Policy Brief on Carbon sensitive urban water futures

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TRANSITIONS TO THE URBAN
WATER SERVICES OF TOMORROW

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Final Version for Distribution

January 2013

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 265122.

Context

Addressing the supply of quality water to a growing population in a world that is changing at breakneck speed is one of the biggest challenges facing society in the 21st century. Attempting at the same time to reduce the amount of embedded carbon and energy used in the delivery systems provides an added test. Most forms of energy generation use water and both water supply and wastewater treatment require energy, particularly electricity. The water industry emits greenhouse gases indirectly, through energy use, and directly, by releasing methane and nitrous oxide during treatment, so contributing to climate change. One effect of climate change in many parts of the world is likely to be a change in rainfall patterns, which may further restrict the supply of groundwater and surface water in areas where it is already limited and even reduce availability in comparatively water-rich countries, such as the UK. At the same time, many countries have increasing populations and demands for water. This could create positive feedback by driving the use of other sources, such as desalination of sea water, which may have higher energy demands and greenhouse gas emissions. Our findings illustrate that the water supply and wastewater industries throughout Europe are significant consumers of energy and emitters of greenhouse gases but have ambitions to make emissions reductions of 20% by 2020 and 80% by 2050.

Reducing energy use in urban water services

Demand reduction, through the reduction of waste and increasing water efficiency at the point of use should be part of the solution to both problems. Savings of up to 10% should be achievable by 2020 and at least 20% by 2050. These will have a proportional effect on energy and emissions for the water supply, but a much smaller effect on wastewater treatment, where they will only reduce the relatively small pumping requirement. Construction and decommissioning were fairly small components of the total carbon footprint (5–15%) due to the long lifetime of capital assets.

Progressive improvements in the efficiency of conveyance and distribution should be able to reduce these components, which are about 40% of the total energy requirement for supply, by 30–50%. Long distance conveyance and distribution is energy intensive: the emissions can exceed those from treatment of lower quality water. It should be avoided in favour of local sources wherever possible. Improvements to motor and pumping efficiency within water treatment works could reduce this use of energy by 10–45%. Other operational efficiency improvements have been shown to reduce the total energy consumption by up to 40% in some cases. Replacement of GHG-intensive treatment processes, such as GAC filtration, has also saved up to 40% of emissions. These savings may not necessarily all be combined, but short to medium term reductions of 20% and longer term reductions of 40% or more appear feasible.

The developments found for the water supply sector probably fall short of the 80% emission reduction target for 2050. This is especially true if source restrictions force the use of lower-quality supplies, such as recycled, brackish or desalinated water. The energy cost of treating these is falling, but is still generally higher than freshwater. A possible solution is to supply water for landscape irrigation, agriculture, toilet flushing in office buildings, cooling towers and industrial processes from such sources, treated to a lower standard, to ensure that freshwater is available to be treated to potable standards. This would reduce the pressure on freshwater and reduce the emissions intensity of treating low quality sources.

In wastewater treatment, improvements to the efficiency of pumps and other motors could provide efficiency gains of 10–40% in this aspect, although it is a smaller proportion of the total than it is in water supply. Other general operational improvements may be capable of saving up to 25% of total plant energy. Aerobic treatments, especially the activated sludge process, are major consumers of energy and the focus for more substantial reductions. Better process control and other efficiency measures, some of which might be combined, have been shown to reduce consumption by 10–50%. These should enable reductions of 20% of total emissions in the short to medium term.

In the longer term (2030–2050), more substantial reductions in energy consumption and GHG emissions are likely to require the replacement of the main aerobic treatment processes by anaerobic treatments. These are more energy-efficient and can also produce usable biogas. Biogas from anaerobic digestion of sewage sludge is an important source of renewable energy and should be maximized by ensuring that it is captured and used for combined heat and power generation. It has already been demonstrated in practice that it is possible to make wastewater treatment plants energy neutral by this method. A move to anaerobic primary treatment should reduce the plant energy requirements and increase biogas production, making them into net energy exporters. This will help to offset the remaining energy use by the supply sector. Dewatered or dried sludge can also be used as a fuel. Sending sludge to landfill should be avoided, because it has high direct GHG emissions and provides no benefits. Agricultural use is preferable, because it can displace some chemical fertilisers, but still results in high emissions. The preferred option should be used as fuel by co-firing or incineration with heat recovery, so that the energy is utilised.

Adaptation option maturity

Many of the technologies and interventions discussed in the preceding sections are already being deployed across the European water sector. Others remain simply near-market potentials and yet others are at the pilot or trial stages of development. Table 1 provides a comparative assessment of the relative maturity of major energy and GHG emission reduction strategies.

Of equal importance to innovative technologies and techniques however is the knowledge and professional culture required to drive innovation and delivery of low carbon and energy solutions. Our work suggests that this, perhaps above all other factors, is the area in need of catalysis if our communities are to realize a lower carbon future.

For a copy of the full report on carbon sensitive urban water futures please visit http://www.trust-i.net/

Table 1: Adaptation option maturity

ADAPTATION OPTION	MATURITY	COMMENTS
Increased use of hydropower (inc. micro-turbines)	High	Geographical limitations on application
Demand Management	Med - High	Techniques further developed in some states than in others
Operations optimisation	High	
Asset replacement	Medium	Dependent on asset replacement cycles - medium term gain only
More efficient pumping (e.g. variable speed drives)	High	
Replacement of GAC processes	High	
Sustainable energy driven desalination	Low	
Reduced aeration in WW treatment	Med-High	Variable potential for savings
Use of low temperature anaerobic processes (inc. biogas capture and use)	Medium	
Incineration of sludge	Medium	Overall energy and GHG value debatable

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