COUNCIL FOR SCIENCE AND TECHNOLOGY

Improving innovation in the water industry: 21st century challenges and opportunities

A report by the Council for Science & Technology

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Contents

Executive Summary and Recommendations

Water is an essential national resource to be valued accordingly

Supply availability at increasingly high quality standards generates a financial cost and a significant carbon footprint which is not widely recognised

The water industry's performance in terms of investment in technology and application of innovative solutions is highly variable between companies in both clean water delivery and in waste water and sewage treatment. There is an urgent need for a step-change

Investment in research and development is low for the sector generally

The regulatory regime militates against research and development and provides insufficient rewards for innovative solutions

Insufficient attention is being given to long-term technology planning within the water sector in responding to its environmental impact in particular climate change, its energy use and carbon footprint

There are skills issues which impact on the water companies and their supply chains

Water – by which we mean the provision of clean water and the treatment of waste water and sewage – is a fundamental requirement for human life. Yet as a society we take it for granted rather than viewing it as a critical resource which must be valued. Moreover, much of what we currently have is the product of engineering innovations from Victorian times. This is in itself an incredible legacy, but one which – until recent capital investment programmes, to varying degrees, by the water companies – had not been nurtured as well as it might, particularly over the last forty years or so.

We do recognise that the water companies, guided by their regulator Ofwat, have made some considerable progress over last 15 years, in particular given the neglected capital stock and operational inefficiencies they inherited. The industry has become more efficient and has met an increasingly stringent set of regulatory standards. Nevertheless we believe the industry needs to move even further forward if it is to be world-class and to supply the nation's water needs in the most efficient and environmentally benign manner.

The century-old infrastructure in many parts of the UK means that water and sewerage companies have traditionally focused more on managing their assets to maintain serviceability and reduce costs rather than on service improvement through technical innovation. The current regulatory framework tends to reinforce this position.

We recognise that the infrastructure is still not fully updated. Of particular concern to us is that water is traditionally a low technology industry. We think this needs to change, and the profile of R&D within the industry needs to rise to meet the challenges of the 21st century. Whilst innovation and R&D is occurring throughout the UK water industry, and along the supply chain, it is largely driven by the regulatory framework[1] and appears to be uneven – it is concentrated in the supply chain, in larger companies and more in wastewater

1 *Ofwat through efficiency measures and price controls; the Environment Agency and the Drinking Water Inspectorate through setting environmental and water quality standards respectively.*

treatment than water supply, and varies between the different water companies. This is most apparent on the water treatment side, where regulation has primarily focused on end-of-pipe quality standards.

In terms of encouraging innovation within the industry, we do not believe this is a sustainable position for the UK to be in.

Main drivers

There are three imperatives driving the water industry. The first is the ever-increasing demand for water and the increasingly stringent regulatory requirements which has led to energy use in the water industry doubling since 1990 (and could double again by 2030 if action is not taken soon).

The second imperative is the Government's vision to reduce the water consumption per person to an average of 130 litres per day.

And finally, investment in the water infrastructure involves complex and large-scale endeavours.

In each case, we believe that success will only be possible if the water sector incorporates innovative technological developments.

Different signals

We are concerned that whilst the EU and Governments are understandably setting stringent targets and standards for water quality, energy use, waste recycling and reducing carbon footprints these policies are not as joined-up as they need to be. We are particularly concerned that there seems to be little co-ordination between how more stringent targets on water quality (reducing priority hazardous substances, ammonia, phosphate etc) could impact on more stringent targets for reducing greenhouse gases and on energy efficiencies (and *vice-versa*).

A more holistic approach to target and standards setting by the authorities is therefore needed.

We believe that the introduction of leading-edge technology – particularly on the wastewater side – is central to achieving both improved water quality and sewerage clean-up with lower carbon footprints.

Step changes

We see an urgent need for step-changes in the application of technology to address both climate change effects and enable further improvements to the efficiency of operations within the water sector to be made. We do not believe that current levels of incremental technology improvement will be enough, particularly in terms of addressing the most pressing challenges.

The first stage is to have a clearer understanding of how the system is operating by incorporating modern measurement and control systems as a pre-requisite as the infrastructure is upgraded and replaced. Basic telemetry (flow and pressure measurements) in the water network is currently very dependent on the water company itself and in some cases is either limited or non-existent**.** Many telemetry networks are out of date and

unable to measure adequately key operational parameters. The scope for automated or computer-based controls that can optimise system performance is therefore severely limited. Unless it can be measured it cannot be controlled. We are very conscious that regulatory requirements to improve water quality will have consequential increased energy costs unless smart technology intervenes.

The regulatory regime

The regulatory regime also needs to be addressed. It has a structural bias against R&D solutions and provides insufficient rewards for innovative solutions. The focus has traditionally been on delivering the necessary investment to meet regulatory environmental standards and to deliver operational efficiencies. This has meant little stimulus for the industry itself to be less risk-averse in terms of adopting new technology. Changes are needed to the regulatory regime to incentivise investment in R&D and innovation[2].

More particularly, we do not believe the system has delivered a level of R&D investment commensurate with an industry that has a capital investment of around £3 billions *per annum*. Current R&D expenditure by the companies themselves has fallen from around £25 millions in the 1990s to around £18 millions per annum now[3], or just over one half of one percent of their capital investment. The bias, therefore, is towards capital expenditure solutions in the short-term. This outcome is not dissimilar to the electricity generating industry, where R&D expenditure fell markedly post-privatisation. We believe that Ofwat can learn from Ofgem's experiences.

There is a real contrast between the funding Government provides for R&D to energy companies operating in competitive markets through bodies such as the Carbon Trust, the Energy Savings Trust, the Energy Technologies Institute and schemes such as the trials on smart metering for gas and electricity, with the absence of comparable schemes for the water sector, where competition is more restricted. This needs to be rectified, particularly as Government has made clear it views the environmental sector as one in which the UK has a leading international opportunity.

We believe the regulatory regime needs to change in two main ways. First: to introduce mechanisms to value and reward innovation through new technology, including innovative low-carbon solutions, which would in themselves create a virtuous circle by helping to stimulate the wider supply chain to develop low-carbon solutions. The system as currently operated does not generally incentivise R&D investments beyond the five-year regulatory review period – although Ofwat does allow overlap projects spanning two price review periods – and so longer-term enabling innovations are being lost. Second: to introduce mechanisms to value and reward water and sewerage companies when they make the necessary longer-term R&D investments into innovative low-carbon solutions, which would in themselves help to create a virtuous circle by stimulating the wider supply chain to develop low carbon solutions.

2 *The Water Services Regulation Authority (Ofwat) has as its core role the control and economic regulation of the investment by the water companies so that the regulatory requirements are met – and we recognise that the regulatory process is broadly efficient and effective and has delivered higher standards at lower cost over time. At the same time, the Environment Agency and Drinking Water Inspectorate impose a set of quality standards which the water companies must meet. We are concerned that both these pressures risks squeezing out step-change innovations in favour of either the staus quo or incremental change.*

3 *The UK Water Industry Research (UKWIR) carries out around £4 millions of policy-related research per year.*

The companies themselves

At the same time, the water and sewerage companies themselves need to demonstrate their capacity for incorporating the latest technological solutions[4]. Whilst they do have research, development and innovation embedded in their businesses to various degrees, their focus is largely on addressing short-term targets and needs. In general, innovation within the water industry is fragmented, with sub-optimal sharing of information which risks the same problem being approached in different ways by different companies, with little or no cross-over.

The companies themselves have a key role in stimulating innovation. They need to connect better to the R&D base in universities or other research organisations to access leading-edge technologies. They also need to be able to plug into networks which enable technologies to be shared.

We have been impressed with the system in operation in the Netherlands which has an in-built culture in the water industry which places a high value on developing, incorporating and sharing the latest technology, underpinned by a strong research base, and our case-study highlights what this approach has delivered.

Therefore the water and sewerage companies should themselves take steps to increase their levels of collaboration and innovation

Strategic needs and incentives

Incentives are therefore needed to encourage water companies to access leading-edge technology from the research base and thereby increase their absorptive capacity for new R&D. Strategic technology planning by the companies themselves is a key first stage and there are a number of ways that this could be stimulated: for example through a specific requirement by Ofwat that water and sewerage companies should always be looking to adopt innovative solutions and apply new technology appropriately. We recognise Ofwat requires companies to publish 25-year Strategic Direction Statements.

Greater capacity and a more focused approach

We believe that the water sector needs to develop its capacity to address strategic medium-term challenges such as reducing its carbon footprint and developing more sustainable water treatment processes. More R&D is needed in these areas. At the same time, careful consideration needs to be given to a regulatory regime which is supportive of technology demonstrators to prove the technology, although we recognise these can be both expensive and high risk.

Of course, we would expect that water and sewerage companies would be adopting innovative solutions and adapting best technology practice to address persistently difficult short-term issues as core components of their licence to operate – for example reducing leakage and intelligent metering systems.

We believe there needs to be more of a focal point for R&D in the water and sewerage industry – either through Ofwat or a separate body such as the UKWIR. But care is needed to ensure that an over-centralised R&D approach is avoided. Whatever is put in place should

4 *A list of UK water companies and their ownership is at Annex D.*

not disincentivise companies themselves from commissioning and carrying out their own R&D. The key point is that it is the longer-term R&D which is insufficient.

How these higher investments in R&D will be funded is an important consideration which needs further thought. One option would be a levy, but other alternatives need to be considered. Ultimately R&D expenditure must be factored into water prices, but successful innovation will ultimately reduce costs and benefit both consumers and the environment.

Mechanisms to share technology

We believe the Technology Strategy Board, both in terms of its Innovation Platform approach, and the Knowledge Transfer Networks it has put in place, is key to helping water companies share their technology base. The EU R&D Framework programme and the EUREKA *Environ* programme also have important roles to play in stimulating collaborative R&D across the EU to provide innovative solutions, drawing on best practice from organisations in the Netherlands and elsewhere.

The skills base

The skills base in the water industry is a cause for concern. All the companies we visited reported difficulties in recruiting skilled people – both technicians and those at graduate levels. HR planning needs to be a core element of all water company strategies. Ofwat should encourage companies to invest in training and educating a new generation of water professionals.

Public dialogue

There is also a need for public dialogue between the government, water companies, the regulator and the public about the value of water, the work water companies undertake and challenges faced in the coming years for both companies, consumers and society generally.

We believe that Government and Ofwat should put in place mechanisms for public engagement and dialogue on key issues such as water as a scarce resource whose provision entails significant investments and costs; water supply and treatment has a significant carbon footprint; future challenges and the role customers can play in helping to address them; and levels of investment in water infrastructure.

Recommendations

Recommendation 1: Ofwat should make clear it will be looking to introduce performance assessments to reward water and sewerage companies in terms of improved social and environmental outcomes stemming from adoption of new technological solutions as part of delivering their business plans, by:

- requiring each company to have in place a technology plan as an integral component of their strategic plans for each five-year review process
- rewarding water and sewerage companies when they make the necessary longer-term R&D investments by extending the payback period, subject to agreed criteria being met
- allowing water companies to retain a greater proportion of the net present value of a successful cost-saving innovation[5]

Recommendation 2: Ofwat should adopt incentives to stimulate and reward more research in the water sector. They should consider options such as ring-fencing a certain percentage of price control revenue for research, on a use-it-or-lose-it basis, as introduced by Ofgem to help stimulate more research in the energy sector

Recommendation 3: Government, together with Ofwat and the water companies, should put in place mechanisms to deliver a more co-ordinated approach on strategic, medium-longer term R&D in the water industry by:

- devising mechanisms to encourage the necessary structures for this research to be commissioned by and undertaken in partnership with the industry, for example by strengthening the resources UKWIR or a similar body
- setting up an Innovation Platform on Water Technologies through the Technology Strategy Board to identify mechanisms for continuing to drive up water quality standards whilst at the same time driving down the energy footprint
- devising mechanisms to incentivise water and sewerage companies to collaborate more and share information on leading-edge solutions, along the lines of the Dutch model, through a Knowledge Transfer Network for the water industry

Water and sewerage companies themselves need to increase their collaboration and innovation

Recommendation 4: Government, through bodies such as the Energy Technologies Institute, needs to encourage development of low carbon technologies applicable to the water sector

Recommendation 5: the skills shortages in the Water industry need to be addressed urgently, through the Sector Skills Council mechanism. Ofwat should require each company to have in place an HR and skills plan as an integral component of their strategic plans for each five-year review process

5 *Under the current system, most companies only retain any efficiency performance for five years (or, exceptionally seven and a half years); hence they will only receive between 20 and 30 percent of the NPV of their innovation, assuming it has a life span of 20 or more years.*

Recommendation 6: Government and OFWAT should put in place mechanisms for public engagement and dialogue on:

- water as a scarce resource whose provision entails significant investment and costs
- water supply and treatment has a significant carbon footprint
- future challenges and the role consumers can play in helping to address them
- levels of investment in water infrastructure

Introduction

Historical developments in the water sector

Historically water services in England and Wales followed a pattern similar to most European countries. Services were taken over by local authorities from the late nineteenth century onwards, and a mixed pattern developed with some individual authorities running water companies, some large inter-municipal operators, and a surviving handful of private water-supply only companies, which were strictly regulated by a simple cap on their profits at a maximum rate of return of 5%.

In 1973 the service was reorganised. Ten unitary regional water authorities (RWAs) were created, each covering a river basin area, each responsible for water quality, water supply and sanitation throughout the area. The authorities were appointed by the government, not by municipalities, and so were no longer accountable to local government. During the 1980s the following pieces of legislation transformed the way in which the water sector in the UK was run:

- **The Water Act 1983 –** changed the organisational structure of the water authorities. Local authorities lost some rights of representation and meetings were closed to the press and public.
- **Department of the Environment (DOE) White Paper 1986 –** A discussion paper was published on the possible privatisation of the water industry. It proposed privatising the ten water authorities in their existing form. This included responsibility for providing water and sewerage services, and responsibility for river water quality and the control of abstractions.
- **DOE Consultation Paper 1987 –** In response to the White Paper, many organisations expressed concern about privatising the regulatory aspects of the water authorities. In response the DOE proposed privatising the water and sewerage provision aspects of the boards and setting up the National Rivers Authority (now the Environment Agency) to take responsibility for water quality in rivers, lakes and bathing waters.
- **Water Act 1989, Privatisation –** The Director General of Water Services (the Director) was appointed to be the economic regulator of the industry. His duties include setting price limits to control the revenue companies can collect from their customers in bills, and protecting customers. He set up ten regional Customer Service Committees (called WaterVoice committees since April 2002), which are completely independent of the water industry, to represent customers. The water only companies were brought under the same regulatory control. To meet European water quality and environmental standards the Government wrote off £5 billion of the industry's debts and gave them a £1.6 billion cash injection, known as the "green dowry".

The privatisation process created three regulators: the Drinking Water Inspectorate (DWI) monitoring water quality; the National Rivers Authority (now the Environment Agency (EA)) for monitoring river and environmental pollution; and OFWAT, to set the price regime that companies follow.

EU legislation, in particular the Water Framework Directive (and its Daughter Directives) came into force on 22 December 2000, and was transposed into UK law in 2003. It is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands, which depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances (see Daughter Directives)
- ensure progressive reduction of groundwater pollution

Much of the implementation work will be undertaken by competent authorities.

The **Climate Change Act** sets target on greenhouse gas emissions for 2020 (at least 26%) and 2050 (80%) and puts in place the framework to enable these targets to be achieved, including establishing an independent Climate Change Committee to provide advice to Government.

Current roles of the water regulators

In England and Wales the Water Services Regulatory Authority (Ofwat) is the economic regulator of the water industry. Ofwat's primary duties are to protect customers, promote value and safeguard the future. One of the tools they use is to set price limits every five years with the last review occurring in 2004 (known as PR04) and the next due to take place in 2009 (PR09).

Ofwat is also responsible for ensuring that the companies are able to carry out their statutory responsibilities, encouraging them to become more efficient, meeting the principles of sustainable development and promoting competition in the water industry where appropriate. For Scottish Water, this duty lies with the Water Industry Commission. In Northern Ireland this role is currently carried out by government but this will change from 2009, starting with the price review for 2010-2015, when the Utility Regulator for Northern Ireland will take over.

Ofwat's regulatory mechanism is by price-cap, carried out every 5 years according to a formula (RPI + k). RPI is the retail price index, and k adjusts this by reference to performance standards, efficiency and service and levels.

The water industry depends upon the natural environment in order to provide water and recycle wastewater. In Northern Ireland environmental impact is regulated by the Department of the Environment, in Scotland via the Scottish Environment Protection Agency (SEPA) and in England and Wales by the Environment Agency.

As well as the many thousands of tests for drinking water quality carried out by water companies themselves, supplies are continually monitored to EU and UK standards – by a department of government in Northern Ireland, the Drinking Water Quality Regulator in Scotland and the Drinking Water Inspectorate in England and Wales.

The water industry's operations are underpinned by strong regulation that covers all aspects of the industry's core business – drinking water quality, wastewater quality, environmental improvement and price control. Many regulations that directly affect the water industry are derived from EU directives – notably drinking water, urban wastewater treatment, water

framework, groundwater protection, sewage sludge and health and safety at work. Others, for example economic regulation, are UK specific.

The regulated water sector is made up of 10 water and sewerage service providers and 12 water suppliers, plus four other regulated companies (Annex D). In England and Wales, the companies are private, and several companies are subsidiaries of international enterprises. Welsh Water, which supplies services in Wales, is a not-for-profit company.

Scotland and Northern Ireland each have a single water and sewage service provider (Scottish Water and Northern Ireland Water) that are in public ownership but rely upon private companies for delivery of many of their services.

Recent Studies of the water sector

The House of Lords, Sainsbury Review, the Commission on Environmental Markets and Economic Performance and the All-Party Parliamentary Water Group have all produced reports within the last two years or so which have commented on pricing review issues (see Annex A).

Defra's strategy *Future Water* was issued in February 2008, alongside the draft *Social and Environmental Guidance to Ofwat*. Ofwat has also launched a policy statement on climate change and the water sector which addresses both adaptation to unavoidable climate change and the need for the sector to contribute to reducing greenhouse gas emissions.

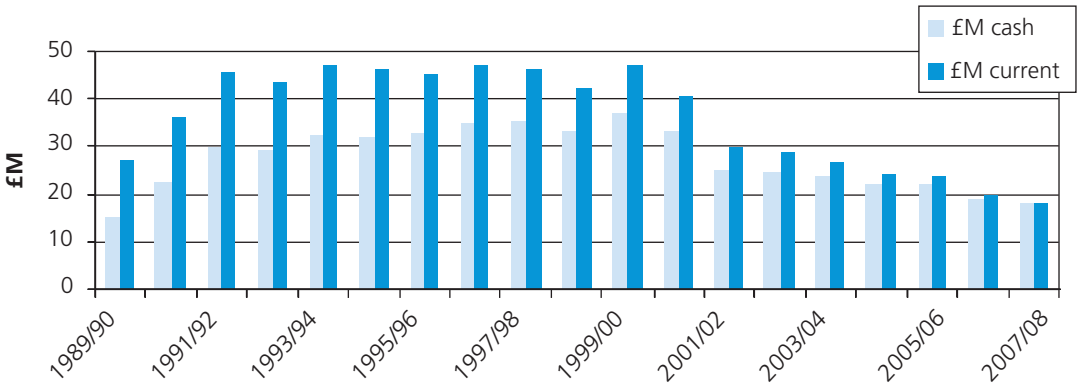
Innovation in the water sector

Fall in R&D since privatisation

Whilst innovation and R&D is occurring throughout the UK water industry, and along the supply chain, it is largely driven by the regulatory framework[6] and appears to be uneven – it is concentrated in the supply chain, in larger companies and more in water treatment than water supply, and varies between the different water companies. This is most apparent on the water treatment side, where regulation has primarily focused on end-of-pipe quality standards.

The evidence shows that there has been a downturn in R&D since privatisation. Investment is currently around the £18 million mark compared to around 45 million in the late 1990s. The table below shows the overall per annum R&D spending by the ten major water and sewerage companies[7]. The R&D intensity (R&D spend against turnover) is less than one half of one percent for water companies, against an average of around 2% for the UK as a whole

R&D investments by the WSPLCs



Before 1989, all water service organisations contributed a fixed proportion of turnover to the Water Research Centre (now WRc plc), who managed a national programme of research. After 1989, investment in R&D rose to an average of around £45M per annum (current prices) by the late 1990s. Since 2000 it has fallen each year and now totals around £18M per annum.

The reductions since 2000 could reflect the pressures on operating costs after the PR99 settlement which reduced water charges by an average of 12%; it could also reflect the changes in ownership of water companies in the last few years with new management having more emphasis on short term profitability, and it could also reflect the end of the large research programmes of the nineties which were driven by the European directives on Drinking Water and Urban Wastewater Treatment. Or it could reflect a more focussed and efficient approach to investment in R&D.

6 *Ofwat through efficiency measures and price controls; the Environment Agency and the Drinking Water Inspectorate through setting environmental and water quality standards respectively.*

7 *Figures provided by WRc PLC.*

Current figures suggest that water companies expenditure on R&D as a percentage of their overall turnover ranges from 0.1 to 0.9% of their turnover. From our conversations with water companies we detected a willingness by the companies to see this figure rise to 1% across the board over a period of 5-year price reviews and be given the opportunity to demonstrate to customers the benefits of more speculative R&D. Water companies have suggested that innovation has been stifled since privatisation. The risk appetite for investment purposes is much lower today than it was. Some of the more speculative endeavours funded historically and in use today in the water and other sectors would not be undertaken in today's regulatory structure.

There is a risk that continued low levels of R&D intensity will lead to limited scope for productivity gains in the future once today's practices and technological developments are incorporated by water companies. It could also mean that water technologies developed elsewhere will not be adopted in the UK due to higher costs of appropriation as a result of under-investment in the water sector's R&D base.

Role for innovation within the water industry

Water has been a relatively low technology industry but as quality standards rise, the infrastructure deteriorates and as the imperative to reduce its carbon footprint grows, the role of technology and innovation must increase. A central question is where along the innovation spectrum an industry such as water might expect to sit.

Ofwat's role in promoting innovation is two-fold:

- to provide the incentives that drive the water industry to innovate in the absence of competitive pressure
- to foster effective competition where that delivers benefits to customers, thus increasing the competitive pressure to innovate

At each price review Ofwat sets companies challenging efficiency targets. Investments in innovative solutions allow the water companies to deliver value for consumers and meet their outputs. They have consistently outperformed the regulatory efficiency targets since privatisation. Research by Ofwat in 2003/04 indicated strongly that management/organisational/procurement innovations were reported by water companies as having the biggest impact on efficiency gains rather than technological innovations. One explanation is that procurement of innovative solutions drives innovation down the supply chain to deliver technological improvements.

It is for companies to manage their businesses and determine how they meet their targets and objectives. Whether to invest in R&D, and by how much, are decided by the individual water companies themselves.

There is a perception within the industry that technology does not necessarily have to be cutting edge. It needs only be fit for purpose in the 21st century. We share that view, but we are concerned that, with some exceptions, the UK water sector is heavily reliant upon technologies, ideas, processes and systems dating from the late 19th century up to the mid-20th century.

We believe the water industry needs to innovate to deliver reliable water supplies efficiently at higher quality with a lower environmental impact/carbon footprint.

Where R&D and innovation will lead to better operational or capital investments or service efficiencies, or where there are new challenges to be addressed and yesterday's solutions are not fit for purpose then we believe the case should be made. However, if the investment is simply technology for its own sake, or it is not cost-efficient over the life of the investment, or if the innovation is seen as a one-off rather than a component of a sustained investment plan, then the case is very much weaker.

To understand the overall health of the water sector, the developments needed and the progress made, better indicators of R&D activity and innovation intensity are needed. These indicators will enable policy makers and regulators to monitor both inputs and outputs – alongside the current portfolio of economic and environmental measures – to determine how best to meet current and future challenges.

R & D within the regulatory framework

The focus of the regulatory regime has traditionally been on delivering the necessary investment to meet environmental standards and to deliver operational efficiencies, which in turn has meant little stimulus for the industry itself to be less risk-averse in terms of adopting new technology.

The water company view is that Ofwat's approach to arms-length regulation and incentivisation through target setting is the right one, as it allows individual companies to determine their own approach on how to meet (and exceed) these targets i.e. in deciding how innovative they want to be.

There is a real perception within the water sector that the regulatory system that has evolved between the companies and Ofwat since privatisation has resulted in various incremental technology developments, rather than major step-changes. One striking example is climate change, which was not on the agenda for much of the 20 years since privatisation and incentives for climate mitigation are only now starting to be conceived.

There is an understandable bias towards capital expenditure solutions in the short-term. This is not dissimilar to that of the electricity generating industry, where R&D expenditure fell markedly post-privatization. We believe Ofwat can learn from OFGEM's experiences.

Our discussions with the water industry have highlighted positive impacts of the regulatory regime as well as circumstances which provide a deterrent to water companies introducing step-change technology.

Regulatory Incentive Mechanisms

The central question is whether the (RPI + k) formula places too little emphasis on delivering capital investment – which includes R&D – rather than on providing incentives for water companies to deliver efficiencies in operating expenditure. The constraints imposed by current incentive mechanisms relate both to the R&D outputs themselves and the costs of their implementation. By its nature, the outputs of R&D are uncertain and the costs associated with both development and implementation are even more uncertain, and often well into the later stages of the development. This is factored into water companies risk/reward assessment of an R&D proposal and does not prevent R&D investment *per se*.

Under the current regime companies can keep a proportion of the efficiencies created through the introduction of a new, more efficient technology for a period of between 5 and

7½ years – in the case of the *frontier* companies[8]. The result is that if the combined costs of introducing and operating the new technology are not cost-beneficial after this period then the companies are very unlikely to introduce it.

This means that revolutionary or step-change technologies, which by their nature require significant implementation costs and effort, are much less likely to be introduced. For example, the costs associated with the implementation of the Brinker® Platelet Technology by Yorkshire Water into their business processes are unlikely to prove beneficial based on a 5-year payback even though it may be technically viable and payback achieved over a longer period.

8 *Frontier companies are those which are able to achieve the lowest unit costs ie the most efficient.*

Case Study: Brinker® Technology Platelets[9]

"A revolutionary technology to repair leaking or burst pipes from the inside thus preventing the need for accurate above-ground location, excavation and repair. Our target is to repair 2,000 leaks using the technology in this financial year".

"*Brinker*® and its patented technologies are working with companies like Yorkshire Water (YW) to revolutionise the global water industry by bringing their globally field proven technology from the hydrocarbon industry to other industry sectors to help their customers.

In order to meet their leakage target Yorkshire Water (YW) repairs 7,000 leaks/bursts each year resulting in some 168,000 interruptions to supply. The resulting water quality problems and reinstatements cause around 18,800 customer contacts in addition to the resources employed to manage the 'events', and deal with subsequent reporting. One of the key priorities in their strategic development statement is to reduce leakage to half its current level by 2035 and they are innovatively seeking to develop and work with companies like Brinker® to take a proven technology from one industry and apply it to help them achieve this challenging target.

One example is a recently developed technology for sealing leaks remotely in the oil industry, without excavation. Initial tests showed potential for dealing with leaks in YW's own distribution network, and subsequently a small number of engineered and real demonstrations have been performed.

Platelets® can be injected into a system with a known or suspected defect. The Platelets® are transported to the leak site with the flow in the system and when they reach a leak, fluid forces entrain them into it, thus providing a seal.

The technology potentially offers important benefits to the industry:

- Allows rapid live main repairs
- Reduced interruptions to supply
- No need to accurately locate the leak
- Zero excavation and associated environmental nuisance/traffic disruption
- Cost savings

We urge Ofwat to amend its rules to extend the payback period beyond five years so that companies are allowed to keep the rewards from over a longer period, subject to agreed criteria being met.

9 *CST is grateful to Yorkshire Water and Brinker® for providing this example of recently-developed technology.*

There is evidence to suggest that uncertainty around the introduction of competition and structural reform has resulted in a decline in R&D investment in the network industries[10]. The most obvious manifestation of this is the focus on cost efficiencies which has resulted in less R&D being carried out, and in particular less collaborative R&D; however there is also an argument based on vertical separation and the loss of integrated R&D between previous business-connected activities. Greater fragmentation within the sector could mean that the ability of smaller companies to invest in proportionately more expensive R&D would decline further, both through the increased costs which would be incurrd and the fact that R&D always has a level of associated risk (ie what is being developed does not work).

One possible mechanism to incentivise take-up of R&D would be to reduce capital costs associated with implementation and first use, for example through enhanced capital allowances or other corporate taxation mechanisms but it is beyond the scope of this report to comment further.

The Regulatory Cycle

Generally speaking the water companies are supportive of Ofwat's "light-touch" approach to regulation and the freedoms this affords on how individual companies take ownership of their business plans and go about achieving their regulatory targets.

Nevertheless, the current regulatory cycle does determine behaviours, not least in terms of R&D inputs.

There are a number of drivers: EU regulations; Ofwat's five-year review period; and R&D capitalisation

EU regulations

A significant proportion of R&D investment is driven in response to emerging quality regulation. In the water companies' view there has typically been a lack of sound science in support of new European legislation and the water sector made clear to us that it has needed to undertake considerable influencing and lobbying work, often on behalf of government and the regulators, to ensure that the regulatory requirements are deliverable over the short to medium term and that the sound science necessary to define and defend future investment is developed. They also pointed out that EU regulations are often only agreed late and implemented at short notice and that this hinders the option of innovating to meet standards as quick, existing high-cost solutions are usually the only answer.

This typically forces incremental rather than step-change within the sector, for example to existing and well-understood processes which offer lower development costs and risk. Incremental, as opposed to more fundamental or 'big bang' change reduces development time and costs as well as reducing the chances of abortive investment should the nature of the legislation or its timeline change].

However, some important R&D is taking place – as part of the PR04 process, Defra, the Environment Agency, Ofwat and the water companies agreed a national research programme on endocrine disrupting compounds (EDCs), which is currently being delivered by the water companies and UKWIR (who are co-ordinating the sampling programme).

10 *Liberalisation and R&D in network industries: The case for the electricity industry:* Jamasb, T and Pollitt, M, Research Policy **37** (2008), 995.

The five-year review period itself

Uncertainty between companies' asset management plan cycles (eg investment in new plant) and the periodic review can have profound impact on company policy, for example when it comes to setting a level of investment in R&D. Most significantly, the five-year cycle for price setting tends to force short-term incremental R&D, where it occurs, rather than longer-term, step-change developments; and where longer-term developments are needed the system cannot readily accommodate them. This is particularly true where continuation funding is needed, for example in keeping researchers and research groups together. The five-year review cycle, under which water companies aim to outperform the regulator's targets, seems to us to have a negative impact on potential long-term benefits of greater R&D intensity in the water industry, and particularly when contrasted with other, non-regulated businesses, which could have up to 20 years to reap the benefits of their R&D. The UKWIR report *Barriers to Innovation* demonstrated the considerable length of time some innovations take to become adopted within the water sector.

It is not just R&D investment that risks being jeopardised; urban water management, water resources and efficiency, and energy use are all issues which will take longer than the five year regulatory cycle to resolve: they need to be supported a 10 to 15 year period and investing companies adequately rewarded over a time frame which spans more than one regulatory cycle.

When Ofwat conducted a consultation exercise in Jan 2006: *Setting water and sewerage price limits: Is five years right*[11]*?* the overwhelming response from the industry was in favour of keeping the five-yearly reviews. This has also been the general feedback received from the water companies visited by CST during this study. Ofwat needs to give greater guidance on investment programmes that extend or should extend across review periods, to prevent or limit 'bunching'.

Progress is being made – for example the leakage targets set by Ofwat have resulted in capital investment to replace the pipework but little is being done to investigate more innovative and less expensive remedies to manage leaks.

Ofwat needs to develop a mechanism which allows companies to retain the benefits of out-performance based on step-change innovation for longer. We recognise this will involve:

- the need for a separate accounting mechanism;
- definition and classification of incremental and step-change investment in R&D;
- recognition and inclusion of non-value related benefits;
- apportioning of associated risk between customers and the business, as well as the resulting benefits; and
- a collaborative approach by the industry, for example through UKWIR, with all water companies participating.

R&D capitalisation

The majority of R&D expenditure (around 80%) falls under the capital programme and companies adhere to the capitalisation criteria as set out by the Accounting Guidelines. Whilst this approach is a business decision and one which can work well in linking R&D to

11 *http://www.ofwat.gov.uk/aptrix/ofwat/publish.nsf/AttachmentsByTitle/pr_length_cons310106.pdf/$FILE/pr_length_cons310106.pdf.*

capital investment, it has limitations. For example it prevents investment in research which is not aimed at a specific aim or application, as well as in market research and costs associated with the protection of intellectual property.

Applied and project-based R&D must be written off in the year of expenditure unless it can be reasonably demonstrated that it is cost beneficial over its entire development cycle. Whilst the costs of writing down capital assets are not an immediate constraint to R&D investment they are obviously a factor in determining balance between the lower risk, shorter-term incremental R&D and the longer-term, step-change whose implementation costs may be significant.

Ofwat sets operating cost targets for water companies: these targets include R&D investment, which results in continuing downward pressure on investment. Current Ofwat methodology allows companies to keep efficiency gains made within the five year regulatory period. Ofwat should consider removing spending on R&D from the operational expenditure target or extend the time period.

The 2009 Review and beyond

There are a number of mechanisms being considered as part of the PR09 process.

Efficiency Targets as Incentives

Ofwat has published a methodology for the way in which the 2009 review will be conducted. As part of this process Ofwat is considering the overall incentive regime, including stronger incentives to continue to drive efficiency and innovation.

Setting R&D in a Longer Term Framework

As part of the 2009 review process, Ofwat required each water company to have produced, by December 2007, a strategic direction statement (SDS) setting out their approach over the long term, including their approach to, among other things, innovation and research and development agendas, particularly where this will help them achieve more sustainable solutions. The SDSs set out the need for innovation, company by company, with priority target areas. There is no one-size-fits-all approach – several take innovation as the main theme while others have been formulated from a customer or efficiency or finance angle and have not referred to innovation or R&D directly, even though their vision for 2030 implies major technological developments. These are being reviewed and assessed as part of the PR09 process.

We support the suggestion that a nationally agreed shortlist of issues to solve within the water industry, alongside a nationally-agreed programme to address these issues, would benefit the UK. This should include:

- Investment in the removal of priority hazardous substances
- Infrastructure maintenance and management
- Energy use, particular for treating waste water
- Water efficiency and metering; and
- Sustainable water and wastewater treatment to minimise or recover use of resources

Developing competition

Ofwat firmly believes that market competition pressures can drive innovation more effectively than regulatory intervention. They are therefore reviewing competition in the sector to further promote and facilitate the development of effective competition. Some argue that this will be a key driver of future innovation – changing both the amount and quality of the research[12]

However, privatisation and the subsequent increase in competition has led to major structural reforms – both vertical and horizontal (ie geographical) – which has meant that the ability of vertically-integrated monopoly companies to spread R&D expenditure over a larger cost base is no longer possible to the extent that it was, and that this may be impacting in a negative way on R&D expenditure[13]

The Cave Review is considering this issue in detail.

Allocated funding

Ofwat is also considering carefully the role of allocated funding, using the example of the Ofgem Innovation Funding Incentive (IFI) for distribution network operators. Ofwat's aim is to ensure that any incentives encourage companies to pursue innovation that will in the end deliver benefits to their customers. There is a concern that allocating specific expenditure to R&D could mean companies pursue poor value schemes in order to spend their allocation creating the wrong sort of incentive.

The Challenge

The policy levers that Ofwat uses need to demonstrate the importance it attaches to innovation and investment in both incremental and step-change R&D which companies can interpret as part of their business planning activities

Environmental Issues

The water sector is a major energy user – 3% of the total UK electricity demand is accounted for by the water industry[14]. The water industry is the fourth most energy intensive sector in the UK and only about 10% of the water industry's total energy use is from renewable sources. The water industry used 7,700 GWh of energy in its total operations during 2005/06, and emitted over 4 million tonnes of greenhouse gases. This contributes to just under 1% of total UK greenhouse gas emissions.

There is a tension between the prime objective of the regulator in ensuring that water companies deliver clean water to domestic users at the lowest cost, and the need for a more holistic approach that reflects environmental imperatives, particularly climate change and security of water supplies.

However, if the water sector is to contribute to meeting the UK's carbon reduction targets it is unlikely to do so based on existing technologies, and R&D investment in low carbon technologies will be necessary.

12 *Markhard, Truffer and Imboden (2004) The impact of liberalisation on innovation processes in the electricity sector, Energy and Environment* ***15****:2 201-214.*

13 *Various academic papers eg Sanyai and Cohen (2004) Deregulation, restructuring and changing R&D paradigms in the US electric utility industry, Brandies University.*

14 *The 2006-07 Water UK sustainability review has data for the sector's energy use, circa 8000 GWh annually, which is 3 per cent of total national demand.*

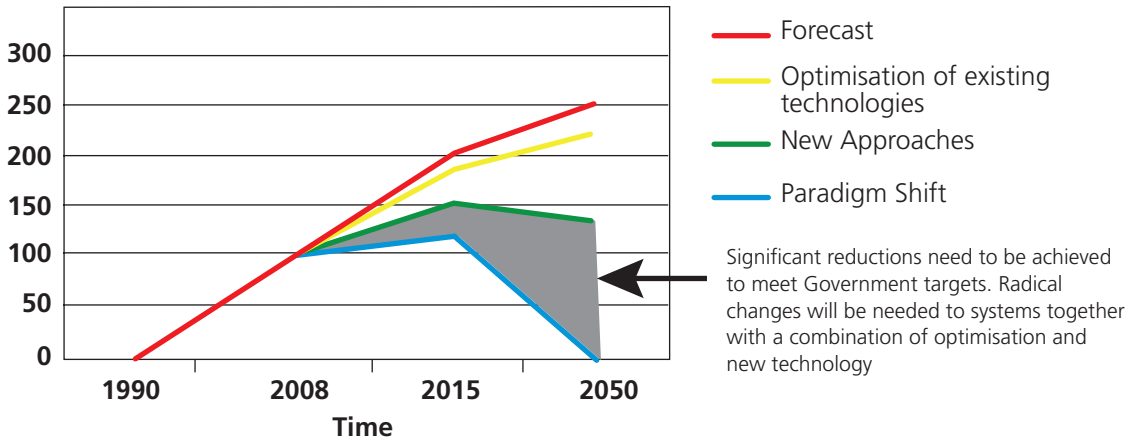
Innovative low carbon technology and reducing energy demand

If the UK is to achieve its greenhouse gas emissions target of 80% by 2050 a paradigm shift is required to reduce its carbon footprint – and hence energy consumption – by considering water and waste treatment holistically across all sectors[15].

This suggests that alternative – sustainable – methods of powering the industry need to be identified – for example wind energy – as well as pump optimisation techniques to reduce energy demand. Stakeholders within the water industry welcome this approach but at least one water company questioned whether Ofwat would look favourably on wind turbines being part of the regulatory asset base. Pump optimisation, whilst highly desirable, is seen by the water companies as a medium to long-term goal. However, the water industry is potentially advantaged to make use of intermittent sources of renewable energy such as wind and solar for non-time-sensitive uses such as pump storage.

We agree there needs to be a more joined up approach across water, energy and environment to allow water companies to take advantage, within the regulated regime, of their ability to generate renewable energy and use it to defray energy intensive processes within the sector.

Figure 14: Forecasted Energy Usage %



Note: Based on forecasted increase in energy usage by water industry energy managers in response to EC Quality Standards

Energy efficiency has been identified as one of the priority R&D areas in a road-mapping exercise UKWIR undertook, and which highlighted the need for:

- energy optimised conventional water treatment
- carbon-neutral and carbon-negative processes
- passive treatment technologies

There is a need for R&D in the areas of optimising energy use in treatment technologies, developments in low-energy use pumping, increasing the availability of renewable / recovered energy use, increasing biogas recovery and the development of carbon foot-printing methodology to aid the move to the delivery of a carbon-neutral/carbon negative service.

15 *We understand that this is not a part of the European Emission Trading System as the vast proportion of this energy is not primary energy. It is electricity – and the power generators are integral parts of the ETS. It would thus be duplicative to create specific climate policies for the sector's power consumption.*

A study by the Environmental Knowledge Transfer Network[16] in collaboration with the water companies, supply chain and university researchers, following the UKWIR road-mapping exercise, has provided an evidence-based and industrially-led business case to enhance the UK's capability within the priority technology area of Energy Efficient Water and Wastewater Treatment.

Energy Efficient Water and Wastewater Treatment – a review

The study highlights three main ways of realising energy efficiency in water and wastewater treatment:

Water saving – treating water and wastewater to full treatment standards and their distribution is an energy-intensive activity. Efficiencies could be achieved through waste minimisation by industry, reduced water demand, leakage reduction, recycling, and point of use treatment.

Reducing operational usage – once treated water and wastewater are then pumped along vast networks of pipes. Energy efficiency could be achieved by developing an understanding of the process inefficiencies, the introduction of best practice and novel processes, and the incorporation of automated control and more efficient mixing, aeration, and pumping technologies.

Generation to offset usage – waste streams with calorific or resource value exist across all sectors of industry. Currently, many of these streams go to sewer or landfill. There is a vast potential to use water industry assets for renewable energy generation on such streams or from other sources to produce energy from biogas, CHP, wind, photovoltaic, hydro, geothermal technologies.

We understand the study has been submitted to the Technology Strategy Board for funding through their collaborative research mechanisms.

Challenges

Consistency of regulation

Whilst three-quarters of the rivers in the UK are now of good biological and chemical quality the energy required to treat sewage to this standard is high. This highlights where regulatory drivers are competing and inconsistent. For example the Water Framework Directive and its daughter Directives will impose a significant improvement in water quality standards with a consequential increase in energy and carbon from the treatment processes needed to meet these standards.

At the same time, however, the EU and Governments are imposing stringent targets on energy use, waste recycling and carbon production. There appears to be no interaction between those setting atmospheric quality expectations (reducing greenhouse gases) and those encouraging improvements to the aquatic environment (reducing priority hazardous substances, ammonia, phosphate), which will result in increased energy use and carbon dioxide.

16 *http://ipmnet.globalwatchonline.com/epicentric_portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/IPM-NET/7%253A%2520Specialist%2520Interest%2520Groups/Tech%2520Area%25204%253A%2520EEWWT/Business%2520case%25203%2520for%2520web.pdf.*

Therefore, if the challenging long-term targets on water quality and consumption are to be met, and if water is to make a significant contribution to the low carbon economy – which it must if the Government's targets for greenhouse gas emissions are to be met – then CST believes that the key to success is the introduction of leading-edge technology – particularly on the waste treatment side.

There is a risk that unless there is a sustained and co-ordinated R&D effort over the medium term these environmental targets (both atmospheric and aquatic) will not be met, or they will be met by the application of inappropriate, but available technologies, with a consequential impact on costs and hence prices to customers.

An important mechanism for approaching this issue holistically would be for the TSB to develop an Innovation Platform on water Technology, bringing together the water sector, the energy sector – in particular the Energy technologies Institute and the Carbon Trust – both sets of regulators, the Science base and Government, all under the umbrella of the TSB.

Future Water: the Government's water strategy for England

In February 2008 Government published its high level vision and evolving priorities for water management in England:

a renewed focus on affordability and fairness of charging for water

a greater emphasis on climate change mitigation and adaptation to be embedded in the water sector

new consideration to be given to the arrangements for surface water drainage

the balance between water supply and demand to be carefully considered, with opportunities for water savings and water efficiency more fully examined

water quality to remain a priority with a particular a focus on a catchment scale approach and tackling diffuse pollution at source.

Accompanying the strategy was a full public consultation on draft statutory Social and Environmental Guidance to Ofwat. This consultation considers the role that Ofwat might play in taking forward some of the policies set out in Future Water. The intention is to inform PR09 but also look beyond 2015.

Annex B contains extracts on Climate Change issues from the consultation document.

Catchment Management

Examples of a relatively new approach to bringing together (i) the need to ensure that water companies deliver clean water to domestic users at the lowest cost, and (ii) the need for a more holistic approach that reflects environmental imperatives, are projects covering catchment management, such as domestic rainwater harvesting.

Catchment management is a relatively new activity within the UK and is very much at an embryonic stage but needs to be promoted. The overarching need is for water companies to work with the regulator and the academic sector to develop the concepts so that the benefits are brought to as wide a market as possible. The German water sector is particularly well advanced in these techniques.

Government set challenging long term targets for vehicle exhaust emissions, which have been met through step change innovations in the globally competitive supply chain for catalytic converters. We do recognise that similar long term targets are being developed through the Water Framework Directive and the 25 year Strategic Direction Statements, and that these need to be supported.

Nevertheless, there is a real contrast between the funding Government provides for R&D to energy companies operating in competitive markets through bodies such as the Carbon Trust, the Energy Savings Trust, the Energy Technologies Institute and schemes such as the trials on smart metering for gas and electricity, with the absence of comparable schemes for the water sector, where competition is more restricted. This needs to be rectified, particularly as Government has made clear it views the environmental sector as one in which the UK has a leading international opportunity. We are therefore concerned that the water sector receives little support for R&D compared to the other regulated sectors.

Government has also indicated that it views the environmental sector as one in which the UK has a leading international opportunity, however little government support is given to R&D in the water sector compared to others. The UK Trade and Investment's Environmental Sector Advisory Group (ESAG) report: *The UK: A World Leader in Environmental Solutions* reported on the strong global competitiveness of the UK environmental technologies sector, but also identified that "it is the early adoption of new technologies that will be key to the UK remaining competitive in this area". The current methodology applied by Ofwat is unlikely to support such 'early adoption' by the water companies.

We believe that Government also needs to provide clearer social and environmental guidance to Ofwat in relation to the role of innovation and R&D in the water industry.

International co-operation and collaboration

Collaborative Research Mechanisms

The UK water industry is successful through collaboration and research programmes such as the UK Water Industry Research (UKWIR)[17]. Through this programme water companies undertake influential policy and regulation forming research, often in conjunction with government and regulators. Important pieces of research such as the UKWIR Common Framework[18], which established a common cost-benefit assessment process accepted by OFWAT and used by the entire industry to develop capital maintenance plans and costs, were developed collaboratively.

Similarly the Water Research Centre (WRC) operate a research portfolio of common interest projects into which companies can buy, and common interest clusters develop with interested companies, either formally through network groups funded by, for example, EPSRC and the Technology Strategy Board, or informally through contacts. All of these collaborative mechanisms work to develop common appreciation of issues and opportunities and provide leverage and support where R&D results. In a directly competitive environment these programmes and networks are likely to either diminish in value or disappear altogether.

Similarly, at the moment it tends to be the larger combined water and sewerage companies which are most active in UKWIR and on the national research agenda: Thames, Anglian, Severn Trent, United Utilities, Northumbrian and Yorkshire. For example these companies recently led the development of a number of strategic roadmaps aimed at providing clarity around medium and long-term technology needs to the supply chain and research community[19]. What is clear is that the impact on collaborative research is determined by the management will of the businesses concerned and the importance which they place on innovation to deliver their organisational goals, whatever the regime.

Annex C provides examples of collaborative mechanisms relevant to water companies. The UK is not seen to be a major player in EU programmes covering R&D in the water sector.

The subgroup is visited KIWA Research in November last year. The Dutch have been held up as displaying best practice and there are good examples of the relationship between academia, water companies' needs, the supply chain and the role Government plays in stimulating this activity that the UK could benefit from looking at.

17 *UKWIR was set up by the UK water industry in 1993 to provide a framework for the procurement of a common research programme for UK water operators on 'one voice' issues. UKWIR's members comprise 24 water and sewerage undertakers in England and Wales, Scotland and Northern Ireland.*

18 *Capital Maintenance Planning: A Common Framework Volume 1: Overview (02/RG/05/3), UKWIR, 2002.*

19 *The outcomes from this work were made available to UKWIR and published: A Road Map of Strategic R&D Needs to 2030 (07/RG/10/3), UKWIR 2007.*

Case Study: KWR – the Dutch Watercycle Research Institute

"What the Dutch don't know about water, nobody knows" *(quote from a German Chief Executive)*

The Dutch have an integrated approach to water management and use across the Netherlands, with an emphasis on *polder*, or collaborative consensual working between the 10 Dutch publicly-owned drinking water companies, [the 486 municipalities dealing with sewerage], the 26 water boards dealing with waste water treatment and water system management, together with the private sector and Government. The total annual turnover of the Dutch water sector is around 2 billion euros. Investing in water technologies is seen as an integral part of maintaining water quality and efficiency, as well as delivering a smaller energy footprint.

The performance of each water company is benchmarked against the others in the sector, against criteria including cost, sustainability and customer performance. If performance is unsatisfactory, then the Dutch government intervenes. There is no water regulator. The companies share their knowledge and the highest performers help the lowest.

The Dutch water sector can draw on a science base of around 400 million euros, largely in applied research and hydrology. KWR has a research budget of 17 million euros – levied from the water companies – and a staff of between 150 aned 180 people. Around 6.5 million of KWR's 17 million euros budget is used to leverage external funding, and there are secondments from the university base into KWR. In addition, TTI Water conducts longer-term research through a virtual institute (TTI Water) which spends around 7 million euros per year. In the Netherlands there are about 100PhD students engaged in applied R&D related to water technologies.

KWR's research agenda is set by its Board (comprising representatives of the drinking water companies). It aims to make an annual surplus of 8% of turnover which it reinvests in new projects.

Innovation programmes cover both water and energy. Leakage rates are less than 5% and there is a low frequency of water supply failure (14 minutes per household per year)

Water metrology (especially telecontrol) is very advanced – they use fixed points for measuring pressure at street level (eg Amsterdam has up to 40 pressure points in the network) which act as a reference for the capacity of the pumping needed; the pumps can then be brought on- or taken off-stream. The Dutch have few reservoirs because of their negative impacts on energy use and water quality. Demand forecasting and hydraulic network models are used to optimise pumping schemes and model operations at water treatment works.

Case Study: Singapore

Singapore's approach to meeting its growing water needs has become widely recognised as a model for sustainable management. Demand for water is predicted to keep pace with Singapore's anticipated 4% to 6% economic growth.

Security of supply is an issue – Singapore depends on Malaysia for around half its water needs and the relationship between the two countries has not always been a straightforward one.

As a result, the country has been actively pursuing the long-term goal of self sufficiency – culminating in recently announced plans for capital expenditure of a further $1.47bn in the next five years on water infrastructure under the *four taps* strategy. Some $20 million has been spent on research and development and private sector businesses have capitalised on the government's R&D initiatives to develop technology solutions.

Although Singapore has plentiful rainfall, it is officially classified as a 'water-stressed' nation, having a water availability of less than 1,000m³ a year per person.

Four National Taps

This is the policy developed by the Singapore Public Utilities Board (PUB) and comprises two traditional sources – catchment harvesting and imports – with reclaimed water and desalination as the two new 'national taps'.

Three water plants recycle nearly 90 million litres a day and two more are in progress: by 2010 recycled water is expected to provide some 30% of the state's supply.

Singapore's first desalination facility, at 4.1kWh/m³ one of the most energy efficient in the world, was opened in September 2005 and has the capacity to produce around 136 million litres a day, which amounts to around 10% of the national water requirement. The cost of recycled water is about half the price of desalinated water and so the emphasis for the future will be on recycling.

Driving self sufficiency

Current projects include the provision of three new to make two-thirds of the country a water catchment area within three years. In addition, Singapore is also looking to diversify foreign sources of supply by piping in water from Indonesia.

In 2007, PUB won the Stockholm Industry Water Award, with a citation that describes the project as 'an exemplary model of integrated water management in a framework of good policy and innovative engineering solutions'.

Singapore is ultimately aiming for self sufficiency – possibly 80% by 2011 – and entirely sustainable, self-contained water management by 2061.

Skills shortage

The skills base in the water industry is a cause for concern.

All the companies we visited reported difficulties attracting high quality employees to the industry, and also keeping employees within the water industry.

The five-year pricing review hinders forecasting the skills and resources needed in the long-term. In many instances employees are dispensed with half-way through the pricing review period and in many cases it is difficult to re-attract the expertise back into the industry. However visits to Yorkshire Water and Severn Trent suggested that these companies are engaged with this issue and are actively addressing the matter. HR planning needs to be a core element of all water company strategies and there needs to be a mechanism to attract more students into the water sector. Ofwat should encourage companies to invest in training and educating a new generation of water professionals.

One suggestion put forward is the need for a sector skills council within the industry that attempts to establish what resources will be needed in the next 15 to 20 years (Ofgem have set-up a similar project which has ring fenced funding). This would assess exactly what is needed: where the skills gaps are; what they are; and how they can be filled. We note that EPSRC has announced an industrial doctorate centre for the UK Water sector in Skills, Technology, Research and Management starting in 2009.

Public Dialogue

There is also a need for public dialogue between the government, water companies, the regulator and the public about the value of water, the work water companies undertake and challenges faced in the coming years for both companies, consumers and society generally.

We believe that Government and Ofwat should put in place mechanisms for public engagement and dialogue on key issues such as water as a scarce resource whose provision entails significant investments and costs; water supply and treatment has a significant carbon footprint; future challenges and the role customers can play in helping to address them; and levels of investment in water infrastructure.

Annex A: Recent Studies of the water sector

The House of Lords, the Sainsbury Review, the Commission on Environmental Markets and Economic Performance and the All-Party Parliamentary Water Group have all produced reports within the last two years or so which have commented on pricing review issues. All four reports focus on the fact that the five-year periodic review does not incentivise water companies to carry out increasing levels of R&D and investment in new technology – specifically;

House of Lords Science & Technology Committee Report

Recommendation 8.11 of the Lords report on water management states "We call on OFWAT to address the disincentives in the regulatory system that discourage companies from investing in R&D. We recommend that OFWAT allocates to R&D a certain proportion of companies' turnover that would be exempt from the efficiency targets, and reconsiders the mandatory return of all efficiency savings resulting from new technology. Any of the money allocated for R&D that is not spent should be returned to customers in the following price review".

Commission on Environmental Markets and Economic Performance Report

Recommendation 6 of the CEMEP report states "Government departments and regulatory agencies' science and innovation strategies should not only focus on the use of science to support policy, but should address their role in inducing and rewarding private sector innovation that furthers the Government's environmental objectives"

Recommendation 8 of the CEMEP report states "Government should review the duties of the economic regulators in the energy and water sectors to give greater prominence to the importance of environmental innovation in meeting sustainability goals, and back this up with guidance as to how a more complex set of duties might be interpreted."

Lord Sainsbury Review

Recommendation 8.11 of Lord Sainsbury's report – *Race to the Top* – states "Regulators should review their policies to ensure that the appropriate level of emphasis is given to innovation in their decision-making in the price-regulated sectors, to protect the interests of both current and future consumers. We would like consideration to be given to how innovation could be incorporated into their duties".

All Parliamentary Party working Group

The All Parliamentary Party Working Group on the Future of the Water Industry made the following recommendation in 2008, after considering evidence from a variety of organisations: "The group would like to see a similar approach to that in the energy sector to incentivising innovation. The group believes that the sector must look to try and establish a common understanding of what kind of innovation is expected in the water sector which would also serve to reduce the risk levels of innovating".

Annex B: Extracts from the consultation on draft social and environmental guidance to Ofwat

15 [Climate Change] Adaptation

15.1 The section on adaptation in the draft Guidance was welcomed by respondents, in particular the expectation that Ofwat would work with, and encourage companies to work with, local and regional government and partners to develop regional solutions. The expectation that companies should take a risk based approach to adaptation measures was also welcomed. Seven respondents made detailed comments. Three noted that climate change projections from UKCIP08 might become available too late to influence planning for PR09. On costs two respondents argued that measures aimed at adaptation should be based on full social cost benefit analysis. One respondent suggested that the Guidance should make clear that Ofwat would need to reflect Climate Change Bill requirements in its final determinations. One respondent suggested that measures by water companies to adapt to climate change should include the implications of low flows in rivers and on groundwater levels and consider the role that catchment management could play.

Government response

15.2 The Government expects that the most recent climate change information should be used for business planning – until Nov 2008 when UKCIP08 is launched, we expect this will be UKCIP02.

15.3 The Climate Change Bill is currently in passage through Parliament, and so setting out its detailed provisions in the Guidance would be premature. It would also be unnecessary to repeat the detailed contents of statutory provisions in the Guidance. However when passed, the provisions in the Bill, like those in all legislation, will be binding.

15.4 The Government agrees that consideration of climate change adaptation measures should include looking at a wide set of options. Catchment solutions, where relevant, should already be included as part of companies' work on adaptation and will be assessed with the Environment Agency as part of their role within PR09.

Revised draft statutory social and environmental guidance

Adaptation

2.37 The Government expects companies to take steps to adapt to future climate change. The Government will set out a strategic national policy framework for priorities for adaptation within which regional solutions will be developed.

2.38 Ofwat is expected to have regard to the Government's national priorities on climate change adaptation. These will be developed as a result of commitments in the Climate Change Bill and framed within the forthcoming cross-Government Adaptation Framework document. Ofwat should also contribute to the development and implementation of the Government's Adaptation Framework. Ofwat is expected to support the Government's

regional approach to adaptation by working with, and encouraging companies to work with, local and regional government and partners to develop regional solutions.

2.39 Working within these frameworks the Government needs to ensure that the best evidence available on climate change is fully integrated into all water policies. Ofwat have an important role in setting expectations that water companies will have regard to the Government's forthcoming guidance on adaptation when carrying out business activities. This should include setting out a clear expectation that companies will take a risk based approach to adaptation measures, informed by the best evidence available, including climate change projections, for example those provided through UKCIP08.

Annex C: The Structure of the UK Water sector

Water and sewerage companies

Appointed Company	Ownership
Anglian Water Services Ltd	Osprey Acquisitions Limited
Northumbrian Water Ltd	Northumbrian Water Group plc
Severn Trent Water Ltd *	Severn Trent Water plc
South West Water Services Ltd *	Pennon Group plc
Southern Water Services Ltd	Greensands Holdings Limited
Thames Water Utilities Ltd	Kemble Water Limited
United Utilities Water plc *	United Utilities Group plc
Dwr Cymru Cyfyngedig/ Welsh Water	Glas Cymru Cyfyngedig
Wessex Water Services Ltd	YTL Power International
Yorkshire Water Services Ltd *	Saltaire Water Limited

Water Only Companies

Appointed Company	Ownership
Bristol Water plc	Sociedad General de Aguas de Barcelona, S.A. (Agbar)
Bournemouth & West Hampshire Water plc	Biwater plc
Cambridge Water plc	Cheung Kong Infrastructure Ltd
Dee Valley Water plc	Dee Valley Water Group plc
Cholderton & District Water Co Ltd	Cholderton & District Water Co Ltd
Folkestone & Dover Water Services Ltd	Veolia Environnement
Portsmouth Water plc	South Downs Capital Ltd

South East Water plc (including Mid Kent)*	Utilities Trust of Australia Hastings Diversified Utilities Fund
South Staffordshire Water plc	Alinda Infrastructure Fund
Sutton & East Surrey Water	Aqueduct Capital Ltd
Tendring Hundred Water Services plc	Veolia Environnement
Three Valleys Water plc	Veolia Environnement

* Visited by CST in connection with this report

Other Regulated Companies

Albion Water Ltd
Independent Water Networks Ltd
Southern Electric
Peel Water Networks