Chapter 1

Setting the stage

This Chapter provides some background on the size of the investment challenge for water and sanitation and identifies where benefits are likely to emerge from investment along the value chain of water and sanitation services. Potential types of benefits include health, environmental and economic benefits, as well as benefits that are more difficult to quantify, such as dignity and well-being. Annex A provides an overall methodological framework for evaluating such benefits.

1.1. Evaluating the size of the investment challenge

The needs for investment in water and sanitation are enormous and are driven by a number of factors, including the backlog due to past under-investment in the sector, population growth, changes in expectations, tightening of environmental standards and climate uncertainty. The OECD conducted an evaluation of future infrastructure investment needs up to 2030 in telecommunications, land transport, water and electricity. This initiative found that required investments in water and sanitation services dwarfed investment needs in other sectors. As reported in OECD (2006a), the average investment requirements in OECD countries and a number of other large countries (including Russia, India, China and Brazil) were projected to be around USD 780 billion per year by 2015 and USD 1 037 billion by 2025, up from a current estimated expenditure on water infrastructure of USD 576 billion annually. According to OECD (2007a), this was far higher than comparable estimates for roads (USD 160 billion per year by 2020) or electricity transmission and distribution (around USD 80 billion per year by 2025).

OECD (2006a) highlighted that there is a wide range of estimates of required annual expenditures in the water sector, however, this depends on the methods used for evaluation. The report stressed the wide variations from region to region reflecting very different levels of infrastructure coverage and economic ability (or political will) to take account of environmental pressures. The headline figures

were estimated based on the review of investment needs in a number of OECD and non-OECD countries, which concluded that going forward, the levels of expenditure on water services for high income countries should be of the order of 0.75% of GDP (ranging between 0.35% and 1.2%) and could go up to 6% for some low-income countries which need to cover previous investment deficits in the sector. Finally, it noted that most estimates tend to focus on investments and ignore the need to cover the costs of operations and maintenance.

With respect to developing countries, Hutton and Bartram (2008) estimated spending required to meet the MDG target at USD 42 billion for water and USD 142 billion for sanitation, a combined annual equivalent of USD 18 billion. The cost of maintaining existing services totals an additional USD 322 billion for water supply and USD 216 billion for sanitation, a combined annual equivalent of USD 54 billion. In addition, administrative costs, incurred outside the point of delivery of interventions, of between 10% and 30% were estimated necessary for effective implementation.

Recent estimates across a large number of countries, including developed and developing countries were compiled by Lloyd Owen (2009). This report identified seven main drivers for investments in water and sanitation services in the coming two decades, including extending access to water and sanitation services to fulfil the Millennium Development Goals by 2015, addressing the challenges of population growth and urbanisation, providing industrial water and wastewater services in the context of global economic growth, meeting WHO drinking water guidelines, complying with national and international environmental standards, securing water supplies and dealing with exceptional rainfall in the context of climate change and rehabilitating existing assets. Lloyd-Owen (2009) estimated that meeting these challenges would call for around USD 2 880 billion in investments over the next two decades (or about USD 144 billion per year) in the 67 countries covered, with associated operating costs which can be twice as high as capital investment costs, as shown in Table 1.1. This report also identified a substantial financing gap, given that only USD 631 to 1 381 billion could be generated from existing sources of revenues (including tariffs), leaving a gap of between USD 1 049 to 2 297 billion.

OECD (2006a) concluded on a cautionary note, by stating that: "Although the benefits are likely to outweigh the costs, it does not follow that these projected expenditures will be realised. Indeed, if past experience is any guide, it is certain that they will not be achieved".

Indeed, in the context of a global economic crisis and constrained public budgets, financing for water and sanitation services is often insufficient, which means that critical investments are delayed, leading to deferred benefits and higher investment costs in future. This highlights the need for re-emphasising the benefits from investing in water and sanitation services but also for identifying areas for priority investment, depending on where the

Table 1.1. **Forecast operating and capital spending in countries covered, 2010–29 (USD bn)**

		Capital spending (capex)			% capex by region
	Operating costs	Low	Medium	High	
North America	1 821	525	630	940	23%
Europe	2 133	642	838	991	28%
Developed Asia	1 018	461	550	640	19%
Latin America	796	119	164	194	5%
Rest of World	992	472	713	1 027	24%
Overall	6 760	2 213	2 880	3 792	100%

Source: Thomson Reuters in Lloyd-Owen (2009).

highest benefits are likely to stem from and where the most cost-effective interventions can be identified.

1.2 The value chain of water and sanitation services

As with any other production process, it is possible to draw out a "value chain" for water and sanitation services, starting with protecting, collecting and abstracting water (groundwater or surface water), bringing it to its point of consumption (households, industrial or institutional customers in the case of water and sanitation services) and taking it away, for treatment and safe disposal.[1] Water is an unusual good, however, as it is naturally "recycled", as shown in Box 1.1.

For water and sanitation services to be provided sustainably, a number of investments must be undertaken, operated and maintained over time at each step of the WSS value chain. Given that the natural water cycle has become affected through man-made activity, it has become much more critical to invest in securing adequate supply of water resources and treating wastewater to sufficient standards so that it can be discharged back into the environment with minimum negative impact.

The chain of investments and activities that need to take place in order to provide sustainable water and sanitation services is shown in Figure 1.3. Although the main focus is usually placed on providing access to water and sanitation services (as reflected in the Millennium Development Goals, for example), that figure shows that additional investments need to take place up-stream and down-stream of providing access in order to ensure sustainable services.

Box 1.1. **The natural and the engineered water cycles**

The ***natural water cycle*** is depicted in Figure 1.1 below. Water reaches the earth's surface as precipitation in the form of rain or snow. Some of the precipitation runs off to enter streams quickly as storm flow. Some is stored in depressions, and a significant fraction infiltrates into the ground and is stored in the soil for plant growth. Some water percolates below the plant's roots and recharges underground storage called groundwater. Stored groundwater feeds streams with a slow supply of water called baseflow. Storm flow and base flow comprise the streamflow that makes its way downstream to the nearest ocean. Transpiration from plants and evaporation from soil, water bodies, and the oceans returns water to the atmosphere and cools the earth.

The engineered water cycle is shown on Figure 1.2**.** Over the last two centuries, the natural water cycle has been modified considerably by human activity, with a dramatic impact over the water environment. Large areas of land have been built on, converted to agriculture, and significantly altered. In metropolitan areas, soils have been compacted and paved over. Large volumes of ocean and fresh water are used for cooling in power plants. Water suppliers withdraw fresh water from surface and ground sources for residential and commercial use. Wastewater is then discharged back into the environment, generally far from where the water was obtained. Water distribution systems distribute water to facilitate its use, but move the water many miles from its source. Water is also lost to the atmosphere from agricultural or lawn irrigation and evaporation.

Figure 1.1. **The natural water cycle**

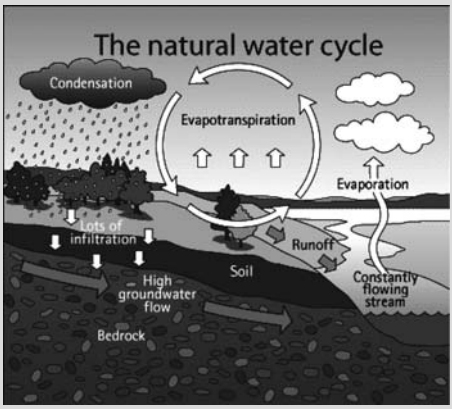
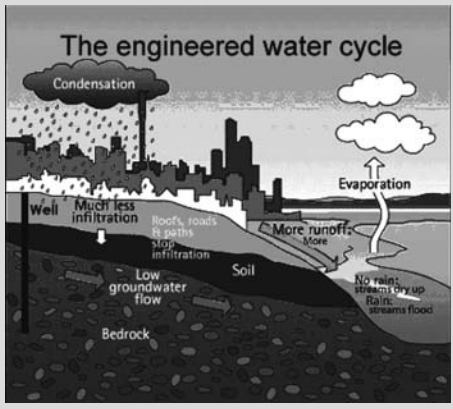


Figure 1.2. **The engineered water cycle**

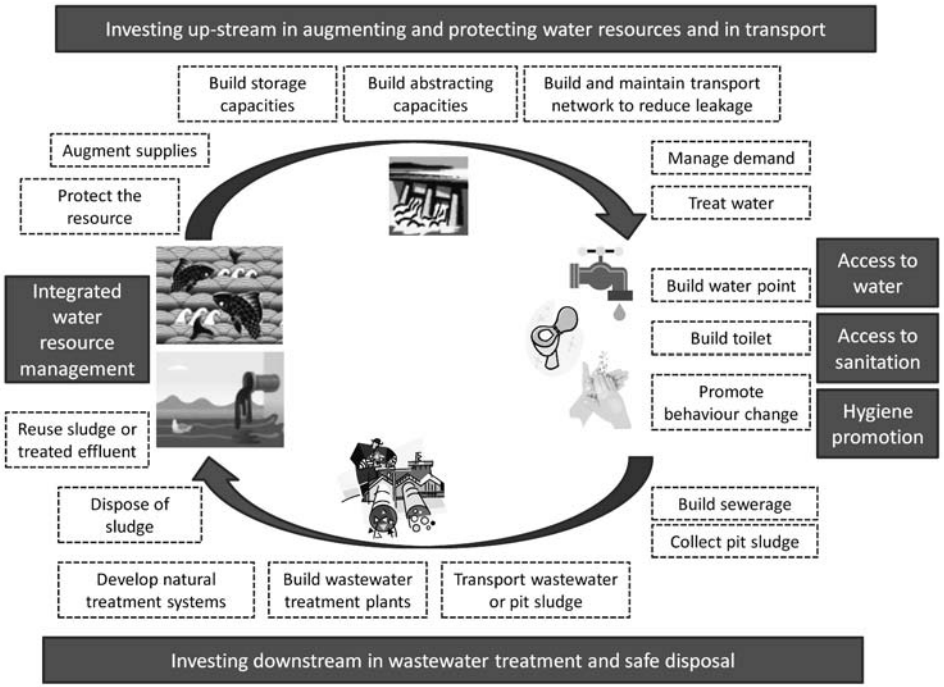


Source: Pickering, N (undated).

Up-stream from providing access, managing water resources is an integral part of providing sustainable WSS. Given that water resources have multiple uses (including for domestic consumption but also for agriculture, industry or the environment), "Integrated Water Resources Management" (IWRM) goes beyond the investments and activities that are carried out for the sole purpose of providing water and sanitation services.[2] If IWRM activities are not conducted adequately, this can affect the WSS provider through higher costs. For example, deforestation may reduce water capture and create the need to invest in additional water storage capacities.

Down-stream, dealing with stormwater and wastewater in a sustainable manner is critical to ensure health (with an emphasis placed on separating humans from their excreta) and protecting the environment. Such outcomes can be achieved in many different ways, depending on the technical solutions used. On-site sanitation solutions tend to collect and store the waste stream on the premises. The waste is isolated and stored permanently on-site when sufficient land is available or transported and treated somewhere else before being discharged into the environment. Off-site solutions take the waste away

Figure 1.1. **The value chain of sustainable water and sanitation services**



via sewerage networks and may or may not entail treatment before disposal. Although treatment reduces the negative impact on the environment, it is not always carried out. The last step consists of reusing the sludge or treated effluent for productive uses, such as agriculture or energy production.

1.3 Potential benefits along the WSS value chain: an overview

A variety of benefits can be generated from carrying out the investments and activities necessary to provide safe and sustainable services at each step of the value chain, including health, environmental, economic and intangible benefits as shown in Table 1.2.

The next four chapters present in more detail the types of investment and activities that need to be carried out to provide sustainable WSS, as well as the categories of benefits stemming from these investments. In each case, we present how the benefits are generated and any available estimates to quantify them, drawing from an extensive review of the literature on the subject (Annex B provides a full list of references). We present the results from a number of expert studies: wherever possible, the report also seeks to evaluate how such studies have been used in the policy-making process, in order to demonstrate how facts and figures can support the development of water sector policy.

Table 1.2. **Typology of benefits alongside the water and sanitation value chain**

Types of investment	Types of benefits
Chapter 2 – Providing access to safe water and sanitation	
Access to safe water near/in the home • Build water access points • Build and extend networks (water and sewers) • Build and operate water treatment plants • Provide point-of-use water treatment methods **Access to sanitation and hygiene** • Build sanitation and hygiene facilities • Promote adoption of hygienic practices **Wastewater collection and transport** • Collect wastewater via sewerage networks • Collect and transport pit sludge outside the home	**Health benefits** • Reduced incidence of diseases, especially waterborne and water-washed diseases **Economic benefits** • Time saved for productive activities • Increase in productivity • Reduced coping costs • Use of urine and faeces as economic input • Impact on tourism from improved amenity **Other benefits** • Increase in cleanliness, dignity and pride • Increased school attendance (especially for girls)

Table 1.2. **Typology of benefits alongside the water and sanitation value chain** *(continued)*

Types of investment	Types of benefits
Chapter 3 – Investing downstream in wastewater treatment for safe disposal and reuse	
Wastewater treatment • Build and operate wastewater treatment plants • Rely on natural treatment processes • Safe disposal of residual sludge	**Health benefits** • Additional health benefits, such as those from improved quality of recreational waters **Environmental benefits** • Reduced eutrophication **Economic benefits** • Reduced pre-treatment costs downstream (for drinking water and industrial purposes) • Protection of commercial fish stocks and aquaculture • Enhanced tourism activities • Increased water supply for irrigation • Saving of fertilisers through use of sludge **Other benefits** • Improved amenity • Increased property values
Chapter 4 – Investing upstream in managing the supply/demand balance sustainably	
Protecting water resources • Establish catchment protection zones • Establish voluntary agreements • Establish regulations **Augmenting and ensuring supply** • Build storage capacity • Build abstraction capacity • Develop alternative sources, such as aquifer recharge, desalination, re-use of treated effluent • Adopt drought and flood management plans **Managing demand** • Reduce leakage (on the network and within customers' premises) • Introduce incentive pricing • Install water saving devices • Raise awareness, educate the public	**Environmental benefits** • Reduced pressure on available resources and improved river flows • Economic impact on use of water for economic activities (agriculture, hydropower) **Economic benefits** • Reduced in-water pre-treatment costs • Uninterrupted supply for production processes • Reduced coping costs from unreliable water supplies • Downsizing of facilities • Reduced need for desalination **Other benefits** • Increased quality of life due to reliable water supply • Indirect benefits: recreational activities on dams or reservoirs

Note: investments in Table 1.2. are presented in the order of the Chapters in this report rather than sequentially along the WSS value chain.

Methodologies for evaluating such benefits are discussed in more detail in Annex A. This Annex also points to the limitations of conducting such analysis, as summarised below:

- ***Measuring benefits from WSS investments is highly location-specific.*** On the one hand, estimates of benefit values fluctuate depending on a number of local factors, such as the prevalence of water-related diseases (for access to the services), the quality of the receiving waters (for wastewater treatment) or the level of development of existing water resources (for augmenting and protecting water supplies). On the other hand, benefit values are highly influenced by overall income levels and by other macro-economic factors, such as exchange rates, which means that transferring benefit values across countries with varying development status can be misleading (see Annex A on how the type of issues that arise with transferring benefit values).
- ***Sequencing matters.*** Because of the cyclical nature of water as a resource and the inter-linkages between various water sector interventions, there may be disbenefits along the way depending on the sequencing of investments. A common example of this is that investments in providing access to water can potentially generate disbenefits in terms of health impact if not coupled with adequate investment in removing and treating wastewater.
- ***Benefits from water and sanitation investments are not always measured in monetary terms, which can make comparisons difficult.*** Given the multi-dimensional nature of the benefits generated by investment in water and sanitation, it has not been possible so far to define a common metric for comparing benefits across different interventions (in the same way that DALYs, or Disability-Adjusted Life Years, is used to compare the effectiveness of a broad range of health interventions). Many benefit studies have not necessarily sought to monetise such benefits. When benefits have been monetised, an indicator of the scale for such benefits is often missing (a straightforward way to indicate scale would be to quote benefits as USD /beneficiary household or as USD /household in the area (even if all households do not benefit directly).
- ***Defining the appropriate discount rate is not straightforward.*** As noted by Whittington *et al.* (2009), the present value of the benefit stream is very sensitive to the discount rate chosen because of the large up-front capital costs and the unusually long economic life of the assets.[3] Given that water and sanitation are primarily seen as social investments with benefits for the wider economy and the environment, the discount rate used would need to be the discount rate used for public and social projects as defined by the Government.

- ***Potential benefits do not always materialise.*** As a result, it is important to be conservative about estimating benefits in monetary terms. For example, time released from not having to walk long distances to fetch water or wait in line at the nearest water point would not always be used productively when in fact, most methodologies would estimate the value of time based on earning potential. Similarly, although it is well established that poor water and sanitation has a significant impact on health, improving access to those services may not be sufficient to realise all health benefits as there may be other counteracting factors, such as air pollution or a lack of hygienic practices.
- ***The distribution of benefits may be as important as the size of such benefits.*** Benefits from investing in water and sanitation are not equally distributed. Whereas benefits from water services tend to accrue to the household that receives the service, benefits from sanitation would spread to the entire community and beyond. For example, installing improved latrines in an urban setting can improve general health and reduce the risk of epidemics but also boost tourism and reduce the water treatment costs. These overall economic benefits would need to be valued in order to define the most appropriate financing strategy for the initial investments. Some of these benefits would have a direct impact on public finances (through a reduction in healthcare budgets for example), whereas others may be more difficult to quantify (for example, increased dignity and pride).

Notes

1. On the wastewater side, excreta or sullage can also be stored on-site without treatment.
2. Integrated water resources management can be defined as the practice of making decisions and taking actions while considering multiple viewpoints of how water should be managed. These decisions and actions relate to situations such as river basin planning, organization of task forces, planning of new capital facilities, controlling reservoir releases, regulating floodplains, and developing new laws and regulations. The benefits stemming from these broader activities are not specifically reviewed in this report but they are considered in a companion OECD report.
3. For example, the water pipes installed by the Victorians in the late 19th century in London are being replaced only now.