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Chapter 4

Water Infrastructure and Water-related Services: Trends and Challenges Affecting Future Development

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The water sector faces serious challenges in both developing and OECD countries. For all water systems there is a growing focus on the best ways to finance and implement improvements in operation and maintenance of systems. How are business models in the sector being affected by the challenges of financing, demand management, scale of water systems, public involvement and equity, competition and climate change? This chapter analyses the evolving dynamics of the water and wastewater sector and discusses policy implications and a range of options for sustainable solutions.

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Summary

The water sector faces serious challenges. The failure to meet basic human needs for water; difficulties in meeting the financial requirements for maintaining, extending, and upgrading both new and ageing water systems; new regulatory requirements for water quality; increasing water scarcity; competition for limited capital, and global climate change will continue to affect the development of the water sector. In addition, the water objectives of the Millennium Development Goals add impetus to efforts in developing countries and the Big 5 economies[1] to halve the proportion of people without access to safe drinking water and sanitation. As existing water infrastructure hits the century-old mark, the developed OECD countries are facing immediate needs to replace and upgrade infrastructure, respond to new water quality regulations, and ensure the security of water supplies in response to climate change, pollution and growing populations. For all water systems, there is a growing focus on the best ways to finance and implement improvements in operation and maintenance of systems.

Business models

Different business models involving various relationships between private and public roles have emerged and become predominant in France, UK, Canada, the US, Germany, and in other OECD countries. These models range from the purely public, to a mix of public and private, to purely private. These models vary in terms of level of decentralisation, who owns system assets, who finances investments and who defines the price and level of service. Different water sector forms, however, do share some common characteristics: water provision is a natural monopoly; it is often capital-intensive in its need for infrastructure for water collection, purification, distribution and waste treatment; and it typically offers a low "return on investment" common to other regulated utility industries. While most water-sector investments have been local and public, private sector participation has also played an important role in some parts of the world.

Key issues

Some key issues affecting the robustness of business models become apparent in the analysis of the future trends in the water sector. These are briefly detailed below:

Financing. Financing is critical for ongoing operation and maintenance as well as responding to needs for new infrastructure. Ashley and Cashman (2006) estimate that by 2015, an average annual investment of USD 772 billion will be needed in OECD and BRIC countries. Water services are more capital intensive than other utilities, requiring twice the capital compared to electricity utilities with the same annual operating expenses. With growing financial needs, along with a decline in public investments in water, and the lack of private investment being directed to this sector (only 5% of private investments tracked by the World Bank went to the water sector), new strategies need to be found to make needed investments. Full cost pricing is a key tool being considered to address funding gaps. Full cost pricing through user charges that account for all the costs of providing water and wastewater services are being considered in communities throughout the world to address water sector needs. Yet, very few systems world wide are currently fully funded by existing or future customers, depending instead on taxes and international aid.

Demand management. Demand management – by reducing the amount of water and wastewater services that are needed through efficiency, conservation, and structural changes – can substantially reduce the capital requirements of existing water systems. A demand management approach to water increases the productivity of water use, rather than seeking endless new sources of supply. Demand management changes the industrial dynamics, increases the time scale of planning efforts (long term *vs.* short term), focuses on the end-goal instead of the path to reach it, involves fewer technical risks and uses less money.

Scale of water systems. In order to address challenges in the water sector, various approaches are being tried that either expand or reduce the scale of water systems. In the US and Canada, approaches to regionalise water systems capture economies of scale by banding together several municipalities. Regionalised water systems can lead to reduced costs, the sharing of expertise, improved performance, enhanced water supply security in uncertain climate conditions, and water systems managed at a more appropriate watershed scale. An emerging area is that of on-site, point-of-use, and closed loop systems where the water and wastewater system is integrated into a residential dwelling or industrial or commercial establishment. This introduces new actors and methods of financing into the water sector including property and landowners, flat complex developers in water-stressed areas, and engineering firms who provide design-build-operate (DBO) functions.

Public involvement and equity. Public involvement will facilitate much larger investments in the water sector. Ultimately, water utilities will be subject to the court of public opinion to determine whether they have convinced ratepayers, taxpayers, and stockholders of the need for new infrastructure investments and the utility's ability to manage those infrastructure improvements effectively. Lack of public involvement can, and has, led to the failure of projects and investments. Because water is fundamental for life and health, ensuring equity is a key goal and a driver in the water sector. Pressures for full cost pricing will make it increasingly difficult to ensure that water is affordable for the poor, and will require the involvement of a health agency to ensure that the needs of the poor are being met.

Competition. Seeing the success of the introduction of competition in the telecommunications sector in terms of reduced cost and improved service, competition is being tried in the water sector. Because of the high costs of infrastructure and the key public health nature of the service, introducing competition in water has been more difficult. It is being done in a few key ways: third party access, or allowing a third party to use the capital intensive water distribution network, is being tried in England; water transfers are being used to reallocate water among users; and benchmark competition in the form of performance scorecards has been used in Australia and the UK.

Climate change. Climate change and water pollution are considered by Ashley and Cashman (2006) to have the greatest impact on increasing the cost of water services. In different regions of the world, climate change will affect where, when, how much and how water falls; increase the vulnerability of water supplies; increase the severity of droughts and flooding events; threaten coastal aquifers, among other impacts. Investments will be needed to protect water security, and the diversity of sources of water, as well as to introduce low cost methods of increasing supply, including demand management.

Changes to existing business models

Existing business models are changing in significant ways to respond to challenges in the water sector and to take advantage of key opportunities. We expect these trends to continue into the future. Public models are responding to competition from private actors by instituting efficiency through re-engineering their operations and services. Private sector models are also changing the nature and role of their investments. After a decline in private investments in 2002, we see private investments picking up again with changing actors and new strategies.

Having been stung by public backlash against previous privatisation agreements, the private sector is embracing the need for transparency and stakeholder involvement in successful privatisation agreements. Local private

actors are also taking a much more significant role in the water sector, particularly in China and the Russian Federation. Private companies are also moving from concessions, which involve high capital risk, to operation and management contracts in some regions. There has also been a growing trend towards wastewater contracts *versus* water contracts, possibly because wastewater contracts are less politically charged. Companies are also focusing on key regions and withdrawing from others. We anticipate that in the future, local private actors will become more predominant, and that concessions will continue to be attractive in some stable economies, but in others Operation and Maintenance (O&M) contracts will be preferred.

Through all of this, we expect water sector actors to continue to depend on public finance, while seeking to expand innovative mechanisms of financing that take advantage of local capital, as well as get rewarded for positive externalities. Robust business models will integrate new scales of service, including regionalisation when appropriate and on-site systems as they emerge. The nature of the landscape is also changing and will require business models to interact and partner with numerous actors, including local governments, other water providers and regulators, in a more fluid and effective manner. The ability to communicate with and involve the public in decisions about the water system will be critical for success, as will managing system assets effectively, effective staffing, and adaptive management approaches that identify the problem before arriving at solutions.

Policy implications

Governance in the water sector is critical to protect the social and public goods aspects of water and wastewater services. The need to reduce epidemics of waterborne disease gave birth to the public health movement in the 1880s, and positive externalities from investment in water and wastewater are significant, ranging from USD 4 to 12 per USD 1 invested. Protecting public health, ensuring water quality standards, and the equitable provision of supply requires significant public oversight and governance.

With the changing dynamics of the water and wastewater sector, sustainability in the water sector will require supporting and regulating a range of options within an enabling policy framework. The goal in the policy arena will need to be the creation of a pro-competitive framework, while supporting a range of business models and scales to address water and wastewater needs. This will involve creating opportunities and removing obstacles to new entrants into the water sector, creating opportunities for multiple financing mechanisms, strengthening the regulatory system, focusing on transparency and public education, providing incentives for competition, and funding more research and development in the sector.

1. Introduction

The water sector continues to face serious challenges. The failure to meet basic human needs for water; difficulties in meeting the financial requirements for maintaining, extending, and upgrading both new and ageing water systems; new regulatory requirements for water quality; increasing water scarcity; competition for limited capital, and global climate change will continue to affect the development of the water sector. New ways of delivering water and disposing of waste, emerging players in the water sector, and innovative ideas about sustainable water planning, demand management and community transparency are creating new opportunities in water management. As a result, existing business models are innovating or giving way to emerging business models that may reshape the sector.

World wide, estimates of revenues in the water sector range from USD 350-650 billion (Maxwell, 2005). The scope of the water sector is complex, owing to its diversity, interactions and synergies with other industrial, commercial and financial sectors, and its international nature. Most traditional estimates of the scope of the water sector have focused on urban water services because of better availability of data and challenges in defining boundaries to water services. While these estimates are valuable, globally about 70% of water used by people goes to the agricultural sector for the production of food and fibre (although this varies widely from country to country). Thus, estimates of the current and future role of water in the agricultural sector are also critical, though the primary focus here will be on urban needs.

Water services are provided through a variety of approaches, though most involve centralised systems with large supply, distribution and treatment facilities – what has been described as the "hard path" (Wolff and Gleick, 2002; and Gleick, 2003). Increasingly, however, there is a realisation that the hard path alone may not provide for a range of unmet and new needs, and that combining centralised infrastructure with new approaches for water supply, demand management and community engagement may be more successful, and are often less costly.

Decreasing water availability, declining water quality and increasing water withdrawals are placing greater demands on limited water resources. This increasing water stress is already constraining socio-economic growth in some countries. Global climate change is likely to have significant impacts on water availability, quality and demand (IPCC, 2001). No good estimates are available of the additional costs (or reduced costs) that climate change may impose on water resources in different regions, nor the effects it may have on the effectiveness of any particular business model. Nevertheless, the importance of the problem must be acknowledged, and more comprehensive efforts must be made to better understand climate change impacts and adaptation costs and benefits.

The *social benefits* that water and wastewater services provide are well known, including reduced mortality and morbidity from waterborne diseases. Most of these benefits accrue outside the financial accounts of the infrastructure investor, creating a significant gap between "project" and "social" rates of return. Since the development of water and wastewater infrastructure grew out of the public health revolution in the late 1800s, there is a strong link between public health and the development of water and wastewater utilities. Public capital has often been used provide backing for infrastructure bonds, or to provide low-cost or no-cost capital to undertake infrastructure projects that protect public health. The increasing drive to full cost pricing from customers is shifting some of the underlying capital and operating costs from governments to water users; a drive that to some extent fails to consider the positive externalities generated by the services. It is also well recognised that increasing public involvement in water decisions can lead to greater willingness to pay for water and wastewater services, which will be required to sustain and increase investment levels to meet needs.

The importance of water as a social good and a *human right* has been well recognised in numerous international fora. The United Nations Committee on Economic, Social and Cultural Rights declared access to water a fundamental human right, entitling everyone to affordable, safe and accessible water supplies for domestic uses. While water is recognised as a human right and a social good that should be affordable to all people, this does not mean that water should or can be free for all people. Extracting, collecting, treating, testing and distributing water all require certain levels of infrastructure and resources. In order to deliver potable water to the tap, maintain system infrastructure and expand to underserved areas, a sustainable source of funds needs to be maintained.

Finance plays a key role in the water sector. The gap in required financing in the water sector and projected financing is enormous and growing, and chronic underinvestment in the water sector is an ongoing problem. Although there have been efforts to increase the role of private capital as a way of reducing the burden on public funding, such privatisation approaches have run into public opposition. The participation of private actors in recent years has not been particularly successful as a means for increasing capital investment in the sector. Indeed, some participation has been highly polarised and controversial. If substantial additions to private participation are to be encouraged and successful, new models will have to be developed that satisfy basic public interests and generate political and social acceptance. Private capital may also be generated through the use of municipal, public or private bonds, where future system users pay for current system investment needs.

One of the contributions of economics to public policy is its focus on incentives and their effects on behaviour. Greater levels of infrastructure investment, and different types of investments, will be encouraged or

Box 4.1. **Definition of privatisation**

We also note that "privatisation" has been defined in many ways, and no single definition is used consistently. For the purposes of this assessment, privatisation in the water sector involves transferring some or all of the "assets" or "operations" of public water systems into private hands. There are numerous ways to privatise water, such as the transfer of the responsibility to operate a water delivery or treatment system, a more complete transfer of system ownership and operation responsibilities, or even the sale of publicly owned water rights to private companies. Alternatively, various combinations are possible, such as soliciting private investment in the development of new facilities, with transfer of those facilities to public ownership after investors have been repaid. Over the last decade, offers to privatise water services were coming from newly amalgamated, large multinational corporations. There seems to be a cooling in this trend as we describe later in this chapter, with regional actors playing a greater role. Opposition to privatisation continues at local, regional and international levels.

When the service being privatised has "public good" characteristics, like water, government regulation or oversight has traditionally been applied. Economists and others argue that goods and services previously provided by public officials or agencies may become less vulnerable to political manipulation when privatised, but private entities may also become less responsive to public interests. Examples include protection of water quality, commitment to efficiency improvements that reduce the volume of water used, maintenance of basic service levels, transparent prices and billing practices, and investments in water reclamation or additional sources of water supply.

discouraged by different patterns of incentives. In this chapter, we discuss *incentive patterns* mostly through the lens of "business models", by which we mean the entities providing the water, wastewater and stormwater management services.

2. Current business models

2.1. Functions common across business models

Every water system includes a variety of functions, such as maintenance of underground pipe systems or collection of revenues. Box 4.2 presents a useful and relatively complete categorisation of functions from Gleick *et al.* (2002). The list in Box 4.2 is not the only such list one could create. For example, one could combine the operation and maintenance (O&M) functions into one, as is usually the case. Or one could divide a water system based on

Box 4.2. **Water system functions**

1. Capital improvement planning and budgeting (including water conservation and wastewater reclamation issues).
2. Finance of capital improvements.
3. Design of capital improvements.
4. Construction of capital improvements.
5. Operation of facilities.
6. Maintenance of facilities.
7. Pricing decisions.
8. Management of billing and revenue collection.
9. Management of payments to employees or contractors.
10. Financial and risk management.
11. Establishment, monitoring, and enforcement of water quality and other service standards.

Source: Gleick *et al.*, 2002.

geographic area, as in Manila, Philippines, where potable water services were divided into areas served by different contractors when its water system was privatised in the 1990s.

2.2. Current business models

Current business models are successful based on their ability to attract capital, maintain and expand water services, protect water assets, communicate with the public, and provide safe water and wastewater services to users.

The traditional focus on public *versus* private ownership or operation of built assets does not allow one to fully distinguish the entire context within which business models in the water sector operate. For example, water rights are valuable assets that affect service provider behaviour perhaps as much as "built" assets. The context in which business models operate should be defined to include other important characteristics, such as:

- Where does investment capital come from?
- Who repays the capital?
- How is the service organised (*i.e.* central systems, decentralised systems, etc.)?
- How are service quality, potable and ambient water quality, and economic factors, such as tariffs or rates of return to invested capital, regulated?

Table 4.1. **Current and emerging business models in OECD countries**

	French (*affermage*)	Concession	English/Welsh	Canadian	German	US	Closed loops
Status	Stable	Some decline in OECD and non-OECD countries	Limited dissemination	Stable	Stable	Stable with some emerging private	Emerging
Level of decentralisation	Municipality	Municipality	Regional	Regional or municipal	Municipality	Municipal/regional	Condominium
Who owns the assets	Municipality	Municipality	Utility	Municipality	Municipality	Municipality or regional district	Property developer
Who pays for investments	Municipality/basin organisation	Utility	Utility	Municipality	Municipality	Municipality or regional district	Property developer
Who defines the service	Municipality	Municipality	Regulator	Municipality	Municipality	Public utility or service commissions	Property developer
Who sets the price	Municipality	Municipality	Regulator	Municipality or Regional District Board	Utility	Public utility or service commissions	Property developer
Robustness *vis-à-vis* key drivers	Attracts no private capital. Depends on municipal capacity to raise funds.	Depends on emergence of domestic operators and their capacity to raise private funds.	Fails to attract private capital. Apparent shift towards mutual funds.	Attracts no private capital. Regional models capture economies of scale, particularly useful in less dense areas surrounding urbanised areas.	Until recent reform due to EU regulation, service provided by multi-utilities (water, energy, urban transit), with cross subsidisation.	Attracts no private capital. Depends on municipal capacity to raise funds.	Best qualifies in new, extensive, peri-urban habitats.

A range of business models exists currently in OECD and non-OECD countries. These business models vary as to who owns the assets, who makes investments, the scale of the system, who sets the price, and how robust the business model is at attracting investment. A few existing models and their context are laid out in Table 4.1.

It should be noted that some countries (France, Germany) have allowed the development of *régies*, where the utility belongs to the municipality and has no legal identity (it exists only as a service of the municipality). This model is now criticised, typically in the EU, as being opaque. There is a general tendency to sever the service provider from the municipality and to corporatise it (French *régie*, or German *Eigenbetrieb*), with, at least, a separate budget.

United States and Canada

There are a number of purely public examples in the United States and in Canada. By purely public, we mean systems where built assets are entirely owned and operated by public entities. An old and venerable business model is that of a water, wastewater or flood-control department within a general-purpose unit of government (*e.g.* a city, county, province, state or federal government).

Funding for public systems might come from a tax base or fee-for-service revenue (*e.g.* water sales). Revenue sources that are earmarked for water sector services and sequestered from general revenue, are referred to as "enterprise funds". Both departments whose budgets are supported by commingled general funds and those supported by sequestered funds are purely public models within general-purpose government, but the incentives these models face may be quite different.

Special districts separate not only revenue but also governance from the general-purpose government entity. Such districts usually have a separately elected governing board whose sole duty is (usually) to provide water, wastewater or flood-control services. Residents within the service area may vote, whether they own property or not. Businesses within the service area do not have direct say in who sits on the governing board. This business model is common in the western US.

Another model is that of a corporatised public utility. This model is like a special district, but is managed like a corporation with one shareholder. The shareholder can be a city, as in Louisville Water, a water-supply utility owned by the City of Louisville, Kentucky in the US; or a state, as are the water-supply utilities throughout Australia. Corporatised utilities typically have appointed rather than elected boards, where appointments are made by the owning entity. These boards are often composed of experts in various areas (*e.g.* engineering or finance), and need not represent the stakeholder groups in the community.

In both the United States and Canada, geographically interdependent municipalities have taken advantages of economies of scale to consolidate their operations into regionalised water service providers. This is discussed further in the following section of the report.

French and German models

Some systems maintain full public ownership of all assets but involve various degrees of operation and maintenance management by private companies. Operating contracts and design-build-operate (DBO) method for procuring new assets are becoming more common. Under most of these contracts, the public entity collects payments from customers or raises revenue from other sources, and pays the contractor for their services.

Concession and franchise agreements are often similar to design-build-operate-transfer (DBOT) in that the private investor typically owns assets until the end of the agreement, but at least in concept there is no requirement for a design-build component. For example, a concessionaire or franchisee might be granted the right to operate an existing system, collect revenues, pay for operation and maintenance, and make minor improvements. In some cases, ownership of the system resides with the public, but the concession grants an exclusive licence to operate and maintain the system. Major improvements might be negotiated under a separate agreement with the concessionaire or franchisee, or might be designed and constructed by others, then included in the concession or franchise. Concessions often include the exclusive right to construct new assets, while franchises tend to be more limited in that regard. The franchisee or concession holder usually collects revenues from customers.

Another variation of the public ownership/private management business model is the French system of *affermage*. In this model, publicly owned assets are leased to the private operator. The operator pays a fee for use of the assets, which is then recovered from customers as part of the water or wastewater service charge. Capital improvements are usually budgeted and funded by government. A unique incentive sometimes exists for the leasing company in *affermage*. If they can defer the need for a capital improvement, they are allowed to keep the interest on the deferred investment sum in excess of the increase in investment cost due to inflation. This creates an incentive for high-quality maintenance and creative measures (*e.g.* water main leak reduction) to reduce demand for new facilities.

Dutch model

The Dutch water companies often have mixed public-private ownership, with public operation of assets. This creates an incentive for efficiency because the private owners would like to earn higher dividends on their investments, but regulation moderates the profit motive by requiring that more than 50% of the ownership interest is public.

English/Welsh models

In 1973, England passed the Water Act, which placed the responsibility for managing the entire water cycle from collection, distribution, conservation, sewage collection, and pollution abatement in the hands of Regional Water Authorities (RWA). In 1974, the water industry was restructured into ten Regional Water Authorities (RWA). A few water agencies retained their autonomy and were designated Water Supply-only Companies (WSCs). Some district councils chose to retain sewerage collection, public health and land-use planning functions, and they collected sewage fees and paid the RWAs for treatment services.

Despite the improvements in the 1970s and early 1980s, a number of major challenges remained. During this period, the British economy slowed, decreasing resources available for system improvement and management. At the same time, new standards developed within the EC put pressure on water agencies to upgrade facilities. Huge capital investments were required, but underinvestment by public agencies worsened overall conditions. By the mid-1980s, an estimated GBP 26 billion was needed to bring the old water system to EC standards of water quality and environmental protection.

These trends were supplemented by the ideological goals of the Thatcher government to push for privatisation of many public services, including transportation, energy, telecommunications and water utilities. As a result, the Water Acts 1988 and 1989[2] were passed, privatising the water systems and services in England and Wales. The acts gave the privatised water companies 25-year concessions for sanitation and water supply, and protected concessionaires against any possibility of competition.

There was no formal public consultation at the time the industry was privatised despite (or because of) polls that suggested that 75% of the public did not support privatisation (Saunders and Harris, 1990). Since 1997, the new Labour government has made an effort to widen public participation in concession agreements.

As a result of the initial structure and form of privatisation, a variety of problems materialised early that led to changes, modifications and revisions in the government agencies responsible for oversight, customer protection and regulation. We offer here a summary of the most relevant issues that arose, and the responses by public agencies. Among the problems:

1. Tariffs rose sharply following privatisation, necessitated by huge investments in water-system improvements, with little public input. The different regulatory authorities with different mandates sent conflicting signals to the water companies.
2. Public opinion was divided on how much should be spent on environmental protection.

3. The rise in tariffs led to an increase in water debt and disconnections, drawing widespread public criticism.
4. There was public anger over the fact that water companies were continuing to earn substantial profits even in drought years, when consumption restrictions had been imposed on the public.

In response to strong public opposition, strong government regulatory oversight and a reorganisation of government regulatory authorities eventually helped improve service, stabilise and monitor rate increases and ensure water quality protection. The model is now stable, and regulators are working to improve competition and introduce new actors into the water sector.

Small and/or domestic private

It is also worth differentiating between locally owned private companies and multinational private companies, which we explore later in the chapter. In many developing countries another model of private provision exists: small private companies act as vendors of water and water-treatment equipment. Water vendors sell water from tanker trucks in peri-urban areas of the world, particularly in parts of Brazil, India, China and Indonesia. The quality of water sold in this way is typically unregulated, although licensing these actors as part of municipal supply is growing in some countries. In addition, private vendors of water-treatment equipment often operate the equipment under contract. A typical client for these service providers is an industrial or large commercial facility that needs on-site wastewater or water treatment. This business model seems to be growing rapidly as on-site and smaller scale technologies become more reliable and economical, and are increasingly used in residential and commercial applications.

2.3. History, importance and future of business models in the OECD and Big 5 countries

Private sector participation in the provision of water and sanitation services is not a new concept. Private entrepreneurs, investor-owned utilities, and other private entities have provided water and sanitation services in different parts of the world for many years. In England, for example, private water services began in the 16th century and lasted for over 300 years before local governments took a more active role (NRC, 2002). In France, private water services began in the mid-19th century under the reign of Napoleon III (Gentry, 2000). Water services in the US were largely provided by the private sector during the 18th, 19th and early 20th centuries. Commencing in the latter part of the 19th century, however, local governments throughout Europe and the United States substantially increased their investments in public water supply, and took over many formerly private systems, to ensure service coverage for all segments of society, reduce the incidence of waterborne diseases, including cholera, and provide water for fire

fighting (Gleick *et al.*, 2002; NRC, 2002). Public sector investment continued to grow throughout the 20th century as governments recognised the broader economic and social benefits that a safe, reliable water supply provides.

In the 1990s, public and private entities looked to privatisation in a range of sectors to meet a variety of needs. During this period, private sector participation in the water and wastewater sector increased in many countries throughout the world. Private sector participation in water and sanitation, however, varies considerably among countries. Table 4.2 shows the per cent of

Table 4.2. **Per cent of the population served by the private sector in 2005**

	Water	Sewerage
United Kingdom	90	93
France	76	57
Czech Republic	68	65
Spain	45	52
Greece	44	37
Italy	41	29
Hungary	26	25
Australia	22	6
Brazil	20	14
Portugal	19	16
Germany	17	14
Mexico	16	9
United States	15	5
Austria	7	0
China	5	3
Canada	4	2
Russian Federation	4	1
Belgium	3	40
Indonesia	3	0
Slovak Republic	3	3
New Zealand	2	6
Poland	2	2
Turkey	2	1
Ireland	1	36
Norway	1	5
Sweden	1	1
Denmark	0	1
Finland	0	1
India	0	0
Japan	0	0
Korea	0	7
Luxembourg	0	0
Netherlands	0	11
Switzerland	0	0
Iceland	n.a.	n.a.

n.a.: Signifies no data available.
Source: Pinsent Masons, 2006.

the population in each country served by the private sector in 2005. While this includes those served by purely private and mixed public-private schemes, this table does not include the use by public utilities of private vendors for functions such as outsourced billing or administration. This table also does not characterise the extent of informal, or small-scale private sector involvement, including water tankers and bottled-water providers. These unregulated private actors are very common in countries like India.

The private sector is dominant in the United Kingdom, France, and the Czech Republic and plays a significant role in Greece, Hungary, Italy, and Spain.[3] In most OECD and Big 5 countries, however, the private sector plays a relatively minor role in the provision of water and sewerage services.[4] Variation in private participation among countries is due to a number of factors, including the existence of supportive policies, a stable political and financial climate, local history and conditions, and public perception.

The data available for all the 35 countries of interest (OECD plus Big 5 countries) does not provide the level of detail on type of contract needed to assess which types of private sector arrangements are most common in which regions, and which models are growing over time. More detail is provided below on the emerging and developing economies.

Trends in private sector involvement in emerging and developing economies

The World Bank maintains data on the number, amount and type of investment (concession, greenfield,[5] divestiture, and management and lease contract) involving private participation in the water and sewerage sector in middle- and low-income countries. Eleven of the 35 countries included in this study fall within that category (Table 4.3). The following discussion will focus on these countries.

Table 4.3. **Countries in World Bank PPI database included in this study**

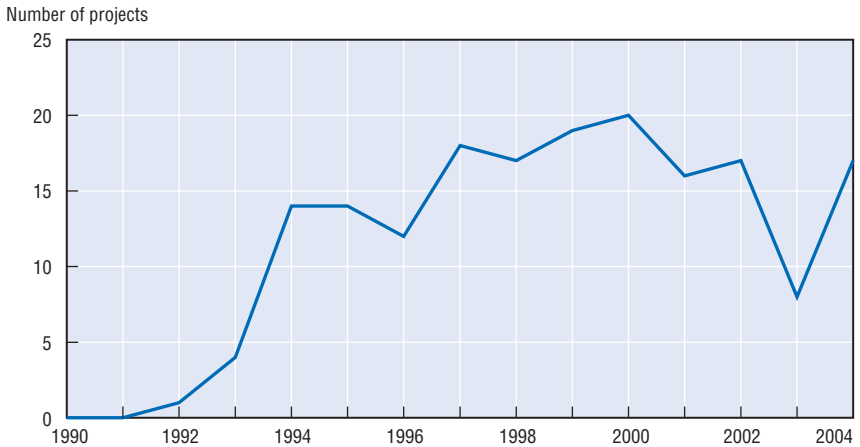
	Category
Czech Republic	Upper Middle Income
Hungary	Upper Middle Income
Mexico	Upper Middle Income
Poland	Upper Middle Income
Slovak Republic	Upper Middle Income
Turkey	Lower Middle Income
Brazil	Upper Middle Income
Russian Federation	Lower Middle Income
India	Low Income
China	Lower Middle Income
Indonesia	Lower Middle Income

Source: World Bank PPI database.

Between 1990 and 2004, a total of 177 projects representing USD 11.2 billion (in year 2000 dollars) were initiated in the countries listed in Table 4.3. Figure 4.1 shows the number of projects involving private entities by the year that they reached financial closure. The number of projects rose sharply in the early to mid-1990s, peaked in 2000, and dropped precipitously between 2000 and 2003. The number of projects, however, appears to be rebounding, as they more than doubled between 2003 and 2004. Over 70% of the projects initiated between 1990 and 2004 were in Brazil, India and Mexico.

Figure 4.1. **Number of water and sewerage public-private partnership investment projects, 1990-2004**

In the eleven OECD + BRIC countries listed in Table 4.3



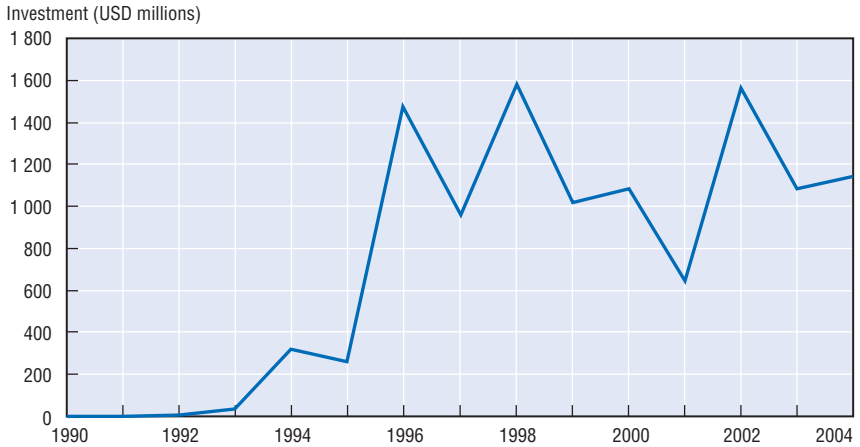
Source: World Bank PPI database.

Large privatisation projects are riskier investments. By 2004, seven out of 177 of the projects (representing 11% of the total investment) initiated in those countries listed in Table 4.3 (11 out of 35 OECD + BRIC countries) between 1990 and 2004 were either cancelled or in distress.[6] By comparison, 7% of projects (representing 37% of the total investment) initiated during the same period in all middle- and low-income countries were either cancelled or in distress. Thus the failure rate of projects initiated in those countries listed in Table 4.3 is less than the average of all middle- and low-income countries, suggesting that the countries addressed in this chapter may be more capable of supporting privatisation efforts.

Total public-private partnership investments in the water and sewerage sector in the eleven OECD + BRIC countries listed in Table 4.3 were USD 11.2 billion (in year 2000 dollars) between 1990 and 2004. Investments in the water sector, however, exhibit high annual variability, particularly since 1996

(Figure 4.2). Current investments in the eleven OECD + BRIC countries listed in Table 4.3 are nearly 30% below their 1998 peak level of USD 1.6 billion (in year 2000 dollars).

Figure 4.2. **Total project investment in water and sewerage public-private partnership investment projects, 1990-2004**
In the eleven OECD + BRIC countries listed in Table 4.3



Source: World Bank PPI database.

Table 4.4 lists the per cent of projects and investment in water and sewerage by type of private investment in the eleven OECD + BRIC countries listed in Table 4.3. Concessions and greenfield projects are the most popular type of arrangement, accounting for 39% and 37%, respectively, of the projects between 1990 and 2004. Similarly, investment in these types of projects was also high. Divestiture was the least common type of arrangement, but accounted for 20% of cumulative investment, indicating that these projects are among the most expensive. Concession and greenfield contracts are likely more common because ownership of the asset potentially provides greater protection for the investor against abuse by the governmental contracting entity.

Table 4.4. **Per cent of projects and cumulative investment of water and sewerage projects, by private investment type, 1990-2004**
In the eleven OECD + BRIC countries listed in Table 4.3

Type of private investment	Projects (%)	Investment (%)
Concession	39	40
Divestiture	7	20
Greenfield project	37	37
Management and lease contract	17	3

Source: World Bank PPI database.

Trends in private sector involvement in OECD countries

Country-specific information on water privatisation in developed countries is not collected in a consistent manner.[7] The Privatization Barometer maintains data on privatisation efforts in Europe, but does not provide specific information on contract type, *i.e.* concession, BOT, divestiture, etc. Thus, it is difficult to quantitatively assess private sector involvement in OECD countries other than those included in Table 4.3. Anecdotal evidence, however, suggests that the prominence of various contract types depends upon a number of factors, including the existence of supportive policies, a stable political and financial climate, local history and conditions, and public perception. England and Wales, for example, have divested most of their assets to private companies, although clearly divestiture is the least common type of contract in developed countries. In the United States, however, DBO and pure O&M contracts are more common than, for example, DBOT contracts because public financing of privately owned assets (private activity bonds) is limited under the tax code, while earnings to those who lend to government for construction of public assets is tax exempt. In France, concessions and leases are more common. In the Czech Republic, concessions are dominant. And in Ireland, BOT contracts are more common.

3. Key drivers and opportunities in the water sector

After carrying out a detailed analysis of the water sector's characteristics and the impacts of the drivers presented by Ashley and Cashman (2006), we believe that there are a few key principal drivers of change and opportunities that have the potential to transform the water sector. In this section, we look more closely at the principal drivers, which include financing, demand management, the scale of water systems, climate change, and public involvement and equity.

3.1. *Financing*

The key challenges of the water and wastewater sector include the need to expand access to water and wastewater services, invest in replacing and maintaining ageing infrastructure, and address security and environmental concerns. Addressing these challenges will require both large capital investments for new infrastructure, ongoing investments in maintenance, repair, upgrading and operation of existing facilities, and integration of new ways of organising, funding and producing revenues and reducing costs within utilities.

In most of the countries that are the focus of this chapter, the networks developed for water supply, distribution and treatment are generally considered well developed and the most valuable assets, comprising some 60-80% of the total value of all urban water and wastewater systems. According to Ashley and Cashman (2006), the current value of existing sewerage assets in the UK alone is

some USD 200 billion, and it is several times larger than that in the United States. Comparable levels of investment and development, however, have not been made in some of the OECD and Big 5 countries. In transition economies, the need for maintaining and upgrading existing infrastructure is combined with sometimes significant needs to expand coverage and at the same time address the challenges of poor governance, institutional neglect and inefficiency, and deterioration of the water asset base.

There is a range of estimates of required annual expenditures in the water and wastewater sector. Ashley and Cashman (2006) estimate the needed annual expenditures based on income categories. In the high-income countries, they estimate that 0.35 to 1.2% of GDP will be required to finance needed infrastructure, maintenance and services. In middle-income countries, they estimate 0.54 to 2.60% of GDP is needed and in the low-income countries, an estimated 0.70 to 6.30% would be needed. Because financing infrastructure needs in low-income countries requires a larger percentage of GDP than in other countries, these requirements will reinforce and worsen income disparities, suggesting that attempts should be made to rectify this problem.

Table 4.5 provides an estimate of the projected annual expenditures on water and wastewater services and includes the influence of the drivers on projected needs (Ashley and Cashman, 2006). The total projected needs in the OECD and Big 5 countries approach USD 800 billion by 2015, which is consistent with a recent study by Andrieu (2005). Scenarios of future expenditures for water vary widely and should be viewed sceptically. No standardised method for estimating needs is used. Moreover, most scenarios tend to focus on "investment" needs and exclude recurring expenditures for operations, maintenance, repairs, replacement and overhead. While these expenses are sometimes covered by revenue, shortfalls often lead to inadequate expenditures for operations and maintenance, and a resulting increase in future investments. While considerable uncertainty is involved in these estimates, it is clear that water-related infrastructure investment needs could be huge and that governments will need to pay particular attention to water in the future.

Access to capital

There are major drivers affecting the ability of OECD and non-OECD countries to make needed investments and finance the expansion and maintenance of water and wastewater infrastructure and services. Limited tax revenue that is available to support financing these investments will be increasingly constrained by growing demands on public resources, including the need to support ageing populations. Currency risks in the Big 5 economies are causing a shift to more local financing in these countries. Increasing demands on water and wastewater services also increase the financial pressures on the sector. Ashley and Cashman (2006) project that socio-economic changes including

Table 4.5. **Projected expenditures on water and wastewater services**
Average annual investment (in USD billions)

	By 2015	By 2025
Australia	6.86	9.95
Austria	2.59	3.91
Belgium	2.75	4.38
Canada	10.27	15.74
Czech Republic	3.12	2.83
Denmark	1.82	2.74
Finland	1.35	2.15
France	16.86	25.84
Germany	23.38	35.84
Greece	2.17	3.34
Hungary	2.02	2.79
Iceland	0.09	0.14
Ireland	1.35	2.15
Italy	16.83	25.23
Japan	46.98	63.41
Korea	12.76	18
Luxembourg	0.24	0.39
Mexico	167.78	153.65
Netherlands	5.43	7.88
New Zealand	1.14	1.63
Norway	1.58	2.55
Poland	7.93	7.18
Portugal	1.96	2.97
Slovak Republic	1.35	1.22
Spain	10.97	15.96
Sweden	2.26	3.6
Switzerland	1.97	3.19
Turkey	9.33	9.66
United Kingdom	19.14	27.96
United States	101.65	167.63
Russian Federation	11.49	26.41
India	74.8	108.31
China	182.1	247.18
Brazil	19.8	32.02
Total	**772.12**	**1 037.83**

Source: Ashley and Cashman (2006), "The Impacts of Change on the Long-Term Future Demand for Water Sector Infrastructure", in *Infrastructure to 2030: Telecom, Land Transport, Water and Electricity*, OECD, Paris.

population growth, age profile changes and rising expectations for water services; environmental challenges such as climate change and water pollution; and internal politics, including governance challenges and urbanisation, will increase water infrastructure and services costs. Technologies that increase efficiency are estimated to reduce unit costs of water services.

Ultimately, in financing water services, the questions of who pays for what, what the scale of financing is, whether financing is protected, and the venues for accessing capital are critical. Water systems typically acquire funds to maintain and expand service through the general budget, local budgets, consumers, taxpayers and the system operator (reinvestment of profits). New models are also accessing capital through involvement of mutual funds that seek long-term fixed rates of return on capital, engineering service firms that build an on-site water system and obtain an ongoing service contract to service their capital investment, and landowners or homeowners who purchase an on-site system as part of the purchase of an existing property or the construction of a new one.

Accessing the capital is critical, and it depends on establishing trust among investors and users that the water system is operating efficiently and effectively. Capital can be accessed through general budgets, local budgets and private lenders. Accessing private capital and public capital will require a high credit and bond ratings and guaranteed returns on the investment.

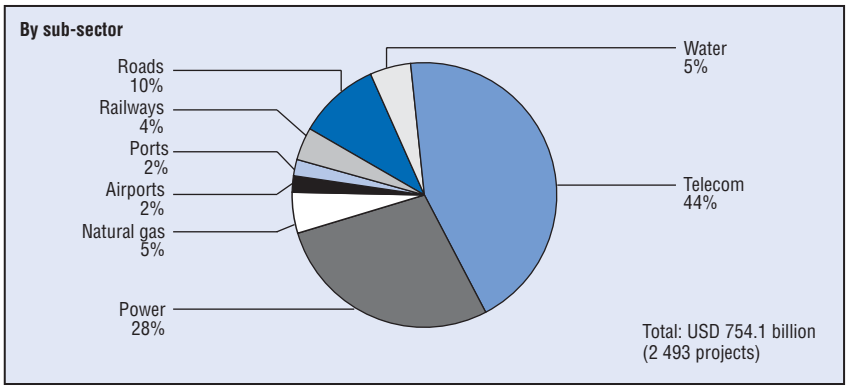
Capital must be serviced. This needs to be done through adequate cost recovery mechanisms that maintain service and infrastructure quality while accruing funds to service debt. Debt should be serviced by users of the water system. This is the most appropriate way of ensuring the longevity and sustainability of the water system. Debt is also sometimes serviced by taxpayers paying into a general or local budget that subsidises the debt servicing.

The role and nature of traditional actors in the water financing sector are changing significantly. General budgets which funded much of the construction of water infrastructure are shifting away from ongoing funding because of competition for government funds and decreasing funds. Infrastructure Canada documents very compellingly a situation faced in many OECD countries:

> *Trends in the past 30 years indicate that the proportion of the national pie devoted to public infrastructure has been declining. Not only has public investment been on the decline, but also investment requirements to maintain, upgrade, and expand infrastructure have been on the rise. Thus a gap has developed between what is needed to bring public infrastructure to satisfactory levels and current expenditures on this infrastructure. A 1984 study by the Federation of Canadian Municipalities estimated that this gap was 25% of annual investment in urban infrastructure.* (Infrastructure Canada, 2004, p. 10.)

The private sector is being looked to fill in this funding gap in the water sector. The private sector has not met the demands of huge investments in the water sector, nor does it appear that the private sector can do this alone. What has been demonstrated is that a very small portion of private investments in developing countries have been made in the water sector (Figure 4.3).

Figure 4.3. **Five per cent of private investments in World Bank PPI database directed to the water sector**



Source: Moss, J. *et al.* (2003), p. 12.

A critical dimension of the context within which water business models operate is that of access to capital. It is clear that the sector's capital needs are not being fully met, although there is still much debate about the specific types of investments needed (*e.g.* dams *versus* efficient appliances). Advocates of increased private involvement in the water sector often claim that private capital is essential if these needs are to be met. Certainly that is true in some sense since most government investments in the water sector are paid for with bonds sold to private investors. But it is not true unless private water companies are more attractive to investors than government bonds. Sometimes, they are less attractive (*e.g.* when government bonds are tax exempt as in the US). Investing in a private water company is more attractive than buying a government bond only when the rate of return on the private investment is relatively high or is guaranteed to some extent (*i.e.* it is low risk). If government can credibly make such guarantees, it can also borrow and invest directly.

In some parts of the developed world, bond financing is a primary vehicle for investments in the water sector. When investor-owned utilities exist, equity investments in the stock of those companies are also an important source of capital. Because equity investors demand higher rates of return than bond investors, however, debt is often a significant source of finance even for investor-owned utilities. Direct investment of tax revenues is also sometimes a source of finance, especially in rapidly growing economies like China and India today. However, that same tax revenue can be used to amortise large loans; a more effective way of raising capital than pay-as-you-go financing with tax revenue. Consequently, the vast majority of capital invested in the water sector is borrowed or raised (as equity investments) in private capital markets, regardless of the business model that delivers services.

Stated differently, the key issue in accessing sufficient capital is usually not the source of that capital. Instead, there are other issues that affect the risk and financing costs for both investors and those who are being asked to repay investors via user fees or taxes. For example, customers in peri-urban areas may not trust their water supplier, whether public or private, and will oppose rate increases and thereby reduce investment, even when the cost of piped water is estimated to be much lower than the cost of water vended from trucks.

Full cost pricing

Designing appropriate rates that ensure full cost pricing is one of the most important challenges of effective water management. Water systems typically recover their costs of operation via a mix of customer charges (prices), own-country or local tax revenue, international loans or aid (other-country tax revenue), or charitable donations. But if a water system cannot sustain adequate levels of finance via these sources – and many cannot – it will not be able to extend services to poorer, marginal areas that lack water and sanitation, nor will it be able to properly maintain existing systems. Multilateral banks and others have increasingly put pressure on utilities in developing countries to increase funding by increasing user charges. This is often labelled as a trend toward "full cost recovery" but is more accurately labelled as a trend toward "full cost pricing". The strategy of moving toward full cost pricing requires that utilities increase rates for water and wastewater services to meet maintenance and expansion goals. Doing so is not possible without effective communication with, and trust between, customers and utility management.

The inability or unwillingness of governments to finance needed infrastructure and maintenance, and increasing demands on public finances, is driving the move towards a greater portion of system costs paid through user fees. There will continue to be overt pressure to recover infrastructure and operation and maintenance costs through full cost pricing as the water sector grows. The issue of full cost pricing is often combined with calls for more private sector involvement in the sector, and as costs become increasingly covered by user fees, this will be more attractive for private sector business models.

Currently, very few systems throughout the world are fully funded by current or future customers of the service. Indeed, some believe that the pressure for full cost pricing by international lending institutions and others in developed parts of the world, toward less developed parts of the world, is inconsistent with the history and current practices in much of the developed world. It is very common for water sector business models to involve a mix of customer charges and general tax revenue.

Whenever possible, local levels of government have worked together to obtain financial support from higher levels of government, thereby reducing the need for local agencies to increase customer charges. Complicating the issue of

full cost pricing are inherent failures of market capitalism that affect all actors. For most industries and public welfare utilities, we need to consider the extent to which all benefits and costs are internalised. The costs of poor ambient water quality from ineffective wastewater treatment are borne by downstream users, while many of the benefits of adequate supplies of clean drinking water accrue externally in reduced health costs in the community. Many external costs may be internalised through government regulations and enforcement, including regulations governing the quality and disposal method of treated wastewater and sludge. External benefits, however, may also be internalised via subsidies. This is in fact the most common rationale for tax revenue supported spending in the water sector, rather than full cost pricing.

It is of course, in theory, possible for full cost pricing to account for additional anticipated costs from climate change or water pollution. Full cost pricing could also internalise the external public health benefits of water and wastewater service provision by requiring annual payments from the public health department as part of the overall revenue stream. If well designed, rates should incorporate the costs of externalities and the costs of removing water from in-stream uses. Anticipated climate change or water pollution infrastructure needs could be incorporated into prices borne by water system users. For pollution outfalls into the water system, *point-source charges* could be levied which could feed into water system revenues.

Investments in water interventions often pay enormous dividends, but in unconventional ways. Table 4.6 shows the estimated "cost/benefit" ratio for water actions in developing regions and Eurasia. As these data indicate, the investment of a dollar may return as much as USD 4 to 12 in health, social and financial benefits, but often those benefits accrue to parties other than those making the investment. Overall, the UN concluded (UN, 2003) that an investment of USD 11.3 billion dollars per year to meet the Millennium Development Goals for water could produce an overall benefit as large as USD 84 billion a year. This disparity in who bears the costs and who receives the

Table 4.6. **Benefit/cost ratios for water interventions in developing regions and Eurasia**

Type or result of intervention	Benefit/cost ratio
Halving the proportion of people without access to improved water sources by 2015	9
Halving the proportion of people without access to improved water sources and improved sanitation by 2015	8
Universal access to improved water and improved sanitation services by 2015	10
Universal access to improved water and improved sanitation, and water disinfected at the point of use by 2015	12
Universal access to a regulated piped water supply and sewage connection in house by 2015	4

Source: Modified from WHO/UNICEF (2005).

benefits is rarely openly discussed or considered in water policy decisions. Measuring these varying costs and benefits, and identifying ways of capturing the benefits and reinvesting them in the water system, are key components and challenges to those looking to expand old or develop new business models.

Good governance is critical to addressing financing needs. Well-governed countries and utilities are typically able to borrow enough to meet their investment needs. Similarly, better governance reduces the risk premium required to induce investment. Selected national or regional policy interventions may be necessary to improve credibility and reduce risk premiums in the most neglected and backward parts of countries where investments in water systems are risky at present.

Well-developed civil courts capable of resolving contract disputes in reasonable time frames and at reasonable cost would also be helpful. This is especially important for the development of business models that include numerous smaller projects and actors. The transaction costs associated with development of these models are large. Administration costs, as noted above, are larger per dollar of investment in small projects, and even a few contract disputes among hundreds of contracts can prevent return on investment from being adequate to promote yet more investment.

Communities are often concerned that when a private company takes over a local water system, the drive for full cost pricing and profits will lead the company to increase water rates that are paid by users. The drive for *greater public involvement* will be integral to the success of any efforts towards full cost pricing. In cases where rate changes need to be made, improved services should be clearly described and rate changes should be tied to comprehensive consumer education and information programs describing the changes and their reason. While the driver of public involvement won't affect how many business models try to more fully recover costs from users, it will determine how successful these attempts will be.

With large potential increases in costs from climate change, water pollution and more stringent regulations, environmental drivers will make it more difficult for utilities to recover all costs from user fees. This will mean that tax revenues or government support will most likely continue to be needed to finance major projects that address climate change impacts. Full cost pricing does not account for the external costs of climate change or water pollution that will affect the water system's sustainability.

3.2. Demand management

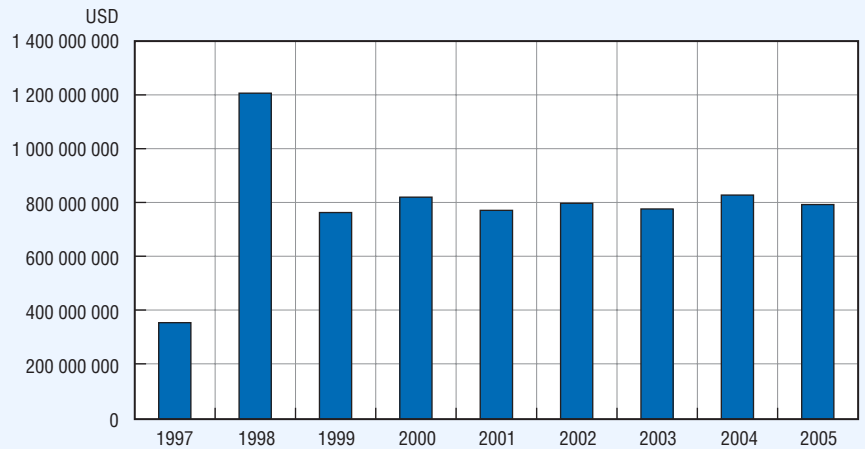
The amount of capital and financing needed to satisfy water supply and sanitation needs depends in large part on the size of those needs and on choices made to satisfy them. In some cases, substantial reductions in capital

Box 4.3. **US drinking water revolving fund**

As noted earlier, water systems must make significant investments to install, upgrade, or replace infrastructure to continue to ensure the provision of safe drinking water. These investments include installation of new facilities to improve the quality of drinking water as well as maintenance necessary to sustain ageing infrastructure. In the United States, a mechanism was created to help states meet federal requirements under the Safe Drinking Water Act. This bill established the Drinking Water State Revolving Fund (DWSRF) to make funds available as grants to finance infrastructure improvements. The programme also emphasises providing funds to small and disadvantaged communities and to programmes that encourage pollution prevention as a tool for ensuring safe drinking water.

The DWSRF programme awards capitalisation grants to states, which in turn are authorised to provide low-cost loans and other types of assistance to public water systems to finance the costs of infrastructure projects. States may also use a portion of their grants to fund a range of set-aside activities including source water protection, capacity development and operator certification (US EPA, 2000). The federal appropriation for this programme in 2005 was USD 843 million split among all US territories though less money than this is usually dispersed. Figure 4.4 shows actual federal grants from 1997 to 2005.

Figure 4.4. **US drinking water state revolving fund grants**



Source: www.epa.gov/safewater/dwsrf/nims/dwus06.pdf.

requirements can be achieved by expenditures to reduce demand through technological improvements, structural changes to water use, or other approaches. Below we offer a few examples on experiences in the United States and Canada.

The world is in the midst of a major transition in water management and use. Over the past century, the construction of massive infrastructure in the form of dams, aqueducts, pipelines and complex centralised treatment plants, funded with a limited set of financial tools and approaches dominated the water agenda. This "hard path" approach, focused on expanding water supply, brought tremendous benefits to billions of people, reduced the incidence of water-related diseases, expanded the generation of hydropower and irrigated agriculture, and moderated the risks of devastating floods and droughts. But the hard path also had substantial, often unanticipated social, economic and environmental costs. Tens of millions of people have been displaced from their homes by water projects over the past century, including more than one million displaced by the reservoir behind the Three Gorges Dam in China alone. Twenty-seven per cent of all North American freshwater fauna populations are now considered threatened with extinction, a trend mirrored elsewhere around the world. Adequate flows no longer reach the deltas of many rivers in average years, leading to nutrient depletion, loss of habitat for native fisheries, plummeting populations of birds, shoreline erosion and adverse effects on local communities.

A new way of thinking is emerging: called the "soft path" or *demand management* by some analysts. The soft path continues to rely on carefully planned and managed centralised infrastructure but complements it with small-scale decentralised facilities. The soft path for water emphasises improving the *productivity of water use* rather than seeking endless sources of new supply. It delivers water services and qualities matched to users' needs, rather than just delivering quantities of water. It applies economic tools such as markets and pricing, but with the goal of encouraging efficient use, equitable distribution of the resource, and sustainable system operation over time. It includes local communities in decisions about water management, allocation and use. And it uses the tool of backcasting as a way to help communities and water users think about long-term objectives, rather than short-term expediencies. The industrial dynamics of this approach are very different, the technical risks are smaller, and the dollars risked are potentially far fewer than those of the hard path.

The implications for business models and investment paths can be profound. Rather than focusing on the different business models, the soft path – or demand management – would suggest that water managers and planners focus on the long-term objectives, such as meeting basic needs, or integrated sanitation and ecosystem restoration, and then explore different financial paths for satisfying those objectives. Thus, society's goal should not be promoting specific business models, but might instead focus on improving the social well-being associated with the use of water and the provision of water services.

The concept of increasing the productivity of a unit of water is central to the idea of demand management. In many cases, water is not needed itself, but

performs certain functions, whether it is to carry away human waste, cool industrial processes or grow crops. Each of these functions that water provides is actually not dependent on the actual amount of water used, but on how effectively the water that is used satisfies the end goal. If a smaller amount of water can perform the same function, this increases the productivity of a unit of water. For example, water efficient shower heads use less water but serve the same purpose of allowing people to clean themselves. Drip irrigation systems used in agriculture use significantly less water and reduce evaporation losses by directing water to where it is most needed, underground, while fulfilling the function of growing crops.

The traditional approach to meeting increasing water needs has been to augment availability by building massive water-supply projects. Increasingly, these projects are becoming more expensive as communities need to go farther and farther a field to find and access new supplies still uncontaminated by pollution and sewage from growing urban centres. The cost of water per cubic meter increases each time a new water source is tapped, increasing the costs to the utility and the end-user (Wegelin-Shuringa, 1998).

A demand management approach that focuses on *efficiency and conservation*, including reducing unaccounted for water in the water sector is often the best "new" source of water to satisfy the social and environmental needs of growing populations. It was often thought that improving economic prosperity required increases in water use. But technology improvements have severed this link. While producing a ton of steel in the 1920s required as much as 200 tons of water, today it requires less than 4 tons of water. This is a fifty-fold increase in the *productivity* of a given unit of water. One of the cornerstones of a demand management approach to providing water services is increasing water productivity, the amount of output – whether it is satisfying a human need or producing a ton of wheat – for a given unit of water that is used.

In Singapore, an aggressive strategy to improve efficiency and conservation was implemented to significantly reduce the water losses in the system. Rates of unaccounted for water in badly run or decaying systems can reach as high as 60% of water produced, which is a huge financial drain on any utility and ratepayers. Reducing the rates of unaccounted for water in the system achieves social and environmental objectives while improving efficiency and reducing costs. The Singapore PUB developed a comprehensive and proactive strategy to detect and control leakage. As the city seeks new methods of meeting its water needs, Singapore's demand management approach focusing on efficiency and conservation in the water sector has proven to be a more effective "new" source of water and permitted the city to avoid or delay the huge capital expenditure associated with new supplies in a region with few natural alternatives. Singapore saved nearly SGD 26 billion in avoided capital expansions by reducing unaccounted for water levels from over 10% to 6% over the course of six years.

Water efficiency improvements in many parts of the western United States have greatly reduced per capita water use and eliminated the need for a wide range of new supply investments. New reservoirs costing billions of dollars have been *cancelled* by investing in conservation improvements. For example, the Two Forks Dam outside Denver – a billion dollar project designed to boost Denver's water supply – was cancelled in 1990 due to opposition from local and federal governments over its ecological impacts, together with the belief that conservation and efficiency were appropriate and adequate alternatives. Denver then succeeded in reducing demand, successfully demonstrating how to replace large capital projects with improved management.

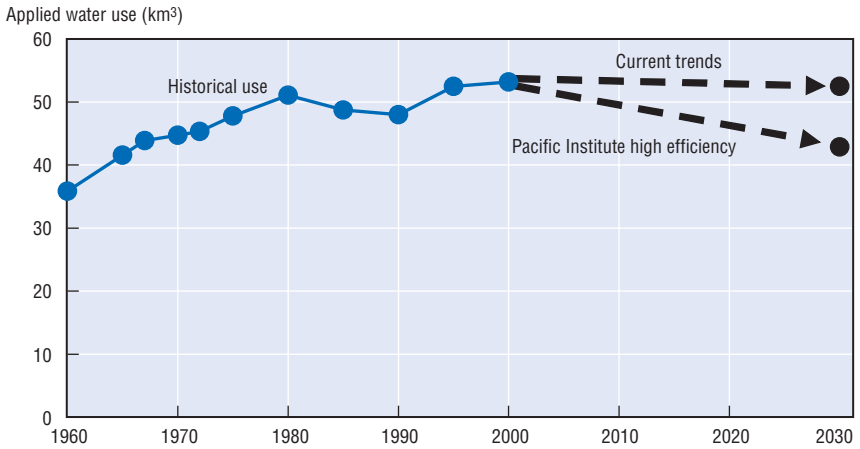
A recent study in Kings County, Washington State, found that a small community could cost effectively reduce the size of a planned wastewater treatment plant by aggressively implementing indoor water conservation measures (Wolff, 2004). Water in this community was quite inexpensive, so unlike the example above, water-use efficiency was not justified by avoided costs for water supply. Instead, water-use efficiency was justified by avoided costs for new sewer lines and wastewater treatment facilities. These new facilities were driven by an environmental concern – groundwater pollution from septic systems. But the capital required to respond to this driver was not as large as initially believed, once indoor water-use efficiency was included in the plan. Similarly, Australia recently cancelled plans for a desalination plant to serve Sydney after alternative approaches, including groundwater, improved conservation and efficiency, and new recycled water efforts, were found to be cheaper and less controversial to develop.

Investments in conservation and efficiency could limit the growth in new demand so effectively that few new centralised supply investments would be required. While investment would be required for conservation and efficiency programs and technologies, these are likely to be far less costly than large infrastructure projects (Gleick *et al.*, 2002; Gleick *et al.*, 2005). A study by the Pacific Institute compares a high-efficiency scenario developed for California to the year 2030, along with the "Current Trends" scenario from the official state water plan (Figure 4.5). The difference between the two represents nearly 10 billion cubic kilometres per year in supply investment that can be avoided (Gleick *et al.*, 2005).

Another classic example of avoiding a multibillion dollar infrastructure investment is the experience of New York City in developing innovative policies for satisfying a new federal requirement for water filtration. In order to meet the new standard, the City of New York would have had to spend an estimated USD 6 billion for a state-of-the-art filtration system. Instead, they petitioned the US government for permission to work with local residents in the upstate watershed to reduce contamination from local septic and sewer systems, to protect land from inappropriate uses that contributed to water contamination,

Figure 4.5. **California statewide trend in total water demand between 1960 and 2000**

With projections to 2030 in the current trends and high efficiency scenarios



Source: Gleick *et al.* (2005).

and to locally manage stormwater runoff. By implementing a wide range of watershed management tools, the city was able to meet its water quality obligations for about a third of the cost of the centralised infrastructure.

Infrastructure Canada notes the key role that demand management can play in reducing the need for new infrastructure through reducing water consumption and peak demand for water and wastewater, reducing unaccounted for water in the system, and increasing water recycling. They also note the key role that adequate water pricing can play in reducing demand, improving efficiency and increasing conservation. A critical piece of demand management is effective public outreach that communicates the value of water and the importance of conservation. Often, in water rich countries like Canada, and parts of the United States, the perception is that water is abundant and can be used without fear of scarcity. This has led to some of the most wasteful water consumption rates in the world.

3.3. Scale of water systems

Water systems have typically been governed at municipal, regional and subnational levels. Water systems are often local or regional in scope, conducting abstraction, treatment and delivery within relatively small areas, compared to the distance that other utilities (such as telecom or energy) may travel. While water regulations are typically made at the national level, governance over water supplies and systems is usually done at the municipal level. Water and wastewater services have historically been a function of the municipal government, with some financial assistance from national governments.

An economy of scale exists when enlarging a facility or programme will lower the cost per unit of the product or service being delivered.[8] Economies of scale often exist in water systems. Dams and reservoirs, for example, are typically sized based on this concern; a smaller dam and reservoir might cost less, in total, but would have higher costs per unit of water storage. Similarly, the additional cost of sewer pipes to bring sewage from large areas to a single wastewater treatment plant rather than to two smaller plants has often been justified by the lower unit cost of treating sewage at a larger plant.

Diseconomies of scale are also possible. That is why some water systems are horizontally fragmented. For example, sewer systems in flat terrain are often smaller in area than in sloping terrain because it is more difficult to move water over large distances when terrain is flat. Discharge to natural watercourses at many rather than a few locations makes more sense, and administrative boundaries tend to conform to the boundaries of the underground pipe system. Also, small management units may have administrative cost advantages over larger units, especially when systems are simple, neighbours are relatively far away, or they have different management priorities and objectives.

Regionalisation of water systems

Numerous regions are beginning to take advantage of economies of scale through the regionalisation of water systems. While water services are typically managed at the municipal level, watersheds are typically larger than municipal boundaries. Different municipalities also have different capacities to manage water systems (McFarlane, 2003). Regionalised water systems can take advantage of managing water systems across many municipalities to reduce costs, share expertise, improve performance, enhance the security of water supply in uncertain climate conditions, and address and manage water systems at a more appropriate watershed scale.

The river basin or watershed approach has been used in many regions including in parts of the US and Canada, and is now supported by the European Union. The regions using and promoting this approach have found that management at the river basin level is ideal for water resource planning, demand management, infrastructure development, financing and other functions. The river basin approach considers all of the water falling into one river basin or watershed and manages the needs of all residents in the watershed. This will require supramunicipal levels of co-ordination and government, and will help manage all water inputs, extraction, loss, and in-stream uses in the entire river basin system.

Environmental drivers that increase the costs of the system, including climate change, water pollution and environmental regulations (supranational and national), will potentially make it more attractive to manage systems at

larger scales. Environmental concerns are creating greater awareness of and planning for the interconnectedness of water systems at the watershed scale. Previously, water-system boundaries were defined politically, and little attention was paid to watershed boundaries. Consequently, this driver will help to focus attention on the possible economic benefits of management at the watershed scale; benefits that, if real, will help to overcome parochialism common in local government.

Ensuring water security is also a key benefit of regionalised water systems. As water becomes polluted, or climate change impacts water security in certain regions, management of water and wastewater systems may need to be undertaken at a larger scale allowing water systems to develop partnerships with other systems as added security. The scale of systems may need to expand as the regional scope of water resource abstraction increases, as more regions seek to obtain water from greater distances. By banding together several municipal water systems, or urban with rural systems, each water system can benefit from having several water supply sources at their disposal in the event of failure of any particular source. With climate change impacting the nature of water supply in many regions, increasing the number and type of water sources will enhance water security.

Decentralisation of governance in some countries (*e.g.* Brazil, the Russian Federation, India, China, Indonesia and parts of eastern Europe) may help to reduce costs by shedding the diseconomies of scale embedded in large bureaucracies. Such bureaucracies have large transaction costs; that is, their actions require the involvement of so many parties at so many levels that relatively small opportunities for improvement cannot be captured without significant spending for meetings, memoranda, and so forth.

The development of *international standards* may create economies of scale as well. Vendors of equipment, in particular, can reduce their costs if sizes (*e.g.* metric *versus* imperial), public health codes or tests, and enforcement approaches are standardised.

Financial concerns have and will continue to drive discussions about water-system consolidation, especially smaller ones, into regional entities or via private companies that can provide economies in purchasing or administration even when the systems are physically separate (Beecher, 1996). There is evidence that both of these approaches can reduce costs significantly. For example, Wolff and Hallstein (2005) also report that consolidation of wastewater operations in three small communities in Minnesota resulted in a 30-50% reduction in bulk chemical purchasing, back-office functions like utilities billing, and so forth. On the other hand, Wolff and Hallstein (2005) also report that a regional consolidation in Kentucky failed to achieve expected cost reductions. Financial pressure will drive the search for economies of scale, but they are not always possible.

In "Regional Water Works: Sharing Urban Water Services", Susan McFarlane (2003) of the Canada West Foundation documents the usefulness of regional water management and key principles for moving it forward. Case studies on two successful regional approaches in Vancouver and Edmonton are documented.

That paper posits that regional water services can improve water availability, quality and affordability in rural areas; enhance management, planning, and protection of watersheds; and increase cost effectiveness of urban water services by expanding the coverage area. There are financial benefits that can be gained if regionalisation of water services leads to increased revenue, reduced costs and improved efficiency. Municipalities that are adjacent to one another are connected because water usage or disposal of wastewater by one municipality affects the water security of another municipality. By consolidating services, municipalities can share water wealth and protect existing water supplies. Smaller municipalities often find it difficult to meet more stringent government standards. Banding together to form a larger entity or joining with a larger municipality may help smaller towns gain the resources and expertise needed to implement new standards.

Also documented are a series of challenges and pitfalls in the regionalisation of water services. These include problems if a municipality is not able to pay the costs of extending the water service to its town. Smaller municipalities are often suspicious of their larger city neighbours and may be concerned that water system sharing may lead to further erosion of autonomy in other arenas. If there is a fear that water is scarce, this may lead to more contentious rather than collaborative relationships between neighbouring municipalities.

MacFarlane's paper offers a series of key recommendations in moving toward a regional approach to water systems:

- Large cities should be open to exploring the development of shared water services.
- Ensuring the safety of drinking water should be viewed as a shared responsibility.
- Water service sharing agreements should fully account for their environmental effects.
- Water service sharing agreements should account for the full cost of water services including the long-term replacement of infrastructure and maintenance of watersheds.
- Water conservation mechanisms should be built into water service sharing agreements.
- Formal structures for managing regional systems should be created.
- Provincial governments should become more involved in facilitating regional water systems.

- Water management and land-use planning should occur at both an integrated level and at the larger regional level.

On-site, point-of-use, and closed loop systems

At the same time, advances in technology are reducing the diseconomy of scale associated with small systems. Membrane bioreactors may make high-quality treatment available at low cost at much smaller scale than was previously available. And microfiltration, reverse osmosis, electrodialysis and advanced technologies make it possible to treat small, intermittent water flows that are not easily treated with biological processes like activated sludge or membrane bioreactors. On-site wastewater recovery (so called "closed loop systems") is much more economical now, and may become even more attractive in the future, so long as energy costs are manageable.

New technologies that reduce costs and improve efficiency in the water and wastewater sector are important drivers that will have significant impact on provision of infrastructure. World wide, the provision of water and disposal of human waste has followed a particular technological trajectory, involving massive centralised projects that abstract, treat, deliver water, depend on water to transport and dispose of human waste, and require significant energy inputs. The dominant technologies were developed in relatively rich societies where capital was available to undertake large centralised projects.

The transfer of these systems in the developing world through multilateral aid and government support has faced numerous challenges, including lack of capital, population growth, and inability to fund or conduct ongoing maintenance. At the same time, developed country governments need significant investments to maintain and repair ageing infrastructure, as well as meet increasingly stringent standards. In addressing these challenges, a host of technologies have emerged or become more predominant over time.

On-site and closed loop systems are a small but growing share of the water and wastewater sector. On-site systems are varied in form and function. They can be low-energy and low-cost systems for water collection, storage, disinfection and waste treatment. On-site systems can also be expensive and energy intensive, such as conventional mini-water plants (using, for example, reverse osmosis or ultraviolet technologies) and wastewater treatment plants (*e.g.* membrane bioreactors).

Drinking water. On-site water provision can be as simple as rainwater harvesting (mandatory in many parts of India and growing in Australia), where untreated rainwater is used for washing and gardening, and treated rainwater (through UV or filtration) is used for drinking. Many urban residents in developing countries depend on groundwater to supplement limited supplies of piped water.

In some places, individual homes and apartment complexes often maintain their own well or borewell, pumping it to an overhead tank for use throughout the day for washing and other non-consumptive uses. This water is also used for drinking when other drinking water is not provided to or purchased by the household.

A small number of "point-of-use" systems for drinking water have recently been developed to test the idea of solving problems with access to safe water for individual users, rather than municipalities, regions or villages. This approach relies on private market forces to distribute water purification options to end-users directly, eliminating community, municipal or centralised private water development requirements. For example, the Centers for Disease Control and other private and public groups developed the Safe Water System of chlorine disinfection solution, which has been launched in numerous African countries and India. The PuR system developed by Procter and Gamble Company provides a sachet to safely disinfect drinking water at the point of use. There are advantages and disadvantages to the use of these options to meet the needs of individual water users, which will not be discussed here. But the commercial availability of such options suggests that some consider this an appropriate business model for meeting water needs.

In some regions, for example in Mexico and India, drinking water is critical to provide on-site to attract potential residents to water scarce areas without adequate piped supply. Developers and builders in these areas in India are integrating mini-reverse osmosis (RO) facilities on-site. Developers in peri-urban areas either contract this service out to third parties, who then maintain the RO or wastewater treatment plant, or sell this service as part of the housing package, to be managed by the homeowners association through dues.

Wastewater and waste. The use of on-site systems to treat waste in peri-urban areas in developing countries is growing. Two low-cost on-site and closed loop methods for sanitation are popular and supported by overseas development aid.

One is *ecosanitation*, a method promoted by the Swedish government, which is based on closing the nutrient loop in sanitation and moving away from conventional waterborne sanitation. The traditional sanitation path was developed in countries rich with water resources, and is not often a good fit in countries facing water scarcity. In addition, a core tenet of ecosanitation is that human excreta contains valuable nutrients that can be used to provide food security when treated and handled properly.

Ecosanitation involves separation of urine and fecal matter, applying sterile urine directly onto plants, and composting the fecal matter (mostly drying) until it is safe for land application. Ecosanitation approaches have been implemented in India, China, Sweden and parts of eastern Europe.

Ecosanitation facilities are growing rapidly in China and India and both countries host ecosanitation offices. These are often used along with a set of toilet blocks, in areas with high groundwater levels, and in areas where there is no sewerage (peri-urban and rural).

The Dewats system, or decentralised wastewater treatment, is promoted by Germany's overseas development agency, BORDA. Dewats is sometimes referred to as "wet" ecosanitation. Dewats provides a series of modules to achieve tertiary treated water through sedimentation, baffled reactors, anaerobic filters and polishing ponds. The relatively low-cost, low-energy systems use the natural grade to move water. The Dewats system is growing in its application in peri-urban areas, and small- and medium-sized enterprises, particularly in areas that traditionally use water in latrines. Dewats is popular in India and South-east Asia.

Numerous private companies have emerged to provide small-scale conventional treatment for water and wastewater. Emerging economies are increasingly requiring on-site treatment for wastewater instead of connection to overburdened centralised systems. New legislation in India requires all large generators of wastewater to treat all their waste on-site. This has led to an explosion of service providers developing water and wastewater treatment plants for offices, apartment complexes, and other users.

Speaking with developers and consultants in India, we found that many builders of flat complexes are integrating wastewater treatment and water treatment into their buildings because that is the only way to attract residents, particularly in water-scarce urban areas. While developing a mini-conventional wastewater treatment may seem expensive, we found that costs are often one-fifth the cost of water purchased from tanker trucks or other sources. Treated wastewater can be used for gardening, toilet-flushing and groundwater recharge.

The trend is for more peri-urban and rural areas in developing and emerging countries, and in greenfield areas in developed countries, to opt out of conventional large-scale water and sewage treatment systems. Small-scale systems can require less energy, less maintenance (if they are modelled after Ecosan or Dewats), and be far less costly than extending pipes and the centralised system far afield. Small-scale systems often require more space, and may not be appropriate for dense, built-out urban areas.

The growth of on-site systems particularly in emerging economies and in the greenfield areas of developed countries changes the landscape of business models in the water sector. New business models are emerging including flat developers who are now in the business of water and wastewater provision – they are required to do so to develop a saleable property. New consulting firms and full service firms are emerging locally and internationally to provide on-site water and wastewater services not only for industrial use, but also for residential and commercial uses. These firms tend to operate on a DBOT or a DBO basis. This is

reducing the pressure on centralised water-system expansion needs, but is complicating traditional regulatory mechanisms because drinking water or water for other purposes (*e.g.* toilet flushing or landscape irrigation) is provided by a variety of different sources, and waste is treated and disposed of in numerous places.

Stormwater management. Technologies for addressing runoff water-quality problems (called "non-point source" pollution in the US and "diffuse" pollution in Europe) are experiencing rapid innovation and development. This is because runoff problems cannot be completely solved by street sweeping and other best management practices, and are very expensive to solve by end-of pipe treatment. Storm runoff is highly variable in quantity and quality and, unlike sanitary sewerage, is often not piped together to one or a few points. There are numerous places where polluted urban or farm runoff enters streams, rivers or other water bodies.

Consequently, decentralised solutions for preventing diffuse pollution or treating it near the source are being pursued and are increasingly recognised as feasible and desirable. These solutions often involve so-called "low impact development" techniques (*e.g.* see *www.lowimpactdevelopment.org*) that maximise rainfall retention near its source, increase percolation to groundwater aquifers, or filter runoff through vegetation prior to entering concrete channels or other large, conveyance structures. They also involve the use of constructed natural systems such as small "bioswales", "biocells", or wetlands and marshes specifically designed and operated to protect ambient water bodies from diffuse pollution in runoff (Box 4.4).

These techniques are directly applicable to business models that operate combined sanitary and storm sewer systems. Reducing the quantity of rainwater that must be managed by the system can significantly reduce costs for peak hydraulic loading. Cleaner rainwater can significantly reduce costs for treatment or regulatory compliance. These techniques are also indirectly applicable to all business models in the sense that growing public pressure to solve diffuse pollution problems creates opportunities for new actors in the water sector (*e.g.* housing or commercial developers).

3.4. *Public involvement and equity*

Public involvement, if welcomed and managed appropriately, will facilitate much larger investments in the water sector. The large multinational water companies seem to have recognised this in recent years, and increasingly try to communicate with citizen groups as well as governments when they are developing new business. Since customers must repay investments in many cases, it is essential that they trust both the service provider's ability to deliver

Box 4.4. **Constructed wetland for treating urban runoff**

A 55-acre freshwater marsh in Alameda County, California, was designed to remove pollution from urban runoff before it reaches the San Francisco Bay. Water from a 46 square-mile area drains into the marsh. A Gross Pollutant Trap (GPT) collects large pieces of trash behind a series of weirs before they reach the main body of the marsh. Water then flows into one of two ponds. The first is a five-acre, six-foot-deep lagoon with a central island. Incoming water mixes with marsh water containing bacteria and other micro-organisms that remove pollutants. The large surface area of this system provides wind exposure, which contributes to increased mixing and more effective chemical and biological processes. The second pond is a four-acre section of shallow water averaging three feet in depth and covered in aquatic plants.

The plants take up nutrients through their roots. Bacteria in the pond sediments break down biological matter and mediate the removal of nitrogen to the atmosphere. Sediments are trapped in the plant roots along with attached nutrients and other pollutants such as agrochemicals. Water from both ponds then flows through a channel before being released to a natural marsh that borders the bay. The large surface area of this channel allows sun, soil, bacteria and plants to provide a final removal of pollutants before discharge. Fish and plant tissue, sediments in the marsh, and water exiting the marsh have been tested for a wide range of chemical constituents. These tests showed that suspended solids, nutrients and urban toxic materials were removed by the marsh. The marsh itself remains a healthy and viable ecosystem, despite the fact that urban runoff has been flowing through the system since the early 1980s.

Source: Alameda Countywide Clean Program (1998).

services *and* the provider's ability and willingness to transparently and credibly account for the spending necessary to provide those services. This issue applies as much to public as to private providers.

Improving public involvement and *transparency in water decisions* are key drivers in the water sector, as experience has identified the key role public involvement and transparency play in the success and sustainability of water sector projects. In decades of working on the global water and wastewater problem, development professionals have learned that social, economic, and political factors are just as important as technological factors and must be considered at the beginning of any potential project. Officials at multilateral lending agencies have also found that lack of transparency in decisions has played a key role in the failure of many urban infrastructure projects.[9]

Business models can be more or less transparent in their decision-making processes or their access to data and resources. When decisions in the water sector are not adequately disclosed or publicly vetted, controversy can develop around the resulting projects. When the public does not have access to documents, information or decisions being made about the water resources upon which they depend, they may perceive that these decisions are not in their best interests, that government or the private sector is hiding potential problems or flaws in a project, or that these decisions are the result of corruption or bribery. In fact, both theoretical and empirical evidence points to the fact that transparency and external accountability in the workings of government can reduce bribery and corruption (Kaufmann, 2002).

In the case of private sector involvement in water and wastewater services that were formerly provided by the public sector, the importance of maintaining public access and transparency is even more critical; and a closed process can lead to outcomes that are not in the best interests of the public. A lack of transparency in the selection and design of a privatisation scheme can lead to subversion of the competitive bidding process, corruption or collusion, subjective awarding of contracts, or favourable treatment of the selected private sector partner (Kaufmann, 2002).

A lack of transparency can transform broad support to outright opposition from other political parties or the public at large and can precipitate project failure. For example, the Buenos Aires water concession of Aguas Argentinas, a subsidiary of the French companies Vivendi and Suez, is often held up as an example of successful privatisation, with significant improvements including greater coverage, better service, more efficient operations, and lower prices for consumers. At the low point of the economic crisis of the late 1980s, 59% of Buenos Aires' residents favoured privatisation, and just 16% opposed it. Four years after the concession was put in place, those numbers had essentially reversed. According to a case study on the Buenos Aires Water Concession by the World Bank: "… public confidence in the process has eroded. The Buenos Aires concession shows how important transparent, rule-based decision making is to maintaining public trust in regulated infrastructure" (Alcazar *et al.*, 2000).

Transparency and public involvement in decisions about rate increases are also important drivers in the water sector. As the events in Cochabamba, Bolivia, highlighted, rapid and large increases in water rates can cause strong social and political reactions. Public protests and political demonstrations over price increases have also taken place in Tucuman, Argentina; Puerto Rico; Johannesburg, South Africa, and elsewhere. In Argentina and Bolivia, rate concerns along with other factors led to privatisation efforts being cancelled. Across South-eastern Asia, disputes over water tariffs are raging. In Malaysia, rate increases just prior to privatisation led to protests.

Rate increases, whether under public or private provision, may need to happen to cover system operating and maintenance costs. These rate increases need to be clearly tied to communication and public involvement efforts. There is abundant evidence that people – even those with low incomes – are willing to pay for water and sanitation when the services are reliable and the cost of delivering services is reasonably transparent and understandable to customers. This suggests that dissemination of detailed information about the improvement in services, and the capital investments needed to create those improvements, is essential to public acceptance of increases in overall water prices.

Equity and water

Because water is fundamental for life, ensuring equity is a key goal and a driver in the water sector. Addressing the key link between water and poverty is being recognised as a key responsibility for water sector actors (see Box 4.5). Lack of access to water is a factor in ongoing poverty for numerous reasons. The economic costs of poor health and disease due to lack of water are borne by the individual as well as the state. The United Nations includes access to water services as a key component in their Human Poverty Index (UNDP, 2004). The Millennium Development Goals (MDGs) adopted by the United Nations in September of 2000, among other explicit targets by the year 2015, called for the world community to halve the proportion of people who are unable to reach or afford safe drinking water, and to halve the proportion of people without adequate sanitation. The MDGs are key drivers in developing services in underserved areas globally.

While most OECD countries have nearly universal coverage, the *affordability* of water is a critical component for the health of populations. Even in wealthy OECD countries, rapid increases in rates have affected public health among the poorer sections of society. When water was privatised in England in 1989, price increases led to customer dissatisfaction with costs, consumer defaults, and non-payment. In 1994, for example, two million customers defaulted on water payments. These defaults, in turn, led to thousands of disconnections for non-payment of bills. A 1996 study by the Save the Children Fund showed that 70% of low-income customers were taking health-endangering measures to reduce consumption, such as flushing less frequently, sharing baths and washing clothes less often. It concluded that vulnerable groups could not make any further reduction in household water consumption without eliminating essential uses of water. Another study by the British Medical Association correlated the rise in dysentery rates with water disconnections. These studies served to consolidate the negative public image of water companies and led to changes in disconnection rules.

Box 4.5. **The human right to water**

The human right to water remains a vital issue that has begun to play a role in national and institutional choices about meeting basic human needs. A growing number of organisations are arguing that the human right to water means that fundamental changes are needed in the way water is priced, financed and managed.

There is a clear legal human right to water. Far less clear, however, are the rights and responsibilities that such a right implies, and how it is to be implemented in the context of different business models for water supply and sanitation. Gleick (1999) explores the historical precedents, legal background, and rationale for the human right to water in existing international laws, covenants, conventions and state practice. In 2002, the UN issued General Comment No. 15, a far more definitive assessment of human rights law in this context.

While there are serious unresolved concerns about definition, and especially, implementation of such a right, the simple existence of a right to water, from a legal, historical, ethical and moral point of view is increasingly established, and many governments are now trying to resolve uncertainties about implementation.

As noted elsewhere in this chapter, water is both a public good and an economic good, and the serious debate about water privatisation and the role of the private sector has spilled over into every water discussion in the past decade, including the debate over the human right to water. General Comment No. 15 quite explicitly notes that some forms of private participation in water service delivery may be appropriate but it also offers some limits and bounds to the role of private entities in providing this public good and service.

General Comment No. 15 tackles the question of water pricing by noting that water must be affordable and does not have to be provided for free, even for the most basic quantities for human survival. It also leaves open the possibility of governments providing free water, if they choose such an approach and it also addresses the need for increased cost-recovery through user charges and a sustainable economic structure to permit operation and maintenance of water service systems over time. Along with these principles for financing, General Comment No. 15 also pays special attention to concerns about equity and socially disadvantaged groups and the need to ensure that their water needs are met affordably. It also notes specific obligations for transparency and information exchange as a key element of any water management and financing approach.

Source: Gleick (1999) and Riedel, Eibe and Peter Rothen (eds.) (2006), *The Human Right to Water*, Berliner Wissenschaftsverlag.

The question of how to provide water to the poor is of critical importance and affects the pricing structure of utilities, their plan to achieve full cost pricing, and their ability to provide the key public health benefits that water and wastewater services entail. Affordability is an important dimension of the policy discussion that is different than willingness-to-pay. While cost recovery via rate increases may be essential for the sustainable operation of a water utility, it can force the poor to pay more than they can afford for water. An economic willingness to pay does not imply that the payment is affordable or socially desirable. Gutierrez *et al*. (2003) pointed out that the urban poor in Accra pay as much as five times more than other users per litre to fetch water from distant sources. Paying five times more demonstrates that willingness to pay is high, but it also demonstrates that water is essential and the purchaser has no choice.

Pressures for full cost pricing will make it increasingly difficult to ensure that an affordable basic amount of water is provided to the poor, and that the poor do not pay excessive costs for water. This may require that an external public actor, such as a health agency, provide subsidies to the poor to ensure that the health benefits of water and wastewater provision are protecting the poorer sections of society. There are numerous successful strategies to ensure that water is provided for the poor, including rising block tariffs, where prices increase over a certain minimum block of water; free basic amount of water; and subsidies provided to poor consumers. These strategies are either written into contracts with private utilities or guaranteed outside contractual obligations by the state.

A good example of a strategy to ensure water services for the poor without altering the price of water is the approach taken in Santiago, Chile. In the early 1990s, Chilean officials introduced a "water stamps" scheme that covers part of the cost of water purchases for the poorest residents. Until the late 1980s, Chile had used a cross-subsidy programme to address the needs of the poor, but the water utility was not recovering the costs of providing water service, and could not extend service to peri-urban populations. In 1988, Chile reformed its water sector, designing tariffs that recovered the costs of providing service to each zone. When Santiago privatised its water system, tariffs went up by 90% in four years. In order to meet a WHO goal that households not spend more than 5% of income on water, a "water stamps" scheme was introduced. By the end of 1998, 450 000 customers representing 95% of the target population were using water stamps. About 77% of the subsidy went to the poorest section of the population, while about 23% "leaked" to moderate and higher income customers (EMOS, 1995; Gomez-Lobo, 2003).

Governments are ultimately responsible for ensuring that the poor are provided with water and wastewater services. While this responsibility is likely to remain at the national level, new international efforts to develop

accepted guidelines, including the ISO standards setting process on water and wastewater services, may provide new tools for helping to ensure that the poor are provided with a basic amount of affordable water.

3.5. Competition

As policy makers in the water sector seek to capture the benefits of competition to improve efficiency and service in the sector, new approaches and opportunities are emerging. The benefits in terms of reduced cost and improved service that have followed the introduction of more competition and deregulation in the telecommunications sector have been looked to as models. It is far more difficult to introduce competition in the water sector because of the high costs of infrastructure (it is a natural monopoly), and the essential public health nature of the service, since introduction of poor water quality water into an existing system is a health concern. Options that are being considered to introduce a measure of competition into the water sector include third party access, water transfers and benchmark competition.

Third party access

"Third party access" or "common carriage" in the water sector is the use of the water or wastewater system network by a third party to supply water and wastewater services. Water and wastewater transportation networks are highly capital intensive, with capital costs representing 60% of the cost to provide water and wastewater services to a property. These networks are uneconomic to duplicate (Tasman, 1997). Common carriage has governed the telecommunications industry since the 1900s.

Similar to what happened in the telecommunications industry, allowing access to capital-intensive network assets by third parties could increase competition either at the supply end or the demand end of the network. In England and Wales, common carriage has been viewed as an opportunity to encourage competition in upstream markets, including abstraction and treatment. In Australia, common carriage is thought to improve competition in the downstream markets and retail supply.

The implementation of common carriage is furthest along in England and Wales. The Competition Act of 1998 opened up the scope for common carriage. The act, brought into effect in March 2000, requires incumbent companies to develop a code identifying the terms on which they would provide access to their system infrastructure. The act requires the incumbent company to respond directly to new entrants or competitors requesting access to its infrastructure. If the incumbent company does not provide adequate justification for rejecting an application for common carriage or only offers access on unreasonable terms, they are subject to investigation and potentially financial penalties. This was

meant to facilitate new entrants and more competition between established players in the English water market (Ofwat, 1999).

The UK Water Act of 2003 further extended opportunities for competition. From August 2005, new market entrants could enter into common carriage or bulk water purchase agreements with water companies to supply non-households consuming more than 50 megalitres of water a year. New and established water providers are able to use other providers' pipe networks or treatment works, and customers using over 50 megalitres annually can purchase water from their existing provider or from a water supply licensee. The Water Act of 2003 also extends competition in the laying of water mains, sewers, and service pipes (Ofwat, 2004). Australia is considering the use of common carriage to increase competition in their system.

Common carriage could have major implications for improving competition in the abstraction, treatment, and delivery of water and wastewater services. Currently it is still in a trial period in the UK, with consideration of moving common carriage competition to household users as well in the next three years.

In other parts of the world, common carriage seems to be happening on a limited case-by-case basis. For example, Poseidon Resources, Inc. is attempting to build desalination plants for Carlsbad and Huntington Beach in California. They will be contracting with municipal governments to provide water to be used directly in the municipal water supply system. Desalination is a clear case of a new abstractor/treatment facility requiring entry into the water system through common carriage. Because the source water for desalination plants is not regulated there is an unlimited amount of water that can be produced and distributed through new desalination plants, so long as revenues cover costs. This could require some sort of California-wide common carriage rule, or some standards for undertaking it on a local level.

Common carriage or third party access, although probably 10-20 years out in many countries, has the potential to have a significant impact on the water sector. Common carriage can introduce new public and private sector competition in abstraction and treatment of water as well as in the retailing. This may mean new business models that include desalination facilities entering water directly into the water network, private players that introduce efficiency gains as a new source of water, private players that cater to green markets on the retail side by paying for efficiency, and green system improvements (*i.e.* similar to Working Assets Telecommunications in the US).

Another way to conceptualise third party access, although not traditional, is to consider "extending" the water system through licensing arrangements with small and informal water vendors. This allows two regulated systems to exist side by side, providing service in different ways in different neighbourhoods. This is happening in urban and peri-urban areas in developing countries.

Water transfers

A water transfer is defined as "a change in the point of diversion, type of use, or place of use of water" (Gomez and Steding, 1998). Water transfers have both environmental and socio-economic implications, including changes in water quality and employment. While they are not a new phenomenon, water transfers are becoming increasingly common due to scarcity concerns and the need to reallocate water among users. For example, the Imperial Irrigation District and two Southern California water utilities recently entered into a water transfer agreement by which water (but not water rights) from agricultural users is transferred to urban users in Southern California due to land fallowing and on-farm water efficiency measures. In addition, the Chinese government is building a north-south water transfer scheme by which water from the Yangtze River will be transferred to the North China Plain, where land is better suited for agriculture than in the South.

Water transfers will have implications for the water sector business models, including the emergence and expansion of new players. While water transfers can occur on an informal basis, more formal systems that involve water brokers are gaining popularity. Water brokers, either private or public, facilitate transfers among buyers and sellers. In Australia, for example, anyone can act as a water broker, and "water brokers are not subject to any legal obligations other than the general body of law applying to commercial transactions" (Queensland government, 2006). While public institutions can serve as water brokers, private water brokers are more common. Water brokering is a specialised line of work, and it is unlikely that a single public entity will generate sufficient trades to staff and fund a water transfer programme.

It is important to recognise, however, that water transfers are only possible between actors that are capable of changing the point of physical delivery from the seller to the buyer. Either a piped conveyance system, or a tanker or water bag system across oceans, must both exist and have costs of operation that are small relative to the value of the transaction. These conditions are often not met for water. Water is very bulky per unit of value and therefore more difficult and expensive to move than electricity, oil, natural gas or telecommunications signals.

Benchmark competition

Advocates of increased private involvement in the water sector often claim that competition will reduce costs and improve performance in general. However, non-market as well as market competition is contributing to the trend (Wolff and Palaniappan, 2004). Performance measurement and accountability tools are emerging around the world, in both public and private business models within the water sector.

For example, performance scorecards published periodically (*e.g.* annually) can be used along with or instead of performance bonuses. This practice has been used successfully in Australia, the United Kingdom, and other parts of the world. Australian water utilities are municipal corporations governed by a technical board appointed by the state within which they operate. They are responsible for paying dividends to the state treasury and for providing the services and service quality desired by their customers. Standardised performance measurements are required by the state government, which are used by customers and senior managers to evaluate the performance of each utility. Reportedly, doing well in these appraisals has become a significant driver for utility boards and senior managers (based on discussions by author Wolff with utility and Australian Water Association staff in Brisbane, Sydney, and Melbourne in July and August 2005). Benchmarking in the water sector is discussed in further detail as an important enabling policy.

3.6. Climate change

Environmental issues, including climate change and pollution, may have the greatest impact on infrastructure needs and the costs of water and waste services. Ashley and Cashman (2006) indicate that these factors may increase costs by as much as 33%. Climate change will undoubtedly have considerable impacts on water resources, although the extent of the impact and the precise locations where major impacts will be felt is unknown. Climate change will increase the vulnerability of water resources to disruptions. With increasing climate variability, severe drought and flooding events are likely to increase. Sea level rise will threaten coastal aquifers that are already facing over extraction and salinisation. Projected increases in evaporation may reduce the efficiency and the attractiveness of future surface-water storage projects. Per capita water use may increase as climate warms. Agriculture may also need to shift locations as climate zones shift, increase cropping intensity and change cropping patterns to lower water usage products. Investments will be needed to protect the security of existing water supplies, and diversify sources of supply to protect against climate uncertainty. Demand side management, increasing the efficiency of water use and varying water quality will provide low-cost methods of reducing water demand and thus provide new "sources" of water.

The OECD paper on "Domestic Policy Frameworks for Adaptation to Climate Change in the Water Sector" (Levina and Adams, 2006) provides an analysis of the ability of four OECD countries – UK, Finland, USA, and Canada – to adapt to climate change impacts on water resources. The potential climate impacts on water resources include variations in snowmelt and water supply; increase in floods, flash floods and drought; insufficient water; and saltwater intrusion (Table 4.7).

Table 4.7. **Climate change impacts related to water in four countries**

	Country/state province basin	Climate impact					
		Snowmelt water supply	Flash floods	Floods	Drought	Insufficient water	Saltwater intrusion
USA	California	X	X	X	X	X	X
	Colorado	X	X		X	X	
	New York			X	X		X
Canada	British Columbia	X		X	X		
	Ontario	X		X	X		
USA/Canada	Great Lakes Basin				X		
United Kingdom	England and Wales			X	X	X	X
	Scotland			X			
	Northern Ireland			X			
Finland	All		X	X			

Source: Levina and Adams (2006).

Levina and Adams document climate change general circulation models which predict decreases in snowpack and frequent thawing and an increase in floods as well as summer droughts in Finland. In the UK, drought is predicted to have a major impact on water security, with decreasing runoff in the south-east and growing populations leading to greater water scarcity. Winter flooding is also anticipated to be an expensive problem. In the United States, the states of California, Colorado, and New York were profiled. California and Colorado both depend on winter snowmelt to provide water supply during the dry summer months. With earlier snowmelts, reduced snowpack and growing populations, these states will face significant water challenges as temperatures increase. The low lying state of New York will face concerns related to the effects of sea level rise and increased storm frequency on protecting the integrity of water infrastructure. While Canada is a very water rich country, climate change will also impact different regions of Canada with climate variability, decreased runoff in the summer, increased runoff in the winter and lower water levels in major fresh water bodies.

The impact of climate change on water resources will undoubtedly be significant. As climate change affects where and when water falls, those who previously had licences to extract water may be affected by water scarcity. This may cause water rights regimes to be reapportioned or recreated to address changes in water availability. The environmental driver of climate change will make it more challenging to operate and maintain built assets, and may require increasing levels of investment to keep up with changes in water security. Environmental regulations may require the development of new infrastructure or partnerships to create compliance with stricter standards.

Controlling the extent and speed of climate change may reduce the cost of adapting water-supply and flood-control systems to altered precipitation patterns. Any such avoided costs in the water sector are an offset to the cost of controlling climate change through investments in energy efficiency or low-carbon energy production technologies. Environmental drivers that increase the costs of the system, including climate change, will potentially move the level of governance to higher levels. As water becomes polluted, or climate change impacts water security in certain regions, governance of water and wastewater systems may need to be undertaken at a larger scale allowing water systems to develop partnerships with other systems as added security. The scale of governance may need to change as the regional scope of water resource abstraction increases, as more regions seek to obtain water from greater distances.

With large potential increases in costs from climate change, water pollution, and more stringent regulations, environmental drivers will make it more difficult for utilities to recover all costs from user fees. This will mean that tax revenues or government support might continue to be needed to finance major projects that address climate change impacts, although accurate full cost pricing should account for the external costs of climate change that will affect the water system's sustainability.

4. Influence of drivers on business models

The six key drivers and opportunities explored in this chapter will interact and shape the water sector in the decades to come. How will business models respond to these drivers, and which business models will be most robust in overcoming the challenges while taking advantage of the opportunities presented here?

Financing is an ongoing challenge in the water sector. Most countries are facing increased infrastructure maintenance and repair needs. Climate change, security concerns, and new and more stringent water-quality standards will have a significant impact on water resources and the provision of services, potentially greatly increasing projected financial needs in the water sector. The public sector, however, is reducing government expenditures, creating an increasing gap between capital availability and capital needs. The private sector also fails to invest the level of capital that is needed to fill this gap, a problem that is exacerbated by a recent shift from concessions to operation and maintenance contracts in some places, effectively reducing the amount of capital that the private sector is supplying.

How can business models achieve the financing necessary to meet current and future infrastructure needs? There are four opportunities outlined in the above section that can help business models meet infrastructure needs.

The first is *changes of scale*. Business models are emerging that are taking advantage of differences in scale to increase cost effectiveness of water services, increase revenues, and also introduce new models to achieve capital needs. Regionalisation of water services has improved efficiency, cost-effectiveness and watershed management in key areas in Canada and the United States. Expanding the scope of service can improve a water systems ability to finance needed investments. Decentralised, on-site systems are changing who is responsible for and paying for water infrastructure. Engineering firms are building water systems using private capital, and maintaining ongoing service contracts to finance this capital. And home and landowners are investing their own capital (or servicing the debt on needed capital) in order to build on-site systems for single family or multifamily complexes.

The second opportunity to meet infrastructure needs is through *demand management*. Demand management changes the nature of needs for infrastructure. Increasing water productivity and efficiency, and improving conservation, can reduce the need for new and expensive water supply or wastewater treatment projects. As new water supply projects become more expensive due to sourcing water from greater distances, the cheapest new source of water has often been water gained through conservation, efficiency and improved management. Demand management can reduce the amount of financing and new infrastructure needed in water systems. Funding would instead be used for ongoing efficiency and conservation measures.

Competition is a key opportunity to reduce ongoing financing needs and improve the capacity of utilities to access financing. Competition that increases efficiency and improves water system management will reduce costs, thus requiring less ongoing revenue to support water system operation. Competition that improves the efficiency and effectiveness of water utilities can also have a huge impact on improving the utility's credit worthiness, thus allowing it to access private capital and public bonds. By being able to demonstrate that all measures for efficiency and cost effectiveness are being employed, a utility can make a strong case for its ability to manage capital.

The final and ultimately most important opportunity to achieve financing needs is *public involvement*. In the end, the public, whether as ratepayers, taxpayers, or stockholders, will finance whatever debt is incurred to build new infrastructure. Ultimately, water utilities will be subject to the court of public opinion to determine whether they have convinced ratepayers, taxpayers and stockholders of the need for new infrastructure investments and the utility's ability to manage those infrastructure improvements effectively. Public communication about the water system, the state of water system assets and the need for repairing and upgrading of water infrastructure is critical for the success of any efforts by any utility, public or private, to meet its investment needs. Public involvement will facilitate much larger investments in the water sector. Since

customers must repay investments in many cases, it is essential that they trust both the service provider's ability to deliver services *and* the provider's ability and willingness to transparently and credibly account for the spending necessary to provide those services.

Ultimately, business models need to meet the existing financing challenges and the new challenges posed by climate change. Existing business models must seek opportunities for demand management, improved efficiency through competition, and increased public involvement in order to sustain in the challenging decades ahead. Business models may also take advantage of scale changes, whether larger or smaller scales, to introduce new sources of capital and financing.

We can already see examples of public models seeking more efficiency, and a greater attention to public involvement by the private sector. The international private sector has given way to the local private sector, which is more connected to local populations. The private sector is also shifting in ways to manage financial risk, some of which are related to the drivers identified, and others of which are not. The changes in business models that are being observed and that we expect to continue are described below.

4.1. *Changes to existing business models*

Described below are key trends in each business model that we expect to continue over the next five to ten years. We anticipate that in the future, local private actors will become more predominant, and that concessions will continue to be attractive in some stable economies; but in others, O&M contracts will be preferred.

Public models

Greater efficiency. In the late 1990s and early 21st century, a growing trend toward privatisation in the United States led some public utilities to re-evaluate their efficiency and services in order to stave off privatisation pressures. These efforts were sometimes termed "re-engineering" and involved evaluating the complete water management system in an effort to identify potential efficiency improvements in operations that would permit a reduction in labour, energy and other costs. Business process "re-engineering" has been defined as the fundamental rethinking and redesign of existing processes to improve performance in areas of cost, quality, service and efficiency.

The East Bay Municipal Utility District (EBMUD) – a public water agency that serves over a million customers in northern California – recently implemented a "re-engineering" programme to help improve maintenance practices. EBMUD brought in auditors to review business practices around purchasing and handling materials, managing and scheduling maintenance, and setting priorities for

system repair and preventive maintenance. They then implemented a series of actions that they estimated would lead to savings of nearly USD 7 million per year, with an initial outlay of only USD 1.2 million (US NAS, 2002).

A similar program was implemented by the Phoenix Water Services Department (PWSD) in Arizona. The city was especially concerned about the possibility of privatisation and worked to identify possible advantages of the private sector over public operations and then studied how to improve their performance in those areas. PWSD's efforts focused on labour relations and performance, dispute resolution and customer service. Improvements were also evaluated in the area of maintenance strategy and job training. After reviewing possible improvements, PWSD implemented a series of changes that saved more than USD 10 million in the first three years and permitted them to meet their goals while reducing the need for new staff. According to PWSD director Michael Gritzuk, "Privatization doesn't even begin to address the scope of what a re-engineering project can address" (AWWA, 1999).

Private and mixed private-public models

Scope. Privatisation failures, driven in part by financial and political factors, have shifted the types of contracts sought by private investors. In both developed and developing countries, companies are focusing on limited projects with a narrower scope, *i.e.* an individual component of a water system, rather than large, multiscope projects (VanDe Hei, 2006).

In addition, concession contracts are becoming less popular, while operation and management contracts seem to be increasingly attractive. In the United States, for example, VanDe Hei (2006) notes that concession contracts have been replaced by operation and management contracts in small communities. Izaguire and Hunt (2005) note a similar trend in developing countries, where the number and size of new concession and lease contracts has declined since 2000, while the number of management contracts has increased. Both VanDe Hei (2006) and Izaguirre and Hunt (2005) attribute this trend to privatisation failures and the resulting risk averse behaviour displayed by companies. Concessions involve a high degree of capital risk, and companies are pursuing ways to minimise this risk: "Renegotiations and cancellation of water contracts have raised questions about the viability of private participation in water, particularly in concessions with significant investment commitments" (Izaguirre and Hunt, 2005).

Table 4.8 highlights a fundamental shift in investment patterns among private companies world wide. Private contract awards in wastewater exceeded that in water in the late 1980s. In the 1990s, however, private contracts in water were over two times greater than contracts in wastewater. Contract awards in the water sector have fallen, and between 2000 and 2004 were 20% less than during the previous five-year period. But, since the early 1990s, wastewater

Table 4.8. **Worldwide contract awards in the water and wastewater sectors**

	1985-89	1990-94	1995-99	2000-04
Water	48.6	33.14	136.05	109.69
Wastewater	56.53	13.57	57.94	72.05

Source: Pinsent Masons (2005).

contracts have been steadily growing. This transition from investment in water to wastewater is particularly true in China, where investments in wastewater have exceeded those of drinking water in two of the last three years (Pinsent Masons, 2005).

Environmental and technological factors are driving growth in wastewater investments. Growth in wastewater investments is due to growing concern about water pollution and its associated environmental and human health consequences, as well as more stringent wastewater discharge standards. In addition, there is a greater need for sanitation services, as a smaller percentage of the world's population has access to adequate sanitation than has access to a clean water supply. Additionally, technological improvements that allow more economical wastewater re-use are driving investments in this sector.

Political factors are likely driving greater *private* involvement in wastewater investments. Water investments have drawn a substantial amount of opposition due to concerns about corporate control of water resources. This opposition has slowed and in some cases halted privatisation projects. Wastewater, however, is less visible and fundamental compared to water supply. As a result, it has drawn less public opposition and allowed private companies to steadily expand their role.

Greater transparency and stakeholder involvement. Public opposition to water privatisation contracts and a series of water privatisation problems, notably in Cochabamba, Atlanta, and Buenos Aires, are driving the private sector to seek greater transparency. Corporate transparency, however, has largely focused on reporting, rather than involving stakeholders in the decision-making process. Thames Water, for example, recently released an extensive corporate responsibility report, which provided information on 25 key performance measures, including water pollution incidents, percentage of operational wastes recycled, and length of rivers suffering from low flow due to abstraction. The report also describes the importance of building stakeholders relationships: "We recognise that importance of stakeholder engagement and are working hard to raise awareness, skills, and capacity at all levels within the company to help improve our stakeholder relationships" (Thames Water Utilities Ltd., 2005). However, they acknowledge that they do not presently have a formal system of engaging stakeholders.

Business trends. The role of multinational and local companies has changed significantly since the mid-1980s. Table 4.9 shows the distribution of contract awards by recipient globally. Between 1985 and 1989, local companies in developed countries were granted over 90% of contract awards. Buoyed by successes in their home countries, some of these local companies, most notably Suez, VE and RWE, sought contracts in the international market, marking their transition to multinational corporations. Between 1995 and 1999, multinational corporations were awarded nearly 70% of contract awards. Since 2000, however, there has been a shift away from multinational corporations toward local companies in developed and developing nations. In 2005 alone, 13 new companies, mostly local and regional players, entered the water market (Pinsent Masons, 2005).

Table 4.9. **Worldwide contract awards by recipient in the water and wastewater sector**

Water and wastewater	1985-89	1990-94	1995-99	2000-04
Local – developed	94.89	1.66	8.64	29.26
Local – developing	0.6	5.18	43.4	45
Expatriate Chinese	0	0	8.99	7.98
Multinational	9.64	40.17	132.42	99.7
Total	**105.13**	**46.71**	**193.99**	**181.74**

Source: Pinsent Masons (2005).

Political and financial factors as well as changes in governance are largely driving the trend toward more local and regional players. Strong public opposition to water privatisation schemes by multinational companies, especially in Latin America, resulted in a number of project failures. Foreign exchange risk, *i.e.* companies pay for the infrastructure in hard currency but are repaid in soft currency, has also created problems for multinational corporations. In addition, local capacity building may also be improving. In the Pinsent Masons Report (2005), Owens cautions that this trend may have negative implications: "This is not necessarily a good thing as while local or expatriate funding obviates exchange rate risk, it plays a limited role in mobilising new sources of funding needed to attain the Millennium Development Goals as expatriate funding has only been identified being used in China to date."

Table 4.9 also indicates that an increasing number of contracts have been awarded to expatriate Chinese companies. Proliferation of Chinese players working regionally is due, in part, to access to funds from local and regional sources, including Hong Kong, China, which help stabilise currency and thus reduce financial risk. In addition, a recently enacted Chinese law prohibits foreign

companies from earning a fixed rate of return on investments (Pinsent Masons, 2005). Chinese companies, however, can earn a fixed rate, and municipalities can change regulations to suit their needs. These conditions favour local players and some multinational corporations have either exited the Chinese market entirely, *e.g.* RWE, or have opted to work with Chinese companies and municipalities under joint ventures. The needs in the water and wastewater sector in China remain high, and local and regional players have only partly filled the void left by multinational corporations who have exited the market.

In recent years, the international water market has contracted in some regions, but is growing in others. Suez, for example, has relinquished control of a number of projects, mostly in developing countries, and is focusing on expansion in Europe, North America and China; in Europe, their three priority markets are the Czech Republic, Hungary, and the Slovak Republic (Pinsent Masons, 2005). Veolia is focusing on China, which is projected to become its largest international market. And RWE AG has decided to shift its focus from the global water market to the European power market (Pinsent Masons, 2005).

4.2. Robustness of business models

In the face of a dynamically changing water sector, we also want to evaluate what underlying characteristics successful business models will share in the future. A few of these characteristics include the ability to incorporate multiple scales into water management, the ability to develop strategic partnerships in an ever widening circle of water sector actors, the ability to leverage innovative sources of financing while still maintaining a level of public funding, the ability to incorporate adaptive management and performance based incentives to improve performance, and the ability to communicate with and involve the public in decisions about the water system. Successful water system business models will also manage system assets effectively, staff their businesses effectively, and ensure proper assessment of the problem *before* proposing a solution.

Many of these determinants of success are detailed in the report *Beyond Privatization: Restructuring Water Systems to Improve Performance* by Gary Wolff and Eric Hallstein (2005). The analysis uncovered several problems in organisations, these included: insufficient funds, inefficient staffing, poor asset management, limited transparency and public participation, and ineffective performance measurement and reward. For these ailings, the authors propose a variety of solutions that they define as the *six determinants of success*. These six characteristics of high performance organisations would be present in either public or private models and are: effective staffing, consistently sufficient funding, detailed asset management systems, performance measurements and rewards aligned to organisational objectives, decision processes that are

transparent and open to the public, and using an effective planning process that identifies and assesses problems before arriving at solutions. These and other determinants of success are detailed further in the discussion below.

As we saw in the discussion on scales of water systems, water utilities are seeking *economies of scale* through regionalisation and river basin approaches while at the same time new water actors are emerging that are taking advantage of technology improvements to implement small-scale on-site systems. Successful business models will have to leverage both opportunities by integrating economies of scale through regionalisation, while allowing small-scale systems to provide services in areas that are not cost effective for centralised system expansion. It may also be the case that regionalised or river basin approaches may work in some cases, particularly where water systems are well developed, while on-site systems will predominate in areas that lack water systems or are unattractive for centralised water systems.

With the increasing number of actors being introduced into the water sector, successful water utilities will need to *manage a network of relationships* with vendors, competitors, and regulators in order to provide water services. This is already happening in the most privatised water system in England. The introduction of third party access will presumably introduce new actors into the system that are providing water services which the "host" water utility will need to work with in order to provide access to the water network. English water utilities will need to not only manage these relationships, but also relationships with several regulatory agencies, Ofwat, the economic and service regulator, the environmental regulator, and the drinking water inspectorate.

Because of the importance of water as a social and public health good, *public financing* in the water sector will still make up a portion of the needed funding in most OECD and developing countries. Effective water utilities will combine dwindling public financing with new financing mechanisms, while mitigating the social and equity impacts of full cost pricing for water. Moving toward full cost pricing will be desirable as a goal. Successful water utilities will incorporate new financing mechanisms that access private capital by accessing private savings invested in local financial institutions and capital markets. These utilities will also seek to get paid for the positive externalities generated by water services, including being paid for the public health benefits and the property development benefits of providing water services. These could be paid through funds from the public health agency or developers that benefit from water access at their development.

Water sector actors that can continuously improve performance, reduce costs and improve efficiency will be the most successful over the long term. Outward measures of performance are sure to be incorporated in many regions to compare water utility performance. More and more public utilities are facing

competition from newly emerging private actors. Successful business models will be prepared for competition in the market and for the market by integrating performance based incentives and adaptive management into their operations.

Those business models and water utilities that can *communicate with the public* that they serve are the most likely to be successful. Water utilities that can involve users of the water system in decisions about service, water rates, water quality, infrastructure investments and other key business decisions will be very successful in generating needed investments, achieving full-cost pricing, and building trust in the water system and its operators. In many OECD countries people take the massive underground system of pipes and hidden water and waste treatment facilities for granted. People simply expect clean water to flow from the tap. Proactive water utilities that can demonstrate the importance of the water system and the infrastructure and maintenance needs of the water system, and triangulate this with the needs of water system users, will be the most successful in generating needed investments, while protecting health and providing the desired level of water service.

Water system *assets need to be managed effectively* in order for business models to survive. As described earlier, the water sector is highly capital intensive, much more so than other sectors. This means that a significant amount of money is tied up in underground and overground infrastructure. These assets and this investment need to be protected and maintained on an ongoing basis. A successful business model would undertake a one-time system-wide asset condition assessment; this would be followed by ongoing inspection of assets. Long-term costs for lack of asset management would need to be factored into decisions on annual maintenance expenditures.

Efficient and effective staffing is also needed for business models to be successful. Staff need to be trained and have access to professional development that exposes them to new ideas and technologies in the field. In some cases, regionalisation may allow different agencies to share staff positions that could not have been funded by one municipality, and yet are critical for planning and management. Ensuring that technical and management skills that are not available on staff are contracted through outside firms is also important.

Planning processes undertaken at successful water utilities will start at *defining the problem* instead of jumping to pre-determined solutions. For ideological or political reasons, sometimes a particular solution is prescribed for a water utility, without even appropriately diagnosing the problem. Effective and sustainable water sector business models will undertake strategic planning efforts that define the problem, identify causes, evaluate options, before selecting and implementing solutions. In an adaptive management approach, these solutions will also be continuously evaluated for their effectiveness at addressing the root causes and solving the identified problems.

5. Policy implications

How can national and state governments facilitate the success of water, wastewater, and stormwater managers in the next few decades? As existing and new water sector providers respond to infrastructure needs and growing populations, the implications for government policy are significant. Governments can play an important role in creating the conditions necessary for water and waste system providers to make needed investments, achieve social and health goals, and protect against threats to water security, while at the same time providing strong regulatory oversight.

5.1. *Balancing multiple objectives*

Governments are balancing multiple objectives in the water sector, including those linked to environment, public health, affordability, reliability and allocative efficiency. Gleick *et al.* (2002) in "The New Economy of Water" identifiy a core set of principles that are critical to ensuring that the restructuring of water and wastewater services, particularly the move to private sector partnerships, adequately balances the multiple objectives listed above. These principles include: meeting basic human needs for water, subsidising water rates when necessary for reasons of poverty, ensuring that governments retain control over the water resource itself, and ensuring that negotiations over privatisation contracts should be open, transparent and include all affected stakeholders. These principles are summarised below in Box 4.6.

The Principles for the New Economy of Water create an overarching framework, within which further government actions can be identified that do not violate the principles, but that will enable a diversity of actors to succeed in fulfilling water and wastewater needs.

5.2. *Creating an enabling policy framework*

With the changing dynamics of the water and wastewater sector, sustainability in the water sector will require supporting and regulating a range of options within an enabling policy framework. We have identified an initial list of policy responses to provide for a robust response to the multiple drivers in the water sector. These policy responses will take advantage of technological opportunities to reduce costs, while assisting utilities in managing water and wastewater services in the face of environmental, security and financing challenges. The goal in the policy arena will need to be to create a pro-competitive framework while supporting a range of business models and scales to address water and wastewater needs. This will involve creating opportunities and removing obstacles to new entrants into the water sector, creating opportunities for multiple financing mechanisms, strengthening the regulatory system, focusing on transparency and public education, providing incentives for competition, and funding more research and development in the sector.

Box 4.6. **Core principles in restructuing water and wastewater services from "The New Economy of Water"**

1. Continue to manage water as a social good

1.1. Meet basic human needs for water.

Contract agreements to provide water services in any region must ensure that unmet basic human water needs are met first, before more water is provided to existing customers.

1.2. Meet basic ecosystem needs for water.

Basic water-supply protections for natural ecosystems must be put in place in every region of the world.

1.3. The basic water requirement for users should be provided at subsidised rates when necessary for reasons of poverty.

2. Use sound economics in water management

2.1. Water and water services should be provided at fair and reasonable rates.

Provision of water and water services should not be free. Rates should be designed to encourage efficient and effective use of water.

2.2. Whenever possible, link proposed rate increases with agreed-upon improvements in service.

Experience has shown that water users are often willing to pay for improvements in service when such improvements are designed with their participation and when improvements are actually delivered.

2.3. Subsidies, if necessary, should be economically and socially sound.

For example, subsidies to low-income users that do not reduce the price of water are more appropriate than those that do because lower water prices encourage inefficient water use.

2.4. Private companies should be required to demonstrate that new water-supply projects are less expensive than projects to improve water conservation and water-use efficiency before they are permitted to invest and raise water rates to repay the investment.

Privatisation agreements should not permit new supply projects unless such projects can be proven to be less costly than improving the efficiency of existing water distribution and use. Rate structures should permit companies to earn a return on efficiency and conservation investments, or to be financially rewarded in some other manner.

Box 4.6. **Core principles in restructuing water and wastewater services from "The New Economy of Water"** *(cont.)*

3. Maintain strong government regulation and oversight

3.1. Governments should retain or establish public ownership or control of ambient waters.

Permanent and unequivocal public ownership of ambient water sources gives the public the strongest single point of leverage in ensuring that an acceptable balance between social and economic concerns is achieved.

3.2. Public agencies and water-service providers should monitor water quality. Governments should define and enforce water-quality laws. Fortunately, this is the case in most of the countries addressed in this study, with the exception of bottled and vended water.

3.3. Contracts that lay out the responsibilities of each partner are a prerequisite for the success of any privatisation.

Contracts must protect the public interest; and good contracts will include explicit performance criteria and standards, with oversight by government regulatory agencies and non-governmental organisations.

3.4. Clear dispute resolution procedures should be developed.

It is necessary to develop practical procedures that build upon local institutions and practices, are free of corruption, and difficult to circumvent.

3.5. Independent technical assistance and contract review should be standard.

Weaker governments are most vulnerable to the risk of being forced into accepting weak contracts. Many of the problems associated with privatisation have resulted from inadequate contract review or ambiguous contract language. In principle, many of these problems can be avoided by requiring advance independent technical and contract review.

3.6. Negotiations over privatisation contracts should be open, transparent and include all affected stakeholders.

Numerous political and financial problems for water customers and private companies have resulted from arrangements that were perceived as corrupt or not in the best interests of the public. Stakeholder participation is widely recognised as the best way of avoiding these problems.

Source: Gleick *et al.* (2002).

Creating opportunities for innovative business models and strategies to succeed

Governments and water utilities face a range of uncertainties and vulnerabilities in the water sector, including climate change, water availability and financing challenges. In the face of uncertainty, it is important to cultivate diverse actors that can introduce an array of approaches that allow adaptation and innovation to respond to changing needs. Supporting a range of approaches is the best antidote to address uncertainties, challenges and risks.

The regulatory system in OECD countries is typically hardwired to regulate piped water supply and waterborne sewage treatment in centralised systems using a series of accepted technologies. This technological determinism toward conventional methods of water and waste treatment limits opportunities for new entrants into the sector and for innovative methods of achieving societal and water quality goals.

New actors attempting to provide on-site treatment of waste and provision of water may be limited because regulations require new and existing properties to connect to underground systems of water supply and waste disposal. There may also be no method to disconnect from the existing system or be served by a non-conventional entity. Ecosanitation proponents note that regulations often presuppose water-based transport for human excreta, ultimately excluding ecosanitation from the range of available options.

Standards for water and waste treatment need to be performance-based rather than technology-based. Technology-neutral standards afford providers in the water sector with greater flexibility and capability to innovate to meet needs. Standards should state quantitative and qualitative system objectives to achieve public health goals, rather than specify the type of technology that should be employed (Winbald and Simson-Hebert, 2004). In addition to providing a greater scope for on-site water and waste service providers, performance-based standards will also provide incentives for providers to seek out more efficient and cheaper ways of achieving set performance standards.

For example, New York City led a highly successful effort to manage watershed lands in order to protect ecosystems and water quality rather than build large new water-treatment infrastructure. In response to growing concerns over drinking water quality, the United States Environmental Protection Agency issued regulations in 1989 that required filtration of all surface water unless municipalities could employ other methods that would produce comparable water quality.[10] In lieu of constructing a filtration plant that would have cost city residents USD 6 to 8 billion, New York elected to design and implement an innovative environmental protection strategy to protect water quality in the entire watershed. This approach saved the city

USD 4 to 6 billion and brought many of the watershed's stakeholders into a collaborative process that both respected watershed landowners' economic well-being and protected the city's water quality. This approach has also spread widely since it was "discovered". For example, most water suppliers in the US have subsequently been required to develop plans for protection of their source watersheds based on the city's experience.

There are a range of policy approaches that can promote the entry of non-traditional service providers to operate on-site systems or for new entrants to come into the market. In India, for example, a series of rules implemented in the last few years require most new large generators of water to provide on-site wastewater systems. Ofwat, the economic regulator in England and Wales, has created a framework to facilitate effective competition in the water and sewerage industry through a series of legislative acts. Inset appointments allow the existing supplier of water to be replaced by another service provider in a specific site. All service providers need to be licensed as a water or sewerage supplier by Ofwat.

Third party access legislation, which quickly followed with the Competition Act of 1998 in England, promotes competition in the water sector, more so than in any other part of the world. There are many critics of the full privatisation/competition route taken in England, and whether it has been successful at improving efficiency. While similar legislation may not be appropriate elsewhere, it provides an example of how incumbent operators can be regulated to allow for new entrants into the water sector.

Creating and supporting a range of financing mechanisms

Governments are ultimately responsible for the provision of water and waste services. The best mechanism to ensure that this happens is to continue to promote and support a range of financing approaches. While in the past, governments were more involved in financing in the water sector, providing national backing for municipal bonds and national grants or loans for water-system services, the current drive for private investment at the expense of public responsibility needs to be reconsidered.

Governments and water utilities will not succeed, in our opinion, at increasing the availability of capital in the water sector until lending organisations and governments focus on making funds available to the full variety of business models, not just those involving private actors. For example, Mexico's CNA (Comision Nacional de Agua) has restricted its loans to water utilities that are engaged in projects with a private partner. Although this has stimulated private involvement in the water sector, it has also created a public backlash that may eventually (or soon) undermine the very companies this policy has lured into the Mexican marketplace.

It is possible that reinsurance along the lines proposed in the Camdessus report released at the 3rd World Water Forum in Kyoto may eventually help reduce currency risk for investors in the water sector, and thereby promote more investment. But little has happened in that regard since the Forum, in part because the reinsurance scheme was designed to promote private participation in the water sector rather than investment across international boundaries in general.

Because of the national character of many of the water sector challenges, national governments will need to take a more active role in ensuring the success of municipal and regional water providers. Many of the new financing challenges facing municipal and regional water utilities, such as climate change and security concerns, are national and supranational in character. Some climate change impacts, for example, may only be mitigated through transnational treaties, in which only national governments have the capacity to engage. Additionally, protecting national security has also traditionally been a responsibility of national governments. As a result, national governments must develop cost-sharing policies with water utilities to address national challenges such as climate change and security.

Standard setting organisations, including national and transnational governments that implement new regulations in the water sector, must identify and support associated financing options for water utilities. Similar to what was done in the United States with the Clean Water Revolving Loan Fund, governments should consider specifically associating each new regulatory requirement with a sufficient number and type of financing mechanisms to ensure that the full range of business models has access to capital needed to satisfy the requirements.

In the United States, tax exempt status for earnings from municipal bonds has helped finance water infrastructure. Re-evaluating the role, particularly in OECD countries, that national governments can play in supporting a system where future users pay for needed water infrastructure, will be an important enabling policy. US overseas aid work in financing in the water sector, has also introduced water sector improvement bonds in India and other areas, partially backed by USAID. The partial backing has provided enough security that small Indian municipalities can go to local and international financial markets to procure loans.

It is also critical that financing be made available for non-traditional approaches to needs satisfaction in the water sector. New York City was able to finance their watershed protection programme without any changes in current US policy. Similarly, on-site systems can also be financed in conventional ways often enough that the market for these systems is growing. But the full impact of these new approaches may not be fundable with existing financial mechanisms

because new ways of doing things involve risks that must be managed. Policy intervention to reduce risk or spread it via insurance mechanisms could be very helpful.

Improving the ability of water quality regulators to monitor a range of systems and sources

With the changing dynamics of the water sector, water sector regulators need to be prepared to monitor water quality from a variety of different sources. This includes regulating ground water extraction, regulating on-site systems, and ensuring adequate financing for monitoring and enforcement.

In the face of growing water scarcity and overextraction of groundwater supplies, governments will need to establish monitoring and control over groundwater sources. The typical water rights attribution in groundwater in most countries is that groundwater is the property of the landowner. This has often led to problems of overextraction and salinisation of coastal groundwater. Governments will need to systematically identify and monitor existing wells and borewells, and establish ongoing systems to regulate abstraction and groundwater quality.

The growth of on-site systems and providers will introduce new regulatory challenges. Governments will need to create opportunities for these actors to pre-dominate by removing regulatory obstacles, and creating new regulations allowing non-traditional arrangements for water and waste provision. In addition, governments will need to determine how to regulate these systems for drinking water quality and waste disposal to ensure that public health and the environment are protected. This may require the development of guidelines for on-site drinking water quality, quality guidelines for use of treated wastewater for landscaping, gardening, or toilet flushing, and quality specifications for the disposal of waste or wastewater effluent.

Governments will also need to develop a system to monitor these multiple sources of drinking water and waste treatment. This includes identifying who will be responsible for this monitoring and enforcement, whether it is municipal governments, health departments, environmental agencies, or existing water utilities. Regulators also need to identify where funding will come from to support these new and more complex regulatory functions, through on-site user fees or taxes. These multiple challenges need to be addressed in order to provide an environment where new business models can grow while being protective of public and environmental health.

Providing incentives for competition

Private sector involvement in the water sector was promoted with the idea that private actors could introduce more competition into the market. Public

economists have long known that water and wastewater systems are natural monopolies that cannot compete in the usual way. This is being opened up in key ways with third party access requirements in England, and this is being considered in Australia. This has been discussed earlier. We will focus on the important enabling policy of benchmarking to introduce competition into the water sector.

Competition for the market is not limited to private companies, but can be achieved through benchmarking efforts. Specifying an appropriate set of performance standards and indicators may require considerable effort and refinement. Indicators must be both observable and measurable. The challenge is to select a set of standards and indicators that is sufficiently detailed to be meaningful for management and oversight decisions and which is, at the same time, available and attainable at a reasonable cost. A few dozen robust measures of performance are usually superior to larger numbers of indicators or standards.

Documents that provide both in-depth discussion and comprehensive lists of performance measures in the abstract include Alegre *et al.* (2000) and Matos *et al.* (2003). In this book, see Chapter 1, Box 1.6, for a list of water utility performance indicators from the American Water Works Association (AWWA) and Water Environment Federation (WEF). Lafferty and Lauer (2005) provide data on numerous US water utilities in comparison with the indicators in Crotty (2004). A World Bank initiative along these same lines, known as the Water and Sanitation International Benchmarking Network, is available at *www.ib-net.org*. Benchmarking is a growing field and the data available will likely increase significantly in the next few years, forcing business models to respond.

Continuing to focus on public education, public involvement and transparency

Ensuring that users know about water-system needs is undoubtedly the best way to ensure public support for funding and potentially increased user fees. Ideally, consumers and residents should be involved in the water service and rate decisions that affect them. Consumers are in the best position to be able to weigh service improvements against rate increases to determine the best strategy that meets their needs and fits their budget. This demand-driven planning approach ensures sustainable outcomes.

There is broad consensus in the water sector that that *openness and transparency* are critical elements to success in privatisation. But, governments need to go further than requirements for transparency during privatisation. Broad-based and ongoing education and communication with the public is a critical function of the water utility. This is important because of the public health and societal goods dimensions of water. This is also critical in ensuring public

support for new facilities, rate increases, or restructuring efforts. Water users should not be consulted when rate increases are needed, but throughout the process of arriving at solutions for water-system challenges. If the public feels ownership of the water system, they will be in a better position to proactively choose solutions rather than react to solutions that are chosen by others.

Broad participation by affected parties ensures that diverse values and varying viewpoints are articulated and incorporated into water-sector decision making. It also provides a sense of ownership and stewardship over the process and resulting decisions. Water is a resource that is essential for life and health and plays vital social, economic and environmental roles. Water management is linked to issues of poverty alleviation, public health, social equity and the sustainability of ecosystems. The best way to balance the multiple roles of water is to ensure that water-resource decisions involve multiple stakeholders and the public at large in needs assessment, planning and implementation of any potential project. Governments must ensure that the public is aware of and educated on water-sector decisions, provide access to information, and include public input in all decisions and plans made about water resources.

Better decisions and better outcomes result from the *free flow of information* in the water sector. Ensuring open access to documents, information, and contracts instils public trust and inspires public confidence. As mentioned earlier, *transparency* in contractual negotiations also ensures that decisions are sustained from one political regime to another, and prevents corruption and collusion in contract awards. *Public access* to information ensures that government and potential private-sector partners are accountable for agreed-upon outcomes.

Water sector decisions should ensure public access and oversight, monitor the public interest, and ensure public participation and transparency. In the case of governments considering privatisation, this should include the following:

1. Ongoing public forums to educate the public and to obtain community input on water system issues.
2. Periodic third party assessments.
3. Public advisory committee with broad community representation to advise governments proposing privatisation or restructuring.
4. Formal public review of contracts and licences and responses to public comments in advance of signing agreements.
5. Public education prior to any transfer of public responsibilities to private companies.
6. Technical support to communities to assess restructuring impacts on equity, environment and welfare.

Many private companies are realising the importance of public involvement and transparency to help ensure stable business environments, and the long-term sustainability of their operations. Increased transparency and public involvement may improve public trust in the private sector and increase the ability of the private sector to float private bonds. Increasing transparency and public communication will also allow public sector providers and governments to float bonds and successfully advocate for more public financing.

Funding more R&D in the sector

Funding increased research and development in the water sector will be critical to capturing opportunities for efficiency and cost reduction that can help make water utilities more financially sustainable. As described earlier, the energy generation potential of wastewater processed through microbial fuel cells, and other technological opportunities, will need further development in order to be ready for wide-scale commercialisation. Subsidies to research are not always justified and can be abused. But in general there is a strong case for fundamental research that both has the potential to dramatically change how business is done and is so broad that individual investors could not possibly capture the full benefits of it, and therefore underinvest in it. Microbial fuel cells for energy production from wastewater are a good example, as are development of standardised methods for testing the performance of new technologies in water treatment, wastewater recycling, and so forth.

6. Conclusion

Ultimately, the water sector must include a *full range of financing approaches* in order to meet its investment needs and successfully maintain and expand service. Achieving that full range will require the development of *enabling policies*. This chapter has concluded with a limited policy discussion, because that is the next logical step in tackling the challenges of underinvestment while leveraging the opportunities emerging in the sector in the form of new ideas and approaches.

Based on the analysis in this chapter, we believe that policies which enable every reasonable type of financing mechanism, rather than a few chosen by "experts", have the greatest likelihood of success. Each OECD and Big 5 country will need to design policies grounded in their own institutional history and that are likely to work as next steps in the evolution of institutions in each country.

We need to move beyond the single-solution approach. By providing an environment where new financial mechanisms, technologies and solutions can emerge and become successful, within the boundaries of the principles described above, governments have a greater chance of success in meeting current and growing needs in the water sector.

Notes

1. Big 5 economies are Brazil, the Russian Federation, India, China and Indonesia. This chapter will focus on OECD countries and the Big 5 countries.
2. Public Utility Transfers and Water Charges Act 1988 (Chapter 15) and Water Act 1989.
3. "Dominant" is defined as having more than 50% of the population served by the private sector, and "significant" is defined as having 25-50% of the population served by the private sector.
4. "Minor" is defined as having less than 25% of the population served by the private sector.
5. The World Bank defines a greenfield project as one in which "a private entity or public-private joint venture builds and operates a new facility for the period specified in the project contract. The facility may return to the public sector at the end of the concession period." DBOT, BOT, and BOO fall within this category.
6. Distressed projects are defined as those that the government or the operator has either requested contract termination or are in international arbitration.
7. The privatisation database maintained by OECD was discontinued in 2001.
8. The services delivered by water systems are numerous and can be defined in a variety of ways. For example, flood-control services are often defined based on protection against flooding from a specified duration (*e.g.* one hour) and frequency (*e.g.* once every ten years, on average) of precipitation event. Flood protection in practice uses several or more duration-frequency objectives. Another example is water supply, which can be of potable or less-than-potable quality. Or one could enumerate the services provided by the water (*e.g.* human consumption, waste removal, irrigation) rather than the service of delivering water of a specified quality. Focusing on the ultimate services for which water is desired is essential when considering options for managing water demand (see Wolff and Gleick, 2002). Simpler "aggregate" categories (*e.g.* delivery of potable water) are sufficient, however, for the purposes of this chapter. This function represents the cost of delivering services without specifying the inputs (*e.g.* labour, capital, water, energy, knowledge) required to deliver them. There may be and often are numerous combinations of inputs that would deliver a specified level of services at a specified cost. For example, programmes to promote water use efficiency often substitute knowledge for physical water while maintaining the same level of end-use services to customers.
9. Much of this comes from the discussion on the World Bank Rapid Response website (*www.rru.worldbank.org*) moderated by Clive Harris on "Canceled Infrastructure Projects: Causes and Consequences".
10. The 1989 Surface Water Treatment Rule (SWTR).

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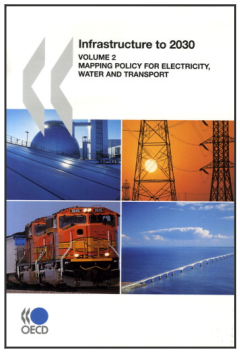

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