Financing the future : the long-term future demand for water sector infrastructure

Financer l'avenir : la demande future à long terme dans le domaine des infrastructures du secteur de l'eau

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RESUME

Avec le triplement de la population mondiale au cours du 20ème siècle, les mégapoles ont du développer des réseaux d'adduction d'eau et des infrastructures mais celles-ci ont eu du mal à faire face à l'augmentation des besoins. Afin de suivre le rythme de la demande, des investissements considérables ont du être faits dans la construction et l'exploitation des infrastructures de distribution d'eau. Toutefois, ces investissements ont été consentis à des niveaux variables selon les régions du monde. De manière générale, la fourniture des services en eau est forte consommatrice de capitaux avec un faible retour sur investissement. Cet article propose une estimation des besoins en investissements futurs qui seront nécessaires pour continuer à répondre aux besoins en eau dans le monde entier. Il ressort que les niveaux d'investissement et de dépenses d'exploitation requis pour assurer un approvisionnement suffisant sont considérables et continueront à augmenter. Des projections donnent une idée de l'ampleur des défis que les responsables de la planification et de la gestion des ressources en eau, à tous les échelons quels qu'ils soient, devront relever. De plus, tout incite à croire que les besoins en investissement continueront à croître ainsi qu'en parallèle, les dépenses de maintenance des infrastructures.

ABSTRACT

In the 20th Century as global population has tripled, large megacities developed water service and infrastructure systems have struggled to keep pace. To provide for this explosion in water use there has been significant investment in the past in the provision and operation of water infrastructure. Investment in infrastructure has been very variable globally. In general water services require high rates of capital and maintenance investment with a low return on assets. The paper presents an estimation of future investment needs in water services infrastructure taking future global trends into account. It is shown that the levels of investment and expenditure required for the proper provision of water services are substantial and growing. The projections illustrate the scale of the challenge that faces those at all levels responsible for planning and providing for water service needs, indicating that there is no room for complacency. Furthermore, it is unlikely that there will be any significant tail-off in investment requirements over time; rather that priorities will switch from infrastructure investment to infrastructure maintenance.

KEYWORDS

Infrastructure investment, Water services

1 INTRODUCTION

The demand for water infrastructure systems has grown worldwide with global population trebling in the 20th Century and the associated growth of large megacities. In many countries there has been significant investment in the provision and operation of water infrastructure to provide for the growth in water needs and expectations. Even in cities with extensive existing water infrastructure systems there has been increasing pressure to maintain the services to ever higher standards. Urban infrastructure is an important component of economic development, both for investment and also to provide the essential services for other sectors (Kessides and Ingram, 1995).

Investment in water infrastructure has been very variable globally. In England and Wales since 1989 water companies have invested some $100bn in water related infrastructure assets to meet European environmental as well as performance standards. A further $20bn is to be invested in the period up until 2010 (House of Lords, 2006) in order to meet increasingly stringent standards and growth in demand. Whilst much of Western Europe, North America and most of the OECD countries have now effectively full access to water and sanitation services, access by much of the rest of the world is much more variable. It is apparent that the world is facing an unprecedented challenge when it comes to water services. In part this is due to population growth, but it is also caused by expectations and lifestyle, new demands and climate and other uncertainties such as energy costs and terrorism.

As part of the OECD's International Futures Programme, a 2-year project focussed on the future evolution of infrastructure needs in telecommunications; energy provision; transport and water (OECD, 2006). This paper presents an estimation of future investment needs in water services infrastructure taking future global trends into account. It is shown that the levels of investment and expenditure required for the proper provision of water services are substantial and growing. The study took into account the potential effects of social, economic, environmental, technological and political drivers and how they are likely to influence investment in water infrastructure in the period up to 2025. It is unlikely that there will be any significant tail-off in investment requirements over time; rather that priorities will switch from infrastructure investment to infrastructure maintenance.

2 PAST PROVISION OF WATER INFRASTRUCTURE

Global water consumption rose considerably in the 20th century; both in total amount needed and in per capita demand. Increasing pollution loads and water abstractions outstripped the assimilative capacity of ecosystems, with some 2 million tonnes of waste being discharged daily, polluting some 12000 km^3 of receiving waters in 2003 (UN, 2003). Across the world, urbanisation has progressively gone through stages of densification of habitation. Water service and infrastructure are meant to keep pace with these changes in developed countries, as typically there is an assumption that the services will follow the newest needs in terms of how people work and live (Juuti & Katko, 2005).

In the recent past most OECD countries have at least attempted to maintain their water assets and extended these where necessary to cope with increasing populations, demands and expectations, often stretching the capacity of the original systems due to peri-urban growth. At the same time advances have been made in providing water and sanitation services elsewhere in the world. The water supply and sanitation decade (1981-90) was reasonably successful in cutting the numbers of people without these services, despite a six-fold increase in the human use of water (Cosgrove & Rijsberman, 2000).

3 GLOBAL TRENDS AND FUTURE NEEDS

The future demand for and consumption of water will be influenced not just by climatic factors but also by policy decisions, the actions of millions of individuals, the type of and access to water infrastructure and services, changes in technology and affluence as well as a whole host of other factors. In developed countries water for industrial use is expected to decline due reduced unit water usage and increased water productivity. Water for agriculture and irrigation will continue to be the biggest source of increasing demand in absolute terms (OECD, 2006a). In developing countries water demand for domestic, industrial and agricultural uses will continue to grow.

In relative terms domestic water will account for 21% of global demand in 2025, as against 10% in 1995; industrial use should remain relatively unchanged at around 20%, whilst agriculture as a proportion will decline from 70% in 1995 to 56% in 2025 (Alcamo, Hendrichs & Rösch, 2000). In absolute terms, water consumption in North America, Western and Central Europe will decline along with Japan and Australia, a trend that is already well established in Europe (Eurostat, 2003). However, global domestic consumption will increase by 71% of which more than 90% will be in developing countries; industrial water consumption will also grow faster in developing countries.

It is possible to see differences between developed economies in high income countries, transition economies in middle income countries and, developing economies in low income countries. In developed economies there are common concerns over the maintenance of existing assets. A new wave of (sub)urbanisation, responding to demographic changes, rising levels of affluence will drive investment in new infrastructure. Coupled with this is a growing scarcity and competition for resources, prompting interest in demand management and calls for 'closing the water cycle' (WSSTP, 2005). Environmental protection and pollution control also have the potential for profound impacts on future services. For example it has been estimated that it will cost some $300bn to implement the WFD in Europe by 2017 (WSSTP, 2005; SAM, 2004).

In transition economies the drivers are similar modulated by the need to improve service coverage and address the residual problems of poor governance, infrastructure and organisational neglect and inefficiency that have resulted in the deterioration of the asset base (OECD, 2005). Replacement rather than maintenance will drive the need for new investment. This coupled with the low rates of cost recovery have focused attention on the need for capacity building and to restructure the way in which services are delivered. In developing economies there is a great need to extend basic services to burgeoning populations, often in rapidly urbanising situations. Here the need for basic services tends to take precedence over other concerns and an emphasis on partnerships and capacity building. There has also been a need for the institutional and legal frameworks to be reformed in order to facilitate the process of improving service provision. The levels of investment and expenditure required for the proper provision of water services are substantial and growing. The role of the international finance community is often crucial for transition and developing economies even where the proportion of required investment may be limited, as it has the ability to leverage local funding to support investment.

4 KEY DRIVERS ON FUTURE QUALITY AND STRUCTURE OF WATER-RELATED INFRASTRUCTURE INVESTMENT

The key drivers likely to impact on the long-term demand for infrastructure in the water sector have been grouped under four broad headings; socio-economic, technological, environmental and political.

Socio-economic changes are expected to increase unit costs of water service infrastructure delivery into the foreseeable future. This will be due to the following: population growth; population profile changes; rising unit demand, lifestyle and expectations for water services; more extensive service provision; increasing use of private sector services with risk costs.

It is expected that technology will help to attenuate the overall increasing costs of water services. This will be due to: New techniques (scientific, sensor and ICT) and better ways of managing information and hence performance, resulting in smarter ways of operating new and current systems; greater energy and resource efficiency. This presupposes continuing investment in R&D at current levels.

Environment is likely to be the greatest driver for adding costs to the future delivery of water services and managing the infrastructural impacts. The main factors are: climate change and responses to this that may require large new infrastructure; expectations about security of quality and contaminant control to protect ecosystems; increasing uncertainties and the need to develop systems with in-built redundancy; interactions across sectors such as water and energy.

Political changes are expected to increase the relative costs of future water service delivery, principally due to: planning, land use and urbanisation control processes; effectiveness of governance up and down the process; the forms and needs of revenue collection (which may not improve due to political will); increasing service levels to 'be the same as everyone else' driving infrastructure performance up.

5 CURRENT LEVELS OF INVESTMENT

The current levels of investment and expenditure were derived In order to estimate future requirements. The current estimates were based on an analysis of available country level data for a range of countries, these included: the USA, Canada, UK, Brazil, Russia, China, India, Central and Eastern Europe, Central Asia as well as Austria, Belgium, France, Italy and Portugal.

Based on detailed estimates of allowed expenditure in the UK and in the case of the USA on a Needs Survey (EPA, 2005) these amount to 0.72% and 0.75% of GDP respectively. The value of water assets in England and Wales is in excess of £ 200 billion. Assuming a figure of 3% (Fay & Yepes, 2003) of asset value to be spent on maintenance this implies an expenditure of £6 billion per annum, or the equivalent 0.6% of GDP, excluding new investments and expenditures required for Scotland and Northern Ireland.

According to Dangeard (2003): "Orders of magnitude concur on some $ 30 billion per year for developing countries investment expenses". A figure for China's pollution abatement expenses given by the National Environment Protection Agency is close to 1% of GDP, which seems low, although increasing. India's expenditure is believed to be less than 1% of GDP. *In France, water expenses of private sector and administrations are 1.2 – 1.5% of GDP".* (emphasis added). An analysis of Eurostat data on Environmental Protection Expenditure (public and private sector expenditure), indicates a range of between 0.16% – 0.35% of GDP for High Income and 0.27% – 0.75% of GDP for Middle Income countries on waste water and sanitation alone. Given the limitations in reporting this is likely to be an underestimate. In 2003 an OECD report stated: "In the area of pollution abatement and control (PAC), investment and operating expenditure related to water (i.e. sewerage and wastewater treatment) ranges between 0.3 and 1% of GDP. Water supply and irrigation expenditure are of the same order of magnitude as PAC expenditure." Other reported figures for wastewater for example are for the Netherlands 0.6% of GDP and France 0.8% of GDP (IWA, 2005). Based on the available reported information the derived figure of expenditure for India is similar to that of high income countries at 0.71%.

The reported figure for China is 1.4%, compared with the 5 year plan estimate of 1.5%. From the above, derived figures have been used in the study for estimates of the percentage of GDP spent on water services:

High Income Countries	0.35% to 1.20% of GDP
Middle Income Countries	0.54% to 2.60% of GDP
Low Income Countries	0.70% to 6.30% of GDP

6 ESTIMATION OF EXPENDITURES

The projections of future expenditures have been based upon the assessment of current levels of need and expenditure up to 2025 focusing on OECD countries plus Brazil, China, India, China and, Russia. The starting point for the calculations has been each country's Gross Domestic Product (GDP) (World Bank, 2005). The projected GDP growth rates for EU countries up until 2015 were assumed to average 2.3% p.a. overall, with USA growth as 2.5% p.a., China 5.3% and India 4.1% p.a.

The baseline used for current expenditures has been estimated from the proportion of GDP allocated to water services indicated above. These give a current global requirement (not actual) figure of $576.4bn to be invested annually. In future for the high income countries, an investment rate of 0.75% of GDP was presumed up until 2015. For Russia, the OECD (2005b) figure of 0.32% of GDP seems an underestimate, but this has been used nonetheless up until 2015. For China, 1.5% was taken from the 5 year plan and for India, the figure derived was 0.71% and for Brazil, Almeida & Mulder, (2005) give an estimate of only 0.20%, which seems rather low but has been used. It is argued that over time the percentage of GDP required to be spent on water sector services will be influenced by two main factors, the impact of the four drivers outlined above and, the relative exposure of countries to these drivers. The relative influence of social and economic, technological, environmental and political developments will be to increase (e.g. socio-economic, environmental, political) or decrease (technological) the required levels of expenditure. At the same time it is argued that as circumstances differ between countries it cannot be assumed that the drivers will have the same effect on each country. Therefore an adjustment, based on informed subjective judgment has been made to capture the relative importance of the drivers to the countries. These two sets of factors have been used to modify the estimations of future percentage of GDP expenditure on water sector services over time. Two different time periods were adopted; 2005 to 2015 and 2016 to 2025.

In estimating the changes in investment profiles as a result of the 4 main drivers the effect of technology has been assessed as reducing the costs by some 6.66% on baseline. This was taken from typical current figures for efficiency gains for the England and Wales service providers. For the other drivers, the costs have been assumed to increase by a total of some 33% as a consequence of environmental drivers (current UK estimates). The greater need to attract private sector participation and funding will mean that risk premiums will be higher, with more account of profit margins; hence the increase for socio-economic drivers has been taken as some 25%; with the effects of internal politics as slightly more than half of this figure at 15%.

If the estimates of national GDPs are accepted then there are three main variables that influence the expenditures on water sector services and infrastructure. These are; the future projections of growth of GDP, the percentage of GDP spent on water services and, the impact of future socio-economic, technological, environmental and political factors on expenditure. In order to gauge the relative influence of each of these factors on the projections of future expenditure levels a sensitivity analysis was carried out varying each of the three independently. The assumptions of GDP growth

were varied by +/-10% as this was assumed to be a reasonable uncertainty band on current assumptions. In the case of the percentage of GDP spent on water services the maximum and minimum figures were employed to give upper and lower bound estimates. Lastly, the impact factors were varied

Country	GDP ($ bill)	GDP/cap ($)	GDP Growth (%)	Class	Projected expenditure on water infrastructure as % of GDP		Average annual investment ($ billion)		Main Drivers			
					By 2015	by 2025	by 2015	by 2025	socio-economic	technology	environment	Political
Australia	602	29893	2.3	HI	0.75	1.08	6.86	9.95	M	H	H	L
Canada	1050	32921	2.3	HI	0.75	0.83	10.27	15.74	M	H	M	L
France	1724	27738	2.3	HI	0.75	0.83	16.86	25.84	M	H	M	L
Germany	2391	28988	2.3	HI	0.75	0.83	23.38	35.84	M	H	M	L
Italy	1620	27984	2.3	HI	0.75	0.92	16.83	25.23	H	M	L	M
Japan	3810	29906	1.9	HI	0.75	1.26	46.98	63.41	H	H	H	L
Korea	1010	21419	2.3	HI	0.75	1.23	12.76	18	H	H	M	H
Mexico	1000	9887	2.4	MI	1.95	0.85	167.78	153.65	H	M	L	M
Poland	475	12452	2.3	MI	1.95	0.85	7.93	7.18	M	H	H	L
Spain	971	23627	2.3	HI	0.75	1.06	10.97	15.96	H	M	M	L
UK	1717	28938	2.3	HI	0.75	0.86	19.14	27.96	L	H	H	L
USA	11724	39496	2.5	HI	0.75	0.64	101.65	167.63	L	H	M	L
Russia	1414	10179	3.5	MI	0.32	0.85	11.49	26.41	H	M	L	H
India	3291	3080	4.1	LIL	0.71	2.50	74.8	108.31	H	M	L	M
China	7334	5642	5.3	MIL	1.5	1.90	182.1	247.18	H	M	L	L
Brazil	1462	8049	2.4	MI	0.2	1.90	19.8	32.02	H	M	L	H
TOTALS							772.12	1037.83				

Table 1 : Investment in Water Services – Selected Countries

Of the three variables the assumptions of GDP growth appeared to have the least overall impact. Varying the estimates of GDP growth by 10% on the original estimates resulted in a 6% overall increase or a 3% decrease in total average annual expenditure by 2025. By contrast varying the assumptions regarding the impact of the four factors identified resulted in either a 29% increase or 32% decrease in total average annual expenditure by 2025, with the impact becoming more significant with time. The assumptions of % of GDP spent on water services had a similar though lesser impact on total average annual expenditure, on the upper estimates by 2025 increasing by 24% over the baseline or at the lower estimate decreasing by 18%. Here, the impact decreases over time, reflecting that as countries become more affluent less tends to be spent relatively on water services. The results reinforce the observation that it is the discretionary factors over which governments have a greater level of choice and control that have the greatest impact. In other words the assumptions as to what the future will look like have a significant impact on the

estimated levels of expenditure. Nonetheless even at the lower bounds of the assumptions made, the estimated annual expenditures are still far in excess of anything previously calculated; 0.03% of GDP for High Income, 1.10% of GDP for Low Income, 0.31% of GDP for Middle Income countries respectively and 0.46% of GDP for developing regions.

It should be noted that the projected investments represent an estimate of what in an ideal world would be required to provide and maintain adequate levels of water infrastructure services to all sectors of a countries' economy and population. The projections illustrate the scale of the challenge that faces those at all levels responsible for planning and providing for water service needs, indicating that there is no room for complacency. Although the benefits in terms of health, resources and productivity are likely to outweigh the costs (UN estimated health benefits of $84bn per annum for MDGs), 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.

7 DISCUSSIONS & CONCLUSIONS

Globally the sustainable provision and financing of water sector infrastructure will continue to present a major challenge even if only the current maintenance and backlog in basic service coverage is to be addressed. On top of this are the challenges of meeting the MDGs as well as addressing the issues of service provision to accompany economic growth, environmental pollution and balancing anthropomorphic and ecological requirements for water. The ability to compete for and raise the finances required for infrastructure provision as well as the ability to generate the income to pay for the provision of services looks set to remain problematic. Most public expenditure on infrastructure, especially in developing countries is financed through tax revenues. Increasingly governments find this difficult as their tax revenues are insufficient to meet all competing needs. The shortage in available resources for investment is compounded by: the competition between expanding populations and industrialisation for access to a finite water resource base and the lack of political will to change existing allocation patterns in the face of increasing scarcity.

The estimates of what would be required to provide and maintain adequate levels of water infrastructure services are substantially more than has previously been realized or estimated (Faye & Yeppes, 2003). This is even allowing for the potential uncertainty in the assumptions made. The reasons for this are likely to be manifold but it is worth noting that there have been relatively few studies of this sort (ibid). The present study has been based on estimated needs and requirements, where there are statutory drivers requiring providers to commit to levels of investment to meet standards and requirements rather than expenditures based on ability and capacity to invest. This study has also taken into account in a systematic fashion the impact of political, social, economic, technological and environmental change drivers on future requirements and levels of expenditure.

The requirements in terms of financing new as well as maintaining or replacing existing infrastructure and revenue generation to cover the costs associated with water service provision will be unlikely to diminish over time. Rather as the infrastructure and institutional deficits are addressed and overcome the emphasis will change from one of provision of new services to investment in replacement of infrastructure as well as the maintenance and enhancement of existing level of provision. This coupled with rising health and environmental standards and requirements is as much if not the greatest economic cost driver. Thus the financial and economic burden will not fall away over time. Whilst the scale of investments

required to meet the long term future demand of the water sector should not be underestimated it is not just financial investment that is required. The accompanying institutional and capacity building challenges pose just as great a barrier to be overcome. Only by addressing both at the same time will it be possible to meet the future needs not to do so could have dire consequences for us all, not just the developing world.

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