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WATER LEADERS

A new model for water access

A GLOBAL BLUEPRINT FOR INNOVATION

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WATER LEADERS

This report is second in the series of White Papers produced by the Global Water Leaders Group.

A New Model For Water Access

The report of the Global Agenda Council on Water 2014 -2016

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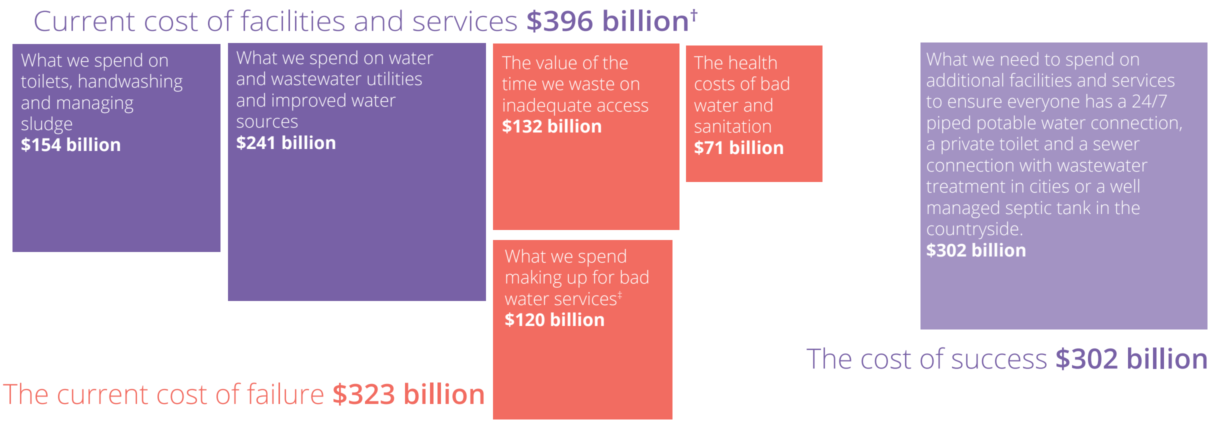
We waste $310 billion a year on bad water and sanitation.



†All data excludes rich economies of the European Union, North America, Japan, Korea, Australia and New Zealand
‡Includes packaged water purchases, point of use water treatment, water tankers and home storage

It is cheaper to do water better. How can we make it easier too?

There are huge economies of scale in public water and sanitation: well managed utilities deliver cheaper, healthier and more convenient water than alternatives. Private toilets and hand-washing facilities in the home reduce health costs and improve personal productivity. We should all enjoy these advantages, but current global trends seem to be working against broadening access to them.

Public utilities are not investing fast enough to keep pace with the depreciation of their existing assets or the rapid rate of urbanisation. This pushes up the costs for both the rich and the poor. The rich pay more to insulate themselves from the failure of public services, buying packaged water, installing home water treatment and storage systems and ordering tanker deliveries. Spending on these private domestic solutions (such as bottled water, point of use treatment, tankers and storage) is growing at an average of 9.1% per year compared to 5.1% for total spending by utilities outside the advanced economies.

The poor pay more for failing services in the time they spend managing inadequate access arrangements and the impact of water borne diseases have on their health. It makes it more difficult for them to accumulate the capital they need to invest in improving their private domestic sanitation facilities.

We must reverse this cycle of decline before it is too late.

A new model

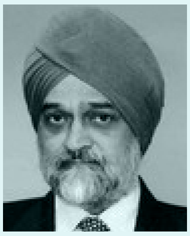
This paper outlines a new model for water and sanitation access. It won't deliver the best solution right now, but it will make better solutions available to more people, and in the long run make the best more attainable. This is how it works:

1. It begins with a social contract: water and sanitation are human rights, but they don't happen without commitment. The first step is to bring together the stakeholders to identify the benefits they will receive as a result of improved access, and to commit to the actions required to deliver the results.
2. The second step is a local design: water is an intimately local resource. There is no one solution for every community. Each one has to map its own pathway to better access.
3. Decentralise to cut the up-front capital costs: water kiosks, franchised water distribution services, micro-utilities, and neighbourhood wastewater treatment facilities may not offer the perfect solution, but they do offer a better and more affordable solution in the interim.
4. Spread costs to make each payment affordable: low income households struggle to save up large lump sums, so use micro-credit and short billing cycles to make utility services and private toilet investments affordable.
5. Innovate to drive down the overall cost: mobile phones, waste-to-energy systems, the internet of things, and new approaches to water and wastewater treatment can dramatically cut the cost of water and sanitation systems. We need to be at the cutting edge of innovation.

We're looking for partners to make this a reality at a pilot scale. Be part of it.

Contact Samantha Yates, Secretary General of the Global Water Leaders Group on sy@globalwaterleaders.org for next steps.

The Global Agenda Council on Water 2014-2016



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A new model for water access

The World Economic Forum gave the Global Agenda Council on Water the mandate to develop a new economic model for water access in June 2014.

This paper represents the result of that mandate. It outlines a blueprint for accelerating access that is ready for action. The main points that it makes are as follows:

A scheme of continuous improvement

The Sustainable Development Goals for Water and Sanitation cannot be met "one hand-pump a time" in the way that the Millennium Development Goal for water was achieved. The challenge of the SDGs is not a basic threshhold that needs to be met, it is a scheme of continuous improvement: we need to develop the systems that delivers that.

It is affordable – and urgent

Outside the high income economies we spend $217 billion a year on water and wastewater utilities, but inadequate access to water and sanitation inflicts further costs of $323 billion on the global economy. On the one hand it means improved access is affordable; on the other hand it means that we are facing a battle against time: the cost of coping with inadequate access is rising faster than utility investment.

Innovating within and beyond the networks

This calls for innovation across the board, both in terms of the business model for delivering improved water and sanitation services and the technologies used. Besides finding ways of accelerating the expansion of traditional networks we must also look at how decentralised systems can offer better outcomes for those who cannot immediately be reached by networks.

Pathways to better access

It is possible to map out the lowest cost pathways to improved water and sanitation for which there is an economic benefit to the individual and to the economy at every step of the way. These pathways depend on individual local circumstances and aim to bring improved access to all. With the commitment of all the stakeholders they can be made to happen.

Stakeholder led governance

The first step is to bring together representatives of all the stakeholders: the community, the central and local government, the funding agencies, and businesses that will benefit from better access together with the utility, NGO and corporate service providers can make this happen. Having identified the value of the benefits each will get from a project, each makes a commitment to contribute to the delivery. This stakeholder governance board oversees progress and disburses funding as milestones are achieved.

Visionary leaders wanted

To make it work we need to identify the visionary politicians who are committed to accelerating access to water and sanitation, and highly motivated water sector professionals who can help make it a reality.

The Global Agenda Council's term ended in June 2016, and responsibility for leading the implementation has been passed to the Global Water Leaders' Group, a not-for-profit organisation which brings together the CEOs of water utilities around the world. It is working with the organisations represented on the Global Agenda Council including Water.org, Water Health International and Veolia to develop a series of pilot projects around the world to demonstrate the potential of this approach.

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WATER LEADERS

The Sustainable Development Goals

The Sustainable Development Goals for water and sanitation represent a dramatic increase in scope in comparison to the Millennium Development Goals. The MDGs set a simple threshold for what represented safe drinking water (i.e. a household water connection, a public standpipe, a borehole, a protected dug well, a protected spring or rainwater collection) and what represented safe sanitation (i.e. connection to a public sewer, connection to a septic system, pour-flush latrine, improved pit latrine). They could be met through small investments in public infrastructure (e.g. installing standpipes) and improvements in household facilities (e.g. covering latrines). SDG 6 calls for significant improvements at every level of water management: at the household level piped domestic water connections and private toilet facilities are required. This in turn entails action at the community level to provide both water supply networks and systems for wastewater collection (sewers or tank evacuation) and treatment.

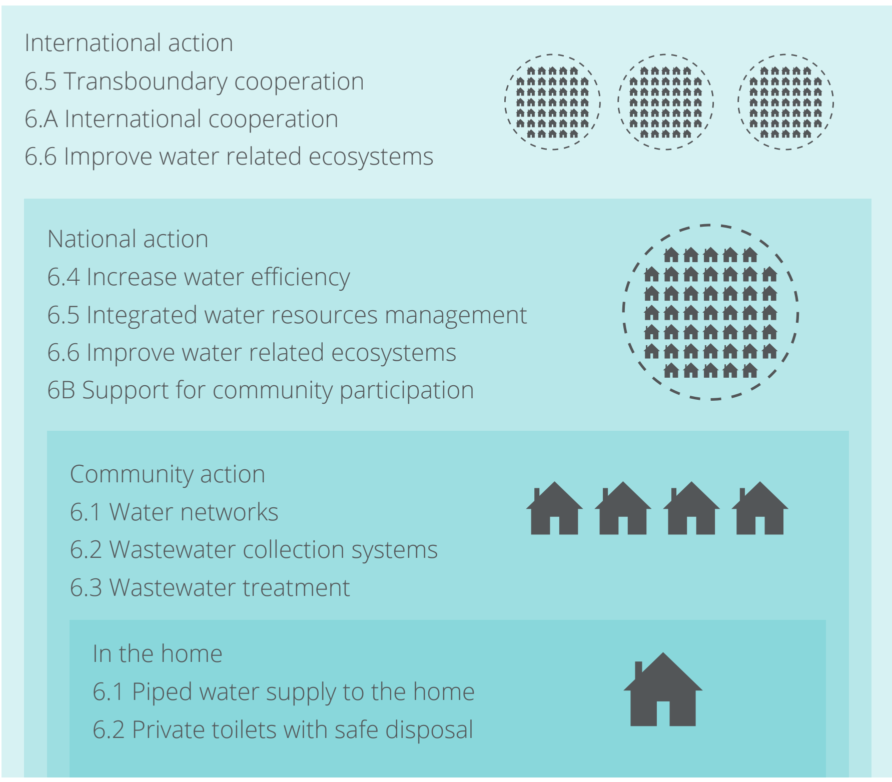
At the same time, delivering the goals for safe drinking water and sanitation needs to be done in the context of the goals for sustainable freshwater withdrawals (6.4), reducing pollution (6.4) and the improvement of water eco-systems (6.6). These inter-relations are set within the framework of integrated water resources management (6.5).

Altogether the Sustainable Development Goals change the meaning of access to clean water and sanitation. It is not possible to achieve the goals one hand pump at a time. It requires inter-related action at every level, with actions to deliver domestic facilities taking place at the same time as the development of community infrastructure and the evolution of national policy and regulation. Furthermore, larger amounts of finance will have to be mobilised, both at the domestic level (for water connections and toilets), and at the community level (for water networks, wastewater collection systems, water resource development and wastewater treatment). It requires a very different approach from that which was required to meet the MDGs. The following points seem self evident:

- Individual agencies working on their own will not be able have a significant impact: no central government department, no municipal organisation, no NGO involved has the ability to act from the domestic level up to the international level throughout the water cycle.
- The solution to the SDGs will be multidimensional: besides water and wastewater, toilets and taps, rivers and aquifers, the solution set for the SDGs will involve finance, infrastructure, innovation and governance.
- The SDGs will be achieved in stages: unlike the MDGs which could be achieved as a result of a single action, the SDGs can only be achieved as a result of a series of actions over a period of time.
- The SDGs will have to be largely self-financing: the scale of the investment required for both domestic facilities and community infrastructure is well beyond what can be achieved through government grants and international aid. This means that business models that are able to finance future growth from current revenues are going to be an important part of the solution.

There is a real risk that if the public water model does not improve its competitive offering, expensive private solutions will become the norm.

Figure 1. The SDGs require action at every level



Source: WHO / UNICEF Joint Monitoring Programme

SDG Goal 6: Clean water and Sanitation

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all. Definition: Population using an improved drinking water source which is located on premises and available when needed and free of faecal (and priority chemical) contamination.

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. Definition: Population using an "improved" basic sanitation facility at the household level which is not shared with other households and where excreta is safely disposed in situ or treated off-site.

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. Definition: Proportion of wastewater generated both by households as well as economic activities safely treated compared to total wastewater generated and the proportion of water bodies in a country with good ambient water quality compared to all water bodies in the country.

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. Definitition: the output over time of a given major sector per volume of (net) water withdrawn; and the ratio between total freshwater withdrawn by all major sectors (as defined by ISIC standards) and total renewable freshwater resources, taking into account environmental water requirements.

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate . Definition: the extent to which integrated water resources management is implemented, structured in four components: policies, institutions, management tools, and financing; and the proportion of surface area of transboundary basins that have an operational agreement/arrangement and/or institution for transboundary water cooperation.

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. Definition: the percentage of change in water-related ecosystems over time.

6a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. Definition: Official Development Assistance (ODA) is defined as flows of official financing administered with the promotion of the economic development and welfare of developing countries as the main objective, and which are concessional in character with a grant element of at least 25 per cent.

6b Support and strengthen the participation of local communities in improving water and sanitation management. Definition: the presence, at the national level, of clearly defined procedures in laws or policies for participation by service users, and the presence of formal stakeholder structures established at sub-catchment level.

Source: UN Water: Metadata on Suggested Indicators for Global Monitoring of the Sustainable Development Goal 6.

SUSTAINABLE DEVELOPMENT GOALS

The current status of water access

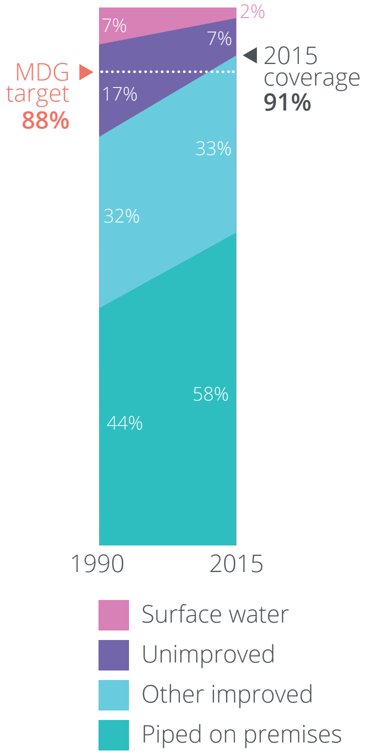
Most of the work which has been done on assessing the current status of water and sanitation access has been aimed at determining whether communities have achieved the MDG threshold for improved water and sanitation. The graphs below represent the final assessment of the achievement of the goals for water and sanitation by the Joint Monitoring Programme (JMP) set up by the WHO and Unicef. Although the data represents an important record of achievement, they do not give the necessary detail about how people access water and sanitation from the perspective of an economic analysis of how the Sustainable Development Goals might be achieved.

We propose a more granular approach to classifying the way people access water and sanitation. The main features of this approach are as follows:

- We don't make the assumption that a piped water connection represents safe or convenient water. Very few utilities outside Europe, North America and developed Asia supply potable water 24/7.
- We think that it is important to study the ways that households cope with non-potable water supplies, notably in terms of packaged water purchases, and point of use treatment.
- We don't believe that it is possible to manage septic tanks and pit latrines in urban areas without coliform bacteria building up in surface water and groundwater sources. In that sense it is wrong to assume that "improved" water sources such as protected wells, boreholes and utility supplies are necessarily safe to drink.

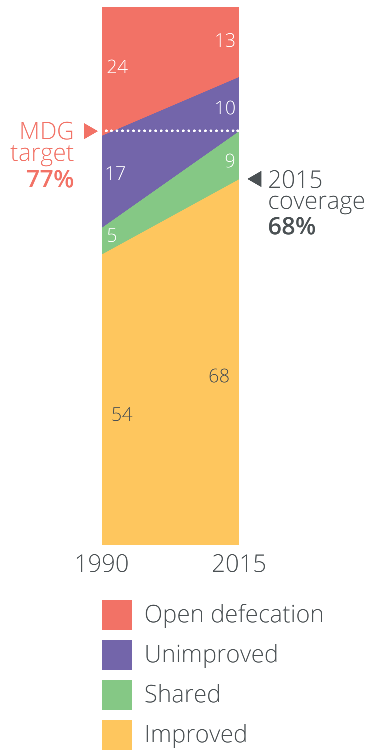
We suggest categorizing provision as on the following page.

Figure 2. MDG target for water



Source: WHO / UNICEF Joint Monitoring Programme

Figure 3. MDG target for sanitation



Source: WHO / UNICEF Joint Monitoring Programme

Figure 4. Modes of water and sanitation access

Open defecation: this is essentially the status of having no toilet. It is not considered to be improved sanitation from the point of view of the MDGs because it creates risks for women and girls, it is inconvenient, and it is to some extent a health hazard.

Shared toilet facility: this is a facility which gives some privacy, but is used by multiple households. It represents some risk to women and girls and it is likely to be inconvenient when compared to private toilets. Shared toilets were not considered compliant with the MDG for sanitation.

Private toilet facility: a toilet facility which is used exclusively by one household. It was a necessary (but not sufficient) criteria for achieving the MDG for sanitation and remains an objective for the SDGs.

Handwashing stand: handwashing is critically important in reducing the risk of diarrheal disease. One of the key metrics for SDG 6.2 for sanitation is the proportion of households with handwashing facilities with soap and water.

Inadequate faecal sludge management: if pit latrines are not lined or emptied, if septic tanks are not pumped out, if the subsequent sludge is not removed to a suitable place for composting or treatment, then it can either represent a health risk through direct contact or through infiltrating surface water or groundwater sources. The actual status of FSM was not measured by the JMP for the MDGs.

Good faecal sludge management: this involves regular evacuation of latrines and septic tanks with the resultant waste dried, composted or disposed of at a location which does not compromise health. Our assumption is that good FSM is fully effective in the rural context where population density is low, but in the urban context, even good FSM does not preclude the risk of coliform bacteria infiltrating ground and surface water sources.

Sewer connection: these are more efficient at collecting and transporting waste than manual evacuation and vaccum trucks, but they rely on flush toilets and therefore a plentiful water supply to work effectively.

Wastewater treatment facilities: SDG 6.3 requires only "safe" treatment of wastewater. This is assumed to mean primary and secondary treatment with some form of disinfection.

Distant, unimproved source: e.g. surface water or unprotected well that requires a journey of longer than half an hour round trip to fetch. This would be classified as an unimproved source according to the MDGs because of the inconvenience of the source and the health risk.

Nearby, unimproved source: e.g. surface water or unprotected well that requires a journey of less than than half an hour round trip to fetch. This would be classified as inadequate access according to the MDGs because of the health risk.

Distant improved source: e.g. a stand pipe or protected well which requires a journey of more than than half an hour round trip to fetch. This would be classified as inadequate access for the purposes of the MDGs because the source is too distant. It is only a wholly safe source of water if it is not compromised by wastewater infiltration as a result of poor sewerage and/or faecal sludge management.

Nearby improved source: e.g. a stand pipe or protected well which requires a journey of less than than half an hour round trip to fetch. This would be classified as achieving the MDG for water, although it is inadequate from the point of view of the SDGs because the source is not within the home. It is only a wholly safe source of water if it is not compromised by wastewater infiltration as a result of poor sewerage and/or FSM.

Low performance piped water supply to the household: this kind of network would typically deliver water for less than 12 hours per day with a high risk of water borne disease. It would be considered an "improved" source of water according to the MDGs, but it represents a considerable health risk.

Standard performance piped water supply to the household: this kind of network would typically deliver water for more than 12 hours per day, and although the water might not be as dangerous as it would be in a low performance network, it still represents a health risk in areas where there is bad sewerage and a lack of FSM.

High performance piped water supply to the household: this represents the gold standard of 24/7 piped potable water. It meets the requirements of the SDGs as long as the source of water itself is sustainable.

Packaged water purchases: higher income households will buy packaged water to ensure the water they drink is potable. This may be in the form of 20 litre garafons or carboys or standard 1.5 or 2 litre PET bottles. In some low income urban areas water is sold in 500ml sachets. Bottled water is generally better quality than sachet water.

Point of use treatment: households which rely on water sources which are known to be contaminated generally use some form of home treatment such as boiling, filtration, or chlorination. This is not always wholly effective, but it signficantly reduces the risk of water borne disease.

Tanker deliveries: these are used both as an "unimproved" source of water beyond piped water networks, and as a supplementary source of water where piped networks are unreliable. They are operated both by public utilities and by private businesses. Low income households might buy in small quantities (multiple 20 litre containers) but high income households may be able to store as much as 10,000 litres on their premises.

Home water storage systems: where piped water supply is irregular or it is necessary to rely on tankers, households have to store water to ensure that it is available when required. Higher income households will typically invest in water tanks and related systems to ensure continuous access.

How do people access drinking water today?

We propose dividing water access first by where it comes from (e.g. an unimproved source, an improved source, and or a utility). Then we suggest dividing non-utility supply water according to how convenient it is to access (i.e. does it take a round trip of more than half an hour to fetch). We categorise utility water supply as folllows:

- High performance piped networks: supply piped potable water 24/7.
- Standard piped networks: supply non-potable piped water more than 12 hours per day on average with no outages longer than 48 hours in a year.
- Low performance piped networks: supply significantly non-potable water for less than 12 hours per day, with outages of more than 48 hours being a regular occurrence.

We have used the World Bank's IB-Net database to classify utilities in this way by region (see Figure 5).

This suggests that the majority of utility water supply is not in fact potable. Furthermore many of those counted as having access "improved water sources" also in fact rely on utility water services delivered out-of-house through public standpoints and water kiosks supplied. That water is likely to be non-potable as well. Combine this with the fact that even "improved sources" such as protected wells and bore-holes in the urban environment may be infiltrated by faecal colliform bacteria as a result of poor faecal sludge management, and it becomes clear that potability is a much larger issue than might be implied by the MDG standards for water supply.

Given this situation there is a large market for private domestic solutions to improve the quality of water supplies. These include:

- Packaged water: there are a range of options available. At the bottom end of the market sachets are popular in West African cities and are developing a presence in south and south Asian cities. Typically they contain 400ml – 500ml of water and sell for less than $0.03 each. This is the equivalent of $60/m3, but it affordable because it is only bought in small quantities. At the other end of the market there are 20 litre carboys and garafons supplied to household water dispensers and coolers on a subscription basis. For the purposes of this study it is important to distinguish between packaged water sold as a "lifestyle" convenience, and packaged water purchased because it is the best alternative for access to safe drinking water. By and large life-style purchases are 300 ml – 1 litre bottles sold at high prices, while the "access" market is typically sold in 1.5 litre bottles and larger formats. We estimate that around 750 million people globally buy packaged water each week for "access" reasons rather than lifestyle or convenience reasons. The annual total spending this generates in shown in Figure 6 below.
- Point of use treatment: most households which rely on potentially contaminated water sources will take some action to remove pathogens from the water they drink. The effectiveness of these methods vary from completely ineffective (eg straining through a cloth) to completely effective (eg point of use ultrafiltration, reverse osmosis or uv radiation systems). For the purposes of this analysis we will focus on those approaches that give significant protection against pathogens including chlorination, boiling, ceramic filters, ultrafiltration, reverse osmosis and UV irradiation and ozonation. Demographic and Health Surveys have collected some data on the use of different purifcation strategies. We have used these together with data from commercial market research reports to estimate spending on point of use treatment around the world.

Our estimate of how the world outside the high income countries of Europe, North America and Asia access water detailed in appendix 2 at the end of this report.

Figure 5. Utility services by performance level

Region	High	Standard	Low
Middle East & North Africa	20%	68%	12%
Sub-Saharan Africa	14%	66%	20%
Latin America & Caribbean	19%	76%	5%
Europe & Central Asia	26%	67%	7%
East Asia & Pacific	15%	76%	9%
South Asia	0%	54%	46%

Source: IB-Net

Figure 6. Spending on packaged water for access

Region	2015 access related packaged water spend	CAGR	2030 expected spend
Mid. East & N. Africa	$6bn	7.8%	$19bn
Sub-Saharan Africa	$4bn	9.0%	$13bn
Latin Am. & Carib.	$15bn	7.2%	$43bn
Europe & C. Asia	$5bn	3.6%	$8bn
E. Asia & Pacific	$21bn	9.6%	$84bn
South Asia	$7bn	12.0%	$36bn
Total	$58bn	8.7%	$203bn

Source: BMC, Zenith, TechNavio, synthesised by GWI

Tankers and supplementary supplies

Around 100 million people around the world rely on water tankers and other containerised water deliveries for at least part of their water supply. Tanker deliveries are considered to be an unimproved water source from the point of view of the MDGs because the water supplied is typically non-potable and inconvenient. There are generally three circumstances in which tanker deliveries relied upon:

- Where the utility network does not reach a population which it has a mandate to cover, and the utility arranges for tanker deliveries instead.
- Where the utility is unable to deliver water through its piped network throughout the year (typically because of network failures or seasonal fluctuations in water availability) and it provides tankers as a remedial service.
- Where the utility services are inadequate for a number of reasons and households turn to private vendors to meet their needs.

There is a grey area between private and public tanker supply because utilities often subcontract the management of tankers to private operators who may arrange water sales on their own account as well as on the utility's account.

The heartland of tanker water supply is Delhi. The Jal Board operates around 800 tankers which provide mostly free or heavily subsidised water to those parts of the service area without access to water either because residents live beyond the network or because of seasonal piped water supply outages. Besides this official tanker supply system there are around 2,000 private operators (known as the"tanker mafia") who typically serve middle class households with home water tanks for storage and informal settlements beyond the Jal Board's service area. In addition, tanker supply has also become normalised across the Middle East region.

There is very little formal data on the tanker supply market. Anecdotal figures from media reports and surveys conducted by aid institutions suggest that the price of water supplied by tanker can be as high as $50/m^3$, although this would typically be for water sold in quantities of less than 200 litres. Altogether we estimate that the market for tankers and other non-pipe water deliveries is worth around $7 billion per year and it is growing at the rate of 12% per year as the rate of urbanisation outstrips the rate at which utilities can meet the needs of their customers.

Figure 7. Point of use water treatment

Region	% boiling	% bleach/chlorine	% filtration	Total spend	CAGR
Mid. East & N. Africa	0.7%	0.0%	9.6%	$4bn	7.5%
Sub-Saharan Africa	8.7%	5.9%	0.7%	$3bn	5.9%
Latin Am. & Carib.	36.8%	8.8%	0.9%	$10bn	7.6%
Europe & C. Asia	55.5%	0.5%	0.9%	$9bn	6.5%
E. Asia & Pacific	47.6%	0.6%	2.0%	$16bn	12.6%
South Asia	8.6%	1.8%	5.3%	$9bn	9.2%
Average/total	16.8%	2.5%	2.7%	$52bn	9.1%

Source: DHS estimates, GWI and various

Figure 8. Spending on tankers

Region	% using tankers regularly	Total spend on tankers
Mid. East & N. Africa	2.6%	$1,059m
Sub-Saharan Africa	1.0%	$621m
Latin Am. & Carib.	1.2%	$564m
Europe & C. Asia	0.9%	$241m
E. Asia & Pacific	0.6%	$894m
South Asia	3.3%	$3,671m
Average	1.6%	$7,051m

Source: GWI estimates

Figure 9. The cost of supplementary supplies

Location	Cost	Source
Delhi, India (drought)	50.00	Tanker
Port Moresby, PNG	48.21	Tanker
Enugu, Nigeria	19.39	Tanker
Kiberia, Kenya	17.29	Jerrycan
Dar es Salaam, Tanzania	13.76	Jerrycan
Antananarivo, Madagascar	13.10	Tanker
Kanpur, India	13.10	Tanker
Accra, Ghana	11.79	Tanker
Cape Verde	11.46	Jerrycan

Source: GWI from various reports

Home water storage

Where water supplies are intermittent or it is necessary to rely on tanker deliveries, it is necessary to store water in the home. Low income households will typically do this in containers such as jerry cans, pots, and jars. Higher income households on the other hand will typically rely on plumbed in storage tanks, either beneath the house or on the roof. These require significant up front investment and some on-going cost in terms of serving and pumping. Typically a system might cost in the region of $600 to install. There is no published data on the number of households which have installed home storage systems. However based on sampling using Google Maps as a rough guide, we estimate that around 7% of households (including those living in apartments) in areas which have irregular piped water supply benefit from a plumbed in water storage systems. We estimate total annualised spending to be in the region of $3.9 billion.

Figure 10. Spending on household storage

Region	% with plumbed storage	Total spend on storage
Mid. East & N. Africa	4.8%	$357m
Sub-Saharan Africa	1.3%	$231m
Latin Am. & Carib.	4.7%	$529m
Europe & C. Asia	3.8%	$262m
E. Asia & Pacific	4.0%	$1,487m
South Asia	2.6%	$801m
Average/total	3.3%	$3,668m

Access to sanitation

There are potentially three aspects of sanitation: the actual toilet facility, the manner in which faecal matter is collected and made safe and the availability of handwashing facilities with water and soap in the household.

The most significant issue from an access point of view is open defecation, i.e. the circumstance where there is no actual toilet facility, no means of protecting from faecal contamination and in most circumstances, little scope for hand washing. Besides being inconvenient and a health issue it is also unsatisfactory from the point of view of the safety of women and girls. Ending open defecation is a significant priority for the development community.

The next level up from open defecation is a shared toilet facility which is out of house. It is inconvenient, and inadequate from the point of view of the safety of women and girls. The extent to which shared facilities are a health issue is a function of faecal sludge management (FSM) and handwashing. The key issues for FSM are evacuation and sanitisation. Latrines and septic tanks need evacuation when they are full, and any material collected or dug out needs to be sanitised or it becomes a public health risk.

The top level of sanitation service is a private flush toilet with sewer connection to a wastewater treatment plant and handwashing station. The table in appendix 3 details our estimate of the different ways the world's population accesses sanitation.

Do we solve water in private or together?

Spending on public water services is in danger of being eclipsed by spending by households to cope with the failure of public water services. Outside the high income economies, the total market for packaged water, point of use water (POU) treatment systems, water delivered by tankers and home water storage systems was in the region of $120 billion in 2015. This compares to total capital and operating spending by utilities on water services of $124 billion. What is more, spending on coping with failing public utility services is growing at nearly twice the rate of total spending by water utilities. It means that if current trends continue, by 2030 - the deadline for the Sustainable Development Goals - the cost of coping will dwarf the cost of utility supplies.

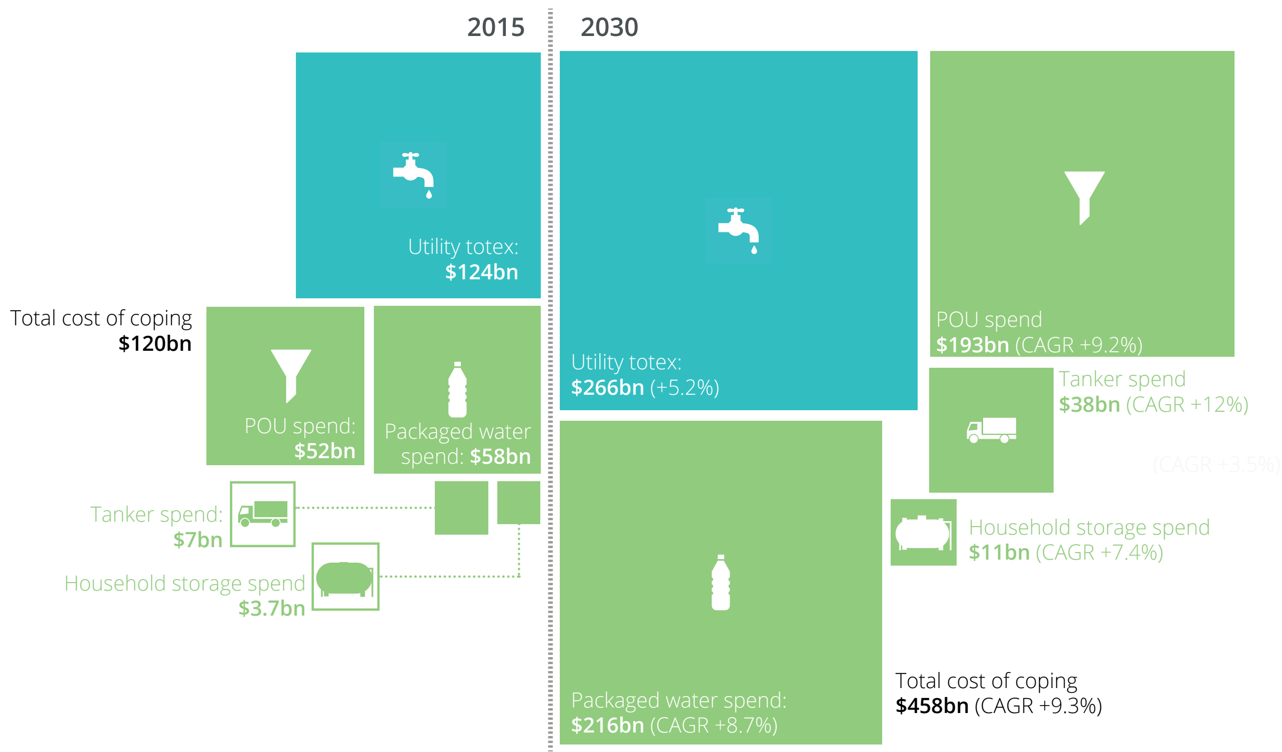
It raises an important strategic question for the utility sector: is the middle class abandoning the idea that utilities should supply drinking water?

If it is, then it is a major challenge for universal access to safe drinking water. We need the economies of scale that ensure utility service can offer to drive down the cost of water for the poorest households. For example the per capita annual cost of treating water to potable standard is likely to be in the region of $11. The per capita annual cost of treating water in potable standard in the home is likely to be in the region of $26 taking amortised capital and operating costs into account.

Furthermore if the middle classes insulate themselves from the failings of public water supply, then it is likely that the failings will become even greater, as they withdraw their financial and political support for improved utility services. This may not matter in the short term, but in the long term it will precipitate a crisis because ultimately all private solutions depend on large scale public infrastructure investment in resource development.

How can utilities compete better? We live in a world where there is de facto competition for consumer spending between utilities and those who supply private solutions to the shortcomings of utility services. Public utilities are seeing their share of this spend squeezed every year that they fail to deliver. In order to have a future, they must not only offer a better service, but market that service more effectively than their competitors.

Figure 11. The relative size and growth rates of public and private water solutions.



Source: GWI and others

The price of inadequate access

Each mode of access comes with a number of direct and indirect costs. These include:

- Direct costs: this includes utility charges as well as any direct payments for water and water-related services such as packaged water purchases (in as much as they are a necessary alternative to non-potable water supplies), purchases from tanker operators (both public and private) and purchases from other private water vendors. Additionally there are the direct costs of facilities such as hand washing stands, toilets, latrines, septic tanks and point of use water treatment systems. Some, but not all, of these costs have been explored in depth by Guy Hutton's cost benefit analysis of the MDGs for water and sanitation published by the World Health Organisation (WHO/HSE/WSH/12.01). Although the direct costs are a mixture of operating costs and capital costs, for the purposes of simplicity we suggest converting the capital costs into annualised total costs based on the expected life of the asset and a notional discount rate. We recognise, however, that this conversion represents the nub of the challenge for water access: it is largely because these high capital costs cannot easily be converted into more affordable "pay-as-you-go" costs that water is often unaffordable.

- Time costs: The biggest cost of inadequate access to water and sanitation is the time spent fetching and carrying water, as well as the time spent using inconvenient sanitation. We will follow Hutton's methodology in calculating this cost, although we will extend it to apply to close but not private facilities (under the MDG's, inconvenience was only a factor in whether a water source was improved or not if it required a journey of longer that 1 km to reach).

- Direct healthcare costs: this refers to the additional burden on healthcare systems resulting from the health risk of bad water and sanitation. These have been enumerated by Hutton, and we follow his methodology.

- Economic healthcare costs: this refers to the time spent off work as a result of water borne diseases. It covers the time spent by those who are ill themselves and the time spent by those caring for ill children. These costs are calculated on the same basis as the time costs detailed above. Although we use Hutton's methodology for calculating the direct and economic healthcare costs, we do not make the assumption that the achievement of the MDGs for water and sanitation eliminates the healthcare costs. Rather we feel that it is only by fully achieving the relevant SDGs that the healthcare impact of bad water and sanitation can be eliminated.

- Value of life: a certain number of deaths each year are ascribed to bad water and sanitation. We use the World Bank formula to calculate the economic cost of the loss of life through water borne disease.

Utility costs

Utilities services are funded in four ways: user tariffs, tax payer subsidies, and out of the depreciation of the existing assets. This latter point is an important explanation of why the water utility sector is in such a bad state across much of the world. It also introduces complexity when trying to determine the cost of a utility service. Depreciation is a non-cash item on the profit and loss account but it is a very real cost nonetheless because utilities are very asset heavy businesses, with much of the operational activity revolving around the maintenance of the assets. Typically they have fixed assets of 3.8x their revenues on their balance sheets. If these assets are not maintained or renewed the cash savings made are paid for out of the future service levels the utility can offer. It means that the reality is that for many people around the world water services are going backwards. Lagos in Nigeria for example had 300,000 connections serving a population of 1.4 million in 1970. Today it has a population of 21 million[1], but the number of water connections has fallen to 150,000 as a result of systematic under investment over the years.

Borrowing from the future health of the network is a false economy because a well maintained system is also the cheapest system to operate. For example growing leakage initially adds to operating expenditure because more water needs to be made and transported for the same volume to reach the customer. Beyond a certain point leakage accelerates the depreciation of the assets because without mains pressure pipes are more easily damaged.

Ideally utility spending should be fixed so as to cover best practice in operations and maintenance, capital renewal, capital investment required to meet changing circumstances (i.e. growing water scarcity or the requirement to meet tighter environmental standards) as well as capital investment to facilitate the extension of the service to new customers. This happens rarely in South Asia and sub-Saharan Africa, and addressing this issue is an important part of our proposed model for water access (see box overleaf "beating the cycle of utility decline"). The main reason utilities tend to "borrow from the future of the network" rather than optimise spending on operations and maintenance and capital renewal and expansion is because tariffs are set too low to cover costs and the different cannot be made up through taxes and transfers.

Given the complexity of determining the actual cost of utility service we will use two separate data sources in this report. The first is actual totex (i.e. capital and operating expenditure) by utilities as collected by Global Water Intelligence (see Figure 12). This gives a rough and ready figure for current actual costs. The second source of data is the World Bank analysis of service costs undertaken as part of its work on costing the MDGs (see Figure 13). This aims to show what the theoretical cost of adding a new customer to a water and sewerage service across the world. It shows a higher figure for the cost of a water service than the GWI figure because it does not assume that the cost will be subsidised through accelerated depreciation of the assets. It shows a lower figure on the wastewater side. There are two possible reasons for this. First because few utilities undertake wastewater treatment and those that do tend not to borrow so heavily from future depreciation. Second, the World Bank data assumes secondary treatment only, but utilities often treat wastewater beyond that stage and have additional sludge disposal costs not calculated by the World Bank. We will use the GWI figures to show the base cost of a water and wastewater service, and the World Bank figures to show the cost of incremental additions to the water service but ignore the World Bank figures for the cost of wastewater service.

Figure 12. Per capita actual utility service totex: GWI data

Region	Water service	Sewer and treatment
Middle East & North Africa	$73	$62
Sub-Saharan Africa	$81	$63
Latin America & Caribbean	$45	$53
Eastern Europe & Central Asia	$57	$45
East Asia & Pacific	$34	$80
South Asia	$17	$28
Average	$40	$62

Figure 13. Per capita cost of joining utility service: World Bank data

Region	Water service	Sewer and treatment
Middle East & North Africa	$59	$57
Sub-Saharan Africa	$54	$60
Latin America & Caribbean	$118	$78
Eastern Europe & Central Asia	$104	$56
East Asia & Pacific	$44	$36
South Asia	$23	$24
Average	$58	$48

1 Source: Lagos Water Corporation

Beating the cycle of utility decline

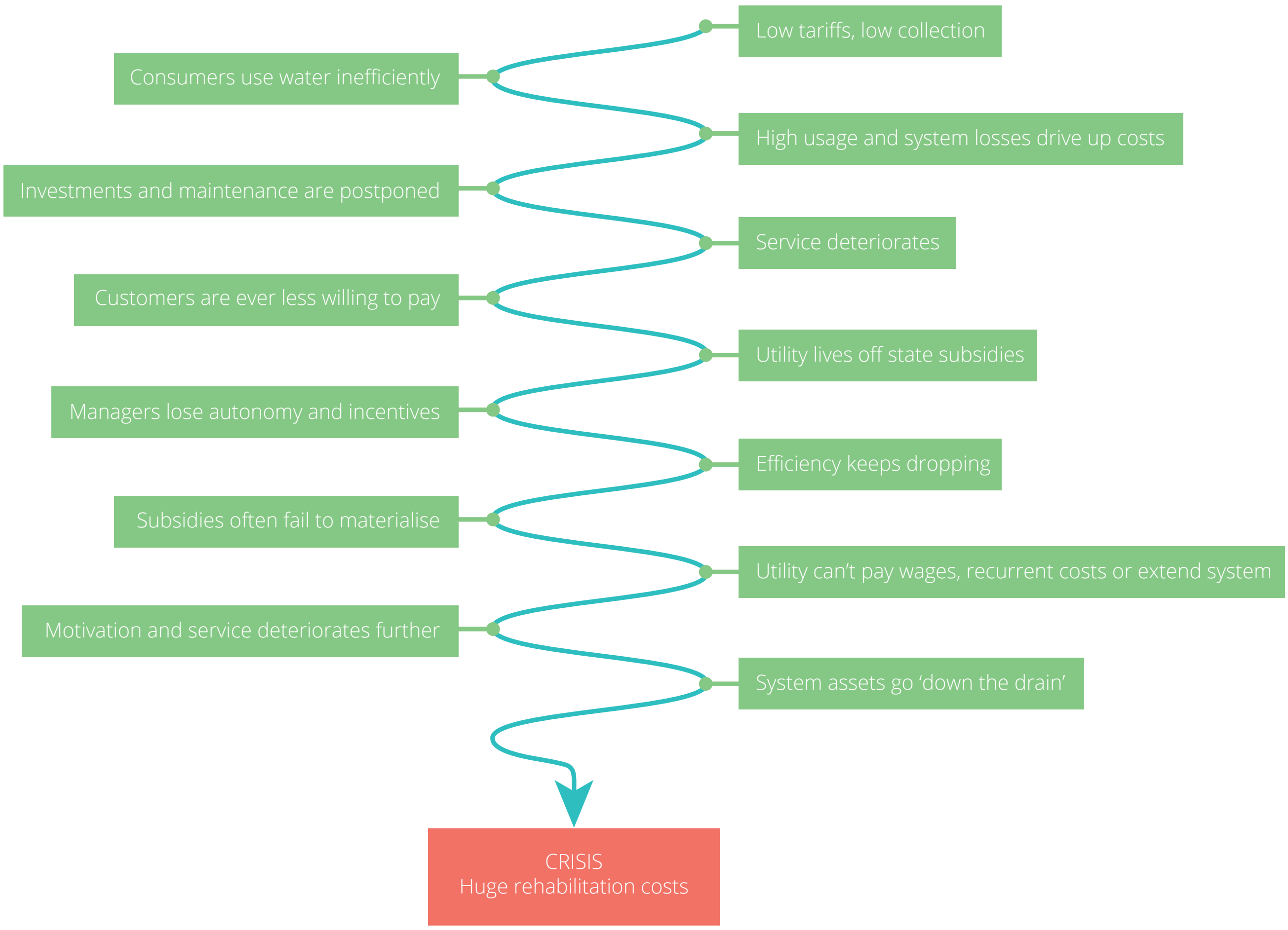
There is a political tension at the heart of delivering a water service: on the one hand water should be delivered at the lowest cost possible because it is a human right; but on the other hand guaranteeing that human right requires heavy expenditure on building and maintaining assets. The most common solution to this is for politicians to avoid increasing tariffs in line with the cost of the service and at the same time to avoid making up the shortfall through transfers from the tax payer. The result is the cycle of decline detailed below.

The challenge is to break this cycle. In most cases it requires a crisis that political leadership seizes upon to drive change in the sector as the World Bank's report Providing Water to Poor People in African Cities Effectively: Lessons from Utility Reforms illustrates.

However even when there is determination to make a difference, many utilities which have reached crisis do not have access to the money they need to deliver a noticeable improvement in the service. Governments may provide some support, but even that is contingent on demonstrating that real change is taking place. Global Water Leaders Group Executive Director William Muhairwe has been involved in a number of utility turn-around operations, and typically his initial focus is on improving collection rates. This is an area where management has the ability to effect outcomes without external support, and the increased cashflows can be put towards other areas of improvement, beginning the virtuous circle of utility improvement, with improved cashflows leading to improved confidence in the leadership, which in turn leads to greater interest from funding agencies, which in turn leads to service improvements, and increased revenue, and further expansion of funding.

Although we cannot provide the leadership impetus to initiate a utility turn around, we do have the expertise within the group to support it all the way.

Figure 14. The cycle of utility decline



Source: WSP/PPIAF

Other direct costs

- Improved water access: there are a variety of different modes of improved water access which is not a piped-to-premises connection. These include municipal water kiosks and stand pipes, protected dug wells, and tube wells. We will calculate the cost of these based on the World Bank WSP Cost Database.

- Packaged water: We have used a number of different commercial market reports to ascertain the size of the market in terms of dollar spend and volume by country. We have assumed that on average 50% of sales are for "lifestyle" purposes (i.e. not strictly required in order to guarantee safe drinking water in the home), and on the basis of regional pricing and consumption we have estimated the proportion of the population relying on bottled water for access and the spend per head for those who do. We have also included in our calculations estimated data relating to the market for water sachets. This is a relatively small market, but it is growing much faster than the traditional bottled water market.

- Point of use treatment: We have used USAID's Demographic Household Surveys as a source of data on treatment solutions used by households around the world. This data is reasonably comprehensive, but it is not up to date. We have collated it with information on spending on commercial point of use treatment systems published by market research publishers (notably Baytel). We have included the ongoing cost of treatment as well as the amortised capital cost of commercial systems in our calculations.

- Tankers: We have built up an estimate of the size of this market based on anecdotal evidence collected from media reports and local surveys. These assume that the majority of customers who pay for tanker supply do not rely on it all the year round. We have included utility supplied tankers in our calculation of the total spend.

- Handwashing: USAID's Demographic Household Surveys has collected data on the availability of handwashing facilities around the world. The World Bank WSP Cost Database has calculated annualsed costs for the installation of handwashing facilities.

- Toilets: The JMP has published data on the extent to which private and shared toilet facilities are used. We have combined this with information from the World Bank WSP Cost Database to determine the cost of private and shared toilets.

- Good FSG: This involves the capital and operating cost of covered pit latrines and septic tanks. Capital costs include construction (and need to be separated from the cost of the toilet itself), while operating costs involve evacuation as required and sanitisation of the evacuated matter. There is some data available on the prevalence of good FSM, and the World Bank WSP Cost Database calculates the relevant annualised costs.

- Other unimproved water and sanitation: we have assumed that this is essentially cost free, although in reality many people end up paying for sub-standard water, and unimproved toilet facilities require some capital cost.

Further information on the data sources used can be found in Appendix 1 at the end of this report.

Time costs of inadequate water and sanitation

Hutton's methodology for costing the time spent on inadequate water and sanitation makes the following assumptions:

- The water collection time saved per household as a result of using a nearby external source of water as opposed to a distant (further than 1 km) source of water is 30 minutes per day per household in countries outside sub-Saharan Africa, and 1 hour in sub-Saharan Africa. Assuming 5 people per household, the per capita collection time is respectively 6 minutes and 12 minutes per person per day.
- The water collection times saved per household as a result of having a piped domestic connection as opposed to a distant (further than 1 km) source of water is 1 hour per day per household in countries outside sub-Saharan Africa, and 1 and a half in sub-Saharan Africa. Assuming 5 people per household, the per capita collection time is respectively 12 minutes and 18 minutes per person per day.
- The sanitation access time saved per day in moving from open defecation to a private latrine is half an hour per day per person.
- The opportunity cost of time spent should be calculated at the cost of 30% of hourly GDP for adults and 15% of hourly GDP for children.

Based on Hutton's assumptions the implied water collection time wasted for our category of distant source is 12 minutes per person per day (18 minutes in sub-Saharan Africa). For our category of "nearby source" the collection time wasted is 6 minutes per person per day (12 minutes in sub-Saharan Africa). It is assumed that zero additional time is wasted as a result of using a piped domestic source.

In terms of sanitation Hutton suggests 30 minutes per person per day for open defecation, but does not give a time cost of out-of-house sanitation. We propose that using a private latrine or toilet as opposed to a shared out-of-house facility is 10 minutes per day per person.

In addition to the time costs of accessing distant water sources and inconvenient sanitation arrangements, we propose including the cost of managing irregular water supplies in our calculations of the cost of inadequate access. Specifically: managing arrangements for a water supply which operates for less than 12 hours per day is estimated to be in the region of 20 minutes per household per day or 4 minutes per person per day.

These time calculations multiplied by the average GDP per capita per hour and discounted at the rate of 30% for adults and 15% for children to give the monetary value of the time spent managing inconvenient water and sanitation arrangements.

Figure 15. The time costs of inadequate access

Activity	Unnecessary time spent per head
	30 minutes
	10 minutes
	None
	12 minutes/18 minutes (Africa)
	6 minutes/12 minutes (Africa)
	12 minutes/18 minutes (Africa)
	6 minutes/12 minutes (Africa)
	4 minutes
	None
	None

The health costs of access

Inadequate access to water and sanitation inflicts costs in three ways: directly as a burden on the healthcare system, economically in terms of the opportunity cost of the time spent ill or tending sick children, and thirdly in terms of the value of human life where sickness leads to death. Hutton suggests the methodology outlined below for calculating these items. We have used this approach to calculate that the total health costs of inadequate water and sanitation is in the region of $71 billion.

Having established this figure, the next challenge is to apportion these costs between different water and sanitation sources and practices. There is insufficient data to do this wholly scientifically. Annettte Prüss of the WHO and others established in a paper published in 2002 that inadequate water and sanitation was responsible for 4% of all deaths. It also gave different weightings to the different interventions such as basic sanitation, handwashing, and point of use chlorination. It does not, however, attribute specific risks to inadequate FSM or low performance utility networks. Our approach to apportioning the health costs is somewhat based on Prüss's findings, but largely on estimates of the health impacts of different activities.

At the top level, we have divided the health risks into three categories:

- Those relating to drinking contaminated water: We estimate that this accounts for 55% of all health related costs of inadequate access to water and sanitation.
- Those related to not washing hands: We estimate that this accounts for 38% of all health related costs of inadequate access to water and sanitation.
- Those relating to open defecation: here we are counting simply the direct risk to health rather than either its impact on source water purity or the likelihood that someone practising open defecation has a higher risk of not having appropriate handwashing facilities.

Calculating the health costs of inadequate access

Guy Hutton used the following table of costs to calculate the health impact of inadequate access to water and sanitation in his assessment of the costs and the benefits of achieving the Millennium Development Goals.

Benefit by sector	Variable	Data source	Data values
Health care costs of disease	Unit cost per treatment	WHO regional unit cost data	US$0.41-US$135 (cost per visit) US$1-US$738 (cost per day) Variable by country
	Number of cases of diarrheal disease	DHS	1 to 13 cases per child per year Variable by country
	Visits or days per case	Previous study	1.2 outpatient visits per case seeking care (includes return visits) 5 days for hospitalised cases
	Hospitalisation rate	Previous study	10% of ambulatory cases are hospitalised
	Transport cost per visit	Assumptions	US$0.50 per visit
Welfare gained due to days lost from work avoided	Days off work/episode	Expert opinion	5 days
	Number of people of working age	UN Statistics	Variable by country
	Opportunity cost of time	World Bank data	30% of hourly monetary income, using GDP per capita as the proxy for time value
Welfare gained due to school absenteeism avoided	Absent days/episode	Expert opinion	5 days
	Number of school age children (5-14)	UN Statistics	Variable by country
	Opportunity cost of time	World Bank data	15% of hourly monetary income, using GDP per capita as the proxy for time value
Welfare gained to parents due to less child illness	Days sick	Expert opinion	5 days
	Number of young children (0-4)	UN Statistics	Variable by country
	Opportunity cost of time	World Bank data	15% of hourly monetary income, using GDP per capita to proxy time value
Value of loss-of-life avoided (life expectancy, discounting future incomes at 8%, assuming average long-term growth in national income of 2%)	Discounted productive years lost (0-4 years)	WASH study [21]	16.2 years
	Discounted productive years lost (5-14 years)	WASH study [21]	21.9 years
	Discounted productive years lost (15+ years)	WASH study [21]	19.0 years

The risk of drinking contaminated water is a function of the purity of the source and the extent to which this risk has been mitigated through point of use treatment. We assess the purity of different sources according to both the nature of the source and the extent to which it might have been contaminated as a result of bad sanitation practices. This assessment is different in cities (where higher population densities mean that wastewater infiltration into drinking water sources in a much greater risk) compared to the risk in the countryside. This is a departure from the approach used by the MDG Joint Monitoring Project, but it is an acknowledgement that "improved" water sources may not be totally safe to drink if they are at risk from contamination as a result of poor sanitation practices. For example in cities without sewer systems it is quite common for wastewater to infiltrate the groundwater, ensuring that protected wells or and compromised water networks become contaminated. The risk is worse if open defecation is widely practiced, but it remains even when there is "good" faecal sludge management in high density areas because of leaks from septic tanks. The two guarantees that wastewater will not infiltrate drinking water sources in a high density urban area are either a sewer system connected to a wastewater treatment plant or a high performance drinking water utility service.

Our methodology for dividing up the health cost of inadequate access to water and sanitation is to model the number of people believed to be reliant on each form of access (based on JMP data), and to apply a risk adjustment factors (outlined in figure 16 below) to show the extent to which they are exposed to health risks as a result of the source of water they rely on. For example a high performance utility network is assumed to deliver fully potable water, and therefore does not take a share of the health risks associated with water sources. Those relying on an unimproved water source would carry full exposure to health risk, while a standard performance network in an urban environment where open defecation or inadequate FSM were common would exposure its users 50% of the risks that an unimproved source would expose them to. This health risk factor is then applied to the number of people relying on each mode of drinking water access and sanitation practice to apportion the health risks between the different modes. The total health cost of each combination of water and sanitation access has been calculated and shown in the table.

It is assumed that packaged water and point of use treatment is wholly effective even though there is a small risk that some micro-organisms will pass through certain commercial filtration systems and packaged water - particularly that sold in sachets - is not always treated effectively.

We have also apportioned the relative contribution of the safety of the drinking water source and the sanitation practice to the actual health risk for illustrative purposes, although strictly speaking it is not possible to separate the two causes. Furthermore, the cost of poor sanitation management is a community cost rather than a household cost. In that sense it is not possible to talk about the health risk of poor sanitation at the household level, although for the purposes of this analysis we shall do so. We justify this on the basis that our objective is to inform policy at the community level rather than choices at the household level.

Figure 16. Health risk factor adjustment and estimated health cost impact by water source and sanitation practice

Rural	Open defecation or Inadequate FSM*		Good FSM		Sewer only		Sewer and treatment	
	Risk factor	Cost	Risk factor	Cost	Risk factor	Cost	Risk factor	Cost
Unimproved	100%	$3,013m	100%	$241m	NA	NA	NA	NA
Improved	25%	$6,136m	0%	$0m	NA	NA	NA	NA
Low performance network	100%	$1,447m	50%	$141m	50%	$270m	25%	$218m
Standard network	50%	$3,598m	25%	$1,596m	25%	$733m	0%	$0m
High performance network	0%	-	0%	-	0%	-	0%	-
Packaged water	0%	-	0%	-	0%	-	0%	-
Point of use treatment	0%	-	0%	-	0%	-	0%	-
Urban	Open defecation or Inadequate FSM*		Good FSM		Sewer only		Sewer and treatment	
	Risk factor	Cost	Risk factor	Cost	Risk factor	Cost	Risk factor	Cost
Unimproved	100%	$503m	100%	$184m	NA	NA	NA	NA
Improved	50%	$4,821m	25%	$451m	NA	NA	NA	NA
Low performance network	100%	$528m	50%	$168m	50%	$312m	25%	$325m
Standard network	50%	$1,212m	25%	$1,179m	25%	$666m	0%	$0m
High performance network	0%	-	0%	-	0%	-	0%	-
Packaged water	0%	-	0%	-	0%	-	0%	-
Point of use treatment	0%	-	0%	-	0%	-	0%	-

* excludes direct health costs of risks of open defecation which total $5.2 billion and health costs related to poor handwashing which total $27 billion

The true cost of water

Combining the health cost, the time cost and the direct costs of water access enables us to calculate the cost of water at the global level (excluding the high income economies of Europe, North America and Asia Pacific). This is shown on the below:

Figure 17a. Total global cost of access – absolute costs by mode of access

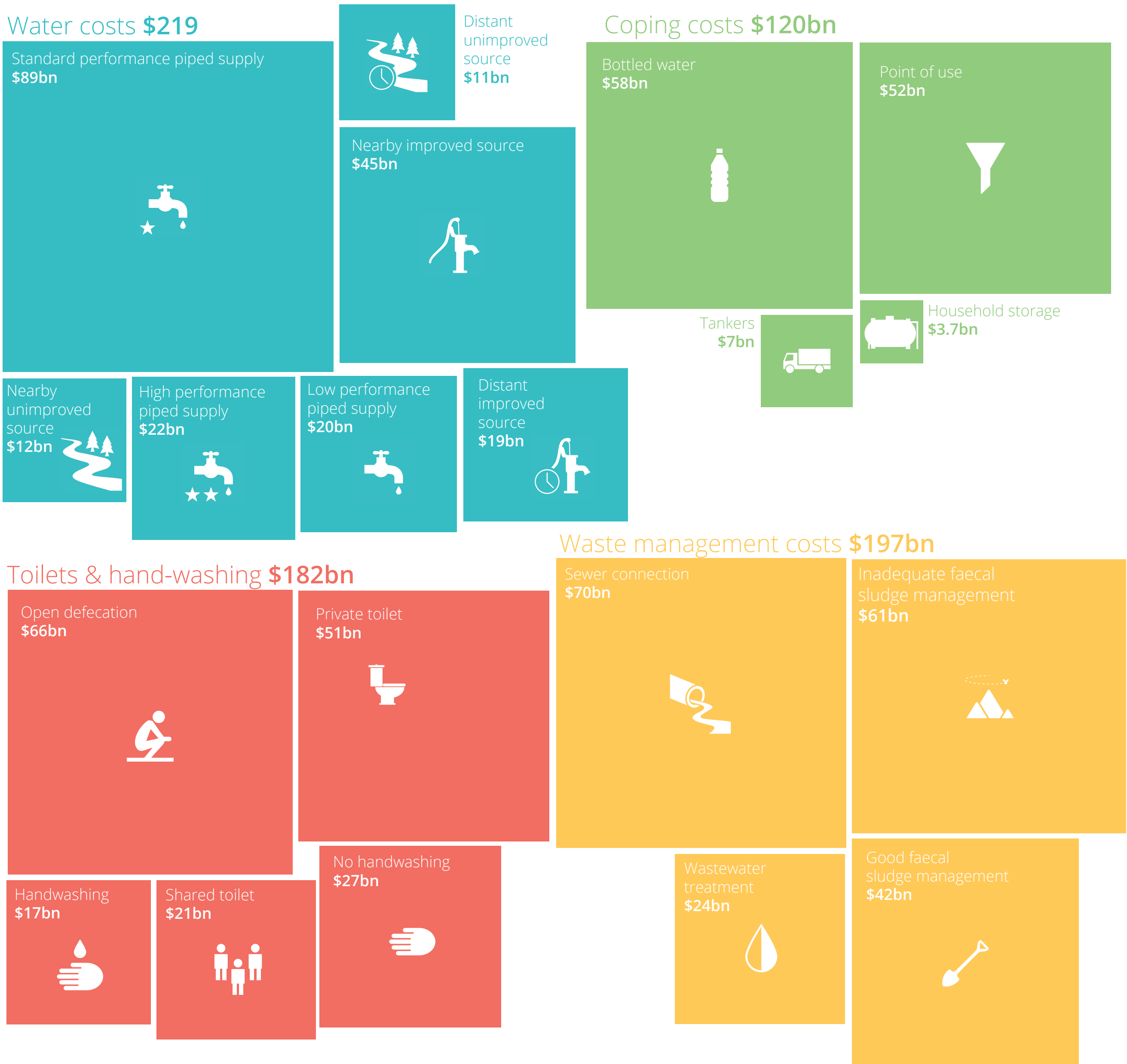
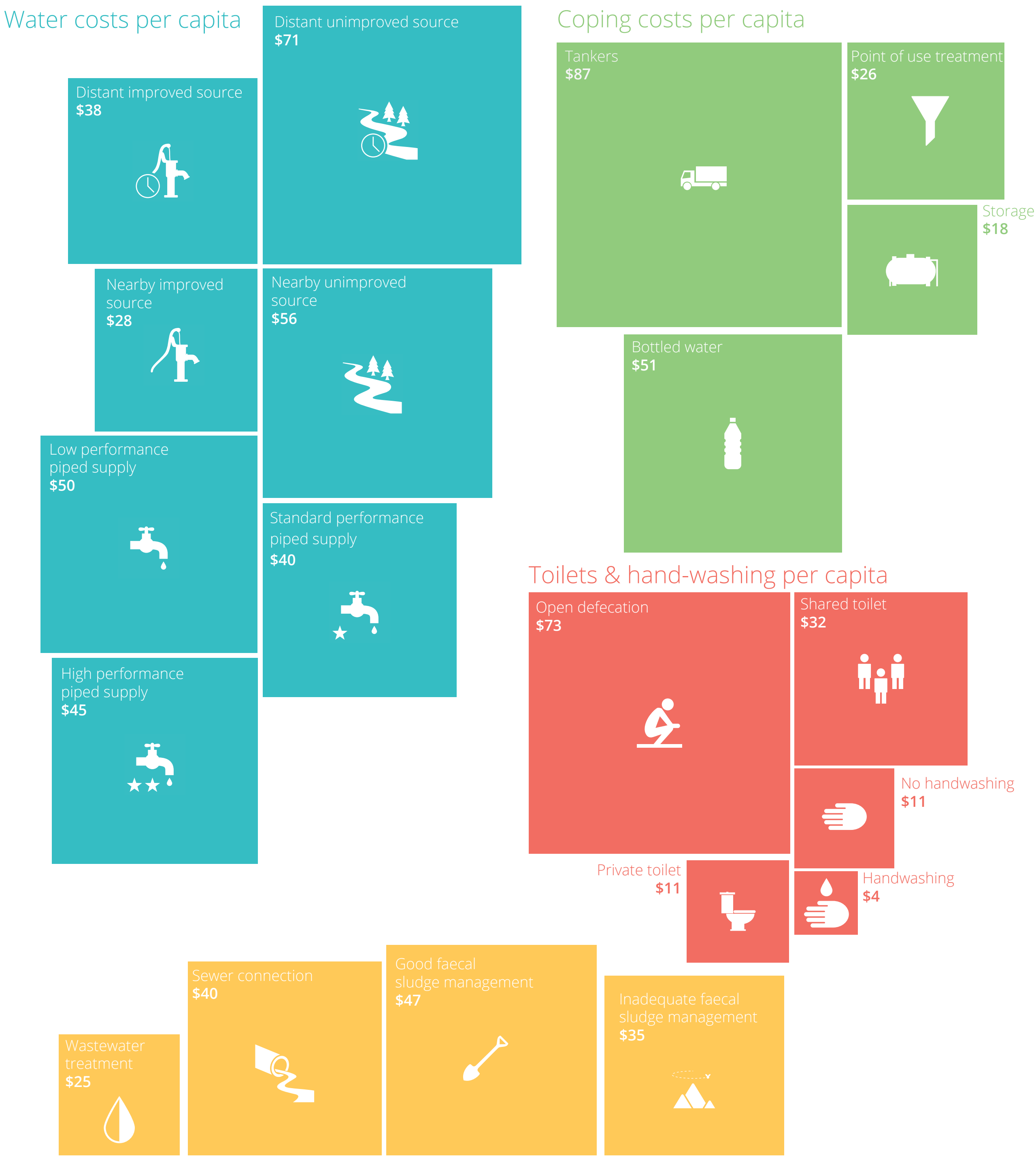


Figure 17b. Total global cost of access – proportional cost types by mode of access

Total cost of access: $718bn

By taking to total cost of each method of access and dividing it by the number of people relying on each we can calculate the per capita costs (see figure 18 below). These calculations are based on the caveat that the actual health costs for households will depend on the combination of water source and sanitation practice each household relies up.

Figure 18. The cost of access for individuals

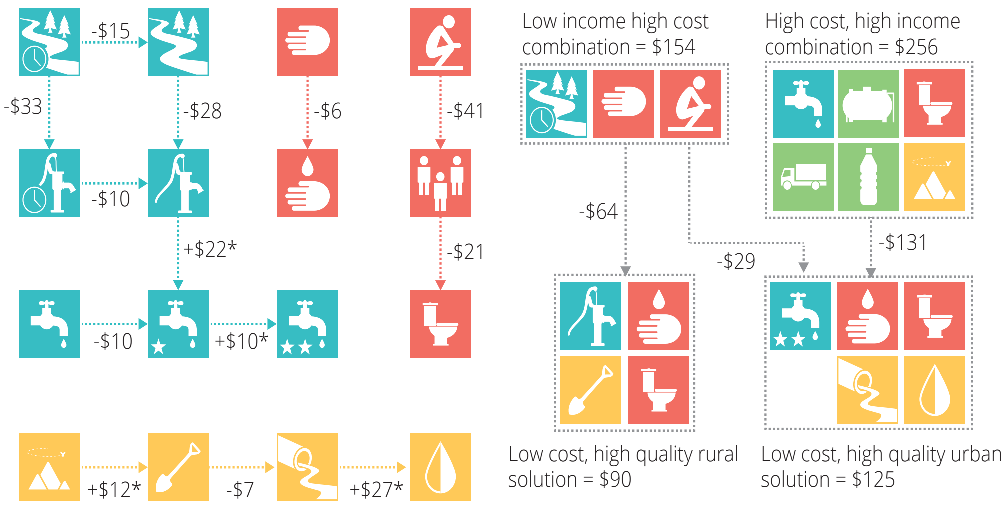


The data shows that in general the economic cost of better access is lower than the economic cost of less good access, and that private domestic solutions to compensate for the failure of public water services (such as bottled water, point of use treatment and tankers) are not cost effective when compared to the cost of a high performance utility service. The best possible solution – a high performance utility connection delivering 24/7 piped potable water with a private toilet, hand-washing facilities and sewer connection to a wastewater treatment plant – costs less than either the lowest form of access to water and sanitation (open defecation, distant unimproved water source and which no domestic hand-washing facilities). The best solution also costs less than the kind of solution that high income households in low income cities typically end up with: a poor utility service augmented by tanker delivers, household storage and bottled water purchases.

Overall the current mix of water and sanitation access modes costs $718 billion a year (excluding the high income economies of Europe, North America and Asia Pacific). If everyone where to have access to 24/7 piped potable water with sewer connections and wastewater treatment in the cities and well managed septic tanks in rural areas, the total cost would be $698 billion.

Using the per capita costs of for different modes of access to water and sanitation outlined in figure 18 it is possible to create pathways towards better access that should give everyone the opportunity to get improved access at reduced overall cost. This is shown in figure 19 below:

Figure 19. Cost savings with improved access to water and sanitation



* Cost increase rather than saving - see text for explanation

Understanding the exceptions

While it is generally true that it is cheaper to do water better, there are three important exceptions:

- All utility services appear to be more costly than taking water from an improved source, whether near or far.
- High performance networks appear to be more costly than standard performance networks (ie ones which do not deliver 24/7 piped potable water). This is not in fact the case if you take into account the fact that the assets of low and standard performance networks should be amortised more quickly than the assets of well maintained networks - see explanation overleaf.
- Improving faecal sludge management, whether through improved practices such as regular evacuation and safe disposal or through sewer connections to wastewater treatment does not appear to pay a dividend.

There are four reasons why these apparent exceptions exist:

- Point of use treatment and packaged water should be calculated as part of the health cost of inadequate water access: people spend on point of use treatment and packaged water because they are concerned about the health risks associated with public water supplies. If these costs were treated as part of the health cost of inadequate access, then the arithmetic would change in favour of good faecal sludge management, sewers, wastewater treatment, improved water sources and high performance utilities.
- Health costs are understated: our model assumes that the health impact of water borne diseases is calculated on the basis of the cost to the health service, the impact of time spent off work (either due to illness or caring for children) and a calculation of the value of life where mortality is involved. It is likely that households - particularly those with vulnerable young children - put a higher price on good health than this calculation suggests. The evidence of this is the fact that around 2.6 million households, many of them below the average level of income, are prepared to invest in point of use treatment or packaged water in order to reduce the health risks of drinking contaminated water, despite the fact that this is very expensive compared to a potable utility supply or an improved water source.

- The trade off between direct costs and health/time costs differs with income: Low income communities will naturally find an out of house improved supply more attractive financially than an in-house supply because the opportunity cost of the time spent fetching and carrying water is lower for them than it is for a higher income household. In urban areas, where incomes are typically higher than average, it is likely that a utility supply to the home will appear better value for money than in the countryside, where lower incomes might mean that an out-of-house improved source is more attractive.

- The costs of bad faecal sludge management are not fully captured: besides its cost in terms of its impact on the safety of water supplies, bad FSM and open defecation also have an environmental cost which has not been factored into this model (we did consider an analysis of real estate values as a proxy for this, but systematic data was not available). If the environmental costs were to be included in the calculation, then it is likely that the value of sewers and wastewater treatment in cities relative to septic tanks and well managed covered latrines would become more clear.

Conclusions from the economic model

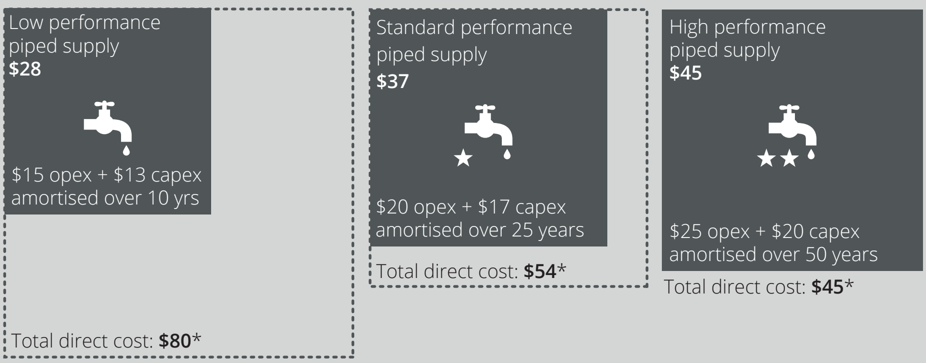
The economic model we have outlined was created in order to investigate the extent to which universal high quality water and sanitation services are afforable in theory. It has shown that almost everyone ought to be able to improve their overall access to water and sanitation at a lower total cost. This total cost includes the direct costs paid by individuals and governments for water and sanitation services, as well as the healthcare costs arising from inadequate water and sanitation and the opportunity cost of time spent managing water and sanitation. it is not wholly a cash cost, and it is borne by both households and institutions. The challenge is to capture the value that is currently in the system and redeploy it to deliver better outcomes for all.

The first step is undoubtedly getting buy-in from all stakeholders. Government agencies, industrial and commercial water users, and households all have an interest in improved access. They must be prepared to put a value on it and commit to invest in delivering improved solutions for all. Without this community based solutions cannot be financed. Instead we will see the continuing trend towards private household solutions such as packaged water sales and point of use water treatment systems. Higher income households will continue to insulate themselves from public services and the problem of inequality of access to water and sanitation will become worse.

Once there is buy in from the stake holders, the step is to find the pathways that will deliver improved access to everyone in the community. This involves analysing the current arrangements, and looking at the alternatives to improve access in a practical and affordable manner. It also involves innovation to bring down the cost of improved solutions, to remove other barriers to access which may exist, and to fill in the gaps where traditional services are unaffordable or unobtainable.

The true cost of utility services

Our model captures the direct cost of utility services (i.e. capex and opex), but it does not capture the cost of accelerated depreciation of the assets as a result of under spending on maintenance. Well maintained networks are less expensive than poorly maintained networks despite spending more on maintenance because their assets tend to last longer. This is particularly the case where there are regular service interruptions which can cause catastrophic variations of water pressure. The assets of a well maintained network might be amortised over 50 years, compared to 25 years for a standard network (ie one which does not deliver 24/7 potable water), and 10 years for a low performance network (ie one which provides non-potable water for less than 12 hours per day on average). The impact of this is illustrated in below:



* including accelerated amortisation of capex but excluding health and time costs (an additional $22 per capita for low performance networks and $3 per capita for standard networks).

Making innovation work

This economic analysis is a useful tool for understanding the challenge, but it does not represent a solution in itself. This next section focuses on innovation around the business model and the technology that can reduce the barriers to access.

Business model innovation

The economic analysis suggests that the SDGs should largely pay for themselves (although in some cases the investment can only be justified if the environmental impacts of untreated wastewater and the quality of life gains from advanced sanitation systems are taken into account). Affordability is a separate issue. It has two sides to it: what is affordable to the customer and what is affordable to the service provider. For a service to be affordable to the customer it not only needs to be priced to reflect the income of the customer; the size of the payments required at any one time must be affordable. This explains why many low income houses buy water from informal vendors for the equivalent of $10/m^3$, whereas with a water connection they might be able to access better quality water for $0.30/m^3$: they cannot afford the $100 connection fee. Connection charges are not the only barrier to better access. Monthly or bi-monthly water bills can also be a barrier to access for households living on a dollar a day. Beyond the utility sphere, private toilets are expensive one-off costs which bring much longer term benefits, and the cost of septic tank evacuation and disposal can be an obstacle to good FSM .

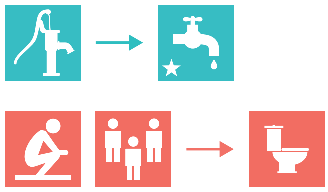
Affordability for the service provider is a similar issue but operating on a much larger scale. Just as low income households might struggle to put together the finance required in order to pay for a connection, so utilities struggle to put together the finance required for large infrastructure projects such as laying new networks and building new treatment plants. They tend not to have the ready cash on hand to finance expansion and upgrades, and they struggle to convince donors and lenders that they are good credit risks.

Innovating for customer affordability

There are a number of ways in which utilities, NGOs, and businesses are developing offerings that suit customers who may be able to pay a few cents per day for service, but cannot afford larger lump sum payments. These include:

Water.org: micro credits for water connections and toilets

Water.org has developed the concept of the Water Credit which allows people in need to access small loans for water connections or toilets, empowering them to accelerate change in their homes and communities. It works with local microfinance institutions to provide affordable loans which are repaid and recycled into new loans. To date it has disbursed 938,000 loans with an average size of $187. The historic repayment rate has been 99% repayment, which is high for the micro-credit industry.



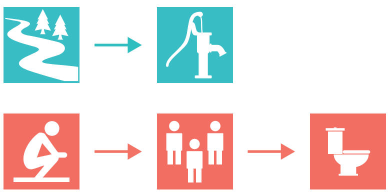
Water Health International: decentralized water treatment centres

Beyond the reach of water networks, households face a choice of different sources of water with different time, health and direct costs. Tankers provide volume but not quality; packaged water provides quality but not volume and,community stand pipes and pumps provide volume but not necessarily convenience or quality. Water Health International provides decentralized water treatment centres with truck distribution of 20 litre containers of water which sell at around $0.04. It is an optimal solution for urban and peri-urban residents in many cases. Although water kiosks are a prominent feature of off-grid water supply, Water Health's innovation includes end-of-pipe treatment reverse osmosis and ultrafiltration. Modular construction makes the model scalable, and ensures affordability.

WaterAid: sustainable community funding

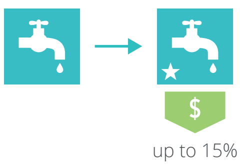
WaterAid addresses the opposite problem of lump sums being a barrier to

A new WaterHealth Centre in India



access. It addresses the problem of ensuring that once a facility has been financed, it continues to be maintained and operated for the long term. It does this by encouraging communities to form a group to collect money to pay for the construction of water and sanitation facilities. Although capital costs are subsidized by external organisations or NGO-run credit schemes, the community commits to funding and managing the running costs. This capacity building within the community is as important as providing the capital for funding in ensuring that water projects are sustainable. sanitation facilities.

Nairobi City Water and Sewerage Company: micro-billing by mobile phone



In Kenya, M-Pesa – a mobile phone money transfer system – has become one of the most popular means of transferring money between users. City Water has been at the forefront of accommodating M-Pesa based payments into utility billing systems. It allows users to use phones to photograph meter readings and send them to the utility, and to change their billing periods to as short a period as 24 hours if required. It means that many Nairobi residents now pay their water bills weekly, with money surging into the utility on Fridays after people have been paid. City Water offers financing plans to help customers spread the cost of new connections over three years. In addition this technology can reduce the cost of service by improving the collection rate (see below).

Innovations for utility affordability

Besides finding ways of making water services more affordable for consumers, it is important to find ways of making service expansion more affordable for utilities. Here are two important innovations:

2ML: 100 days transformation

2ML is the consulting business of former Ugandan National Water and Sewerage Corporation CEO (and Global Water Leaders Group Executive Director) William Muhairwe. It aims so break the cycle of decline in utilities whereby utilities are unable to attract finance to their service levels decline, and because their service levels decline, political support is withdrawn, which in turn makes it more difficult to attract finance, and service declines further. The programme is based on introducing autonomy, accountability and incentivisation for utilities and their management (see section on governance below for details). It focuses on making the most of existing resources (such as improved collection rates and better management motivation) to drive performance improvements which in turn create an attractive environment for funding. The method has been applied successfully in Sierra Leone, Ghana, Nigeria, Zambia, Kenya, and South Sudan. The success of 2ML in driving the performance of utilities illustrates the scope to reduce the barriers to access simply by making existing services more efficient.

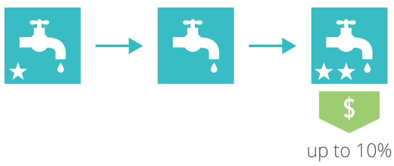
ONEA (Burkina Faso): Franchising beyond the network

ONEA is the water utility for Ougadougou. The city is surrounded by informal settlements which are beyond the service area of the utility. It franchises water services to private operators in these settlements. These operators buy water in bulk from the utility at a discounted rate, and sell the water on to their customers through their own piped networks. It has proved a highly successful means of extending services to areas of the city which might otherwise need to wait for years for a utility service without overstretching ONEA's balance sheet.

Balibago Water Works: Franchised micro utilities

Regulation in the Philippines allows private operators to propose providing piped water services to a community on the basis of government-agreed tariffs. If the community agrees with the proposition, the network can go ahead. This has enabled Balibago Water Works to build micro utilities in 51 communities across the Philippines, serving a total of 150,000 households. Without this regulatory framework and entrepreneurial approach it is unlikely that these households would have a piped water service.

Veolia: Peer Performance Solutions



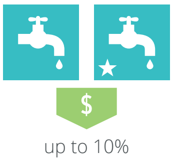
Veolia has developed a payment by result contracting model where it assesses areas in which a utility could improve performance either to increase revenues or to reduce costs. It has proved a significant success in New York City where the Department of Environmental Protection secured savings of more than $100 million. It is adapting the model in the light of its experience in contracts in Nagpur and Northern Karnataka to develop new approaches to helping utilities reverse decline and attract new capital.

Suez: WIKTI knowledge transfer

Suez has pioneered a new kind of partnership with public water agencies focused on capacity building in struggling utilities. The Water International Knowledge Transfer Initiative involves a continuous process of identifying areas where know-how is required, deploying systems for localizing this know-how, measuring performance and focusing on areas where further attention is required. It has been used with significant success to drive performance at Algerienne Des Eaux.

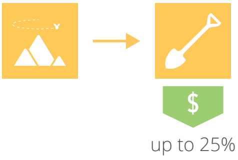
Technological innovation

Besides using new business models to reduce the barriers to access, technology can also play an important role in cutting the cost of solutions, particularly on the wastewater side. Here are a range of technologies which may be appropriate:



Nairobi City Water and Sewerage Company: mobile payment systems

These are now common in Africa. They eliminate the need for paper bills and payment kiosks which are a large reason for the low collection rates that many utilities in low income countries face. Payments reach utilities more quickly and there is less theft by staff along the way. City Water customers can take photographs of their meter readings and text these to the utility which saves the trouble of meter reading. Mobile payment platforms improve communications between utilities and their customers which is an important part of customer engagement and winning support for investment decisions.



The Gates Foundation: Omni Processor

Waste to energy technology potentially changes the economics of faecal sludge management. It means that instead of sludge collection representing a cost with no potential revenues, there is an additional financial incentive to collect sludge and to process it. The Omni Processor dries and incinerates sludge to drive a steam engine that generates electricity for sale to the grid. The Gates Foundation, which developed the technology with Janiki Engineering believes that one machine (which costs less than $1 million) can generate $500,000 of revenue from electricity sales in a year.

Janiki Bioenergy

A year's worth of sludge = $500,000: the Gates Foundation developed the Omni Processor to incentivise good faecal sludge management.

South East Water: One Box pressurized sewer and rainwater collection

up to 15%

Laying sewers in the big cities is an immensely disruptive and expensive process, not least because the trenches are so large. Typically sewers have to be sized so that they can cope with high peak flows which may be ten times the size of normal flows. An interesting alternative has been developed by South East Water in Melbourne, Australia. The system relies on underground tanks connected to a pressurized sewer network with small diameter pipes and a smart control box that controls the pumps that evacuate the tanks as required. SE Water has delivered a sewerage project that would have cost A$507 million for A$255 million, with the savings coming from the fact that the network could be laid by small bore directional drilling rather than trench and fill. Also, the One Box control system makes it possible to manage flows in the system, enabling the utility to reduce the redundancy in both the network and in the treatment facilities. SE Water has also adapted the One Box system for rainwater tanks enabling households to store water for domestic use, and should rainstorms be forecast, it is possible to evacuate the tanks to free up storage capacity for flood control. Although the One Box system is probably too expensive to be implemented on a single household basis in low income cities, it could be adapted for multi-household use, with wastewater collecting in neighbourhood storage tanks before being evacuated by the One Box control system. SE Water is working with an NGO to develop this concept. In low income countries this might reduce the cost of introducing sewerage by 10–15%.

Veolia Actiflo: Pre-engineered high-rate wastewater treatment systems

up to 15%

Packaged wastewater treatment plants which can handle relatively large volumes of wastewater in a short space of time and on a small footprint of ground have been a key area of innovation for the wastewater treatment industry in recent years. Veolia's Actiflow system is one of the most effective technologies in this area. They are an appropriate solution when investigating how to retrofit dense cities with wastewater treatment systems. This could cut the cost of introducing sewerage to build-up areas by 10–15%.

Various potential suppliers: decentralised wastewater treatment and reuse

up to 25%

The most economic solution to wastewater treatment will ultimately be decentralized wastewater reuse, as long as there is a use for the recycled wastewater close to where it is created. Decentralised reuse would remove the need for sewers, and reclaimed water distribution networks which represent 75% of the cost of a water reuse system. The technologies are there: membrane bio-reactors, ultraviolet disinfection, anaerobic sludge digestion. The opportunities are limited by the number of opportunities for indirect potable reuse in a decentralized urban context and the difficulties associated with encouraging direct potable reuse in low income communities.

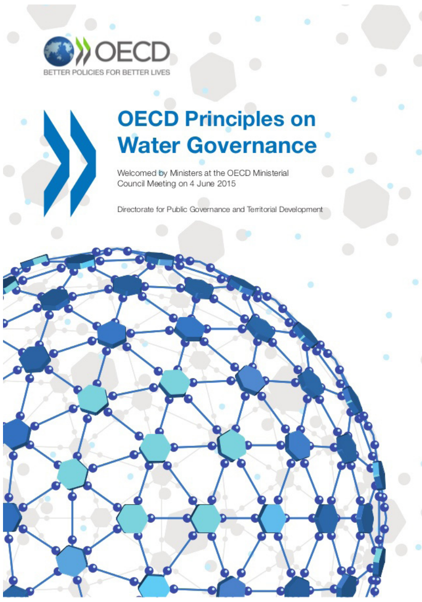
Making it happen

Our data shows that it is possible to reach the Sustainable Development Goals for access to water and sanitation without a significant increase in spending. Instead we need to capture the value that is currently wasted on inconvenience, health costs and private domestic water services to secure an economic benefit from improved water and sanitation. We can accelerate this by innovating with the business model and innovating with the technology to reduce the financial barriers to better water service. This involves re-invigorating public sector utilities as well as empowering private sector NGOs and entrepreneurs to play a role in improving outcomes for those beyond the reach of utility services.

Making this happen requires a pro-active approach to water governance.

Governance

Governance is the key to making things happen in the water sector. A lot of important work has been done on defining good governance. Notably the OECDs Principles on Water Governance should be viewed as the ultimate statement on how governments should approach structuring governance at a national level. Although it is not possible to fault the Principles, it is unlikely that they would be implemented in a country where the political leadership was not already making progress towards improving the management of the water sector. What we recommend therefore is to find a way of implementing the principles on a project level to ensure that there is action on the ground in the short term which can also be used to catalyse change at the national level



Components of success

Successful water projects require the following components:

1. Local leadership: generally accelerated improvement in water access is driven by local leadership, either at the ministerial level or at the utility level. It requires the key people to stay in position for a long time to build the virtuous cycle of utility improvement. Often this process begins when a political or utility leader has responded to a crisis by pushing for change, using that catalytic moment to build momentum. Development partners can play a supportive role in all phases of reform–starting, building, and sustaining. However, they cannot expect to create from the outside the conditions in which better service to the poor becomes a political economy priority, nor to succeed by transplanting 'best practice models' regardless of context.

2. A sustainable business model: One of the main reasons for under-investment in the water sector is the fact that most water services operate on the basis of a negative return on capital in order to deliver affordability. In the end this approach to affordability has been self-defeating because without investment, lower cost community services are difficult to develop, and instead lower income households become dependent on higher costs water sources such as packaged water and tankers, or are sacrificing income or their health in order to access free but unsafe or inconvenient sources. If affordability is a key objective, the first priority must be to facilitate the extension of lower cost and higher quality services. The second priority can then be to arrange the deployment of what subsidised finance may be available to maximise its impact. We believe that most communities will support cost recovery in water services if they are given the choice and can identify the benefits beforehand.

3. Stakeholder commitment: Being a stakeholder is more than just being a beneficiary of a service. It is about having a commitment to its success: something to lose if it does not work out, and something to gain if expectations are exceeded. This is part of the rationale for pricing water services. It is also an opportunity to reach out to the broader community for support. For example many businesses - such as those selling washing and laundry products - will benefit from better water services. They too should be prepared to contribute to the success of water projects.

4. Payment by results: The other side of requiring the financial commitment of stakeholders is ensuring that the service providers play their part. Specifically projects should be structured so that service providers are incentivised to meet the expectations of the stakeholders.

A project governance model

Our proposal is to create a project board which comprises of all of the stakeholders which have an interest in improved access to

The OECD 12 Principles of water governance

1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.
2. Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.
3. Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.
4. Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.
5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.
6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.
7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.
8. Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders.
9. Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making.
10. Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation.
11. Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations.
12. Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.

water and sanitation. This includes representatives of:

- The community
- Central government
- Local government
- Businesses
- Utilities
- NGOs
- Other solution providers

The project board would begin by identifying the potential benefits from improved water and sanitation. The solution providers would then map out the viable pathways towards achieving those benefits and the financial commitments from the stake holders required in order to deliver them. If this can be agreed the solution providers will offer a schedule and a performance based contract for delivery. The project progresses with the solution providers, reporting milestone achievements back to the board until the objectives are achieved.

A utility governance model

The project governance model brings together all potential solutions providers including utilities, NGOs and water related businesses. It aims to ensure coordinated solutions across the whole water and sanitation space rather than concentrate exclusively on action by utilities to deliver services. Utilities nonetheless are the most important solution providers in the water and sanitation space. Specifically improving utility performance is an important part of rolling out water and sanitation services, both in terms of attracting finance to the sector, and in terms of reducing the overall cost of service delivery. There are various approaches to capacity building within utilities which are available, but ultimately in order to drive performance, it is necessary to have the right governance. There are three principals of utility governance which we believe are most associated with high performance:

Autonomy: utilities which are under direct political control are often run for political purposes rather than for the benefit of customers. Politicians often micro-manage decisions in which they have no expertise, and use utilities as an

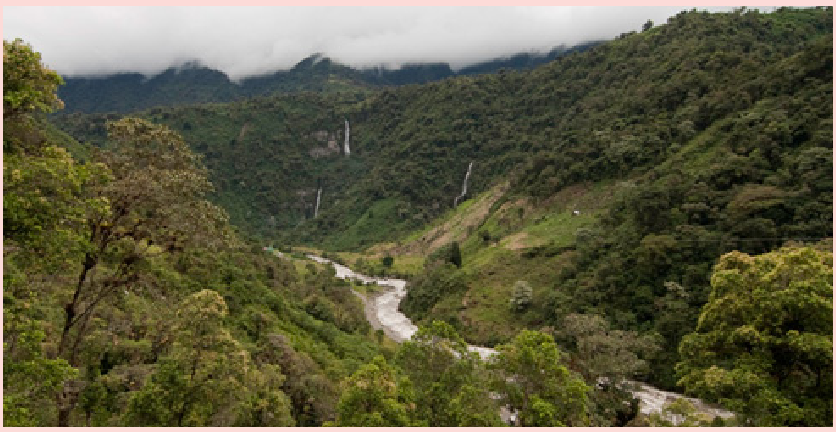
The 2030 Water Resources Group

In 2010 the World Economic Forum together with the International Finance Corporation launched the 2030 Water Resources Group. This was the result of the Global Agenda Council on Water work on analysing the lowest cost approaches to meeting the world's water needs by 2030. It is a unique public - private -civil society collaboration which aims to create a dialogue to drive water sector reform in water stressed regions. The WRG now manages multi-stakeholder platforms for water in 10 countries across Latin America, Asian and Africa. It could be used as the basis for rolling out the propsed proposed project governance model.

2030 Water Resources Group

The Nature Conservancy model

Although the concept of bringing all the stake holders together, getting them to talk about the benefits they will get from better water services, and then asking for financial commitments to help achieve those benefits is a new approach to water access, it has been used successfully to drive action and investment elsewhere in the water sector. The model was originally developed by The Nature Conservancy for its Water Fund programme, and has been successfully implemented in the Northern Andes, Brazil and the United States.



TNC/Erika Nortemann

extension of their political power. Furthermore when utilities are unincorporated departments of government bodies without their own balance sheets they struggle to compete for funding with other departments or to raise funds from third party agencies. The ideal arrangement for a utility is as an independent corporate body with its own balance sheet, run by a chief executive appointed by the board of directors who in turn represent the interests of the stakeholders.

Accountability: the relationship between utilities and politicians should be one of accountability. The politicians should set the targets and agree the resources (both in terms of tariffs and access to finance) available to the utility management, and then hold the management responsible for delivering on those targets. This is the flip side of utility autonomy.

Incentivisation: One of the main reasons why utilities underperform is because the management and staff is not incentivised to deliver results. Unlike competitive private businesses, which have the profit motive to drive performance, there is very little to ensure that utilities deliver continuous improvement. The combination of political appointments, social employment, risk aversion, access to poorly accounted for cashflows, and the ability to make decisions on the award of large capital projects ensures that the performance of many utilities is very weak indeed. There needs to be a system of incentivisation of staff to ensure that performance is delivered across the organisation.

One way of dove-tailing these principles to the project governance model outlined above is through a system of cascading performance contracts. This has been used most effectively in Uganda with the National Water Company, where the government contracts with the board of the utility to deliver a level of service in exchange for the necessary support in delivering those objectives. If the objectives are met, then the board gets incentive payments: otherwise there is some penalty. The senior management team then has a similar agreement with the area management teams, who in turn have contracts with the branch management teams and so on.

The timetable for reforming utility governance may have to be different from the timetable for delivering real change outside the utility area, but it should be possible to implement this contracting based model more quickly than sector-wide governance reforms, and more importantly success at the project level will increase the momentum for change at the government level.

Conclusion

This paper has provided an analysis of the challenge of meeting the access aspects of SDGs for water and sanitation. It began by looking at the SDGs themselves, pointing out that achieving them will require a system of continuous improvement coordinated over many years. It is not so much improved water and sanitation services that is required so much as a machine which delivers improved services. The rest of the paper has aimed to outline the design of this machine, starting with an economic analysis, then an overview of the innovations which might be part of it and concluding with the project governance model that will make it happen.

The economic analysis makes two points. The first is that better water and sanitation is affordable when you consider the broader health costs, time costs and coping costs that inadequate access forces upon the poor. The second point is that under-funding the utility sector through tariffs that fail to cover costs, and through tax-payer subsidies that fail to make up the difference, is largely counter-productive. Failed utilities cost far more than successful ones.

Our economic analysis suggests that there is an under-exploited willingness to pay for water and sanitation services of which we should take advantage..

In terms of innovation, there are four main areas which we have identified which can help. The first area focuses on the business models that can help drive the performance of utilities, so that instead of being trapped in a cycle of decline they develop their cashflows, attract new finance and improve services and reach new customers. The second area is business models that help spread the lump sum payments required to fund water and sanitation connections and facilities. This reflects the fact that access is often affordable in theory but not in practice because the lump sums required are larger than a low income household can easily amass. The third area of innovation which we believe to be important is decentralised business models that work along side utilities to deliver improved services at lower costs without the need for significant capital expenditure. This is an acknowledgement of the fact that in water, the best (i.e. a piped water network) is sometimes the enemy of the good (i.e. improved water access). The challenge of funding large scale infrastructure often means that low income communities go with out any improvement in services for many years. The fourth area of innovation we have identified as important is technological innovations such as waste to energy and mobile phone payment systems that can lower the overall cost of service.

We have not proposed any innovation as the solution to the challenge because it is essential that whatever is implemented is appropriate for the location.

The final section covers project governance: it proposes bringing together all the stakeholders - including businesses - which might benefit from improved water access and matching those benefits with a commitment to contribute to the delivery of an access project. Although outside finance will still be required, funding agencies will be far more likely to invest if they can see that the beneficiaries are financially committed as well. Our economic analysis suggests that there is an under-exploited willingness to pay for water and sanitation services of which we should take advantage.

Once the dimensions of the project are defined and costed, a performance contract with the relevant service providers should be agreed, with payments staged as milestone achievements are met.

Next steps

Members of the Global Agenda Council on Water will be taking the model forward under the aegis of the Global Water Leaders Group. The next step is to set up pilot projects to validate the model, before a larger scale roll out.

Appendices

1: Sources of Data

- "The Costs of Meeting the 2030 SDG targets on Drinking Water, Sanitation, and Hygiene", World Bank, 2016 [http://data.worldbank.org/data-catalog/global-water-costing-study]. Dataset analysing the global costs of meeting the 2030 Sustainable Development Goals for water, sanitation and hygiene. This data was used to estimate the direct costs of basic water supply and sanitation interventions.

- "Estimates on the use of water sources and sanitation facilities", Joint Monitoring Programme for Water Supply and Sanitation, 2015 [https://www.wssinfo.org/documents/?tx_displaycontroller[type]=country_files]. Dataset describing the population served by water supply and sanitation by mode of access, compiled by the JMP from country-level data sources. This data was used to estimate the proportion of the urban and rural population in each country that has access to different levels of water supply and sanitation services.

- Demographic and Health Surveys, USAID, 2016 [http://www.statcompiler.com/en/]. Dataset compiling indicators from demographic and health surveys in more than eighty countries. The data describing the incidence of diarrhoeal diseases in children under 5 was used to estimate the total burden of disease caused by poor water supply and sanitation practices, and therefore the healthcare, welfare and value of life costs for WASH interventions. We have also made use of data describing the prevalence of handwashing practices, the proportion of households using boiling, filtration or chlorination to treat drinking water, and the length of time taken to reach a source of drinking water.

- "Knowing the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level", Prüss et al., Environmental Health Perspectives (Vol. 110, Issue. 5) 2002. Paper describing the reduction in risk of diarrhoeal disease for improvements in water supply and sanitation practices. The information in this paper was used to estimate the relative burden of diarrhoeal disease for different water supply and sanitation interventions, and therefore the healthcare, welfare, and value of life costs associated with these interventions.

- World Development Indicators, World Bank, 2016 [http://data.worldbank.org/products/wdi]. We have used GDP per capita data to estimate the time costs associated with water supply and sanitation interventions, as well as the health, welfare and value of life costs of diarrhoeal disease.

- ILOSTAT, International Labour Organisation, 2016. [www.ilo.org/ilostat/faces/home/statisticaldata]. We used data describing the mean weekly hours worked, combined with GDP per capita data, to estimate the associated with the time burden of different water supply and sanitation interventions.

- CHOosing Interventions that are Cost Effective (WHO-CHOICE), World Health Organization, 2011 [http://www.who.int/choice/country/country_specific/en/]. This dataset describes the typical costs associated with inpatient and outpatient hospital visits in different countries. We have used this data to estimate the health costs of diarrhoeal disease caused by poor water supply and sanitation practices.

- International Benchmarking Network for Water and Sanitation Utilities (IBNET), World Bank [http://www.ib-net.org/]. This database is the largest source of information covering performance indicators for water supply and wastewater utilities. We have used the information on continuity of supply to estimate the percentage of the population served by poor, standard and high performance water supply networks in different regions.

- Commercial market research reports from Global Water Intelligence (utility spending), Baytel (point of use systems), Zenith Global (Bottled Water), Beverage Marketing Corporation (Bottled Water), Technavio (point of use and bottled water), TechSci Research (point of use).

2: Rural access: population distribution and costs

Water source	FSM	Source type	Toilet	Population	Health cost	Time cost	Direct cost	Total cost
Rural unimproved	Open defecation	Far	Open	133,476,082	$40.88	$146.93	$-	$187.81
Rural unimproved	Bad	Far	Shared	44,942,021	$35.53	$76.97	$23.96	$136.45
Rural unimproved	Bad	Far	Private	95,160,736	$35.53	$41.98	$31.44	$108.95
Rural unimproved	Good	Far	Shared	4,370,966	$35.53	$76.97	$42.93	$155.43
Rural unimproved	Good	Far	Private	17,483,864	$35.53	$41.98	$50.41	$127.92
Rural unimproved	Open defecation	Near	Open	82,742,963	$40.88	$125.94	$-	$166.82
Rural unimproved	Bad	Near	Shared	27,859,943	$35.53	$55.98	$23.96	$115.46
Rural unimproved	Bad	Near	Private	58,990,953	$35.53	$20.99	$31.44	$87.95
Rural unimproved	Good	Near	Shared	2,709,599	$35.53	$55.98	$42.93	$134.43
Rural unimproved	Good	Near	Private	10,838,397	$35.53	$20.99	$50.41	$106.93
Rural improved	Open defecation	Far	Open	192,680,257	$14.23	$146.93	$11.75	$172.92
Rural improved	Bad	Far	Shared	79,720,931	$8.88	$76.97	$35.71	$121.56
Rural improved	Bad	Far	Private	168,801,986	$8.88	$41.98	$43.19	$94.05
Rural improved	Good	Far	Shared	3,208,340	$-	$76.97	$54.68	$131.65
Rural improved	Good	Far	Private	12,833,362	$-	$41.98	$62.16	$104.14
Rural improved	Open defecation	Near	Open	317,596,690	$14.23	$125.94	$11.75	$151.93
Rural improved	Bad	Near	Shared	131,404,765	$8.88	$55.98	$35.71	$100.57
Rural improved	Bad	Near	Private	278,237,910	$2.21	$20.99	$43.19	$66.39
Rural improved	Good	Near	Shared	5,288,338	$-	$55.98	$54.68	$110.66
Rural improved	Good	Near	Private	21,153,351	$-	$20.99	$62.16	$83.15
Rural low performance	Open defecation	Piped	Open	51,892,571	$40.88	$104.95	$27.91	$173.75
Rural low performance	Bad	Piped	Shared	18,200,491	$35.53	$34.98	$51.87	$122.38
Rural low performance	Bad	Piped	Private	38,537,922	$35.53	$-	$59.35	$94.88
Rural low performance	Good	Piped	Shared	4,248,339	$17.76	$34.98	$70.85	$123.60
Rural low performance	Good	Piped	Private	16,993,357	$17.76	$-	$78.33	$96.09
Rural low performance	Sewer	Piped	Shared	6,080,510	$17.76	$34.98	$65.39	$118.14
Rural low performance	Sewer	Piped	Private	34,456,223	$17.76	$-	$72.87	$90.63
Rural low performance	Sewer & Treatment	Piped	Shared	3,276,065	$8.88	$34.98	$81.00	$124.87
Rural low performance	Sewer & Treatment	Piped	Private	62,245,240	$8.88	$-	$88.48	$97.36
Rural standard performance	Open defecation	Piped	Open	86,487,618	$23.12	$104.95	$36.99	$165.06
Rural standard performance	Bad	Piped	Shared	61,881,670	$17.76	$34.98	$60.95	$113.70
Rural standard performance	Bad	Piped	Private	131,028,935	$17.76	$-	$68.43	$86.19
Rural standard performance	Good	Piped	Shared	49,563,957	$8.88	$34.98	$79.92	$123.79
Rural standard performance	Good	Piped	Private	198,255,826	$8.88	$-	$87.40	$96.28
Rural standard performance	Sewer	Piped	Shared	17,083,338	$8.88	$34.98	$74.47	$118.33
Rural standard performance	Sewer	Piped	Private	96,805,580	$8.88	$-	$81.94	$90.83
Rural standard performance	Sewer & Treatment	Piped	Shared	18,465,095	$-	$34.98	$90.08	$125.06
Rural standard performance	Sewer & Treatment	Piped	Private	350,836,808	$-	$-	$97.56	$97.56
Rural high performance	Open defecation	Piped	Open	-	-		-	
Rural high performance	Bad	Piped	Shared	-	-		-	
Rural high performance	Bad	Piped	Private	-	-		-	
Rural high performance	Good	Piped	Shared	1,416,113	$-	$34.98	$88.29	$123.27
Rural high performance	Good	Piped	Private	5,664,452	$-	$-	$95.76	$95.76
Rural high performance	Sewer	Piped	Shared	5,790,962	$-	$34.98	$82.83	$117.81
Rural high performance	Sewer	Piped	Private	32,815,451	$-	$-	$90.30	$90.30
Rural high performance	Sewer & Treatment	Piped	Shared	8,041,251	$-	$34.98	$98.44	$133.42
Rural high performance	Sewer & Treatment	Piped	Private	152,783,771	$-	$-	$105.92	$105.92

3: Urban access: population distribution and costs

Water source	FSM	Source type	Toilet	Population	Health cost	Time cost	Direct cost	Total cost
Urban unimproved	Open defecation	Far	Open	6,242,369	$40.88	$146.93	$-	$187.81
Urban unimproved	Bad	Far	Shared	27,416,406	$35.53	$76.97	$23.96	$136.45
Urban unimproved	Bad	Far	Private	58,051,804	$35.53	$41.98	$31.44	$108.95
Urban unimproved	Good	Far	Shared	6,720,579	$35.53	$76.97	$42.93	$155.43
Urban unimproved	Good	Far	Private	26,882,317	$35.53	$41.98	$50.41	$127.92
Urban unimproved	Open defecation	Near	Open	5,504,055	$40.88	$125.94	$-	$166.82
Urban unimproved	Bad	Near	Shared	24,173,741	$35.53	$55.98	$23.96	$115.46
Urban unimproved	Bad	Near	Private	51,185,748	$35.53	$20.99	$31.44	$87.95
Urban unimproved	Good	Near	Shared	5,925,705	$35.53	$55.98	$42.93	$134.43
Urban unimproved	Good	Near	Private	23,702,821	$35.53	$20.99	$50.41	$106.93
Urban improved	Open defecation	Far	Open	12,716,088	$23.12	$146.93	$11.75	$181.80
Urban improved	Bad	Far	Shared	40,793,978	$17.76	$76.97	$35.71	$130.44
Urban improved	Bad	Far	Private	86,377,623	$17.76	$41.98	$43.19	$102.93
Urban improved	Good	Far	Shared	5,238,002	$8.88	$76.97	$54.68	$140.53
Urban improved	Good	Far	Private	20,952,006	$8.88	$41.98	$62.16	$113.03
Urban improved	Open defecation	Near	Open	54,825,852	$23.12	$125.94	$11.75	$160.81
Urban improved	Bad	Near	Shared	175,884,642	$17.76	$55.98	$35.71	$109.45
Urban improved	Bad	Near	Private	372,420,095	$17.76	$20.99	$43.19	$81.94
Urban improved	Good	Near	Shared	22,583,824	$8.88	$55.98	$54.68	$119.54
Urban improved	Good	Near	Private	90,335,296	$8.88	$20.99	$62.16	$92.04
Urban low performance	Open defecation	Piped	Open	5,873,212	$40.88	$104.95	$27.91	$173.75
Urban low performance	Bad	Piped	Shared	17,196,716	$35.53	$34.98	$51.87	$122.38
Urban low performance	Bad	Piped	Private	36,412,517	$35.53	$-	$59.35	$94.88
Urban low performance	Good	Piped	Shared	7,587,771	$17.76	$34.98	$70.85	$123.60
Urban low performance	Good	Piped	Private	30,351,082	$17.76	$-	$78.33	$96.09
Urban low performance	Sewer	Piped	Shared	10,546,396	$17.76	$34.98	$65.39	$118.14
Urban low performance	Sewer	Piped	Private	59,762,910	$17.76	$-	$72.87	$90.63
Urban low performance	Sewer & Treatment	Piped	Shared	7,327,904	$8.88	$34.98	$81.00	$124.87
Urban low performance	Sewer & Treatment	Piped	Private	139,230,180	$8.88	$-	$88.48	$97.36
Urban standard performance	Open defecation	Piped	Open	12,725,293	$23.12	$104.95	$36.99	$165.06
Urban standard performance	Bad	Piped	Shared	58,468,834	$17.76	$34.98	$60.95	$113.70
Urban standard performance	Bad	Piped	Private	123,802,559	$17.76	$-	$68.43	$86.19
Urban standard performance	Good	Piped	Shared	75,877,706	$8.88	$34.98	$79.92	$123.79
Urban standard performance	Good	Piped	Private	303,510,824	$8.88	$-	$87.40	$96.28
Urban standard performance	Sewer	Piped	Shared	32,141,397	$8.88	$34.98	$74.47	$118.33
Urban standard performance	Sewer	Piped	Private	182,134,584	$8.88	$-	$81.94	$90.83
Urban standard performance	Sewer & Treatment	Piped	Shared	27,937,635	$-	$34.98	$90.08	$125.06
Urban standard performance	Sewer & Treatment	Piped	Private	530,815,063	$-	$-	$97.56	$97.56
Urban high performance	Open defecation	Piped	Open	-	-		-	
Urban high performance	Bad	Piped	Shared	-	-		-	
Urban high performance	Bad	Piped	Private	-	-		-	
Urban high performance	Good	Piped	Shared	2,529,257	$-	$34.98	$88.29	$123.27
Urban high performance	Good	Piped	Private	10,117,027	$-	$-	$95.76	$95.76
Urban high performance	Sewer	Piped	Shared	7,533,140	$-	$34.98	$82.83	$117.81
Urban high performance	Sewer	Piped	Private	42,687,793	$-	$-	$90.30	$90.30
Urban high performance	Sewer & Treatment	Piped	Shared	10,533,862	$-	$34.98	$98.44	$133.42
Urban high performance	Sewer & Treatment	Piped	Private	200,143,384	$-	$-	$105.92	$105.92

4: Financial estimates: total spend

Mode of access	Direct costs	Health costs	Time costs	Total costs
Open defecation		$13bn	$53bn	$66bn
Shared toilet	$2bn		$18bn	$21bn
Private toilet	$51bn			$51bn
No hand-washing		$27bn		$27bn
Hand-washing	$17bn			$17bn
Inadequate FSM	$45bn	$17bn		$61bn
Good FSM	$39bn	$4bn		$42bn
Sewer connection (only)	$69bn	$1bn		$70bn
Wastewater treatment	$24bn			$24bn
Distant, unimproved		$3bn	$8bn	$11bn
Nearby, unimproved		$2bn	$10bn	$12bn
Distant improved	$6bn		$13bn	$19bn
Nearby improved	$19bn		$26bn	$45bn
Bad network	$15bn	$2bn	$3bn	$20bn
Standard network	$87bn	$2bn		$89bn
24/7 piped potable	$22bn			$22bn
Bottled water + water sachets	$58bn			$58bn
Point of use (High end + Low end)	$52bn			$52bn
Household Storage	$4bn			$4bn
Tankers	$7bn			$7bn
	$516bn	$71bn	$132bn	$718bn

6: Financial estimates: costs to individuals

Mode of access	Direct costs	Health costs	Time costs	Total costs
Open defecation	$-	$18	$55	$73
Shared toilet	$4		$28	$32
Private toilet	$11			$11
No hand-washing	$-	$11		$11
Hand-washing	$4			$4
Inadequate FSM	$20	$14		$35
Good FSM	$39	$8		$47
Sewer connection (only)	$34	$7		$40
Wastewater treatment	$16			$16
Distant, unimproved	$-	$36	$36	$71
Nearby, unimproved	$-	$36	$21	$56
Distant improved	$12		$27	$38
Nearby improved	$12		$17	$28
Bad network	$28	$17	$5	$50
Standard network	$37	$3		$40
24/7 piped potable	$45			$45
Bottled water + water sachets	$51			$51
Point of use (High end + Low end)	$26			$26
Household Storage	$18			$18
Tankers	$87			$87

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WATER LEADERS