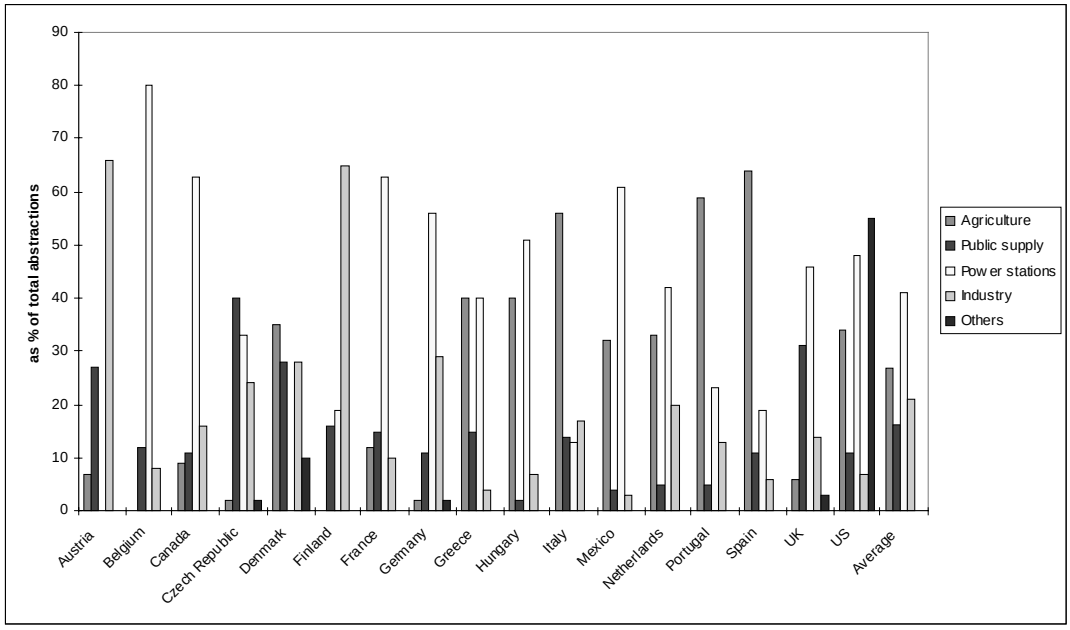
This chapter analyses household water consumption, its trends and environmental significance. It also presents some policies responses that have been implemented in some countries to promote sustainable water consumption. The following Section (3.2) presents the relative importance of household water consumption and describes the patterns and trends of residential water consumption (public water supply). Section 3.3 focuses on the main drivers of household water demand. Economic growth, technology and environmental awareness appear to be the most influential factors on household water consumption. Section 3.4 analyses some policy responses to reduce water consumption, illustrated by the three national case studies. Section 3.5 presents some policy recommendations.

3.2 Water consumption trends and their environmental impacts

3.2.1 Water consumption by sectors

On a global scale, households are relatively low consumers of water compared to other sectors, accounting, on average, for only 8% of total freshwater withdrawals (Figure 17). On average, water used for industrial purposes (including power generation) takes the largest share of water (65%, including 44% for power and 21% for industry), followed by agriculture 30% (OECD, 1999*a*). Relative shares between sectors vary among countries.

Figure 17. Total Water Abstractions by Sector in Selected OECD Countries



Source: OECD, 1999*a*.

There are important differences among countries in the methodologies used to measure and report water statistics. In Germany and the Netherlands, for instance, water use for agriculture is not included in the national statistics, because the agriculture sector has its own license for water abstraction. On the other hand, in Mexico, the water used for energy generation is not normally included in national water statistics, since it is considered that the water use for that purpose is not "lost". Thus, it is difficult to make a cross-country comparison on water use in each sector. The figures in Table 10, therefore, are estimations.

Table 10. Water Consumption by Sectors

Country	Power Generation	Agriculture	Industry	Public Supply
Germany[13] (2000)	65%	0.1%	22%	13%
Mexico (2001)		82.7%	4.7%	12.6%
Netherlands[14]	65%	1%	36%	8%

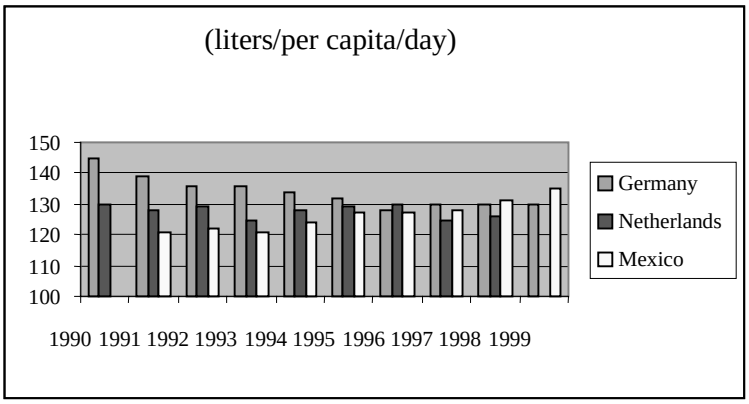
Source: Mexico: Comision Nacional del Agua, 2001. Germany: Federal Statistic Office, 2000. Netherlands: RIVM Milieu-compendium, 2001.

13. In Germany, the agricultural and industrial sectors have their own water rights to extract water, with lower quality standards. Thus they have independent pipe systems, which cover about 90% of industry demand (the public water supply for industry is primarily for the food sector) and almost 100% of agriculture water demand.

14. In the Netherlands figures on agriculture are lacking because their agriculture water use fells below the threshold for registration of used quantities, and because the use is very variable between wet and dry years. Farmers only started using irrigation systems on a regular basis since around 1995-1996, and regional governments are still struggling to monitor it.

Few data exist for water consumption per household. Normally, consumption is estimated by "public water supply", which refers to water supplied by water networks, and includes other users besides those in the domestic sector, such as restaurants and small businesses. Nevertheless, households are the largest consumers of public water supply. In the three national case studies, household consumption represents between 50% and 80% of public water supply. Per capita levels vary considerably among OECD countries, ranging from 100 to 300 litres per capita per day (OECD, 1999*a*). Per capita consumption decreased in the 1990s in the Netherlands and in Germany (from 145 to 128 l/cap), and has since stabilised in Germany (Figure 18b). In contrast water use per capita in Mexico increased from 121 litres per day in 1991 to 135 litres in 1999. Demographic changes (population growth), the increasing numbers of households connected to the water network, economic growth and water saving policies are the most likely drivers of these trends (see Section 3.3).

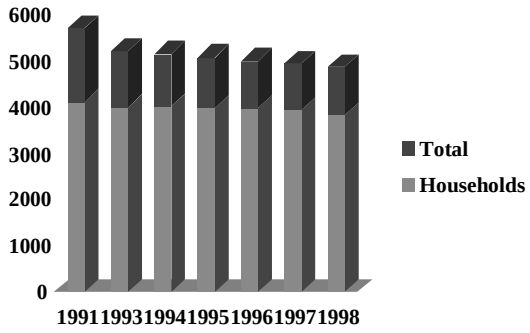
Figure 18. Household Water Consumption



Source: Germany: Federal Association of German Gas and Water Industries (2000). Netherlands, Waterstatistiek, Vewin (1998). Mexico: CNA, 2001.

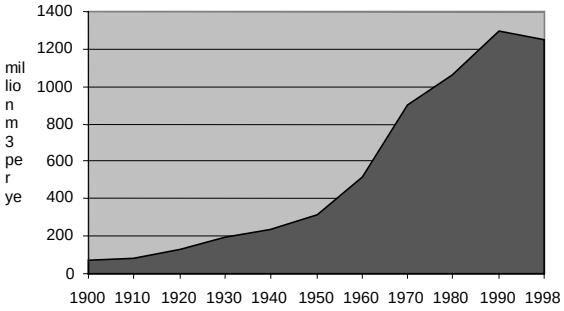
In the Netherlands and Germany, 99% of households are connected to water supply networks, and 98% to sewage systems. Water consumption is decreasing in both countries (Figures 19 and 20). In Germany, water supply decreased 15% from 1991 to 1998. Public water losses (due to leaking water pipes) is an important source of water pitfall and a priority area for water efficiency. In the Netherlands water losses is very low, 4.8% (57 million m^3); in Germany, losses represent 9%, whereas in other countries they are higher 25% in France, 27% in Italy, 29% in England and 40% in Mexico (OECD, 1999*b*).

Figure 19 Germany:
Public water supply 1991-1998



Source: Germany Federal Statistics Office, 2000.

Figure 20 Netherlands:
Total public water supply 1990-1998



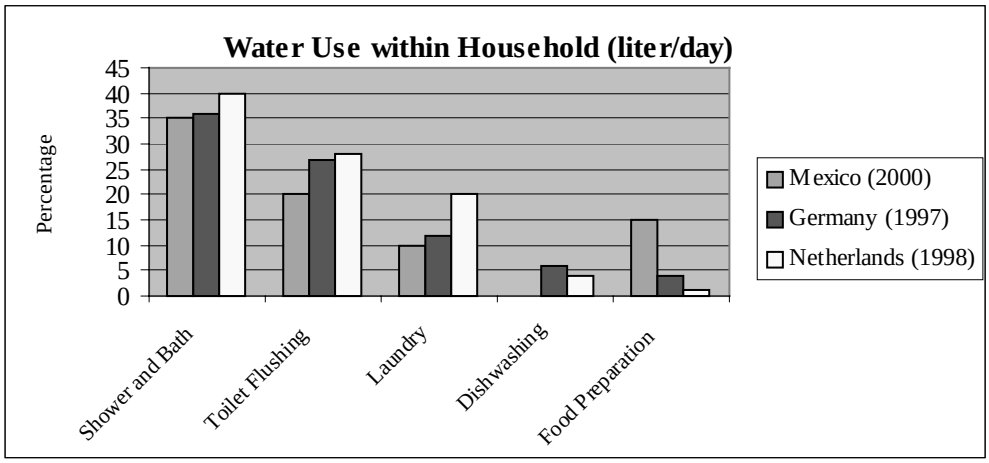
Source: Vewin, 1998.

In Mexico, water consumption is a matter of concern, particularly relating to two main aspects: water supply (affected by both geographical characteristics and public policies) and water treatment. Some regions in Mexico suffer from water scarcity whereas others have abundant water resources. At national level, only 17% of available water is extracted. However, water extraction varies by region and may result in water deficit, as is the case for Mexico City for example. Water supply is an important social concern, since only 87% of the population is connected to the public water system; of these 95% of urban households are connected and 65% of rural households. Nevertheless, some progress was made over the last ten years: 18 million people were connected to the public water supply system.

3.2.2 Water uses within households

Water is used for different household activities. Approximately 35% to 40% of household water is used for personal hygiene (shower and bath), 20% to 30% for flushing, and 10 to 20% for laundry. Food preparation and drinking make up the smallest share of water use: 1% in the Netherlands, and 5% in Germany and Mexico, although it can reach 15% in Mexico when included as a cluster of activities around food preparation (*e.g.* dishwashing, cleaning, drinking, etc) (Figure 21). A recent study realised by the Mexican Institute of Water Technology (2000) estimates that an average metropolitan consumes 164 litres per day; of which 40% is used for toilet flushing, 30% for showering, 15% for washing of clothes, 6% for food preparation, and only 5% for drinking water (CESPEDES, 2000). These consumption patterns reflect those in the Netherlands, perhaps due to the fact that Mexico City has higher economic growth than many other regions in Mexico.

Figure 21. Household Water Use



Source: Germany: Bundesband, 1997. IMTA 2000, NPO, 1999. Mexico: Comisión Nacional del Agua, 2001. Netherlands: NIPO 1999.

Table 11 summarises the indicators for household water consumption use in the three case studies analysed.[15]

Table 11. Indicators of household water consumption patterns in Germany, Netherlands and Mexico

Indicator	Germany	Netherlands	Mexico
Share of water abstraction of total water available	22.5%		17%
Of which:			
Surface	66%	33%	33%
Groundwater	33%	66%	66%
Household water consumption as share of total water consumption	13%	28% (OECD, 1997)	12%
Household water consumption per capita (litres)	128	127 (1999)	135 (1999)
Water loss through leakage	9%	4.9%	40%
Population connected to water treatment plants	92%.	98%	23.8%*
Sources: data in national case studies: Lorek *et al.*, 2001. Correljé, *et al.*, 2001; Vilar *et al.*, 2001.			

** Includes urban areas only.*

3.2.3 Environmental impacts of household water consumption

There are two main environmental impacts of water consumption: extraction and depletion, and pollution of ground and surface waters. Although most OECD countries do not face water scarcity problems, there are extensive arid or semi-arid areas where development is restricted by water scarcity. Urban and rural communities are also increasingly competing with other users for water where supplies are limited. Water pollution remains a serious problem, despite major efforts to clean up many of the worst polluted water bodies over the last few decades. Although households are not the major contributors to water pollution problems, they do affect water quality through the effects of wastewater releases and

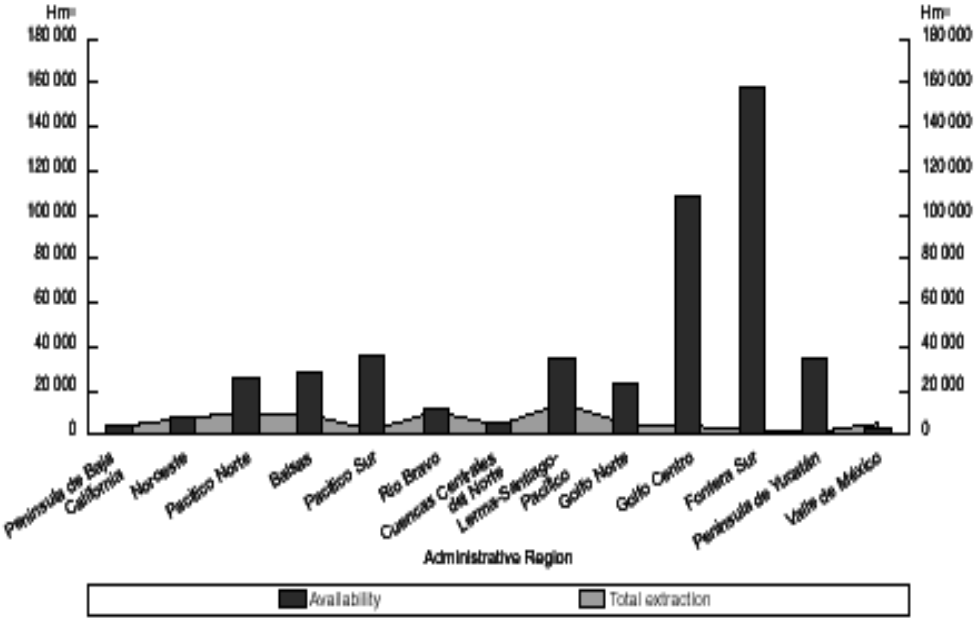
15. see OECD, Towards more Sustainable Household Consumption Patterns. Indicators to Measure Progress. Paris. ENV/EPOC/SE(98)2/FINAL. Available in: www.oecd.org/env/consumption.

run-off from lawn chemicals. OECD countries have improved basic water pollution abatement from households by increasing the number of households connected to basic sewage treatment facilities, and by expanding secondary and tertiary treatment. However, pressures from some household pollutants are projected to increase by 2020.

Water Extraction and Depletion

The pressure on water resources varies from country to country, since freshwater is distributed unevenly within and among countries as are the relative pressures on these resources. Most OECD countries currently abstract less than 50% of their annually available water resources. Germany, for example, exploits 23% of its available water resources (of which 33% comes from ground water, and 66% from surface water) (German Federal Statistics Office, 2000, in Lorek *et al.*, 2001). In Mexico, however, although only 17% of total available water resources are abstracted at the national level, 15% of water resources, supplying 50% of the national water consumption, are over-exploited. Other regions (*e.g.* Mexico City) present a water deficit (CNA, 2001) (Figure 22).

Figure 22. Regional Comparison of water extraction and water availability in Mexico



Source: CNA, 2001.

Overdrawing groundwater sources can result in significant environmental effects, including the subsidence of the land above aquifers, the lowering of water tables and desiccation, and the intrusion of seawater where aquifers are sited near coastal zones, contaminating the freshwater resources with salt and causing salinisation of coastal lands (UNEP, 2000). In the higher areas of the Netherlands, for example, the groundwater level fell on average from 0.10 metres to 0.4 metres below the soil surface between 1950 and 1990 (Milieubalans 1999, RIVM). This has caused damage in approximately 600 000 hectares of water-dependent nature (agricultural areas also suffer from drought problems, but this falls outside the Dutch definition of desiccation). In the Netherlands, drainage of agricultural land accounts for 60% of

desiccation problems, groundwater extractions by industry and water companies for 30%, and other changes in the hydrological system (*e.g.* increase of built/paved area) for 10% (Correljé, *et al.*, 2001).

Water Pollution

Water quality can be affected by direct pollution of water bodies and through the concentration of mineral and salt content caused by excessive water abstraction. Industry, followed by agriculture, is the primary polluter of water resources. The contribution of households is comparatively small, and concerns essentially the effects of wastewater releases on the oxygen availability in aquatic ecosystems (known as biochemical oxygen demand or BOD), contamination by household products (including phosphate detergents, oil and grease), and run-off of lawn chemicals applied on gardens. Phosphates are no longer a serious concern in most OECD countries, following policies and product changes to eliminate phosphate detergents over the past two decades.

Household water pollution has been reduced over the years primarily by connecting more households to basic sewage treatment facilities and better treatment of wastewater. The total share of the population connected to public wastewater treatment plants in OECD countries rose from 51% in 1980 to almost 60% in the mid-1990s, although connection levels vary from under 10% to a high of almost 100% (OECD, 1997). Despite these improvements, household water releases are still projected to increase by 15% by 2020 for OECD regions. In Germany, 92% of the population is connected to public sewage systems and 87% of household sewage is treated in purification plants with three purification steps: mechanical, biological, and tertiary (advanced techniques). In the Netherlands, about 98% of the population is connected to the sanitation network. In contrast, only 23.8% of the urban population is connected to the sanitation network in Mexico: most discharged water goes back to rivers without any treatment, making water quality one of Mexico's most pressing environmental problems. 90% of water pollution comes from industrial activities; household wastewater represents only 9.5% of water pollution (Roemer, 1997 in Vilar *et al.*, 2001).

Households could contribute to reducing water consumption and pollution. When the combined consumption of households is lower, the sanitation network and purifying installations can be smaller and more efficient (Correljé, *et al.*, 2001). Solid and chemical pollution could also be reduced by using solid waste channels as much as possible, by choosing biodegradable soaps, shampoos and detergents, and by avoiding pouring oils and chemicals down the drain. Product modifications (low-phosphate detergents, pre-dosed soap tablets) are expected to continue to improve water quality in some countries (RIVM, 2000).

3.3 Water consumption drivers

Various factors influence water demand at the household level. Though they are all interrelated, some have strong influences in reducing water consumption, whereas others result in increased water demand. Pressure on water supply is mainly due to economic growth both at the national and household level and to demographic changes (increases in population as well as more single households). In some OECD countries there has been a de-coupling of economic growth from water consumption. In these countries, technology and environmental awareness, and to some extent water pricing (taxes), have been key contributors to reducing water consumption. In some countries, however, changes in behaviour are related more to environmental awareness than to economic incentives. This section analyses the main factors related to household water consumption.

3.3.1 Economic growth

Economic growth is the main driver for water use. The theory of the "Kuznet Curve" could be applied to the case of water consumption and management. At higher levels of GDP more households are connected to water networks[16] and to sewage systems for water treatment. On the other hand, higher household income is linked to greater water consumption and ownership and capacity of water appliances (*e.g.* showers, toilets, water heaters, dishwashers, washing machines, sprinklers, swimming pools). In 1995, 94% of the Dutch households had a washing machine and 17% had a dish washer; in 1998 the ownership of these appliances increased to 99% and 35% respectively (NIPO, 1999). This increase is linked to changes in lifestyle (longer and more frequent baths and showers, more frequent use of washing machines, increasing ownership of washing machines and dishwashers). However, in theory, in the long term, there is a point of high economic growth where investments will be made in better water technologies and systems to reduce water consumption per capita and water pollution. Also, in the long term, higher household incomes mean that more consumers can afford water-efficient appliances. In order for this to occur, however, there must be some external and internal incentives that promote water savings, such as environmental pressure, changes in regulations and markets, environmental awareness, increasing water prices, and/or accessibility of water saving technology, etc.

3.3.2 Market influences on household water consumption

Water pricing is an important incentive to reducing water consumption. Normally, governments employ two different methods for water pricing: water flat fees, and volumetric charges linked to individual water metering. However, evidence from the case studies countries suggest that water pricing is not the most influential contributor to reduced water consumption. Generally, households do not know how much they pay per unit of water, or perceived the cost as low. In the Netherlands, for example, a rise in water prices had hardly any effect on household consumption: 50% of the consumers surveyed had no idea how much they paid for water, and the majority considered water to be inexpensive (Table 12) (NIPO, 1999 in Correljé, *et al.*, 2001). However, 62% of the Dutch population still feels that water saving is necessary (NIPO, 1999). In Germany, there has been no connection between price and consumption except when price has risen dramatically. Like in the Netherlands, most German households (84%) are unfamiliar with both water and sewage prices as well as with their volume of consumption.

There is a debate about the role of metering to influence consumption, in Germany, individual water meters, combined with environmental information and awareness, have had a major impact in reducing water use, even if, as some surveys have reported, people request meters primarily for rational economic reasons. In the Netherlands, another important effect of water metering is that companies become more aware of their water losses (leakages) and, hence, repair them. In the Netherlands, research shows that metering of un-metered areas (where people pay a fixed amount depending on the number of persons in a given household) will lead to a 12% reduction of water use by these households (Year report 1998 Municipal Water Company Amsterdam). Hence, linking water price to consumption via water metering appears to strengthen the effect on consumer behaviour.

16. The connection of households to water networks is a social improvement in terms of both health and quality of life. Water is indeed a basic need that must be covered so it is necessary to consider the important impacts on society.

Table 12. People's Opinion about Drinking Water Prices

I think drinking water is...	***1995 (%)***	***1998 (%)***
Very cheap	9	5
Rather cheap	41	38
Rather expensive	20	27
Very expensive	2	2
No opinion	28	28

Source: NIPO survey, 1999.

3.3.3 Technological innovations

Recent product innovations that have improved the efficiency of water appliances have been one of the most important drivers for reducing water consumption. The strong influence of technological innovations (low-flush toilets, increased of water appliances and water metering) has promoted water savings even when consumers are unaware of water issues, and/or without changing lifestyles and behaviours.

In Germany, for example, replacing 12-litre with 6-litre WCs, accompanied by changes in regulation and standards for water appliances, brought water use for flushing down from 42% to 35% between 1976 and 1997. Water use for car washing and sprinklers dropped 3% over the same period, due to reductions on potable water use. Alternative behaviours have taken root, for example, using public car washes and rainwater collection systems to irrigate home gardens. Showering and bathing, laundry and dish washing have remained stable perhaps due to changes in cultural values (perception of cleanliness, more frequent use of washing machines) and technological developments (water efficient appliances) which may have neutralised each other (Table 13).

Table 13. Water Saving Appliances Used in Germany

Toilet Flushing:	Up to the 80s the DIN (Deutsches Institut für Normung – German Standards Institute) norms recommended a minimum volume of 9-14 liters. Since 1985, when maximum limits were established, water consumption has dropped on down to 3 liters per flushing.
Water saving showerheads	Water saving showerheads have contributed to reducing household water use 8 to 12% (Möhle, 1982).
Washing machines	In 1973 washing machines used it was 40 l/kg of laundry. Currently, washing machines are available that use 10 to 13 l/kg laundry.
Dish washer	In 1982, the average dishwasher used 60 liters per rinsing; a decrease of 10 to 30 % since 1972. Currently, the most efficient dishwasher uses 13-16 liters.

Source: Lorek, *et al.*, 2001.

In the Netherlands, although use of water saving technology is optional (contrary to energy performance), three technologies have become more or less standard in new houses: water saving toilets (from 10-litres to 4/6-litres), water saving shower heads (reduction of 10 m^3 per person per year) and low-flow tap systems (reduction of 2-3 m^3 water per person per year) (Table 14).

Table 14. Technological Innovation in Water Appliances from 1995 to 1998, Netherlands

Appliance	Water consumption in 1998 compared to 1995:	Effect on water use
Washing machines use less water:	from 97 to 87 liter per service	Less
Dishwashers use less water:	from 25 to 23 liter per service	Less
Flush-stop devices in toilets:	from 39% to 51% of households	Less
Smaller cisterns on toilets:	from 19% to 27% of households	Less
Switch from geysers to combi-boilers (for central heating + hot water):	geysers from 30% to 24%, combi-boilers from 41 to 50% of households	More
Water saving shower heads:	from 34% to 41% of households	Less

Source: NIPO market research, 1999.

3.3.4 Socio-cultural influences

Population growth and the increase in households, especially single households are important drivers behind increased water consumption. Smaller households use more water per capita than larger households (Table 15). Current trends indicate a likely increase in single households over the next 20 years in OECD countries, which may lead to an increase in water consumption.

Table 15. Water Use According to Number of People per Household, in the Netherlands

Number of persons	**Liters/*per capita*/day**
1	127,6
2	132,8
3	123,5
4	123,7
5	120,1

Source: NIPO, 1999.

A Dutch study analyses water consumption by age groups. Consumers between the ages of 13 and 34 tend to use more water than average (Table 16), mostly because they shower more often and for a longer period. Young children and elderly persons (65 years and older) use less water than average. Those between the ages of 18 and 24 use the most water for showering on average.

Table 16. Water Use According to Age, in the Netherlands

Age	**Liters/*per capita*/day**
0-12	113,7
13-17	137,5
18-24	149,6
25-34	134,5
35-44 s	125,9
45-54	125,1
55-64	129,7
65 years and older	118,6

Source: NIPO, 1999.

It is unclear as to whether young people's behaviour is "culturally determined" (related to a higher valuation of luxury) or whether it is associated with patterns of time spending (in which case they "grow out of it"). In addition, older generations accustomed to living in older houses, without baths, dishwashers, etc., may not have greatly modified their habits. In contrast, it could be expected that tomorrow's cohorts of elderly have become accustomed to the luxury of taking showers more often and to the use of all kinds of (garden and car cleaning) equipment and household appliances. They will not deprive themselves of these luxuries when they get older - in contrast, it can be hypothesised that they will be seeking an even larger recourse to such old age "aids". Consequently, a trend towards more intensive water use is possible (Correljé, *et al.*, 2001).

3.3.5 Individual behaviour

Data about more specific behaviour show that water consumption patterns may be the result of many factors, some of which lead to reduce, and others to more water use. Consumer behaviour is an important component. Some Dutch studies emphasise, for example, that household water behaviour (*e.g.* switching from bathing to showering, or taking fewer baths per week and shorter showers, reducing the use of washing machines and dishwashers) has more impact on reducing water consumption than does technology (see Correljé, *et al;*, 2001). These studies have shown that water savings from behaviour changes (reduction of 5.9 litres per capita per day between 1995 and 1998) has been greater than from water saving technology (reduction of 1.2 litres per capita per day) (Table 17). This is contrary to what most experts believe. However, behaviour and technology are not independent variables, since water saving behaviour will include installation of water saving devices. At the same time, consumers with wasteful behaviour are likely to overrule saving options, for example, by more frequent use of water appliances. As described above, domestic water consumption per capita has decreased during the past ten years in the Netherlands.

Table 17. Factors Determining Decreasing Water Use, in Liter per Capita per Day

	1995	1998	decrease	Increase	Penetration apparatus	Calculation differences*	Duration/ behaviour/ frequency
Bath	9,0	6,7	-2,3		+0,2		-2,5
Shower	38,3	39,7		+1,4	-0,2	+1,6	0
Wash-stand	4,2	5,1		+0,9	+0,1		+0,8
Toilet	39,0	36,2	-2,8		-3,4		+0,6
Clothes washing, hand	2,1	2,1					
Clothes washing, machine	25,5	23,2	-2,3		+1,1	-2,6	-0,8
Dish washing, hand	4,9	3,8	-1,1			+0,6	-1,7
Dish washing, machine	0,9	1,9		+1,0	+1,0	-0,2	+0,2
Food preparation	2,0	1,7	-0,3			+0,3	-0,6
Other	8,2	7,6	-0,6			+1,3	-1,9
Total	134	127	-9,4	+3,3	-1,2	+1,0	-5,9

*Difference in survey method between 1995 and 1998. In 1998 more precise methods were used to calculate water use of appliances.

Source: NIPO survey 1999. These data about domestic water use have been collected in a detailed consumer survey with a longitudinal character (every 3 years). Detailed figures, comparable between years, allow differences between behaviour and structural effects to be discerned.

In the Netherlands, 62% of the citizens consider water saving behaviour necessary (NIPO survey, held in 1998), although only 40% of the Dutch population were concerned about the environment (RIVM, 1999). This and other research shows that consumer behaviour varies across environmental themes and that access to water seems to be a relatively high priority. There has also been a significant change in attitude over time: between 1970 and 1992 environmental awareness grew to the point that environmental pollution was considered to be the second most important societal problem (criminality was first, economic growth, third). After 1993, however, concern for the environmental has dropped down to the seventh position in 1998 (after criminality, public order, social security, economical growth, freedom of speech and unemployment).

In Germany, responsible use of resources became a common cultural identity in the late 1970s and 1980s, and came to symbolise progress. Consuming a large amount of water is not considered a status symbol, and more expensive appliances – kitchen, bath and garden equipment – have become attributes of status for some lifestyle groups. Furthermore, awareness of the need not to waste water is a common issue in most households, and affects decisions of whether or not to buy water-saving household appliances or to install rainwater collecting systems for sprinklers. Nevertheless, because Germany enjoys a generally abundant supply of fresh water, water conservation is not at the forefront of most households' consciousness (Lorek, *et al.*, 2001).

Summarising Indicators for Household Water Consumption

Table 18 summarises the main drivers on household water consumption and their impact on behaviour and water consumption.

Table 18. Main Drivers of Household Water Consumption

DRIVERS	HOUSEHOLD BEHAVIOUR	EFFECT ON WATER CONSUMPTION
Population		+
Economic growth (GDP)	Connection of a larger percentage of households to the water supply networks. Investment in improving systems (leakage).	+
Per capita disposable income (together with environmental awareness or economic incentives)	More water appliances and uses: WC, shower, bath, washing machine, swimming pool, garden and lawn care. Purchases of more water efficient technologies and appliances.	+ -
Changes in Lifestyles (together with environmental awareness or economic incentives)	Rising "comfort" levels: more frequent use of showers, baths, washing machines; higher water temperatures Water conservation and efficiency practices	+ -
Technology	Water saving appliances such as showerheads, 6 litres WC, more water efficient washing machines.	-
Price (Fees, taxes, metering)	Greater awareness of the "cost" of water	-
Environmental Information and Awareness	Careful use of water	-

3.4 Identifying policy responses on sustainable water consumption

Many policies have been implemented aiming at reducing household water consumption. Most OECD countries have based their water policies on the "full cost recovery" principle and the Polluter Pays Principle. This section analyses some of the policy responses on sustainable household water consumption. Section 3.4.1 analyses the institutional framework for water supply and management; section 3.4.2 presents some policies based on standards for water quality and efficiency; section 3.4.3 analyses the polices on water pricing and metering and, section 3.4.4 looks at policies on public information and water saving campaigns.

3.4.1 Institutional framework for water supply and management

Water is considered a public good as well as a public monopoly in the three countries studied. Generally, the national (federal) state promulgates water legislation, and the municipalities have the responsibility for water extraction, distribution and treatment. Municipalities can offer concessions to the private sector under certain conditions and for specific services. In the Netherlands, for example, 20-25 companies supply water to nearly 100% of households. Individual public limited companies (PLC's) produce, distribute (through pipelines) and sell water directly to customers. The transport of wastewater from households to water treatment facilities is a municipal task, while wastewater treatment is in the hands of government water boards. The Netherlands is now working to integrate the entire water chain, so that the operational tasks of water boards, municipalities and drinking water companies are linked, preferably into one organisation. Apart from other advantages, such as economies of scale, integration is intended to lead to combine billing of households which, in turn, should lead to better awareness by households of the "real" costs of water use.

In Germany, water is under independent regulation in the 16 German Länder, and this is reflected in the water and wastewater regulatory framework. The objectives of the German water policy are: the principle of full cost covering, the regular investment in pipe systems as well as in water and purification plants, the reduction of environmental impacts of water abstraction, and the prioritisation of closed water systems. In Germany, water companies are in charge of water abstraction and public water supply. On average, 88 water suppliers serve 1 million inhabitants. However, further analysis shows that 3.6% of suppliers offer 60% of drinking water to nearly 50% of household consumers. On the other end, 4500 small suppliers have an 8.2%. share of the public water supply. Communities normally hold a majority of the shares of the water companies (only 1.6% is entirely in private hands). During recent years, there has been a trend towards privatisation, which currently is under debate.

Participation of the private sector (PLC's) in public water supply and the policy of "full cost recovery" in many countries have improved water technologies, infrastructure, and supply service. This is the case in the Netherlands and Germany where private sector investment, coupled with pricing structures that cover the cost of providing clean water, have resulted in sufficient and high quality water distribution and treatment infrastructure. In Mexico, where the lack of capital [estimated at 1.2% of GDP (CNA, 2000)] is one of the major obstacles to maintaining and improving water supply and treatment infrastructure. Private sector involvement would be stimulated by the removal of subsidies across all sectors and by a regulatory framework that clearly defined the responsibility of different actors in the water sector. The involvement of private sector in the water companies should also be evaluated in terms of the private incentives to promote water savings outside periods of water savings.

On the other hand, the question as to whether or not potable water should be used for toilet flushing should be addressed. This is currently a public debate in the Netherlands. The purpose would be to save the best water (groundwater) for 'higher' purposes, such as drinking water. This, however, would require construction of a second pipeline network in addition to the existing water network. The economic and environmental cost analyses show that it would be viable and effective in some cases but not in others, thus indicating that the decision should be made at local level.

3.4.2 Regulatory framework for water quality and efficiency

The regulatory framework is a vital catalyst for water management, household water quality standards, as well as for technological improvements. Many OECD countries and the EU are working on new regulations and are setting new and higher standards for eco-efficient water appliances (toilets, washing machines, etc). Likewise, governments have been active in the provision of information for households on responsible water consumption. These have motivated technological improvements, often through voluntary initiatives. More widespread use of water efficient appliances could be achieved by mandatory appliance efficiency requirements (minimum performance levels) for new and refurbished buildings and combined with more information to consumers (*e.g.* water-efficiency labels for households' appliances, information on efficient lawn watering and gardening practices, etc). These measures will be of particular importance in countries such as Mexico where water consumption per capita is increasing, but also in those countries where technological options have improved but where consumer use patterns (frequency and duration of water use) are still water-intensive.

3.4.3 Water pricing and metering

There is a clear trend in the household sector away from flat-fee pricing structures, towards individual uniform volumetric tariff systems. Currently, most OECD countries use two-part tariffs (*i.e.* with fixed and volumetric components), with the volumetric portion making up at least 75% of the total water bill (OECD, 1999*a*). There is a continuing increase in the use of household water metering. Nearly two-thirds of OECD Members already meter more than 90% of single family houses, and some countries are now expanding their metering of apartments. This is the case of Germany and the Netherlands, where the majority of households have water metering.

Household water supply and sewage disposal prices have generally increased, and significantly so in a few countries, especially in highly industrialised countries. There is a stronger desire to obtain "full cost recovery" in the provision of water services. This is accompanied by significant reductions in both total subsidies and cross-subsidies between different user groups. And, even where subsidies exist, there is now more emphasis on the need to make these subsidies transparent, as is the case in Mexico. Concerns about the affordability of household water services have led to the development of several innovative "social" tariff structures, many of which contribute to both environmental and economic goals at the same time (OECD, 1999).

Some governments have promoted the uptake of water-efficient appliances through targeted subsidies. In the Länder of Hesse, in Germany, for example, subsidies supported consumer purchases of water-saving kitchen and bath equipment and the installation of apartment water meters. However, the general success of this subsidy is controversial, because water consumption per capita declined to the same level in other Länder over the same period, without the use of financial instruments.

In recent years, most OECD countries have been striving to raise the price of water and decrease subsidies to water use in order to reflect the full cost of water service provision. This is the case of the Netherlands and Germany. Price adjustments have largely been the result of pressures to finance essential

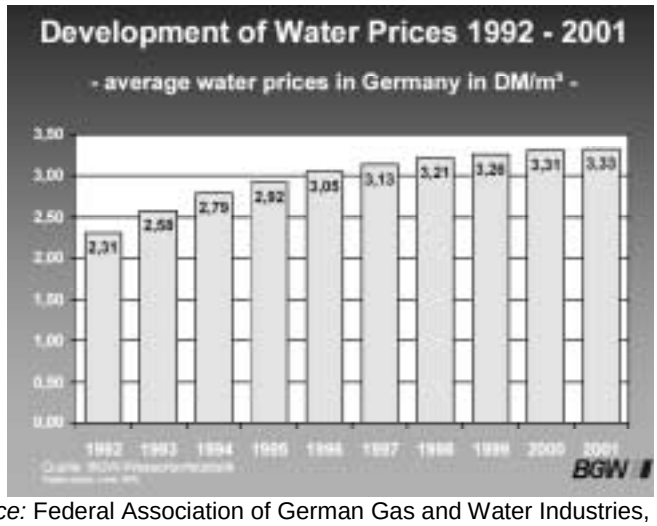
water infrastructure repairs, extensions, and operating costs, but also reflects a growing desire to manage water demand in the face of potential scarcity and to employ the Polluter Pays Principle in wastewater charging systems. Despite increased water prices, few OECD countries achieve full cost recovery of the operating and maintenance costs of water services provision, not to mention any additional environmental or social externalities. However, it is important to note that most *increases* in the cost of water have been for domestic water supply and sewage treatment prices, with significant price increases occurring in some countries. In contrast, water for irrigation is still associated with the lowest charges and the highest subsidies in most OECD countries: as a result a price increase on irrigation water could have a significant impact on water savings and efficiency (OECD, 1999).

In some countries, there is resistance to applying full cost pricing to domestic water service because of social equity concerns (and the risk of reducing popular support, as it is the case on energy taxes). In Mexico, for example, subsidies to household water are as high as 80%. In addition, there are legal barriers to cutting off supplies to households that do not pay their water bill. However, OECD analysis has indicated that more widespread use of household water meters and the use of innovative water tariff systems in some countries has resulted in the simultaneous achievement of equity and full cost recovery. This approach can provide strong incentives to minimise water use, particularly when price increases are combined with domestic metering (OECD, 1999).

In Germany, the legal framework governing water pricing is based on a number of principles derived primarily from the Municipal Charges Acts (Kommunalabgabengesetze) of the 16 Länder, and Municipal budget legislation. Water pricing principles essentially prescribe that water prices and sewerage fees shall be neither below nor substantially higher than the real costs of providing water services (including operational costs, maintenance, depreciation). In general the calculation of sewage fees is based on the cost covering principle. However, as for water treatment, there is an eco-tax on wastewater withdrawals that has been in effect since the 1970s to motivate sewerage companies to invest in treatment plants. The amount of the charge is a political decision, and has increased over time (from 6.13 Euros-12 DM) per m^3 in 1981 to 56 Euro (70 DM) per unit of pollution in 1998.

Water prices increased significantly in the beginning of the 1990s, for technical and structural reasons (*e.g.* technical infrastructure). Hence, households in the New Länder suffered a radical increase in the cost of water. Notably, this is one time that an increase had a dampening effect on consumption, and is assumed to be due to the size of the increase over one year (Figure 23). Price increase rates have since declined from 11% in 1992 to 0.6% in 2001.

Figure 23. Development of Water Prices 1992 – 2001

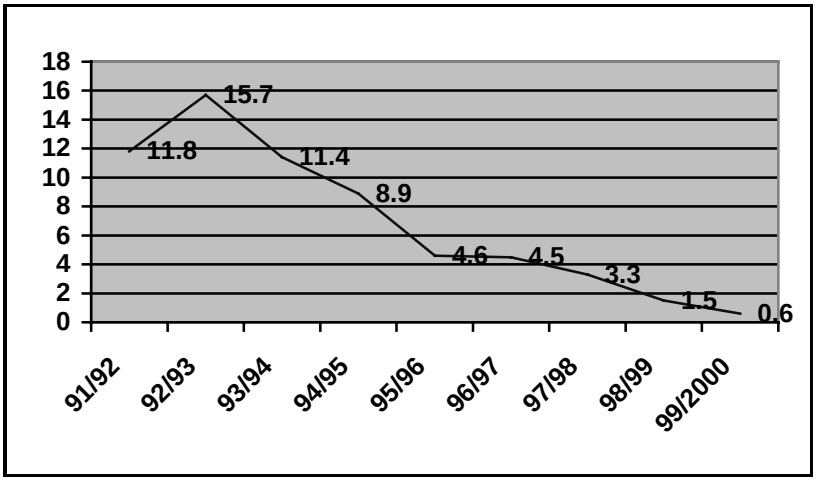


Source: Federal Association of German Gas and Water Industries, 2001.

Although German households perceive water prices as being relatively low, the average price per m³ in Germany is the highest in Europe. A German household spends on average 8% more per capita than an average European. One reason for this is linked to the fact that up to 90% of total costs for water supply are independent of the amount consumed, so supply companies have to compensate for losses in turnover through increased prices to cover their costs (Federal Environmental Agency, 1998, in Lorek, *et al.*, 2001). This represents a new problem that might have negative impacts on water saving behaviour.

The average fee in Germany per m³ sewage was 2.26 Euro (4.43 DM), totalling on average 113.5 Euro (222 DM) per year/person. In addition, inhabitants had to pay approximately 1 DM per day in 2000 for water use and disposal (0.6% of the available income for water and 0.7% for sewage or, in total, 1.3%) (Lorek, *et al.*, 2001). Sewerage fees are calculated by the communities according to connection costs, fixed charges and a volumetric rating system. In 60 % of communities, sewage fees are divided and depend on the volume of freshwater consumed in the household on the one hand and on the amount of rainwater calculated via the surface area of the estate on the other hand. Prices of sewage increased by 70% since the beginning of the 1990s, in 2000, although the rate of increase slowed (Figure 24).

Figure 24. Development of Sewerage Fee Increase



Source: Data Federal Association of German Gas and Water Industries; Figure Lorek, SERI.

In the Netherlands, the price of water changes according to the source of abstraction and the area that is supplied. Drinking water prices vary from 0.81 to 1.27 Euro (1.80-2.80 NGL) per m3 for drinking water from groundwater sources, and 1.36–1.80 Euro for drinking water from surface water. In more densely populated areas, distribution efforts are less expensive, so companies serving larger cities will charge less for the service than those in rural areas. Another factor is individual metering: installing, monitoring and repairing water meters costs a significant amount of manpower, so companies operating without water meters offer more affordable prices.

Table 19. Example of Consumer Expenses on Water in Guilders per Year for an Average Family of 4 Members

	Drinking water (average household use 108,6 m3/year)	Drinking water: (% of average income)	Sanitation tax (transport of grey water)	Sanitation tax: % of average income	Water board tax (purify grey water and water level management)	Water board tax (% of average income)
Lowest	230	0,3%	59	0,08%	315	0,4%
Average	375	0,5%	199	0,3%	375	0,5%
Highest	525	0,7%	352	0,5%	538	0,7%

Source: Consumentengids (Consumers Guide) august 1999 and November 2000 and CBS Statline.

Note: Average household income* 1999: 77,600 Dutch guilders) *in CBS Statline a household is 2, 3 persons, in the Consumers guide it is 4 persons.

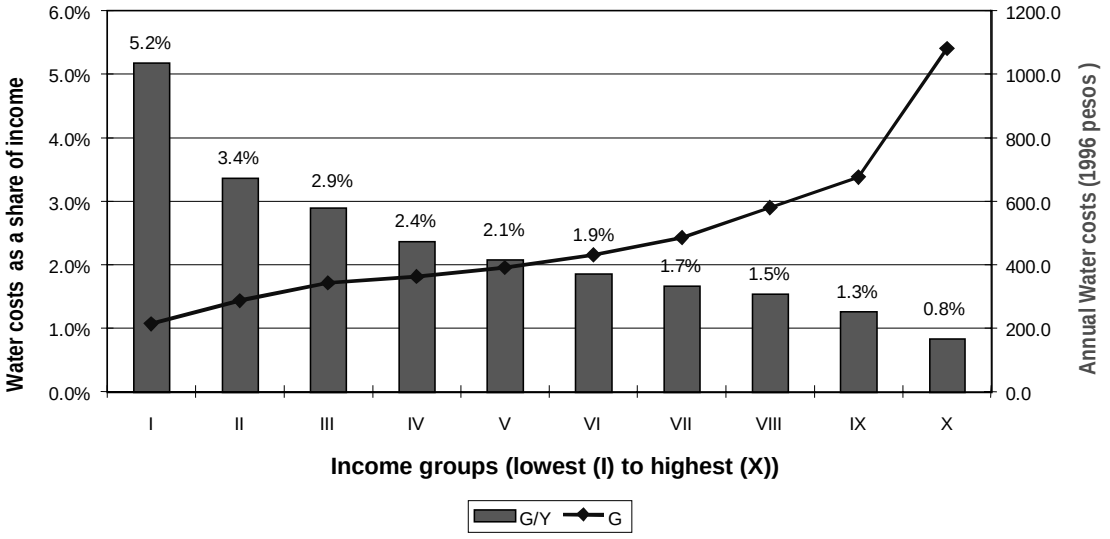
In the Netherlands, there are three types of water taxes: a national tax on groundwater extraction, a provincial tax on groundwater and a VAT (19,5%). The first type of tax concerning groundwater aims at encouraging water companies to switch to surface water as a source. This has worked on occasion, but the considerable price difference between surface and groundwater represents an incentive working in the opposite direction. One of the criticisms of this tax is that it serves the total Dutch tax budget and is not reserved for groundwater management purposes. The provincial tax was even less significant from a consumer viewpoint, but on the income side it has had a positive effect, since provinces are, as a result, able to invest in better groundwater management. The VAT on drinking water was formerly set a low tariff of 6%, but since 1 January 1999 the high tariff (referred to as the eco-tax) has been in effect. To compensate low income groups, the parliament chose to apply the 6% tariff to the first 60 NLG of the water bill. The VAT has not had a significant impact on water consumption because the water price is still perceived as low. The total average spending on water per household is approximately 1% of the average income. On the other hand, the taxes have resulted in 'water flight', where farmers and industries cut their contract with the water companies and install their own groundwater source, sometimes in an inexpensive and unprofessional way so that groundwater protecting layers of clay are damaged. For example, one water company in the Netherlands estimated that their sales declined by 3 million m^3 because of water saving, and by 3 million m^3 because of water flight (a total of 80 million m^3 per year). This is an important aspect to consider, because since there are many private companies involved in water supply, their incentives to promote water saving are null or very low, except when there is water scarcity.

In Mexico, water is highly subsidised, not only for households, but also for industry and for agriculture. The former is subsidised by 80% and the latter by 100%. This is one factor that influences higher water consumption and at the same time, is one of the major reasons for the low public infrastructure for water management and for poor water quality. Currently, in Mexico City, the local government pays 8 pesos (almost US$1) for the abstraction and distribution of each m^3 of water to supply households. Nevertheless, the levy (recaudacion) that year was 0.94 pesos per m^3. In other words, the local

government is subsidising 88.25% of the real cost, and not including the costs in energy for pumping the water to Mexico City (2 500 meters high), or the costs of maintenance and management of the water network (CESPEDES, 2000).

The government uses two different water fees: a flat fee (fixed fee) and water metering. The latter includes social aspects, taking into consideration differential tariffs according to the socio-economic level of the neighbourhoods. Normally, increases in water fees are determined by the inflation rate (15.9% in 1998). However, a study realised in 1999, reported that 20 out of 32 regional states, had an increase in the cost of water superior to the inflation rate, and 6 states inferior. Water subsidies and the fight to obtain fair water prices have very often been on the public agenda for debate, one of the main obstacles being the resistance of both politicians and citizens who base their arguments on the cultural idea that water should remain a free public good. On occasion, social issues such as poverty come into the debate, suggesting that removing subsidies will have negative repercussions on low income families. However, various studies have shown that very often low income districts and rural areas inhabits have to pay more for water, than a household in a rich urban area. This is the case of the district (neighbourhood) Tláhuac in Mexico City. It is a marginalised area, where households are not connected to the water networks. These households, sometimes, obtain water from illegal connection or superficial sources. However, many times they are forced to buy water, having to pay higher prices for private distribution of water. This district ends up paying 30% more for water than a high income household in the same city (Cespedes, 2000). Low income households pay a larger proportion of their income for water (Figure 26).

Figure 25. Average Water Expenses (G) per Year according to Deciles (Y)



3.4.4 Information and water saving campaigns

Providing information and educational support to assist water consumers in increasing water use efficiency and reducing pollution can be a powerful policy tool. Programmes already exist in some countries to inform households of measures they can take to reduce their water use. The latter include the development of water-efficiency labelling schemes for household appliances, and information on efficient lawn watering and gardening practices. In general, these instruments are more effective when coupled with water pricing tariffs, which provide an economic incentive to reduce water consumption (OECD, 1999).

Public information campaigns on water conservation have been widespread in many OECD countries over the past three decades. In the Netherlands, for example, information campaigns are considered to have been a key element in the stabilisation of household water demand (Correljé *et al.*, 2001). One Dutch study estimated that although the difference between concerted conservation efforts and the average is only 10 litres/person/day, it reaches 40 litres/person/day compared to behaviour that incites no conservation efforts whatsoever (Table 20). New research suggests that after ensuring the uptake of water-efficient technologies, the greatest saving potentials can be obtained through providing information to identified target groups to modify individual behaviour (*e.g.* showering, laundry, etc). Metering of individual water consumption and a clear water bill are important instruments for providing information.

Table 20. Self-Reported Behaviour of Consumers

Behaviour:	***Average liter per person per day***
Very careful	120,5
Not very careful	131,5
Not careful at all	160,2

Source: NIPO, 1999.

Virtually every channel for consumer education has been used in the past to support water saving initiatives (mass media, pubic campaigns, education at schools, the internet, outdoor manifestations, eco-teams, etc). Some of these activities have been effective, but often the challenge is how to provide information in the most effective manner so that it can be transformed into action[17]. The use of commercial information channels is a recent development (*e.g.* eco-labels for energy and water efficiency on household appliances). The co-operation of retailers is required for such measures, but this remains problematic. Retailers lack interest and knowledge about environmental qualities of their products, which can discourage even the environmentally aware customers. They do not always volunteer information to clients who are unfamiliar with the impact of environmental friendly actions.

Experiences of water shortage in Mexico and Germany have been important catalysts for water saving campaigns. In the early 1980s, information about the first German regions to experience acute water shortages, and scenarios of further depletion and effects on fresh water resources, showed their results: more and more consumers accepted and demanded water saving equipment and less harmful household chemicals (Lorek, *et al.*, 2001). In Mexico, the Environment Ministry and the cultural TV Channel 11 are currently working on a public campaign for water saving that includes 10 different TV spots, with the potential to reach 31 million citizens. The logo is “Por Principio, cuidemos el Agua” (As Principle, let’s take care of water). There has not yet been an evaluation of its impact on consumers.

3.5 Conclusions

Households are relatively low consumers of water compared to other sectors in most OECD countries. As a result, on an aggregate scale, greater efficiency and conservation gains could be made by addressing more users, particularly those in the agricultural sector. At the same time, water is the one area where consumption trends are stabilising or declining in some countries. It is useful to draw comparisons from this situation to other areas of household consumption where environmental impacts are intensifying. Lessons can be drawn, for instance, from the combination of policy instruments that have influenced household water consumption, in particular full-cost pricing, government standards and voluntary agreements with water companies to increase the availability of water-efficient household plumbing and

17. For more information see OECD, Background Paper on Information for consumer Decision-Making for Sustainable Consumption. Paris, 2001. Available in www.oecd.org/env/consumption.

appliances. In countries enforcing these policies, water conservation has become an integral part of household behaviour without imposing a significant burden on household decisions or routines. However, these experiences also suggest that once technology has been optimised, additional gains in water conservation programmes will have to come from information-induced behaviour change in order to reduce the frequency and duration of household use of water services.

Within households, the most water-intensive activities are baths and showers, toilet flushing, followed by laundry. These are also the most promising areas for reducing water consumption and should be the focus of further policy initiatives to maximise it and to seek for the most effective tools to promote sustainable water use at the household level. In designing policy, attention should be given to the main drivers on household water consumption. Section 3.2 presented the several of these, including those that help to reduce consumption (technology, information, environmental awareness, water price and metering), and those that increase water use (economic growth, water intensive lifestyles, population growth). Governments should provide a clear regulatory framework (for water abstractions, distribution, pricing and treatment) in order to guarantee efficient water services and quality to households. They are market regulators, and should correct market failures and provide economic incentive for more eco-efficient water systems. Policies (cross-sectoral) need to be applied at the same time to:

- Ensure a clear regulatory framework, with high social and environmental standards related to water (*e.g.* eco-efficiency, eco-labels, water quality standards, regulations for building construction) and that is enforced.

- Provide incentives for the participation of the private sector, in order to improve water infrastructure, distribution and treatment.

- Apply "full cost recovery" fees when supplying households with water, taking into consideration social aspects (low income households, and poverty).

- Set higher standards on appliances for water efficiency, and cover a wider range of appliances thus promoting technological innovations.

- Provide clear and accurate information on water issues to citizens, and

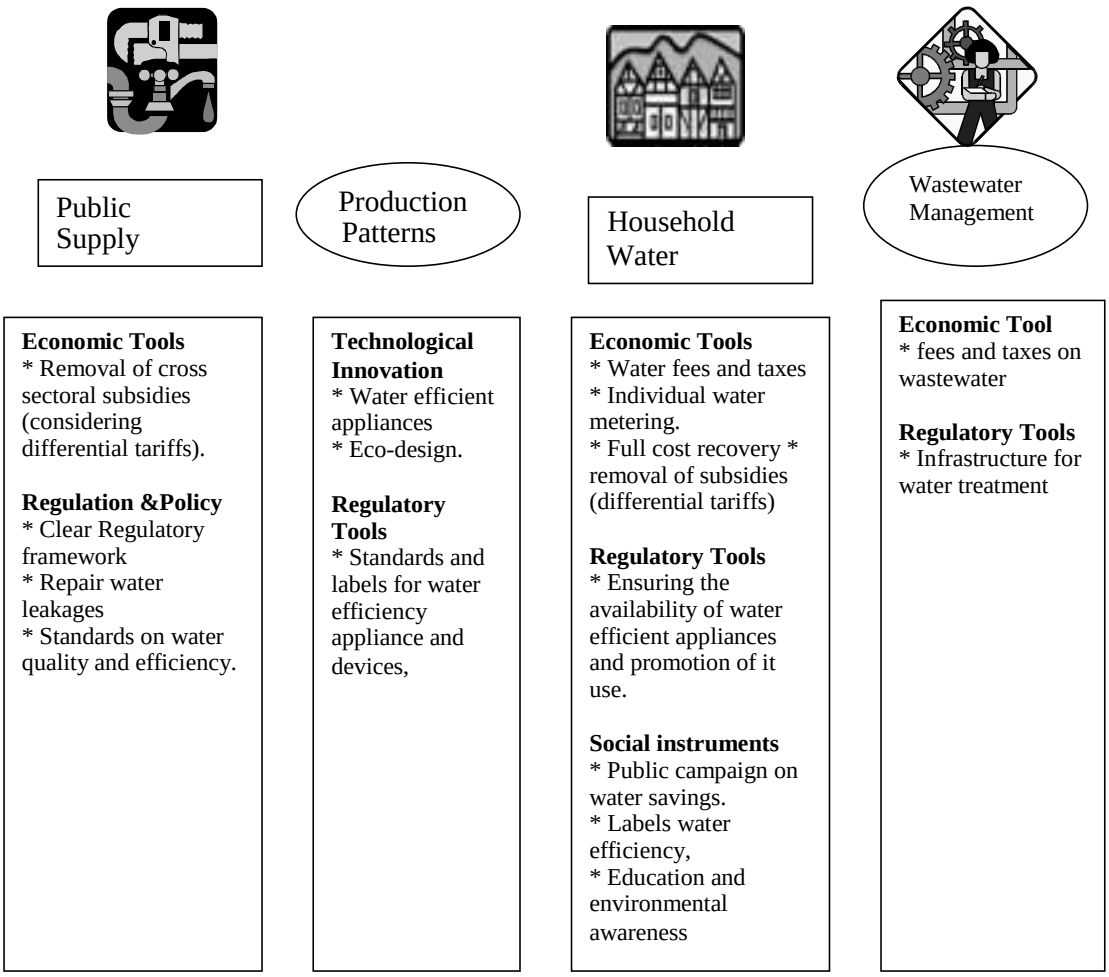
- Raise environmental awareness in general, but also in the more specific area of water.

The examination of water policy in both Germany and the Netherlands provides good examples of policies that have achieved reductions in household water consumption per capita and decreases in the absolute public water supply. A combination of factors have helped to reduce water consumption and pollution, such as technological innovations, policy regulations, economic instruments (private investment, water pricing based on full recovery cost and on individual water metering), public information and environmental campaigns, as well as behavioural changes in water use at the household level. Although, household water consumption is no longer an environmental priority in these two countries, in order to maintain a stable (or even decreasing) level of water consumption per capita further efforts may still be required, such as regulating water standards for new constructions, and up-dating the programmes on water efficiency and public information for responsible water use. In addition, more campaigns are perhaps needed in order to influence those citizens that still waste water, although the costs of reaching this group (likely to be high) would need to be measured against expected benefits.

The case of Mexico shows how low water prices provide poor incentives to (or impede) better water technologies for both water supply and water treatment. It also highlights the importance of private sector investment in water management systems, and the considerable consequences of placing such high

subsidies on water, not only for households, but for all sectors, particularly agriculture. Priority steps in Mexico, then, include the removal of subsidies, changes in the regulatory framework, implementation of the social tariff structure, but also major efforts to increase public information and environmental awareness in order to change the widespread cultural resistance to paying for the real costs of water supply services and treatment.

Figure 26: Government Policies for Sustainable Water



CHAPTER FOUR. HOUSEHOLD WASTE GENERATION

4.1 Introduction

De-coupling municipal waste generation from economic growth represents an environmental priority for the next two decades (OECD, 2001*a*). Waste represents an inefficient use of material and energy resources and is a source of environmental pollution. Total and per capita household waste generation levels in OECD countries are increasing along with economic growth. In the future, both municipal and industrial waste are expected to show high growth rates. While many measures have been taken to improve waste management systems (*e.g.* waste fees, recycling infrastructure, targets for recovery, information, etc), major efforts are still needed for waste prevention[18]. Most OECD governments have been shifting waste strategies from simple collection and disposal to a "waste hierarchy" with a primary emphasis on preventing waste generation. Although landfill is still the most widely used method of waste disposal, household participation in waste recycling schemes are at their highest levels ever in many countries. In other countries, however, municipal waste management has not changed in any significant way: recycling systems are poor, and there is a lack of economic capital to improve the infrastructure and technology for more environmentally friendly waste management.

In OECD countries, households generate on average 67% of municipal waste loads - with a range of 41% to 96% - (OECD, 1999). In the Netherlands, 71% of municipal waste comes from households, in Mexico 75% and Germany 80%. In preventing household waste and improving its management, governments have always faced the problem of how to reach consumers who are in many ways "a diffuse source of pollution". However, it is probably more useful to look at the whole picture of the "*waste chain*" *(the waste generation within production (packaging), consumption patterns, waste collection and waste management)* and to see individual consumers more widely as "co-actors" who interact with and are connected to both the production side and the waste management systems, as the theory of "collective systems of provision" suggests. In this light, it becomes clear that the way governments help shape and transform the *waste chain* either enables or obstructs household behaviour towards sustainable waste management. In countries that have implemented recycling schemes for example, households have become more active in waste management by sorting waste, transporting it to collection centres, and even composting. A small group[19] of more environmentally aware households also seek more environmentally friendly products and less packaging. In contrast, in countries where municipal waste management has not changed significantly, and where recycling systems are poor, the lack of infrastructure and economic capital impede any action taken by households.

This chapter presents household waste generation patterns and the *waste chain* in OECD countries, and particularly in the three case study countries: Germany, Mexico and the Netherlands. Section 4.2 describes household waste generation patterns and trends. It also analyses the environmental

18. Waste prevention refers to the strict avoidance of waste, reduction at source and/or product re-use. (OECD, 2000a)

19. See OECD (2001) Background paper on Information and Consumer Decision Making for Sustainable Consumption, Paris. (Available in www.oecd.org/env/vonsumption)

impact of waste generation, which depends on the volume and type of waste, but especially on the kind of waste management system used. Section 4.3 looks at the key drivers of waste generation and management. Section 4.4 analyses some policy responses in the three case study countries. This Section highlights the importance of developing a policy package for waste prevention and minimisation including: a clear regulatory framework, economic instruments, investment in technology and infrastructure, and social instruments (information and environmental education).

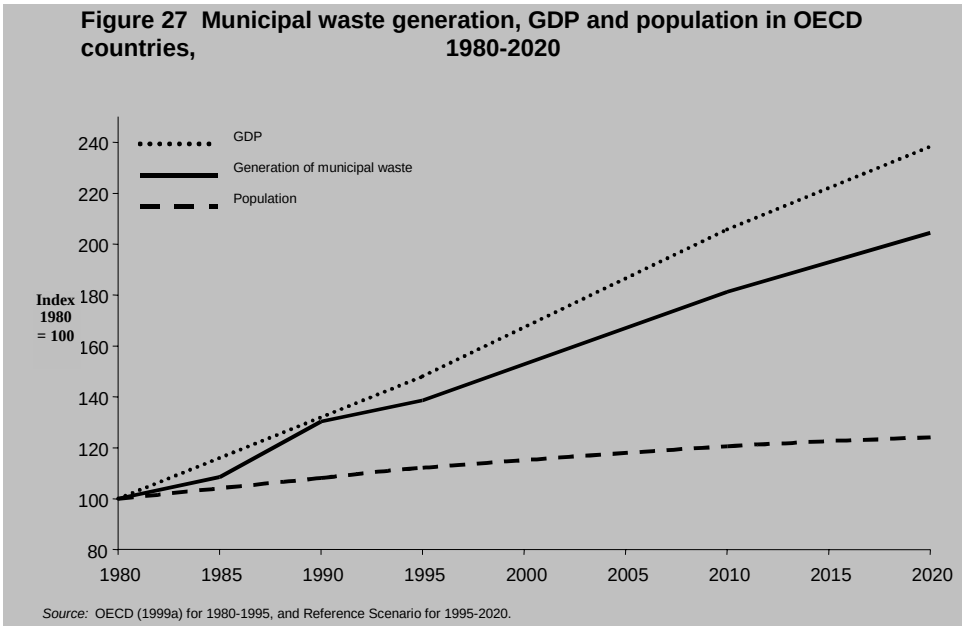
Data on household waste are generally difficult to compare or aggregate, because definitions and surveying methods vary considerably across countries and over time. Household waste generation refers to the waste produced by households. It is the major component of municipal solid waste, but is often not possible to clearly separate household waste from that produced by other actors, such as small businesses and services.

4.2 Household waste generation and its environmental impacts

4.2.1 Municipal waste generation

Along with economic growth and changes in production and consumption patterns waste generation has steadily increased over the last twenty years in OECD countries. Since 1980, municipal waste generated in OECD countries has increased about 40% in absolute terms, and about 22% on a per capita basis. In 1997, OECD countries produced 540 million tonnes of municipal waste annually, corresponding to about 500 kg per person. Projections for OECD countries estimated that by 2020, municipal waste generation will grow another 43%, amounting to 770 million tonnes, which would be 640 kg per capita (Figure 27) (OECD, 2001*a*).

Figure 27. Municipal Waste Generation, GDP and Population in OECD countries, 1980-2020

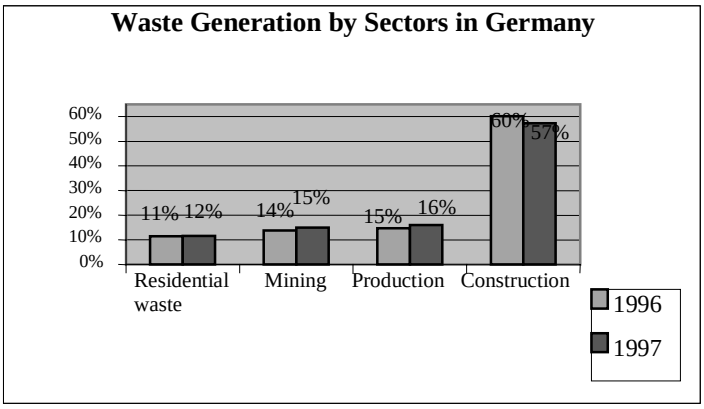


Source: OECD, Environmental Outlook, 2001.

* Note: Estimate excludes Eastern Germany, the Czech Republic, Hungary, Korea, and Poland.

While the total amount of waste generated has continued to increase, the average annual growth rate slowed. Generation of municipal waste increased on annual average 1.8% between 1980 and 1985, and 3.6% between 1985 and 1990 and about 1% between 1990 and 1997 (Stutz, *et al*., 2001). These trends should be interpreted with caution however, because they may also reflect changes in data quality and coverage. In Germany, Mexico and the Netherlands the total volume of waste at both national and municipal level is increasing. Municipal waste accounts for around 12% to 15% of total annual waste in these countries, compared to an OECD average of 14%: inferior to OECD averages for industrial waste (25%), and agriculture and forestry waste (21%), but equivalent to mining (14%) and construction (14%) waste. (OECD, 2001*a*). In the future, in OECD countries both municipal and industrial waste are expected to show high growth rates, while waste generation from the agricultural and mining sectors is expected to grow at a slower rate to 2020.

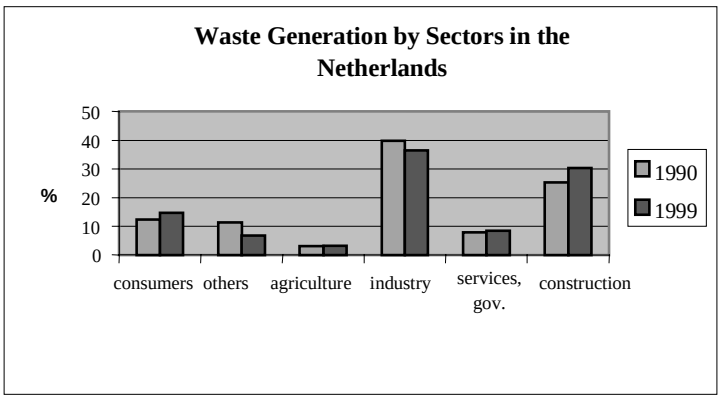
Figure 28



Source: Federal Statistical Office Germany, 2000.

In Germany, the total waste generation increased from 354 million tons in 1991, to 387 million tons in 1997 In 1997, 57% of waste generated at the national level came from the construction sector, followed by production with 16%, and mining with 15%. Municipal waste represents 12% of the total waste generated, 1% more than the previous year (Figure 29).

Figure 30



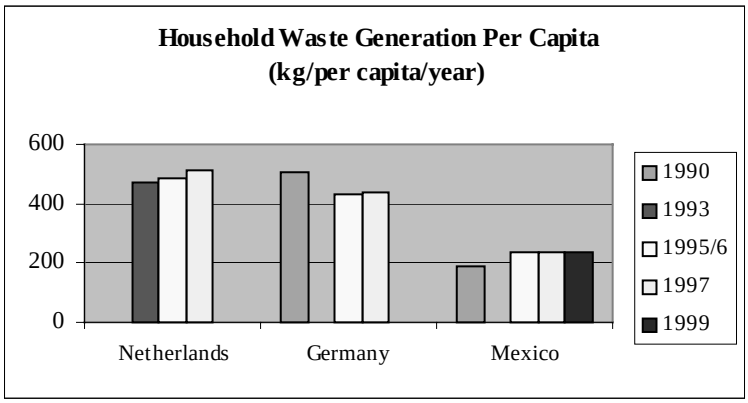
Source: RIVM/CBS (2000).

In the Netherlands, total waste generation grew 12% from 1990 to 1999. Although the industrial sector has managed to reduce waste generation it is still the main source of waste generation (36%) followed by the construction sector (30%) (Figure 30). The household sector represents around 15% of total waste generation. (RIVM/CBS, 2000), but is growing faster (2.4%) than other sectors, besides construction (5%). The share of household waste has being increasing over the last twenty years and increased from 12.3% to 14.7% from 1990 to 1999. From 1985 to 1998, the overall weight of household waste generated in the Netherlands rose by 55% (RIVM, 2000).

4.2.2 Household waste generation per capita

Not only is the total weight of household waste increasing (which could be explained by to an increase in population), but so is the amount of waste per capita. In the 1990s, in the Netherlands, waste generation per capita increased 9.5%. (from 470 kg to 515 kg); and 26% in Mexico (from 190 kg to 240 kg). In the OECD region, average municipal waste generation per capita grew 29% in the EU and 22% in OECD region between 1980 and 2000, and is projected to grow by another 30% by the year 2020 to 640 kg/capita in OECD region (OECD, 2001*a*). In Germany, it is difficult to estimate household waste per capita,[20] since waste statistics changed in 1994. However, it is generally claimed that per capita waste generation has fallen since 1990, from 508 kg/per capita to 435 kg/per capita in 1997. However, other data show an increase from 429 kg/per capita in 1996 to 435 kg/per capita in 1997 (Federal Statistical Office Germany, 2000*)* (Figure 31).

Figure 31



Sources: Mexico: INEGI, 2000. Netherlands: RIVM, 1993-98. Germany: Federal Statistical Office Germany, 2000.

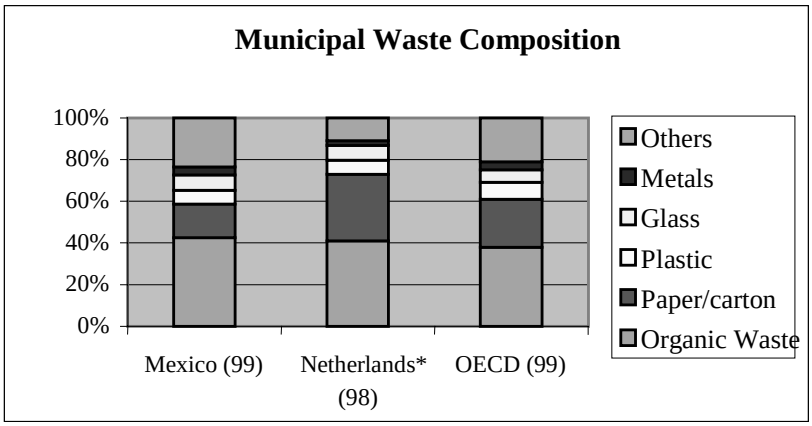
4.2.3 Household waste composition

The composition of municipal and household waste has significantly changed over time. The primary components of municipal/household waste are organic (garden and food residue)(38%), paper and

20. Precise figures are not available to quantify waste flow trends in Germany. Waste statistics at the national level were not really organised until 1994, when major restructuring of the system occurred with the adaptation of the Environmental Statistics Act. Even now, since responsibility for waste management monitoring is at the Länder level and co-ordination between federal and Länder government is weak, the availability of national data is poor (OECD, 2001, *Environmental Performance Reviews: Germany*, Paris).

paperboard (23%), followed by plastic (8%), metals (4%), and in smaller proportions, textiles and bulk waste (durable goods, renovation waste, furniture, electrical appliances, containers) (OECD, 1999). Households also produce very small amounts of hazardous waste, such as aerosol cans, paint, batteries, and home and yard chemicals (0.5%) (Figure 32). In the Netherlands, household organic waste represents 41% of total weight, followed by paper/carton with 32%.

Figure 32



Source: Mexico: Sancho y Cervera (1999). Netherlands: RIVM: 1998 [adapted by Grombault (2000)]. OECD: OECD Environmental Data, Compendium 1999.
* Note: Data on the Netherlands refers to household waste composition, not municipal waste.

There is a clear trend towards increasing packaging for household goods, including pre-packaged foods and food service packaging (Figure 33). This trend began earlier than most might realise. The term "throw-away society", which many equate with current lifestyles and consumption patterns, was established in 1955 – even before the idea of plastic packaging (Brower and Leon, 1999, in OECD, 2001*b*)[21]. In Mexico, the volume of disposable products and packaging, especially plastic, paper and glass increased by approximately 5%, 3% and 1% respectively from 1991 to 1997, while organic waste decreased by approximately 8% (Table 21).

21. Household food losses occur because of over-stocking, over-preparation, plate waste, cooking losses and misunderstanding of quality defects and label interpretation (such as "sell-by" dates or expiration codes). On the other hand, food wastes, as a share of municipal waste, have declined, although the absolute amount of food waste in the waste stream has increased. The relative decrease of food waste in municipal waste is due to better storage (refrigeration, packaging) and also to a greater consumption of processed food, which contributes to increasing tonnage in paper and other materials food packaging (OECD, 2001b). See OECD (2001) Household Food Consumption: Trends, Environmental Impacts and Policy Responses, [ENV/EPOC/WPNEP(2001)13/FINAL]. Available in: www.oecd.org/env/consumption.

Figure 33

Source: Kauffman and Chevrot 2000.

Table 21

Evolution of Household Waste Materials in Mexico 1991-1997(%)

Waste sub-products	1991	1997	Change in the period (%)
Organic Waste (food and garden)	53	45	- 8
Paper/carton	14	17	+ 3
Glass	6	7	+ 1
Plastics	4	9	+ 5
Metals	3	4	+ 1
Textiles	1.5	2.1	+ 0.66
Others	19	16	- 3
TOTAL	100	100	

Source: Sancho y Cervera J., Rosiles .(1999).

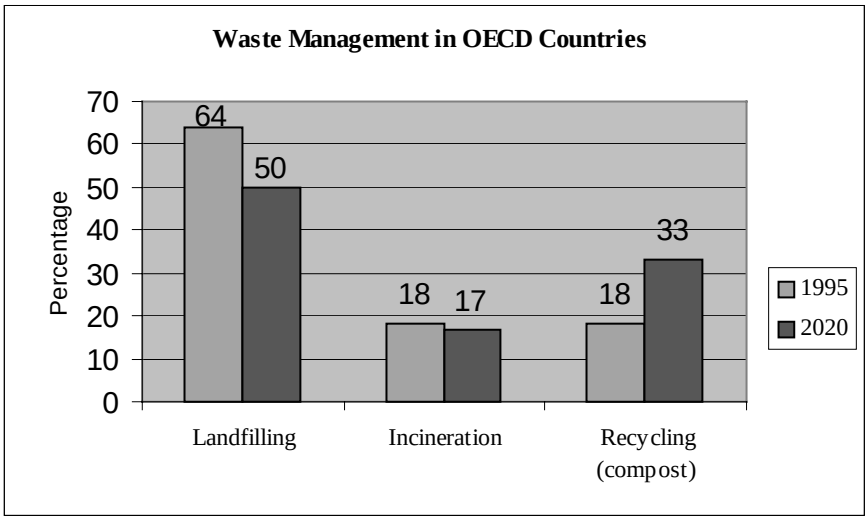
4.2.4 Household waste management systems

There are various systems for waste management and they vary country by country. Most OECD governments, especially in Europe, are shifting waste strategies from simple collection and disposal to a "waste hierarchy" approach with an emphasis on preventing waste generation, followed by recovery systems and finally environmentally sound disposal only for non-recoverable waste. Recycling schemes have been implemented in many municipalities that provide the necessary infrastructure (containers, special bins and sometimes special waste bags) and information to households. Enabling households to take part of the waste management system (sorting waste for recycling and composting) as *co-actors* and not only as passive citizens.

In the mid-1990s, 95% of the population in OECD countries had access to organised municipal waste management services. Approximately 64% of municipal waste went to landfill, 18% to incineration and 18% to recycling, including composting (OECD, 1999). Although landfill is still the most widely used method, recycling has increased considerably in most OECD countries. Continued implementation of waste management policies is expected to help to further reduce landfilling and increase recycling in the future. According to the OECD Scenarios (OECD, 2001*a*), over the next 20 years, the municipal waste

management situation is likely to change considerably. By 2020, about 50% of municipal waste is expected to be landfilled, 17% incinerated, and 33% recycled (Figure 34).

Figure 34. Municipal Waste Management in OECD Countries, 1995-2020



Source: OECD (2001), Environmental Outlook, Paris.

Some countries, such as Germany and the Netherlands, have introduced the concept of extended producer responsibility (EPR) with regard to waste collection and/or recycling of items such as used packaging, batteries and/or tyres. Composting biodegradable waste has also become a major option for reducing the total volume of waste sent to disposal, but is still limited to a few countries. Energy recovery is gradually becoming an integral part of incineration. In the mid-1990s, over 50% of municipal incinerators in OECD regions were equipped with energy recovery systems. Environmental standards for landfilling and incineration have been strengthened in a number of OECD countries (OECD, 2001*a*).

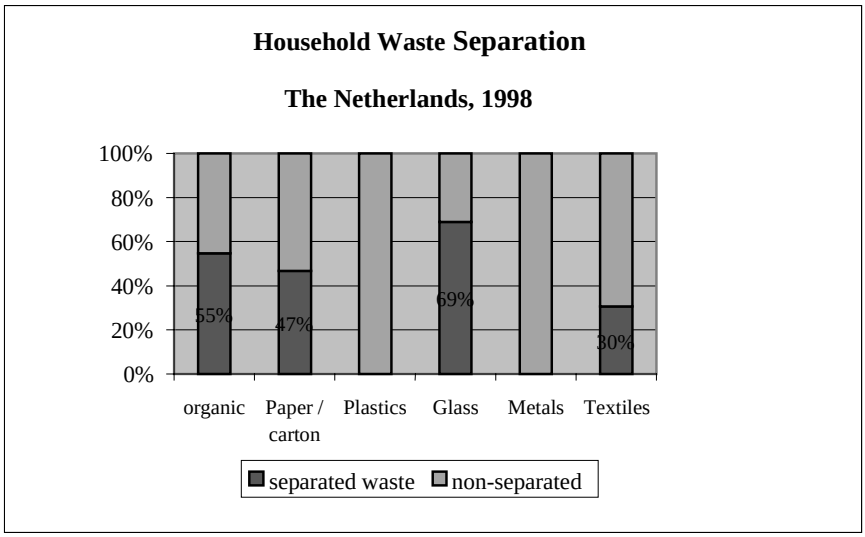
Differences appear at the national level. Germany and the Netherlands have fully fostered the waste hierarchy approach, and developed integrated policies for waste prevention and waste minimisation. Whereas Mexico, as a less industrialised country, still faces problems for the implementation of environmentally sound waste management. Moreover, still 20% of the Mexican population does not have access to municipal waste collection. This is mainly due a lack of economic capital, and an inadequate regulatory framework.

Waste Management in the Netherlands and in Germany

Waste separation and recovery rates in Germany and the Netherlands have increased over the past 30 years, varying widely depending on the materials. In the Netherlands the regulatory framework obliges the separate collection of waste (of paper/carton, glass, textiles, organic waste, packaging, toxic waste, and a rest non-sorted waste). In Germany, the legislation offers take back possibilities for packaging waste (no obligation to make use of them); for all other substances it is the deliberate decision of the local authority as to which kind of fraction to collect separately (toxic, organic, etc.). In the Netherlands, the percentage of waste collected separately rose from 13.3% in 1985 to 45.2% in 1998 (RIVM, 2000) (Figure 35). This is to some extent the result of more categories of waste being collected separately

(recently: organic and textiles), but also the result of the provision of infrastructure, increasing environmental awareness and participation of households in recycling schemes.

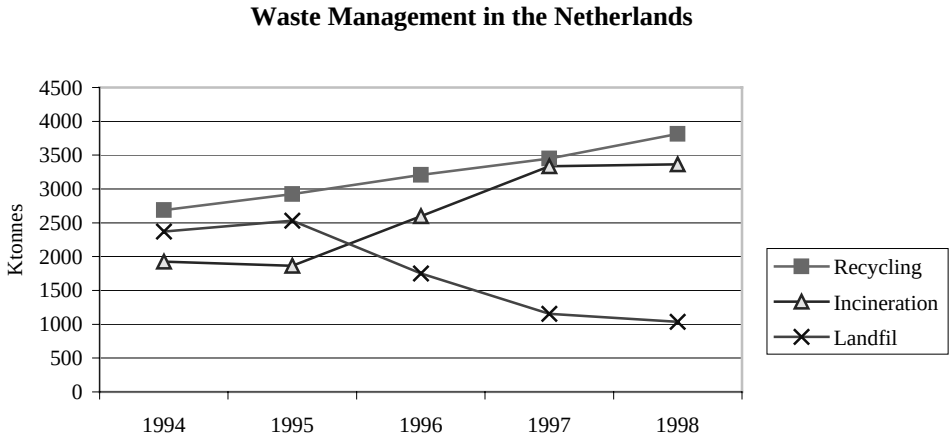
Figure 35



Source: RIVM, 2000.

The Dutch waste recovery rate (via recycling and incineration) has increased from 41% between 1994 and 1998 alone, while waste going to landfill decreased over the same period (Figure 36). Given the specific circumstances of limited space in the Netherlands, high groundwater levels and weak soils, waste policies aim at shifting from landfilling to waste recovery and incineration. Despite the improvements in waste management, however, the total amount of waste generation is still increasing.

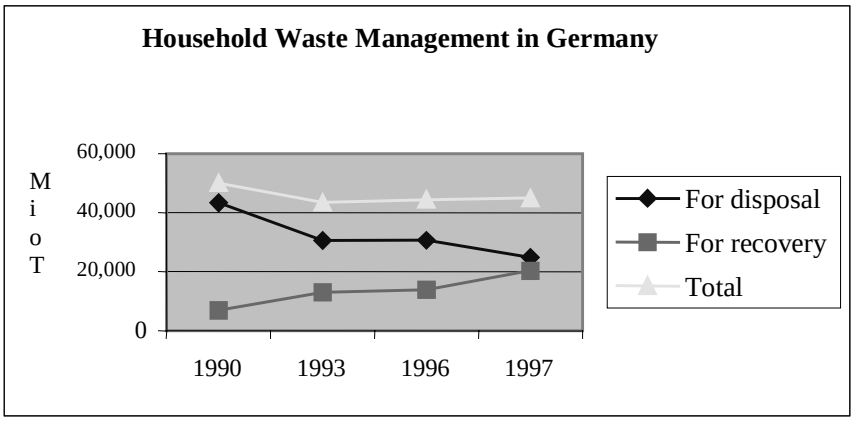
Figure 36



Source: RIVM/CBS, Adapted by Grimbault, 2000.

In Germany, waste recovery rate has also increased considerably. About 14% of household waste was recovered in 1990 and 45% in 1997 (Figure 37). Recycling and incineration are increasing, and a small proportion of waste goes into composting plants. In Germany, paper is the largest fraction of separately collected waste (*e.g.* newspapers, magazines, writing paper, and paper packaging): 10.3 million tonnes were collected in 1999, of which approximately 25% came from households (UBA, 2000. in Lorek, *et al.*, 2001*a*). Glass, which is the second important component of waste recovery in Germany, has been collected separately since 1974. In 1999, per capita glass collection was 39.2 kg, of which 85% came from households. In 1984, Germany set up the separation of organic waste for composting (kitchen and garden waste), originally, a pilot project now the third important component of recovered waste. Currently, about 35% of German households have a separate bin for organic waste. In 1997, 3 million tonnes of organic waste were collected, and 8 million tonnes in 1998. The responsibility for the introduction, collection and treatment of organic waste is in the hands of the local authority. Notwithstanding progress in recycling, the total amount of waste generated by households is still rising.

Figure 37



Source: Federal Statistic Office Germany, 2000.

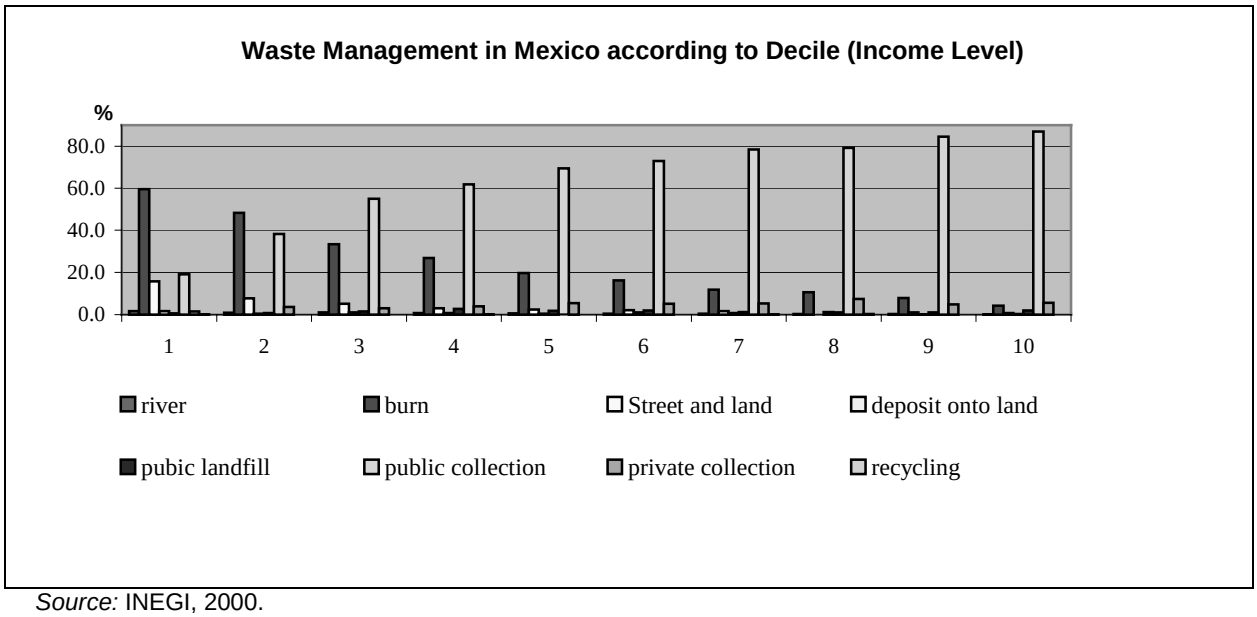
Waste Management in Mexico

Mexico, presents a very different picture. Although it has the lowest level of waste generation per capita among all OECD countries, it also has the lowest rate of recycling (1%): 99% of the waste is sent to landfill (OECD, 2001*d*). Waste management is still based on simple collection of mixed waste for landfilling or dumping[22]. Only 80% of the population have access to a municipal waste collection service[23] (INE, 1999). For the other 20%, who are mainly rural communities and low income neighbourhoods, waste is generally burned or thrown into rivers, public parks, streets or illegal dumps. This is mainly due to a lack of economic capital, infrastructure and technology, as well as a lack of a clear regulatory framework and enforcement. In Mexico, only 50% of the waste generated is disposed of in a environmentally sound manner (Figure 38).

22. "Dumping" refers to disposal of the waste on or into the land, without major technology to avoid air, soil and water pollution. In Mexico, this is called "tiradero a cielo abierto".

23. Household waste collection systems in Mexico cover only 70-85% of rural areas and about 95% in urban areas. At the national level this shows that 20% of the localities do not have access to a waste collection service (INE, 1999).

Figure 38



Source: INEGI, 2000.

Recycling rates in Mexico are very low, between 1% and 5% (mainly paper, glass and aluminium). There are no household separation or recycling systems. The few materials that are recovered are sorted by "pepenadores" (workers that sort waste) from collection vehicle and landfills under very unhygienic conditions, and without any technology. However, there have been some governmental pilot projects for composting, but the results were not successful due to the high costs of operation and the lack of a market for compost. The regulatory framework for waste was re-structured in 1990 but the country still faces several obstacles to private sector investment, and the implementation of waste recycling and recovery systems. These aspects are analysed in the following sections.

4.2.5 Environmental impacts of household waste management

Waste represents an inefficient use of both material and energy resources. It is also a source of pollution and land degradation when inappropriately managed. The environmental impacts of waste generation and management are diverse and vary upon the quantity of waste and the type of material (organic, plastic, paper, metal, etc) generated, but particularly the kind of waste management systems used. Waste separation and recovery, and better technologies for landfill and incineration plants reduce the environmental impacts of waste. But even these waste management processes entail certain environmental impacts, including land use, air, soil and water pollution and greenhouse gas emissions. Hence, reducing the impacts of household waste requires preventing waste generation, increasing waste recovery (via recycling and incineration-with energy recovery), and disposing of any remaining waste in an environmentally safe manner. This is in fact the approach of the waste hierarchy[24], that has been fostered by the EU which is being rapidly implemented in OECD countries, remarkably in Scandinavia, the Netherlands and Germany.

24. The waste hierarchy suggests that the first step to reduce the environmental impacts of waste is *prevention.* Secondly, *material recovery* (recycling). The third step, is *energy recovery* (incinerators with energy recovery systems), the last option, is the *final disposal* (in environmentally sound landfills).

The comparative evaluation of the environmental impacts of the waste management process is difficult.[25] As a result, the discussion below identifies only the general environmental impacts related to waste generation and treatment.

Air pollution and Greenhouse Gas Emissions

The environmental impacts of waste on air pollution and greenhouse gas emissions depend on the type and quantity of waste and the waste management technology used. Waste incineration causes emissions into the air. The main air pollutants released through incineration are acidic gases, polyaromatic hydrocarbons, dioxins and furans, dust and heavy metals (OECD, 2001*a*).

Waste incineration can reduce waste mass by up to 70% and waste volume by up to 90%. Incineration can also recover energy and reduce some negative environmental impacts such as methane. In the EU, emissions from incinerators were reduced after 1990 by the closing of many small incinerators, the introduction of cleaning systems, and higher temperature incineration (which reduces the release of toxins). However, despite these benefits waste incineration is criticised because of outstanding environmental burdens caused by flue gases (dust, carbonates, NO_x, SO_x, and dioxins), solid residues (fly ash, flue gas gypsum, slags and ashes containing heavy metals, chlorides and fluorides), restricted acceptance and utilisation of solid residues, and high investment and treatment costs resulting in high waste treatment fees for inhabitants (Lorek, *et al.*, 2001).

Landfills and waste dumps contribute to greenhouse gas (GHG) emissions. Waste-derived GHG emissions comprised 2% of total GHG emissions in OECD regions in 1998. Landfills and dumps accounted for 34% of methane emissions in 1998. According to the OECD Environmental Outlook, waste derived methane emissions in OECD regions will increase by 20% from 1995 to 2020. In non-OECD countries, where waste generation is expected to double. Landfilling is expected to continue being the main disposal method, waste-derived methane emissions are projected to increase by about 140% over the same period. These emissions can be mitigated either by avoiding landfilling of organic matter or by collecting and utilising the gas at the landfill sites. The EU and some other OECD countries have already introduced, or plan to introduce general bans on landfilling organic waste (see Section 4). Efforts have also been made to establish gas collection facilities at existing and new landfill sites (OECD, 2001*a*).

Soil and Water Pollution

Another environmental and health problem related to waste treatment is soil pollution, which, in turn, often leads to the pollution of ground and surface waters. Waste dumping (direct disposal on or into the land) and landfills without adequate environmental safeguards can leach toxic substances and nutrients. The extent of these problems varies according to the type of waste, the construction, and the hydro-geological conditions of the landfill sites: dumps are the poorest waste management option in terms of water, land and air pollution, and the loss of energy and resources.

25. Many approaches for evaluation have been developed and date back to the late 1960s. Today there are different standards, methodology and approaches (*e.g.* Life Cycle Analysis) to describe the environmental impacts of a product or a technical process, but no consensus exists on the best methodology and definition. Naming and scope of the subsequent steps of analysis differ from country to country and from institute to institute. The OECD and the EU have been working on the harmonisation of these issues.

Environmental Benefits of Recycling

The recycling of many materials has significant environmental benefits. For example, every ton of iron or aluminium recycled, not only replaces a ton that would have been mined, but also avoids several tonnes of "hidden" material flows associated with the extraction and processing of these metals (Adriaanse, *et al*., 1997 in OECD, 2001*a*). In addition, recycling requires only a fraction of the energy needed to produce these metals from primary ore. The following energy savings have been reported for products using recycled rather than virgin materials: aluminium 95%; copper 85%; lead 65%; zinc 60%; paper 64%; and plastics 80% (BIR, 1998 in OECD, 2001*a*). However, other studies pointed out that the total energy and material investment for recycling plastics can be several times as high as the total savings in energy and material achieved in the process (Lorek, *et al.*, 2001).

4.3 Household waste generation drivers

Household waste generation patterns are the result of a diverse set of driving factors that shape the day-to-day and long-term decisions that households make in their everyday life. The most influential drivers on increasing household waste generation are economic growth, consumption patterns, product prices as well as production systems. There are other drivers that contribute to reduce waste generation and increase household participation in recycling schemes such as eco-design, provision of recycling facilities, environmental awareness. This section will analyse the drivers for both household waste generation and household waste management (mainly participation in recycling schemes).

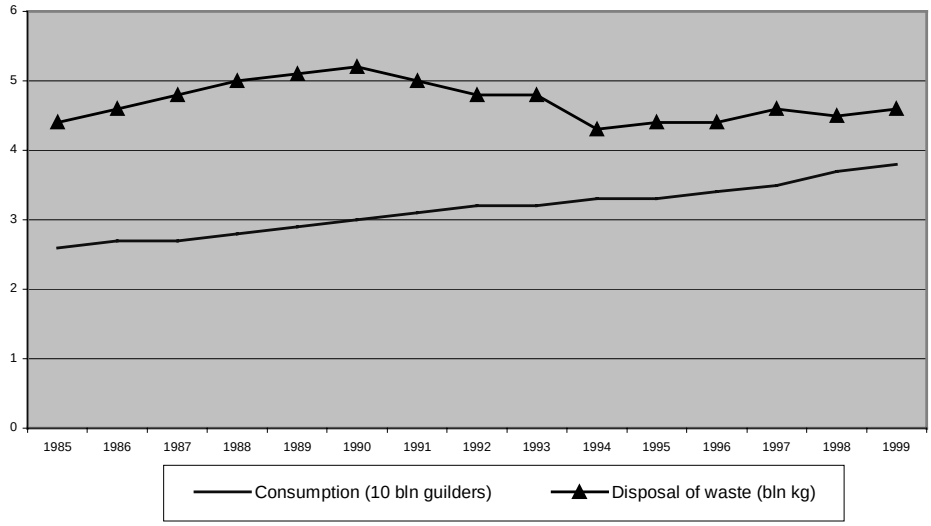
4.3.1 Economic drivers

Economic Growth

Many factors shape household demand for different goods and services of which two primary determinants are current and expected future income and the prices of goods and services. The steady rise in income after the Second World War, strong urbanisation, globalisation of trade and rapidly developing information technology have stimulated private consumption, and led to an increase in the generation of municipal waste (Stutz, *et al.*, 2001).[26] Historically there has been a strong link between private final consumption and municipal waste generation: to date, there is not evidence of a de-coupling of waste generation from economic growth. Although waste management systems are more environmentally friendly, the fact that more waste is being recycled does not mean that the volume of waste generated is being reduced. Whereas overall consumption steadily increased in the Netherlands from 1985 to 1999, the total weight of household waste to be disposed of roughly remained constant over the same period because a larger percentage is going to recycling, but total waste generation is still increasing (Figures 39 and 40).

26. For further information on waste generation and economic growth see Christian Fischer (1999), and Vagn Isaksen (1999) articles in http://www.etc-waste.int/

Figure 39. Disposal of Household Waste and Consumption, in the Netherlands



It has also been seen that the generation of municipal waste is higher in urban areas than in rural. In Mexico, for example, the generation of waste (food waste, paper and plastic) is higher in areas with more economic growth and urbanisation. Mexico City alone produces 14% of national municipal waste. An average resident in Mexico City (which has the highest levels of economic growth in Mexico) produces 485 kg of municipal waste per year, almost double that of an average Mexican in South Mexico (area with the largest index of poverty)[27] (Table 22).

Table 22

Municipal Waste Generation by Geographical Zones in Mexico.

Zone	Population (projected 1998)	Generation per Capita (kg/capita/year)	Annual Generation (ton)
Centre	51,117,711	287.6	14,702,565
Mexico City	8,683,824	485.0	4,212,465
North	19,501,930	325.2	6,342,240
South	12,615,849	247.8	3,039,721
North Border	6,347,055	348.9	2,214,455
Total (National)	98,266,369	311.3	30,598,315

Source: Sancho y Cervera J., Rosiles G., 1999.

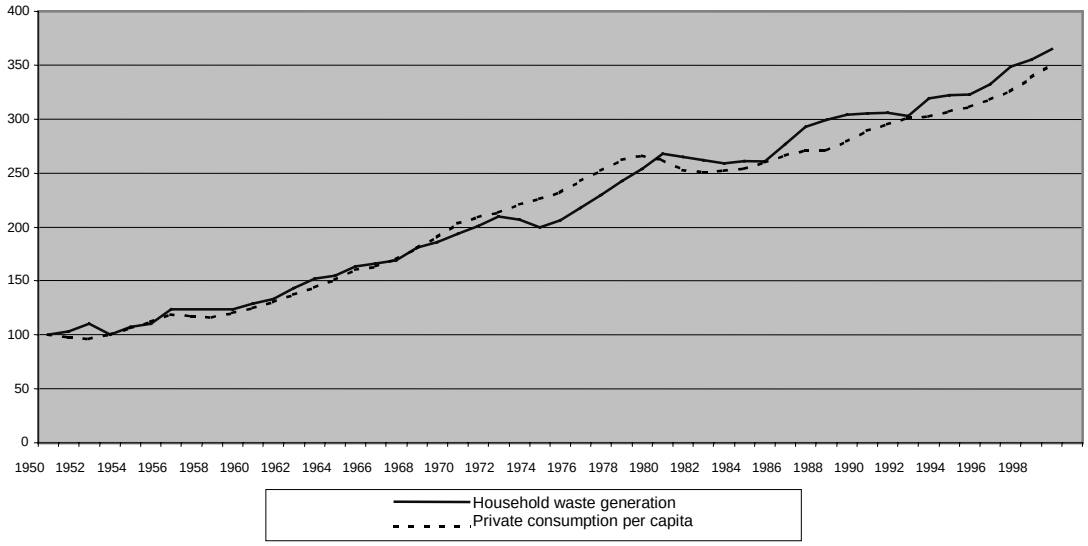
27. In average, municipal waste generation per capita in 1998 was 485 Kg in Mexico City, where in the South of Mexico, this number is only 248 kg (Sancho and Cervera, 1999 in Vilar, 2001).

On the other hand higher economic growth (GDP) allows for the better development of cleaner technologies and better environmentally friendly waste management. A clear trend in OECD countries is the shift from landfill to recovery systems.

Household Income

An increase of household income leads to an increase of consumption of product and services, thus greater potential for waste generation (depending on the structure of consumption) (Figure 40). Since 1950 in the Netherlands, there has been a steady increase of consumption and a linearly related growth of waste generation per capita. While some analysts have argued that higher income could lead to better purchasing decisions and lower waste generation, empirical evidence suggest that the this correlation exists only in the case of single pollutants, not for mass flows like waste, waste water or CO_2 emissions. Nevertheless, the observation in some cases is that high-income citizens can afford to pay the premium for "green" products, mainly organic food (although the main concern for organic food could be health and not the environment[28]), recycled or recyclable products. The same might occur for products with less packaging (there is no evidence for this effect yet).

Figure 40. Household Waste Generation and Private Consumption per Capita



Source: RIVM/CBS, 2000.

4.3.2 Technology and infrastructure for waste management

Infrastructure and technology are vital drivers for better separation, recycling and disposal of waste. The provision of the optimal recycling infrastructure is a crucial factor for household participation in recycling schemes. There are two types of waste collection systems for household waste: "*collect systems*" and "*bring systems*". In the former, waste is collected -either mixed or sorted- at the household door. In some countries, like Mexico, mixed waste is still collected, there is not a collection system for sorted waste. In countries where recycling systems are in place, households are asked to sort their waste in

28. See OECE (2001). Household Food Consumption Patterns. Paris.

separate bags, or bins. This waste is collected directly at the household door by the municipality or private company.

In the case of *bring systems*, citizens are asked to bring their sorted waste to the appropriate containers (glass, paper, packaging, and textile) which are located close to the households (a few metres). For other kinds of waste (including toxic and often bulky waste) central collection stations have frequently been set up. In this case the provision and location of containers has an important influence on household participation. Participation is much lower when its involves a high level of effort in significant opportunity costs (*e.g.* distance to collection centres). For example, in Mexico, some communities have pilot recycling systems (*e.g.* Grupo Bio in Mexico City, Carlos Padilla in Morelia, Sociedad XXI in Oaxaca). Citizens who participate in these schemes are very committed to the environment, as demonstrated by their willingness to bear the costs of transporting their waste to the recycling centres. However, the commitment of even these consumers has been lost through the high costs of sorting, storing and bringing the waste to the recycling centre.

4.3.3 Demographic and cultural drivers

Many socio-cultural aspects influence household waste generation and waste management, such as demographic trends (*e.g.* population, age structure, single households, labour force, more/less hours of work, etc) education, cultural values, access to environmental information and environmental awareness. The most important socio-demographic influence on waste generation are population growth, the increasing number of single households and the increasing participation of women in labour market. That influences consumption of pre-prepared and packaged food.

A Dutch study (SCP, 1999), has examined what social-demographic characteristics influence environmental behaviour. Out of several variable (household size, age, income, education and urban/rural) age alone shows to be strongly correlated with waste separation behaviour. Citizens older than 65 separate substantially more than all other (younger) age groups. A survey in Germany reported that 91% of Germans sort their household waste. Women (93%) are slightly more enthusiastic sorters than men (90%). While 92% of the over-thirties separate their waste, 16 to 29-year-olds are not so devouted. Only 87% of them make use of the possibilities available for separating waste. 84% of single people separate and sort waste, whereas this figure is 93% for families (DSD, 2001).

4.3.4 Information and environmental awareness

Information and environmental awareness are important factors for reducing the amount of waste by inciting consumers to purchase fewer packaged products, or to participate in recycling schemes. Comprehensive efforts at recycling have become somewhat of an environmental "badge" in some countries Sorting waste and recycling have become icons of "green identity" (Chappells, *et al*. 2000). A Dutch survey on environmental behaviour of citizens, for instance, reported that the majority of the citizens interviewed related their environmental behaviour with waste prevention and recycling actions (Table 24). A recent Dutch report of the Sociaal Cultureel Planbureau (2000) confirmed that waste separation, buying environmentally friendly products and waste prevention are widespread and are linked with an attitude characterised by environmental awareness.

Nevertheless, experience shows that the provision of an adequate infrastructure for recycling system that does not represent high opportunity costs to households, are stronger influences on behaviour than environmental awareness. Waste separation systems in the Netherlands, as well as in Germany, for example, is organised in such a way that even people that do not consider themselves as "environmentally aware" sort (recycle) their waste. Table 23 shows environmental behaviour among Dutch people. The

purchase of returnable bottles (drinks in returnable glass packaging) has decreased over time, while waste separation is increasing. Trends in areas of "green" behaviour are mixed.

Table 23

Environmentally conscious behaviour of citizens in the Netherlands, 1994-99						
	1994	*1995*	*1996*	*1997*	*1998*	*1999*
	% of citizens					
Environmental behaviour						
Buy drinks in return glass packaging	72	70	71	71	70	68
Bring waste glass to waste container	90	91	91	90	90	90
Separate household organic waste	66	76	77	80	78	76
Separate garden waste	61	70	74	92	92	92
Bring chemical waste to collection point	81	83	83	86	85	84
Separate paper and carton	86	87	89	89	89	89
Use own bag when shopping	82	82	82	80	80	79
Source: RIVM, 2001.						

Information is also an important driver for increasing environmental awareness and for helping people participate in recycling schemes. In all countries where recycling systems have been implemented, governments (often at the municipal level) and NGOs have provided information to consumers on waste separation and have used different communication channels (*e.g.* workshops, direct assistance, telephone, providing written material, etc).

Table 24

Drivers for Households Waste Prevention and Recycling		
Driver	**Waste Generation**	**Waste Management (recycling)**
Economic Growth Household Income	**+** **+**	More environmentally sound systems for waste management. More waste is recovered, less is disposed. Better household participation in recycling schemes.
Technology and Infrastructure for waste management.	**-**	Eco-design could prevent waste generation. Technology could improve recycling schemes and waste management systems.
Environmental Information & Awareness	**-**	More and better participation in recycling schemes, which facilitates its management.
Demographic changes (population growth, more single household, more female labour force).	**+**	

(+) more waste, (-) less waste

Table 24 summarises the main drivers for waste management. Major ***economic growth*** leads to more waste generation (there has not yet been a de-coupling of waste generation from economic growth), but it may also lead to better waste management systems. Increasing ***household income*** also leads to more consumption, thus a major potential of waste generation. On the other hand, increasing household income (linked to better education and environmental awareness) leads to better participation in recycling schemes. ***Technology and infrastructure*** are vital factors for better waste management, and in fact, the appropriate

and well designed provision of recycling facilities seems to be the major driver for household participation in recycling schemes. ***Environmental awareness and information*** are important drivers for reducing waste generation and increasing household participation in recycling. **Demographic aspects** such as population growth, and more single households are drivers for increasing waste generation.

4.4 Policy responses to household waste management

Growing attention has been given to waste-related environmental problems. The OECD is encouraging a shift in policy towards the prevention and minimisation of waste generation. This approach requires that both the products and infrastructure change (the so-called "*hardware*" for consumer behaviour, which requires actions by governments and business) as well as the attitude of the consumers towards purchasing and using alternative goods (the "*software*" for consumption behaviour). An *integrated approach* is required (taking into account all phases of the product life cycle and all relevant stakeholders), resulting in different *policy packages* for different cases. Generally speaking, *upstream intervention* (economic and regulatory instruments targeted at producers) should be strengthened in order to reduce the effort needed by consumers.[29]

Policy responses towards waste prevention and waste management have been plentiful. The most common are regulatory tools such as environmental standards for waste management, extended producer responsibility (EPR), integrated product policy (IPP), life cycle analysis, and regulation for the implementation of recycling systems, among others. Governments have also used economic instruments, such as taxes and fees on waste generation, landfilling and incineration, deposit-refund schemes, and a range of social tools, such as environmental information (labels, campaigns, advertising) and environmental education, that have helped to raise environmental awareness and household participation in recycling schemes. Germany and the Netherlands are good examples of integrated policies towards waste management. These countries have designed policy packages that cover the whole "waste chain" and targ*et* all the different actors involved. However, these efforts have not been enough to reduce the volume of waste generated.

This section analyses some of the policy responses for household waste prevention and management. It looks at regulatory policies, economic instruments, technological innovation and diffusion, provision of infrastructure, social tools, and voluntary agreements.

4.4.1 Regulatory instruments for waste management

The regulatory framework is a key element in reducing waste generation and improving waste management. The installation and operation of waste disposal facilities are generally controlled by legal standards and requirements to minimise the emission of pollutants. The regulations that are applied to landfill sites and incineration plants have been strengthened in a number of OECD countries. Emission standards and operating criteria have been implemented for incinerators of municipal and hazardous waste. Measures to prevent the generation of packaging waste, to limit the heavy metal contents in packaging and batteries, and to safely collect and dispose of waste, have been strengthened in recent decades. Nevertheless, stricter monitoring of waste treatment installations and methods is necessary to ensure that they comply with regulations (OECD, 2001*a*).

The OECD has adopted several Council Acts for economically efficient and environmentally sound waste management, such as the Council Recommendation on the "Comprehensive Waste

29. See ENV/EPOC/WPNEP(2001)18, *Policy Instruments for Sustainable Consumption: an Overview*.

Management Policy" (1976) and the Council Recommendation on "Integrated Pollution Prevention and Control" (1991) (OECD, 2001*a*). In the EU, waste management is one of the central issues of environmental policy. The Community Strategy on Waste (amended in 1996) is based on the principles of precaution and of preventive action, as well as the polluter pays principle. In particular it establishes the waste hierarchy: prevention, material recovery, energy recover and final disposal (EU, 1999). In 1994, the European *Packaging Directive* came into force. It laid down boundary conditions and objectives that must be transposed into national legislation. The aim of the EU Packaging Directive was to reduce packaging waste all over Europe by 50% by the year 2001, goal that was achieved. It required Member states to reach a recovery level of between 50% as a minimum and 65% as a maximum by weight of all packaging waste. In this case, recovery includes all kinds of recycling, energy recovery and composting (EC, 1999). The EU also has implemented a set of policies such as the landfill directive, landfill taxes, landfill ban, increasing recovery targets and waste minimisation, and extended producer responsibility (EPR) programmes. Austria together with Denmark presents the lowest values and already complies with the targets set by the EU Landfill Directive for 2016. This success can be partly explained by the fact that these countries have increased the cost of landfilling via taxes (Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management, 2001).

In addition, several efforts have been made to eliminate, or minimise, the amount of waste that goes to landfill. For example, the European Community has introduced a schedule to decrease landfilling of biodegradable material by 65% from 1995 level within 15 years (EC, 1999). In some OECD countries, the sorting and/or pre-treatment of waste destined for landfill has gradually become a part of waste treatment processes, reducing the quantities of waste - or eliminating hazardous waste - that is destined for landfill (OECD, 2001*a*).

Dutch Integral Policy to Stimulate Waste Reduction

In the Netherlands, the basic framework for waste management is contained in the Environmental Management Act of 1993. The Ministry of the Environment (VROM) is responsible for developing and applying prevention and recycling policies. In particular, its authority covers: i) development of national waste management plans every four years; ii) terms for signing voluntary agreements between the various parties; iii) authorisation of treatment facilities; iv) exports and imports of hazardous waste; and v) producer responsibility and the system of mandatory recovery; vi) requirement for product manufacture and use (ACR, 2001). According to existing legal arrangements the municipalities have the obligation to organise a system for separate collection of organic waste, paper, glass, textiles, chemical waste and household electrical appliances (IPH, 1999). In 64% of municipalities waste collection is carried out by a public organisation. In other cases, collection activities are carried out by a private organisation. There is a trend towards creating quasi-independent (but still public) municipal waste collection services from former municipal waste collection departments.

Municipalities are responsible for waste collection within their area. The Dutch waste policy is based on "Lansink's Ladder", a planning hierarchy established in 1979. According to this hierarchy, avoidance of waste generation, re-use, recycling, treatment and disposal have to be considered as consecutive steps of waste policy planning (Domus, 1999). The Netherlands have designed an integrated waste policy for waste reduction that targets all the different actors of the "waste chain" (see Box 1).

Box 1. Dutch Integral Policy to Stimulate Waste Reduction

Four different kinds of measures are taken by the Dutch Government in order to stimulate waste reduction:

- Influencing consumer behaviour towards more environmentally-friendly consumption patterns, and reduction of waste generation by prevention, re-use and recycling of products;
- Influencing product and service design towards waste reduction, including a reduction of packaging waste;
- Provision of an infrastructure for re-use, recycling and incineration / disposal of waste;
- Influencing waste markets by regulation, standard setting, influencing prices and specific buying policies of governmental organisations.

Source: Waste Policy, MINVROM.[30]

Sometimes strict regulations are applied in order to enforce waste policies. Since 1994, for example, Dutch municipalities are obliged to implement a collection system for sorted waste. Also, producers are legally responsible for their products in the waste stage. In some cases this is implemented by way of an obligatory refund, *e.g.* with glass packaging. Since 1995, 30 categories of waste, including household waste, organic waste, toxic waste, paper, packages, tires and car-wrecks may no longer be landfilled but have to be incinerated if they cannot be re-used or recycled (Correljé, *et al.*, 2001).

In 1991, the Dutch Government signed a covenant with industry in order to increase packaging recovery. This covenant was renewed in 1997 and contains overall prevention and recycling targets, as well as specific targets for separate waste streams. The covenant has resulted in a "packaging recovery" rate of 24% compared to 1986 production levels (AOO, 2001).

Table 26

Targets for Packaging Recovery
Second packaging covenant

	Realisation of packaging recovery, 1999 (%)	Goal for 2001 (%)
Paper and carton	70	85
Glass	91	90
Metals	77	80
Plastics	17	27 (+8% re-use)
Wood	24	15
Total	63	65

Source: AOO, 2001

Dual System Germany (Duales System Deutschland -DSD-)

In Germany the "Waste Avoidance, Recycling and Disposal Act" of 1986 provides the basic framework for waste management and is supplemented by federal ordinances. The government drafts

30. www.minvrom.milieu Afval, Afvalpreventie, Afzonderlijke afvalstoffen, Bouwstenen van het afvalbeleid, Monitoring van afval, Nationale milieuverkenningen, producentenverantwoordelijkheid, Resultaten en vooruitzichten, Storten, Verbranden, Wetgeving.

policies on general legislation of waste, as concerns, among other issues: i) producer responsibility, ii) prohibition, restriction and labelling of products, iii) recovery requirements for certain type of waste, iv) technical and environmental requirements for the collection, transport and disposal of waste. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety is responsible for establishing waste legislation. The Länder are responsible for implementing federal legislation and also draft their own legislation. They formulate their regional waste management plans, and issue permits to treatment facilities. The management of collection and treatment of municipal waste is the responsibility of the local authorities and municipalities.

The *Ordinance on the Avoidance and Recycling of Packaging Waste* came into force in Germany in 1991. It placed a legal obligation on retailers and manufacturers to take back and recycle packaging for transport, retailers (secondary) and sales (consumers). For transport and secondary packaging, its purpose is to prevent and reduce waste occurrence. For sales packaging, the German Industry Association prepared the founding of the Duales System Deutschland (DSD, Dual System Germany) so called as it constitutes a second waste collection and treatment system parallel to the traditional municipal waste management. Its main effect was to trigger the establishment of the Grüne Punkt (Green Dot) waste collection system (Box 2). The "Grüne Punkt" frees producers from the obligation to take back packages individually if they pay a fee to the DSD for doing so instead, and for returning recyclable packaging materials to the materials loop.

In 1996 the *Product Recycling and Waste Management Act* confirmed the three level legal hierarchy for waste policy[31], and provides a solid legal basis for the packaging ordinance. Not all measures have had the intended impact. Under the "Ordinance of Waste Disposal"(2001), for example, landfills must reach higher standards by 2005 or face closure. In reaction, landfill owners are trying to fill their landfills before 2005, which has kept the price of landfilling artificially low.

Box 2. Duales System Deutschland (German Dual System)

Following a 1986 initiative of the German Industry Association, ninety-five enterprises founded the Dual System Deutschland GmbH to establish the common take back system in 1990. Producers and retailer of sales packages were exempted from the individual duty to take back packages if they joined a system which operates at the national level collecting and managing sales packages from final consumers.

The DSD AG, was a private company with a state-guaranteed quasi-monopoly. Since 1997 it is a public limited non-profit company. The DSD is financed by selling the Green Dot seal – a trade mark – to producers who want to take part in the system. Enterprises with a licence are allowed to have the green dot on their packages. The green dot has a double function: on one hand it is proof that a business participates take part in the DSD system, on the other hand it is a sign for the consumers to give this package to the DSD collecting system. The green dot is not an environmental label.

The DSD budget of about 4 billion DM is raised through a material-specific fee paid by almost all packaging producers and importers. This money serves to pay companies to run the collection and sorting system, subsidise plastics recycling, cover disposal costs and for PR (Fishbein, 1994). The licence fee is calculated according to the type of material used, weight and volume. It is structured to give licensees an incentive to reduce the volume of their packages and to choose environmental friendly materials. The licence fee has become part of cost calculations for packages. As a result, it is estimated that the average household pays around 200 DM for the DSD System via an increase of product prices (Zülch, 2000, in Lorek ,*et al.*, 2001).

31. 1) Waste generation should be prevented from the very beginning; 2) Unavoidable waste should be recovered, and 3) Non-recoverable waste must be safely dispose - having priority over incineration as "thermal recovery".

Some Obstacles for Waste Management in Mexico

In Mexico, the Ministry of the Environment (SEMARNAT) and the Ministry of Social Development (SEDESOL) jointly with the states are responsible for creating waste policies and legislation and for their enforcement. The municipalities are responsible for waste management and its operation. The main barrier to improve waste management in Mexico is the lack of a clear regulatory framework. The existing laws very often create conflicts and confusions about the responsibility of different actors. There is a gap in environmental coverage in the waste management law, because there is no provision for the separation and recycling of waste. The regulatory framework is not based on the "waste hierarchy" principle.

Municipalities have the competence to partially or totally concede the waste management system to private actors. However, the absence of a clear regulatory framework and economic incentives discourages private sector investment. Moreover, although municipalities have the competence to establish waste fees and taxes, these fees are often based on political criteria, not on the real economic costs of waste management, not to mention the social and environmental costs. Waste management in Mexico is further complicated by the existence of an informal waste management system made up of a network of pepenadores (men who sort waste at the waste vehicles and landfills) and their leader ("el rey the la basura"). This network operates on the black market and has significant political power. The existence of a black market for waste is a further impediment to private sector investment and recycling.

4.4.2 Economic instruments on household waste

Various kinds of economic instruments can play an important role in reducing waste generation and improving waste management systems, ranging from encouraging waste prevention (*e.g.* taxes on packaging, waste collection charges) to discouraging the least desirable disposal practices (*e.g.* landfill taxes). T*axes* and *fees* on household waste collection are the most common instruments used. While these have not proven to be an effective means of influencing individual behaviour, they have financed improvements in the technology and organisation of household waste management, and in this manner have contributed to increased waste recovery and reducing environmental pollution. Other type of economic instruments for waste are deposit-refund schemes, *Pay as You Throw* (PAYT) and, more recently, tradable permits for municipal waste have also been used for household waste.[32]

Fees and Taxes on Household Waste

There are different types of waste fees: general taxation regimes, specific taxes, fixed fees, variable fees and variable fees linked to the production of waste.[33] In The Netherlands and Germany, fees charged to the citizens are used to cover public expenses and finances of the waste management system by the public authority. Based on the principle of cost coverage, they finance the existing waste treatment system, but offer few incentives for waste prevention.

In Mexico, the waste fee is charged as a specific tax (impuesto predial), which is in fact a tax intended specifically to cover collection of household waste, but from which revenues are usually directed

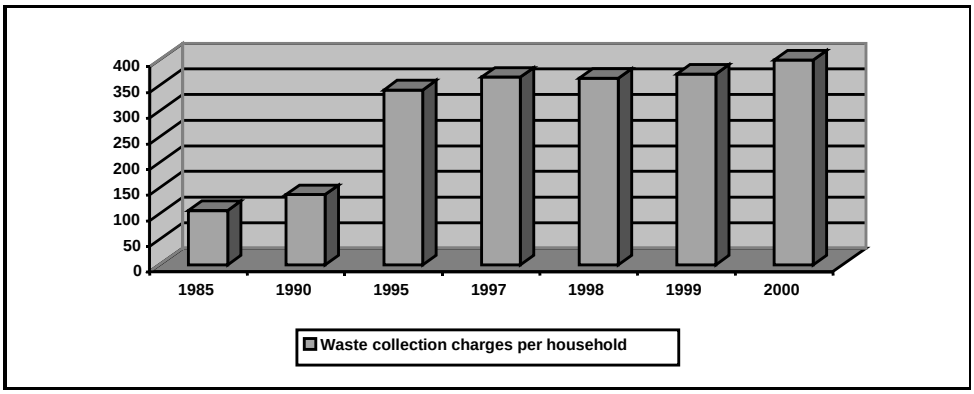
32. For further information, see Roger Salmons, "New Areas for Application of Tradable Permits: Solid Waste Management", Informal Experts Workshop on Domestic Tradable Permits: Lessons and Future Directions, OECD Environmental Directorate, National Policies Division. 6-7 September, 2001.

33. See the technical report of the Association of Cities for Recycling (ACR). The Application of Local Taxes and Fees for the Collection of Household Waste. Brussels. 2001.

to the general budget of the authority, without necessarily being earmarked for waste management. The amount of tax may be established on the basis of a range of elements such as the size of the residence, water consumption, land tax, urban or rural area, among others. There are no incentives for households to reduce their waste generation, since they pay the same amount regardless of the volume or weight of the waste collected.

The main economic instruments to reduce household waste generation are collection and disposal fees, and they will have a major impact if the fee is related directly to the amount (weight or volume) of waste generated. Other kind of taxes could be implemented in landfilling and incineration. The aim is to provide an economic incentive to the municipality or private companies for waste recovery (re-use and recycling). In the Netherlands, in 1999, 22% of the municipalities applied a variable fee linked to waste generation, while 63% relied on fees based on household size and the rest relied on fixed fees or taxes. Due to stricter regulations for landfill and incineration, costs for waste disposal particularly increased over the period 1990-95. As a reaction to the higher costs for disposal, municipalities increased their waste collection charges in this period, on average, by almost 150%, from 137 to 341 guilders per household (Figure 41). Nevertheless, relative to income, waste collection costs to households in the Netherlands are still very small (0.5% of income). On the supply-side, the existing surplus of incineration capacity results in pressures on the waste market. For economic reasons, incinerators try to contract as much waste as possible. If parties involved in waste incineration also take part in waste collection (like some Dutch municipalities), incentives for waste reduction initiatives are reduced (Wolsink & de Jong, 2000).

Figure 41. Waste Collection Fee per Household (Guilders)



Source: RIVM / CBS 2000.

In Germany, the waste fees depend on the type of dwelling and the waste management system used in the municipality. For example, the average community with landfill has to pay 150 DM/t waste for disposal. On the other hand consumers living in a community or region with an incineration plant have to pay high fixed costs due to oversized and (for the moment) unnecessary incineration capacity[34] (370 DM in average). Since 1975, waste fees have increased significantly more than the general cost of living (Table 27).

34. In Germany at the moment, incineration is declining due to cheap availability of waste dumps capacities. According to the "TA Siedlungsabfall" landfills have to reach a higher standard as from 2005. Therefore for several years, and up to 2004, landfill owners who will not be able to reach these standards, lower the prices for waste deposition, to get as much waste as possible and hoping that the landfill pays off before its obligatory closure. From 2005 waste has to be treated in an incineration plant or mechanical biological plant before it can be finally disposed of.

Table 27

Waste Fees Index in Germany (1995-2000)						
The consumer price index for all households in Germany (1995=100)	1995	1996	1997	1998	1999	2000
Total consumer price index	100	101,3	103,23	104,1	104,8	106,9
Waste fee	100.0	106.7	114.7	122.7	125.7	128.1

Source: German Federal Statistic Office, 2000.

The case of waste fees is very similar to water prices; they do not have a strong impact on household waste generation. It is commonly observed that households are not aware of waste fees or perceive them as low. This suggests that it might be more effective to put taxes on product packaging rather than on waste, in order to reduce waste generation. Germany and the Netherlands are moving in this direction with a planned levy on plastic beverage bottles. This policy could have a significant influence on consumer purchasing decisions. However, more analysis is required on the impact of taxes on products and on household waste.

Pay as you Throw (PAYT)

It is generally assumed that if costs for waste collection to households are related to weight or volume, it will lead to lower waste generation and higher separation rates of waste. Based on this assumption, many pilot projects with the PAYT scheme have been implemented in Germany and the Netherlands. In 1999, 22% of Dutch municipalities applied a form of tariff differentiation. Four different systems exist by volume (different container volume), by bag (for which specific bags must be purchased), by volume and frequency or weight. Research shows that tariff differentiation stimulates a reduction of waste offered for disposal although it is also clear that households perceive the costs of waste generation as being very low. It is not clear if PAYT-type approaches provoke illegal dumping (Correljé *et al.*, 2001). However, experience in the US has shown that complementary programmes (recycling, yard waste collection, bulky item pick-up, and education) can increase PAYT effects on source reduction and recycling rates, and discourage illegal dumping. In the US, PAYT has been adopted in over 3900 communities. Although success rates vary, PAYT communities on average have reduced total waste generated by about 14-27%, while increasing recycling by about 32-59% (Miranda and LaPalme, 1997).

Deposit-Refund-Scheme

Other types of economic instruments have been used for waste prevention such as deposit-refund schemes for certain categories of waste (*e.g.* glass, batteries, tyres, electronics, refrigerators, among other durable consumer goods). Currently, in Germany beverage bottles are under the deposit-refund system. Consumers have to pay 0.15 DM (0.08 Euro) for a beer bottle and 0.30 DM (0.15 Euro) for bottled soft drinks. As the quota of refillable bottles has declined continuously over the last several years, it is planned that consumers will have to pay a deposit for recyclable beverage packages. Drink cans and disposable glass and plastic (PET) bottles, regardless of content, will be subject to a deposit of 0.25 Euro (0.50 Euro for a net volume of 1.5 litres or more). The Netherlands is contemplating a similar programme, which is nevertheless heavily opposed by industry.

4.4.3 Technology and infrastructure for waste management

Technological innovations have a great potential to change production and consumption patterns. Cleaner production and eco-efficiency have proven to be successful in reducing industrial waste as well as resource use. Less emphasis, however, has been given to waste prevention at source (*e.g.* less packaging, eco-design). Technological innovations could affect the volume and composition of household waste (*e.g.* using biodegradable or recyclable materials). On the other hand, technology can also extent (or shorten) product lifecycle, resulting in less (or more) frequent product replacement, which has an impact on waste generation.

In the area of material recovery, advanced sorting technologies make the economically profitable reprocessing of discarded products possible by substituting manual sorting processes which require higher labour costs. Recently, considerable quantities of waste have been incinerated in cement kilns, steel ovens and industrial boilers with the development of new energy recovery technologies. These might be an alternative to recycling plants once the pollutant emission and health standards are set clearly and environmentally friendly, providing possibilities for more sustainable waste management.

In Germany, recycling facilities are improving their environmental performance: composting and mechanic/biological systems are obliged to clean their emissions, composting plants have developed rapidly with biogas systems, and incinerators are equipped energy recovery systems. In contrast, waste management technology in Mexico is based on collector vehicles, manual waste sorting (under unhygienic conditions), dumps and landfills (only 50% of the landfills are in compliance with environmental regulation).

In the Netherlands and Germany three factors have been the key to improvements in the handling of waste: increasing environmental awareness (which has prepared the ground and provided public pressure), stricter environmental policy, and the development of more sophisticated waste treatment and recycling technology. Together these factors have solved many of the environmental problems and have facilitated waste separation. For the future, emphasis may either be focussed on improving the quality of recycling by applying high-tech plants for waste separation, or by improving separation and increased organic waste collection. Any future sustainable waste management system will probably need to combine these two options. Most of the discussions are on further plastic packaging recycling technologies. However, these discussions will effect only the kind of waste recovery and recycling systems in place; they are only marginal innovations towards waste reduction (Lorek, *et al.*, 2001).

4.4.4 Eco-design and waste prevention

A great potential still exists to promote waste prevention through changing production patterns via eco-design (less packaging, longer lasting products, multi-use products, more environmentally friendly material) is a crucial area where significant gains could be achieved, without having to deal with the costs of changing households behaviour. Some pioneering industries have started to develop new products based on eco-design and de-materialisation[35] (*e.g.* refillable packages for household cleaning products, toothbrushes with changeable heads, more concentrated detergents). Governments could apply more incentives to accelerate design-for-the-environment initiatives. Industry itself has voluntarily pushed eco-design objectives (*e.g.* "coatings care" programme by the coating industry, "product stewardship" by chemical industry and "eco-design" by Philips). In the Netherlands the regional innovation network "Syntens" has initiated many projects by, for instance in the fields of printing, cooling, cycling and fishing industry. Environmental product design and "Integrated Product Policies" are also implemented by the

35. See http://www.cfsd.org.uk/

food sector organisation "Stichting Duurzame Voedingsmiddelenketen", in "sustainable building" policies and in further development of Life Cycle Analysis methodologies.

4.4.5 Environmental information and awareness

The objective of social instruments can broadly be characterised as increasing the knowledge and influencing the behaviour and willingness of citizens to act in favour of the environment; they aim to influence the "software" of consumption. Waste prevention can be achieved through encouraging consumers to buy products with less packaging, made with less toxic materials or/and recovered materials, and products that can be reused or recycled. Governments (as well as NGOs) have used a large range of social instruments focused on waste issues. The most common are information, environmental education and voluntary agreements. For information and education, governments have used various channels of communication: TV, radio, newspapers, internet, written material, and face to face communication.

The most important source for waste management/waste reduction information is direct communication with the consumers, mostly carried out by communities. In Germany, by the end of the 1980s and the beginning of the 1990s, nearly every town employed its own waste consultant. They started campaigns on waste management providing information via direct telephone lines, face to face contact on local streets and markets, as well as via presentations and actions in schools. Once people were motivated and had begun to voluntarily separate their waste, the role of the waste consultant changed from motivation and general information to answering special questions on waste and leading campaigns. The evaluation of these projects strengthened the impression that general information on waste behaviour often gets lost in the daily flood of information (Mönning, Berg, 2000 in Lorek, *et al.*, 2001).

Since the 1990s, the Dutch Ministry of Environment has used public information to influence the public opinion on environmental issues, in particular by stressing the individual consumer's impact on the environment "A better environment begins with you!" ("Een beter milieu begint bij jezelf"). The campaign highlights options for individual action to improve environmental conditions, including household waste generation. It includes TV-commercials, newspaper ads and information leaflets sent on demand. It is difficult to measure to what extent this has resulted in different behaviour however.

In Mexico, since the creation of the Environmental Ministry (SEMARNAP) in 1994, there have been many efforts aimed at creating an information system on waste with all the different actors involved The government has initiated a campaign called "Por un Mexico Limpio" ("For a Clean Mexico") providing environmental information and education on waste management. Recently the local government in Mexico City is providing this information by Internet. The results of this campaign have not been analysed.

In general, it has often been observed in many countries that information on environmentally sound waste management, and the awareness and dissemination of good practices in the mass media is very poor and is often limited to cultural TV channels, Internet and sporadic coverage in magazines and newspapers. Governments could make use of greater advertising to promoting environmentally aware consumer behaviour. This point was emphasised at the Commission on Sustainable Development (CSD) Rio+5 Earth Summit where governments agreed "to encourage business, the media, advertising and marketing sectors to help shape sustainable consumption patterns" (UNEP, 1997). The United Nations Environmental Programme (UNEP), for example, is working with the advertising sector on how to turn the jargon of "sustainable consumption" into a positive image that people can recognise and react to (UNEP, 1999). This could help consumers make better choices for the environment, preferring products with less packaging, biodegradable products, refillable bottles, etc.

4.4.6 Voluntary agreements

Voluntary agreements (VAs) have gained increasing attention as an instrument for waste management. Most of the EU countries include voluntary agreements in their waste management efforts for reducing waste generation and increasing recycling. They can be used as safeguards against potential drawbacks of current regulations, or for testing new policy areas. Existing evidence shows that adding VAs to a policy mix of traditional command-and-control instruments can improve the flexibility and cost effectiveness of the policies as well as reduce administrative costs (OECD, 2001*a*)[36].

Extended producer responsibility (EPR) is increasing as a policy approach under which producers accept significant responsibilities – financial and/or physical – for the treatment or disposal of post-consumer products. EPR programmes change the traditional balance of responsibilities among the manufacturers and distributors of consumer goods, consumers and governments, particularly at the post-consumer stage. Through such programmes, producers are encouraged to re-evaluate decisions concerning materials (and chemical) selection, production processes, product design, packaging, and marketing strategies in order to reduce the costs of take-back requirements. While the idea of EPR began with a focus on packaging waste, today there is a wide-range of EPR programmes in operation for a variety of products. The current trend shows an expansion of EPR policy to more products, product groups and waste streams. EPR has an important role to play in increasing resource efficiency by harnessing materials that would otherwise have gone to landfill, while at the same time influencing product designers to reduce raw material inputs and to select materials that are easily reused and recycled (OECD, 2001*a*).

Producer responsibility has been introduced in the Netherlands on a voluntary basis for some waste streams, such as car scrap, paper, glass and metals. Some plastic construction materials covenants have been signed with industry on a voluntary basis. A legal basis for extended producer responsibility has been set up for car tires, batteries and durable household appliances.

NGOs and Household Voluntary Initiatives

Co-ordinated voluntary approaches are currently targeted to the production sector but could also be used with households. Co-ordinated voluntary consumer initiatives, often under the aegis of an NGO, support consumers by providing information, encouragement and other types of support through small group meetings, the Internet, workshops, direct action projects, etc. While there is anecdotal evidence of the impact these initiatives have on individual consumers, not much is known about their long-term impact on key consumption patterns and consumer attitudes toward environmental protection. Lessons could be drawn from existing initiatives on how governments can effectively support co-ordinated voluntary consumer initiatives, for example as information providers, facilitators, negotiators, regulators, or founders.[37]

In the Netherlands, a number of co-ordinated consumer initiatives are under way that include household waste prevention and management. 9 210 households, for example, currently participate in the Global Action Plan (GAP) and have achieved a reduction of 26% of household waste (57 kg per household in one year). Other projects are “Green Shopping” and “Consume Less”. Many of these actions have been initiated and financed, by NGOs or by citizens themselves. Projects are subdivided into activities primarily aimed at environmental care, waste prevention, re-use, and recycling. These activities have most effect of

36. For further information see OECD (1999), *Voluntary Approaches for Environmental Policy, An Assessment*, Paris.

37. EPOC, issue paper on Sustainable Consumption November, 2001.

at the local level and have better results if they target the citizens that are more or less environmentally aware.

In Mexico, NGOs have promoted environmental information and education, and implemented various pilot projects for recycling. NGOs in co-operation with the local community have themselves organised recycling schemes and campaigns, a green directory of recycling centres and green shopping guides and manuals for reusing materials (Grupo Bio in Mexico City).

4.5 Conclusions on household waste generation

Along with economic growth and changes in production and consumption patterns, the total and per capita waste generation levels have steadily increased during the last twenty years in OECD countries and are expected to keep growing. Household waste is composed mainly of organic waste and paper followed by plastic. More attention is needed to implement and/or strengthen composting programmes, and to improve the systems for organic waste management, as well as to reduce the use of paper and plastic and increasing their recycling rates.

The main drivers of household waste generation are rising household income and consumption, as well as demographic changes (increasing population, more single households) and changes in lifestyles (*e.g.* working patterns, consumption of more packaged products, processed food). The provision of adequate recycling infrastructure, together with environmental information and education are key drivers behind consumer participation in prevention and recycling.

De-coupling waste generation from economic growth and improving the waste management systems are environmental priorities for OECD countries. This will require an integrated approach that promote changes in present patterns of production, distribution, consumption and collection and management of waste. Some governments have developed "*Integral waste policy*". such as the Netherlands and to a larger extent Germany, which employ a variety of policy instruments (economic instruments, regulatory and social instruments) aimed at preventing waste and improving waste management systems in an environmentally sound manner.

Regulatory frameworks for waste management and *higher environmental standards* have been catalysts for more environmentally sound waste management systems. A clear regulatory framework is also crucial to motivate the participation and investment of the private sector in waste management where it is desired. *Taxes on landfilling and incineration* have been a strong incentive to accelerate the rates of waste recovery. While *taxes* and *fees* on household waste collection are essential to maintaining waste management systems, their impact on household behaviour is less clear. It is commonly observed that households are rarely aware of the costs that they pay for their waste, or perceive those costs as marginal, so much so that households do not feel compelled to reduce the amount of waste they generate. In some countries, unit pricing (*e.g.* PAYT) is being used to make the cost of waste management visible to households. In some instances these programmes have led to a reduction in waste, particularly where they combine waste fees with complementary measures to provide the infrastructure, information and incentives to household to reduce and recycle their waste and to discourage illegal dumping. Some countries expect taxes on disposable products (*e.g.* plastic beverage bottles) or excessively packaged products to have a stronger effect in encouraging household waste prevention than fees applied on waste generation. More experience and analysis is needed on the impact of product taxes and fees on household waste generation patterns.

Social Instruments such as information and environmental education have also been used to promote more sustainable waste management. In Germany and the Netherlands has resulted in major

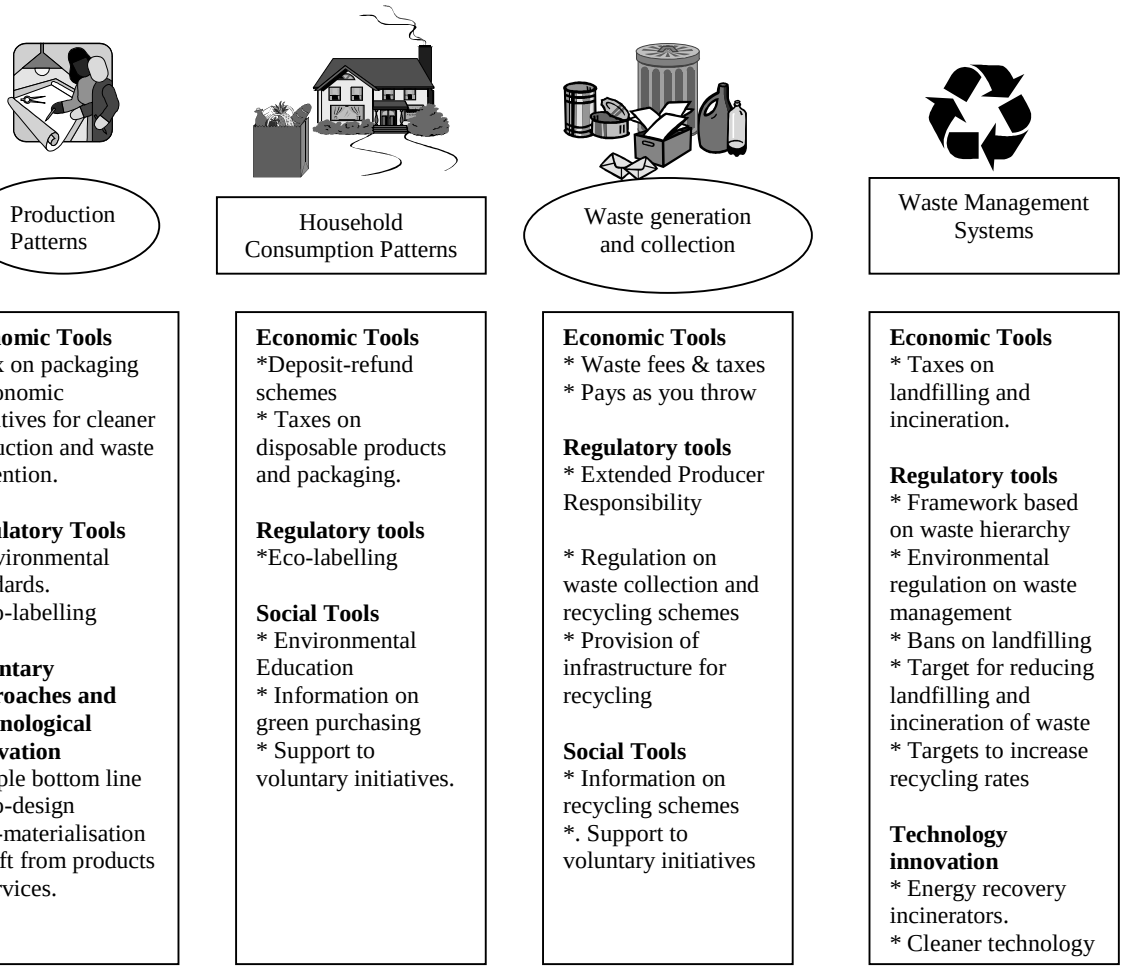
participation of households in recycling schemes. However, not enough clear information has been provided on the importance of reducing the generation of waste. Many information campaigns have been carried out by NGOS rather than by governments.

The analysis of the Netherlands and Germany shows that a combination of measures are most successful in stimulating better waste management: increasing environmental awareness (that prepares the ground and provided pressure for stricter environmental policy); a clear regulatory framework with high environmental standards and targets for recovery; and the development of technology and provision of infrastructure that has allowed more sophisticated waste treatment and recovery rates. Together these factors have solved many of the environmental problems and have as well facilitated waste separation. In the case of Mexico, the main challenge is to create a clear regulatory framework that sets high environmental standards and provides economic incentives for the participation of the private sector and households in environmentally sound waste management. Without the proper technology and infrastructure it is not possible to activate the recycling/recovery market, to promote sustainable household waste management and neither to reduce the environmental impacts of waste.

While waste recovery (*e.g.* recycling, reuse, energy recovery) has increased considerably, it has not been sufficient to reverse the trend of increasing volumes of waste destined for final disposal. As a result, major efforts are still needed for waste prevention. This will require significant changes on both the production and consumption side. On the production side, incentives to reduce packaging and make available "green products" (less packaging, biodegradable or refillable) are needed. Integrated product policy (IPP) and extended producer responsibility (EPR) schemes as well as eco-design, de-materialisation and industrial initiatives to move from products to services are all positive developments in this direction. Using well targeted economic instruments (deposit-return schemes and applying taxes on disposable products) will also be important. On the consumer side it is also important to provide the required infrastructure for recycling schemes, information and environmental awareness, as well as to support and improve voluntary initiatives. Figure 42 summarises the different policy tools that could be used in the different areas of the "waste chain" in order to reduce waste generation and improve the waste recovery and disposal systems.

Figure 42

Government Policy Instruments for Waste Prevention and Management



CHAPTER FIVE. CONCLUSIONS

Significant environmental impact of household consumption

The OECD analysis and the national case studies presented in this report have demonstrated the increasing household consumption levels and the significant link between day-to-day household decisions and environmental impacts. It has also shown that many OECD countries have implemented some kind of policies to reduce the environmental impacts from household activities. These include encouraging energy efficiency, waste recycling, setting standards to increase the choice of environmentally friendly goods in the market, and/or using taxes to increase the relative prices of products with greater negative environmental impacts. Private sector innovations have also brought sometimes important changes in product design and technology which have helped dampen the environmental impacts of consumption patterns, particularly in the areas of energy and water efficiency and waste management.

In general, however, overall results so far are modest. Per capita private consumption has increased steadily in OECD countries over the last two decades, and is expected to continue to grow in the period to 2020. Energy use in OECD countries grew by 36% from 1973-1998 and is expected to grow by another 35% to 2020, despite increases in efficiency. Municipal waste is projected to grow by 43% from 1995 to 2020, to approximately 700 million tons per year in OECD countries. Household demand for freshwater has stabilised or declined in only 9 OECD countries. But in many others population growth and expanded water use have outweighed the effects of water saving technology and behaviour.

De-coupling economic growth from environmental degradation is a priority

De-coupling economic growth from environmental degradation is a priority for OECD countries. Although households as a group are not the largest contributor to most environmental pressures, their impact is significant and will intensify over the next two decades. Priority will need to be given in coming years to address waste generation and energy demand, and in some countries water scarcity is also a priority area.

Reducing the impacts of household waste generation requires minimising waste, increasing waste recycling and recovery (*e.g.* incineration with energy recovery), and disposing of any remaining waste in an environmentally safe manner. The implementation of policies based on the waste hierarchy has been very efficient in improving waste management and reducing environmental damage. The national and international (EC) targets on waste management (*e.g.* recycling, landfilling) have been an effective incentive to accelerate the implementation of waste prevention and minimisation policies. The fees on waste management have helped to improve the technology and waste management systems, but do not have a great impact on household waste generation patterns. The provision of the adequate infrastructure for recycling is a key element to motivate household participation in recycling schemes. But, major efforts are required on waste prevention, which will imply changes in production patterns, distribution systems, and consumption patterns.

Some gains in energy efficiency and energy-intensity but energy demand continues to rise

In the area of household energy use, there have been some gains in the efficiency of many household appliances and other measures to reduce the energy-intensity of space heating, however, household energy demand continues to rise, although more slowly than in the past. Air pollution and human induced climate change are the most pressing environmental problems arising from energy generation and use. As emissions are a consequence of the choice of technologies and fuel use in the power sector, households often do not have much influence over emissions, except by deciding to reduce their energy consumption and recently, in some countries, by buying "green energy". Hence, additional measures to promote energy savings and efficiency will require a combination of supply-side efficiency (*e.g.* gains and shifts to less polluting energy sources) and policies aimed at consumer demand management to improve efficiency, moderate the demand for energy services, and promote the purchase of "green" energy.

Important policy responses have taken place in the area of household energy consumption such as national policies to reduce CO_2 emissions, taxes on household energy, energy efficiency standards and labels, incentives for "green power", and information campaign on energy savings. Information and standards have been most vigorously developed to influence consumer behaviour, and where they have had a positive impact on consumers decision-making. However, governments need to accelerate measures to increase energy efficiency through more or higher energy standards, voluntary programmes, by improving building standards, promoting product modification and changes in household behaviour. Further policy efforts are also needed on energy taxes and more support and investment on green power. The case studies identified successful policies in this area. For instance, the Netherlands and Germany have developed integrated policies to promote sustainable household energy use; Germany has succeeded in reducing household CO_2 emissions.

Some de-coupling in household water consumption

The importance of addressing household water consumption trends varies across OECD countries. Water consumption is the one area where trends in a few OECD countries are showing some de-coupling of economic growth and consumption. However, some other OECD countries, such as Mexico, suffer from water scarcity or over-exploitation of watersheds. The costs of public water supply and treatment are also increasing. Various policies have been implemented to reduce household water consumption. Lessons can be drawn, for instance, from the combination of policy instruments that have influenced household water consumption, in particular full-cost pricing, government standards and voluntary agreements with water companies to increase the availability of water-efficient household appliances. In countries enforcing these policies, water conservation has become an integral part of household behaviour without imposing a significant burden on household decisions or routines. However, these experiences also suggest that once technology has been optimised, additional gains in water conservation programmes will have to come from information-induced behaviour change in order to reduce the intensity of household use of water. The examination of water policy in both Germany and the Netherlands provides good examples of policies that have achieved reductions in household water consumption per capita and decreases in the absolute public water supply.

More consistent policies are needed

Governments could play a more active role in facilitating household action than they currently do. In particular, governments will need to clarify objectives for household action, reinforce existing policies, ensure the provision of infrastructure and green goods, and promote environmental education and awareness.

A general policy guidelines for sustainable consumption should:

1. provide consumers with a consistent set of signals (prices and information);

2. use packages of instruments to address different driving forces on consumption and to balance the strengths of different types of instruments;

3. ensure integrated, cross-sector policies, use complementary measures where some policies are likely to have unaccepted environmental impacts (land-use, infrastructure, etc.);

4. use an integrated approach that addresses environmental impacts throughout the lifecycle of products or services (priority to upstream intervention which can reduce the burden on consumers); and,

5. promote, support and monitor voluntary initiatives by private sector and civic organisations in the context of an appropriate policy framework.

One of the key conclusions emerging from government successes in past years to slow energy demand, improve waste management or reverse water consumption is that a combination of policies is more effective than one instrument applied in isolation. This is because a combination of instruments compensates for the weakness of any one type. It is also because the signal that each type of instrument communicates is felt in different areas of household decision-making (general environmental awareness and specific "action" information; legal efficiency standards embodied in household appliances; user fees), and in this way contributes to providing a consistent message to consumers about the direction (and possibly the magnitude) of change required at the household level. In summary, promoting sustainable consumption patterns requires *integrated, cross-sector policies* that gives consistent messages to consumers and enables them to move towards sustainability.

ANNEX

TERMS OF REFERENCE FOR THE OECD SECTOR CASE STUDY ON HOUSEHOLD ENERGY AND WATER CONSUMPTION AND WASTE GENERATION

Background

The OECD Environment Directorate's 1999-2000 Programme on Sustainable Consumption is intended to support OECD country efforts to reduce the environmental impacts arising from current and projected household consumption patterns. The Programme includes case study analysis of environmental trends in key sectors of household consumption (food, tourism travel, and housing) and policy instruments to effectively promote more environmentally sustainable consumer decision-making. The Programme also includes analytical work on a conceptual framework for addressing consumption patterns, and work on environmental impact indicators.

General Project Description

The case study will focus on energy and water consumption and waste generation at the household level in five OECD countries. It will explore the dynamics behind consumption changes in these areas, including for example shifts in demographic patterns, changes in per capita income, social and cultural aspects that influence lifestyles, available products and information that facilitates or hinders sustainable consumption patterns. The case study will also examine pertinent market dynamics, technological developments, infrastructure, and institutional changes with respect to their impact on energy and water use and waste management decisions made by consumers. The main objectives of the case study are to identify both the environmental impacts of residential housing patterns and the potential points for policy intervention to reduce priority impacts. Links will be drawn where pertinent to the on-going Environment Directorate project on Sustainable Construction (*e.g.* building design and construction considerations to reduce impacts in the use phase), as well as the OECD work on Waste Prevention and Recycling. The case study will also draw on available date from the International Energy Agency.

Objectives

The case study will:

- document trends in energy and water consumption and waste generation patterns at the household level in OECD countries and particularly in five OECD countries;

- describe the forces shaping those patterns;

- discuss the impacts of these patterns on the environment (energy and water consumption, material flows, water quality) and suggest indicators for evaluating those impacts; and

- present integrated policy approaches to promote sustainable consumption patterns.

RESEARCH QUESTIONS

Note: The following set of questions was developed as the common basis of analysis for the three sector case studies on household consumption patterns (food, tourism travel, and housing) included the 1999-2000 programme of work. The questions have been redrafted and prioritised for this case study.

I. Describing Consumption Trends and their Environmental Significance

This section will indicate the relative importance for environmental sustainability of energy and water consumption, and waste generation at the household level (versus commercial and public sector consumption).

- What are the general trends of energy and water consumption, land use and waste generation at the household level? What indicators are available to measure these trends?
  - Energy consumption (for electronic appliances, space heating and lighting) per household;
  - Water consumption;
  - Total absolute levels of waste generation per households (desegregated in glass, aluminium, paper, plastic and compost);
  - Land use per households (urban, suburban, and rural), including green area per household (lawns, gardens, etc.).
- What is the relative contribution of household final energy and water consumption, and waste generation compared to commercial and public sector consumption?
- What are the general environmental impacts from energy, water and land use as well as waste generation per household?
  - Use of fossil fuels and emission of gasses caused by energy consumption at the household level.
  - Grey water emission, water quality and scarcity.
  - Waste generation per household (paper, glass, plastic, metal, toxic and organic waste).
- Which of these impacts are directly attributable to households? What is the relative importance for the environment of the structure (*e.g.* energy sources, waste streams) and scale (per capita impact) of consumption? How well can these be measured? (*e.g.* what part of this consumption is attributed to household consumption choices, and what part is generated by the structure of services, current infrastructure, product design and services etc.).

II. Characterising Household Demand

The case study should provide a description of key influences (forces and actors) on demand formation at the household level, relate these key influences to each other, and describe the direction and strength of relationships between them.

A. Market Influences

- What are the market characteristics for energy and water supply and demand: level of competition; productive structures; price trends and demand elasticity; relative prices and sectoral shifts (*e.g.* "green" energy)?

- What are the market characteristics for waste generation and waste management: price or tax charged for the waste generation at the household level; markets for different waste streams (*e.g.* glass, aluminium, plastic, paper and compost); relative prices and sectoral shifts; impacts of globalisation?

- What is the evolution of household spending patterns on energy, water as well as on waste generation or management (*e.g.* relationship to income changes)?

- Are there market externalities related to consumption decisions for energy, water and land use as well as for waste generation?

B. Technological and Infrastructure influences

- What are the key technological and design influences on energy generation, water supply and waste management: trends in material intensity; production and use efficiency; innovation (efficiency, green energy technologies, recycling systems, dematerialisation of product and services, waste management technologies, new sustainable construction materials)?

- What influence do existing land-use patterns and infrastructure have on the consumption of energy, water as well as on the generation of waste (*e.g.* presence/absence of recycling facilities)?

C. Economic and Socio-Cultural Influences

- Consumption trends related to economic growth (per capita income) (Kuznet Curve). Income per household, social structure and consumption trends by income level (high, medium and low income), number of second or vacation houses.

- Demographic trends relevant to consumption: population growth; age structure of the population; average household composition; labour trends (women; unemployment; youth); urbanisation; evolution of work/home location; household time management.

- What are the composition and coverage of different information flows to the consumer in this sector (*e.g.* positive or negative press, ads and information on energy and water consumption, on waste management or/and information on environmental issues related to household consumption patterns):

- media coverage
- advertising
- public service information
- private service information (given by companies)
- education (formal, non-formal, professional)

- What are the cultural attributes (social meanings) of electricity, water, as well as of waste generation (*e.g.* consuming solar energy, participation in recycling schemes, among others)?

III. Identifying Policy Responses

Governments have and special role in promoting sustainable consumption. The case studies will identify the range of possible policy interventions to determine which combination of policies would be most effective in reducing associated environmental impacts, including those that might come higher in the production-consumption chain.

A. Multiple Influences on Demand - Multiple Responses to Promote Sustainability

- What policy and regulatory frameworks are relevant to the consumption of energy, water, and waste generation (energy and water systems and reforms, recycling systems, urban planning?

- Where are the most susceptible points of change for promoting more sustainable use of energy, water, as well as for decreasing waste generation: market failures; product/service design; consumer choice and behaviour; framework conditions (technology, infrastructure, and institutions)?

- Where would changes provide the greatest environmental gains?

- Which actors would have the most leverage in driving change?

B. Government Policy Responses

- What is the role for governments through direct and indirect measures to affect both the range of options open to the consumer and consumer choice on energy and water consumption and waste generation?

- Economic instruments: what kind of economic instruments have been implemented to promote sustainable household consumption: product taxes, environmental taxes, waste generation fees, subsidy removal, incentives for environmentally preferable products/technology/use. Can the environmental impact (improvement) of these policies be measured?

- Social instruments: information and awareness raising on sustainable household issues: (advertising, eco-labelling, consumer information, public-right-to know, public service information, media); education (professional training, formal and non-formal); participatory decision-making; pilot projects.

- Regulation: minimum product standards, minimum performance standards, bans/restrictions of the production, sale or use of products, extended producer responsibility, regulatory reform to promote innovation, building standards.

    - Governmental regulations/standards on sustainable and eco-efficient use of energy and water.
    - Regulations on waste management (eco-labelling, refill schemes, etc).

- Influencing framework conditions: capital investment, land-use planning, institutional arrangements

Motivating action by other actors: voluntary agreements and partnerships with private sector and/or NGOs focused on sustainable consumption of energy and water, waste management and sustainable housing.

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