Analysing the Impacts of a Carbon Emissions Trading Scheme on the UK Water Industry:

The UK Carbon Reduction Commitment (CRC)

April 2008

A Research Project by Nyla Sarwar

Abstract

The Carbon Reduction Commitment (CRC) is the first mandatory emissions trading scheme to capture the UK water companies, and will come into force on 1st January 2010. The Scheme has been introduced by the UK government to reduce emissions in the non-energy intensive public and private sectors which emit 10% of the UK's emissions and captures those organisations not already covered by the CCAs or the EU ETS. The Scheme will form part of the wider Climate Change Bill and caps will be set in line with carbon reduction targets from the Bill.

The water industry is unique in terms of its impact on the CRC, as it will be the biggest and therefore most influential player in terms of energy use and emissions. There are a number of key challenges for the water industry, and it is important that the industry strikes a balance between increasing quality and reducing emissions, and strong government lead will be essential to achieve this. Additionally there is a major role for increasing awareness of the impacts of other sectors through the *Committee on Climate Change* and an increase in investments in R&D for developing low carbon solutions. Further challenges have been explored and strong government lead is essential to tackle these and ensure the water industry is adequately incentivised to participate in the scheme and make emissions reductions.

This research projects attempts to identify the impacts of the CRC on the UK Water industry- the only energy intensive industry to be captured by the scheme; through consultations with key industry representatives. The project aims to understand the impact of key national carbon reduction policies on the UK water industry; identify company level carbon reduction strategies and plans for the future; and explore the key challenges presented by the CRC for the UK water industry, making recommendations for further development.

Acknowledgements

This report was researched and collated through consultation with regulators, development agencies, and key industrial stakeholders across the entire water & wastewater treatment supply chain. I wish to acknowledge the involvement of the following people in the development of this report. It should be noted that this report may not reflect the personal views of these individuals or organisations.

Organisation	Position
1. Water UK	Policy Advisor
2. British Water	Technical Director
3. Ofwat	Head of Climate Change
4. Environment Agency	Emissions Trading Manager
5. Yorkshire Forward	Head of Sustainable Development
6. Envirolink NW/N8	Director
7. Environmental KTN	Knowledge Transfer Manager- Water
8. Carbon Trust	Utilities Manager
9. United Utilities	Carbon Manager
10. Yorkshire Water	Energy Manager
11. Northumbrian Water	Carbon Manager
12. Anglian Water	Energy Manager
13. Biwater Treatment	Regional Manager/ Engineering Manager
14. Earthtech	
15. Atkins	Principal Consultant- Regulatory Compliance & Research

Additionally, I wish to express my appreciation to my supervisor Dr Julia Meaton at the University of Huddersfield for her regular guidance, support and encouragement.

List of Acronyms

AMP	Asset Management Plans
CBA	Cost Benefit Analysis
CCB	Climate Change Bill
CCA	Climate Change Agreements
CCL	Climate Change Levy
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CRC	Carbon Reduction Commitment
CSCs	Customer Service Committees
DEFRA	Department for Environment, Food and Rural Affairs
DWI	Drinking Water Inspectorate
EA	Environment Agency
ECA	Enhanced Capital Allowance
ETS	Emissions Trading Scheme
EU ETS	EU Emissions Trading Scheme
EU	European Union
FDF	Food and Drink Federation
GDP	Gross Domestic Product
GHGs	Greenhouse Gasses
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention Control
MRV	Monitoring, Reporting & Verification
NAP	National Allocation Plans
OFWAT	Office of Water Services
PR09	Periodic Review 2009
R&D	Research & Development
RCV	Regulatory Capital Value
RDA	Regional Development Agency
ROC	Renewables Obligation Certificate
SDS	Strategic Directional Statements
UK CIP	UK Climate Impacts Programme
UK ETS	UK Emissions Trading Scheme
UKWIR	UK Water Industry Research
UNFCCC	United Nations Framework Convention on Climate Change
WTL	Water Technology List
WFD	Water Framework Directive
WWT	Water and Wastewater Treatment

Contents

1.0 Introduction

> *"The scientific evidence is now overwhelming: climate change presents very serious global risks, and it demands an urgent global response."* Stern (2006)

Stern (2006) highlighted the impacts of climate change in economic terms, stressing that it demands an urgent global response to mitigate its worst effects. In the UK, we have begun to identify ways of reducing our carbon (CO_2) emissions in order to support Stern's recommendations, and the UK government has considered a number of carbon policies to reduce emissions, including emissions trading schemes (ETS) and carbon taxation.

The Climate Change Bill, expected to come into force in Easter 2008, will impose annual targets for the reduction of carbon emissions, and sectoral targets for energy efficiency and renewable energy generation.

The UK water industry is a heavily regulated, energy-intensive industry, with statutory requirements to supply water and wastewater services and to meet stringent health and environmental quality standards (Water UK 2007). It is responsible for approximately four million tonnes of greenhouse gas emissions (CO_2 equivalent) every year. Although, this is less than 1% of total UK emissions, it is rising gradually year on year.

A recent UN[1] report claimed that climate change will lead to a 20% increase in global water scarcity and Stern (2006) stresses that our changing climate will also increase the occurrence of extreme weather events such as storms, floods and droughts.

These are just some of the impacts that the water industry is facing already. Climate change is now beginning to influence operations, asset serviceability and maintenance, and long-term strategic planning and investment decisions too.

2.0 Literature Review

The following review of the relevant existing literature was completed to identify the background and explore the key issues and gaps in research, with regards to climate change and its impacts on the water industry.

2.1 Climate Change

There have been a number of studies analysing the effects of our changing climate, but the Stern Review (2006), a report commissioned by government, highlighted the economic impacts, compelling many individuals and organisations to take realise the urgency and take action.

Stern (2006) discusses the huge market failure that climate change presents and explains that immediate action to mitigate its impacts should be considered as an investment with a long term pay back. He identifies that the world's natural resources will be at risk, including a reduction in crop yields, a 20% increase in water scarcity by 2013 and the worst hit parts of the world will be the developing nations, including Africa and Bangladesh. Climate change will also increase the occurrence of extreme weather events such as droughts, floods and storms, which presents major challenges for the increasing human population.

The Stern Review (2006) reduced economic uncertainties and considered existing scientific evidence. The review highlighted the economic impacts of climate change, urging industry, governments and individuals to take immediate urgent action to mitigate the worst effects. Stern (2006) predicts that strong, immediate, urgent action on a global scale would cost only 1% of global GDP; however, delayed action could mean a global cost of up to 5% of global GDP - the benefits of strong, early mitigating action outweigh the costs.

Al-Gore's Oscar winning documentary film, *"An Inconvenient Truth"* (2006) further strengthened this message, awarding him the Nobel Peace Prize jointly with the Intergovernmental Panel on Climate Change (IPCC), and prompted international awareness and action to mitigate the risks of climate

[1] UN report 2007- *"Coping with Water Scarcity- challenge for the 21st century"*

change, including the introduction of strong environmental policies, by pushing climate change up the political and public agendas.

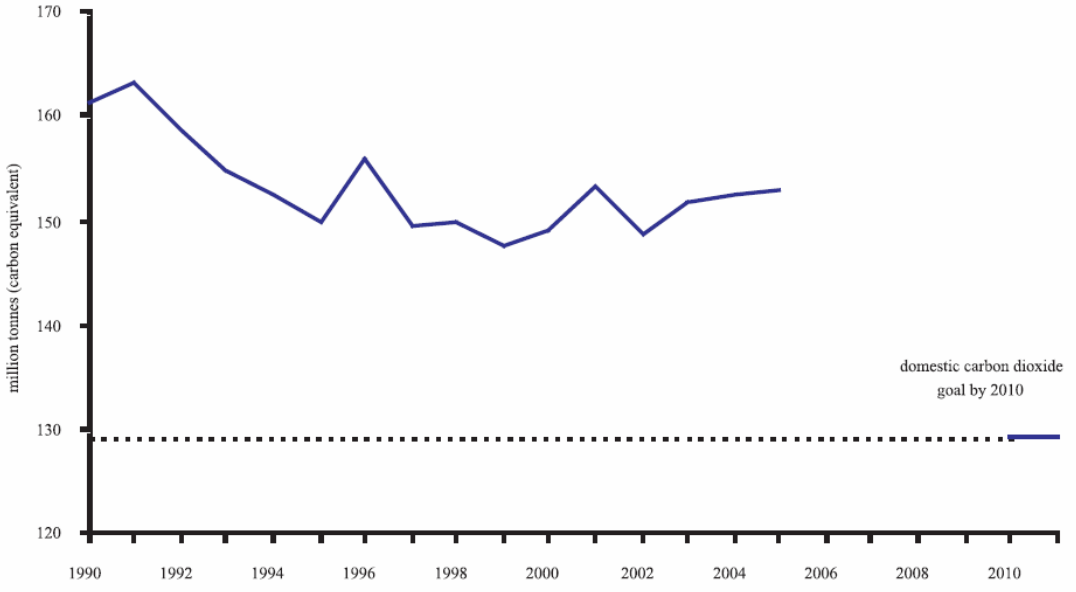
The UK Government has been advised on climate change issues by a number of international organisations, including the Intergovernmental Panel on Climate Change, a scientific body providing policymakers with an objective source of information about the causes of climate change, and the options to respond to it. The information they provide is based on scientific evidence and reflects existing viewpoints within the scientific community around the world (IPCC 2007).

As a result of both the Stern Review (2006) and *"An Inconvenient Truth",* a number of high profile organisations such as Marks and Spencer, Tesco, J Sainsburys and Dell launched high profile green initiatives, including plans to become carbon neutral, reducing carbon emissions and increasing investments in renewable energy generation. Marks and Spencer published *'Plan A'* – the organisation's sustainability strategy, which includes their plans to become carbon neutral, send no waste to landfill, safeguard natural resources and trade ethically; by 2012 (Marks & Spencer 2008). A number of other organisations have also begun to analyse their carbon footprints and consider their corporate social responsibilities.

The UK has three climate change targets: an international target under the Kyoto Protocol to cut a combined basket of Greenhouse Gases (GHGs) by 12.5% below 1990 levels by 2008-2012; a domestic target to cut carbon emissions by 20% by 2010; and a further domestic target to cut carbon emissions by 60% by 2050. The UK met its Kyoto target in 1999, nine years ahead of schedule, largely as a result of the '*dash to gas'* during the 1990s. UK CO_2 emissions dropped by over 6.3% between 1990 and 1997, although emissions have risen since 1997, as shown in Figure 1. The result is that the UK is very likely to miss the domestic target of a 20% cut by 2010, as the Government admitted in the Climate Change Programme Review in March 2006 (Osbourne 2006).

In addition, Figure 1[2] is based on the Government's own data, which does not include the rapidly growing emissions from aviation.

Figure 1: UK carbon dioxide emissions, 1990-2010



Note: Estimates for 2005 are provisional. Updated Aug 2006. Source: Defra

2.2 Climate Policies

Some of the most significant existing environmental policies aimed at protecting our planet from the impacts of climate change are discussed below.

[2] Osbourne (2006)

2.2.1 Kyoto Protocol

The Kyoto Protocol is an international agreement, ratified by 55 countries, which set legally binding emissions reduction targets for developed countries. The Protocol, which finally came into force in 2005 covers carbon dioxide (CO_2), methane (CH4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) (Lee et al 2007).

Whilst, industrialised countries agreed to cut their combined emissions by 5% from 1990 levels by 2012, each country agreed to its own target. The EU agreed to cut emissions by 8%, whilst some countries with low emissions were granted permission to increase them. The UK is on target to meet and surpass the emissions reduction targets required for the Kyoto Protocol (Defra 2008).

One of the reasons for not including developing countries in commitments to reduce emissions was concerned with the ethics and the *Polluter Pays* principle. It is commonly recognised that much of the effects of climate change will be felt by those developing countries that have contributed the least, such as Africa and Bangladesh. Des Jardins (2001) explains that environmental justice investigates the social distribution of environmental benefits and burdens. Therefore a society *"that distributes these benefits and burdens unequally is prima facie unjust"*. Paulsson (2003) explains that this usually occurs when the lower income part of the population is exposed to a disproportionate share of the total population's environmental burdens. They are more vulnerable to the effects of climate change (such as floods, droughts, rise in sea levels etc), as those on higher incomes will move away from areas most threatened by the effects.

However, the US pulled out of the Kyoto Protocol in 2001, believing that it was *"fatally flawed"* as developing countries such as Brazil, China and India, who were among the world's largest emitters of GHGs, were not required to commit to emissions reductions targets in the agreement (BBC 2005). The lack of equal obligations for developing countries in the Kyoto Protocol has been identified as the key criticism of the agreement, and economists argue that for any further international agreement to be effective post 2012 when the Kyoto Protocol ends, it must include both developing countries and 'non-ratifiers' (such as the USA), in order to capture the world's largest emitters (Kolk and Hoffmann 2007; Grub 2000).

2.2.2 EU Emissions Trading Scheme (EU ETS)

The EU Emissions Trading Scheme, launched in 2005, has been described as the first cross-border emissions trading scheme to address GHGs, covering around 45% of emissions from the EU. It covers carbon dioxide emissions from combustion equipment over 20MWt and a range of industrial processes, and has captured over 1,000 installations in the UK. It covers large energy-intensive sectors including electricity and heat generation, cement production, pulp and paper and more. The scheme is part of the EU's Climate Change programme, and was introduced to try and cost effectively achieve the EU's obligations under the UNFCCC and the Kyoto Protocol; which requires a reduction in emissions of 8% by the years 2008-2012, compared to 1990 levels (Schleich et al 2004; Egenhofer 2007).

The hybrid *'cap and trade'* model adopted by the EU ETS is seen to be most effective, with low transaction costs. Parry (2002) explains that the hybrid policy or *"safety valve",* which has been recommended by many economists, and ensures that a proportion of emissions can be grandfathered (freely allocated) in order to meet particular environmental goals, but additional allowances would be available if the allowance price and the cost of abatement was too high. This is a gentler introduction to the scheme and government can reduce the grandfathered allocation annually, in the same way the total emissions allocation will be reduced annually.

Member states were required to produce National Allocation Plans (NAPs), and the allocation process was left to each member state, in line with EU practice. Egenhofer (2007) argued that this high degree of decentralization was *"the price to pay for both member state and industry support"*. This led to inconsistencies in allocation, installation definitions and issues relating to monitoring, reporting and verification.

Allowances are distributed or auctioned at the beginning of each year and the Scheme requires companies to surrender sufficient allowances to reconcile their annual CO_2 emissions. The Scheme was adopted over a short time period, and this led to a number of compromises, which have been discussed below. Companies can sell surplus allowances on the carbon market, and failure to

surrender sufficient allowances will incur severe sanction payments, and companies will be expected to surrender the missing allowances in the following year (Schleich et al 2004).

According to the Directive, at least 95% of allowances were allocated free of charge for Phase 1 (2005–2007). For the first Kyoto commitment period, i.e. for 2008–2012, less than 10% will be auctioned. The auctioning of allowances is generally accepted to be more effective than free allocation (grandfathering), by applying the *Polluter Pays* principle. Egenhofer (2007) adds that the free allocation was a method of 'buying' initial industry acceptance, and to offset the additional costs of participation in the scheme.

The most significant trading in the initial phase was by the power sector, and was stimulated by the rising gas and falling coal prices, which resulted in an increase in emissions. Participants from countries with tight allocations were then compelled to trade for surplus allowances to reconcile their additional emissions. There were issues of data collection and due to the lack of verified data; trading activity was largely guided by expectations in the first phase.

2.2.2.1 Key Lessons Learned

The three key fundamental areas of the EU ETS for review, include cap setting and allocation, distributional impacts and implications for investment. Egenhofer (2007) explains that the highly decentralised process of cap setting and allocation reflects the differences in economies, energy mixes and level of development of member states, and is not merely a political compromise to get the EU ETS adopted. Similarly to the Eurozone, a 'one size fits all' approach was not deemed appropriate at the time.

2.2.2.1.1 Cap setting

Caps, set by member states, were deemed to be too modest, despite them being lower than 'Business as usual' levels. Projections of emissions reduction were also highly inflated and Egenhofer (2007) describes this combination of modest cuts and inflated projections as 'disastrous'. He discusses the collapse of the EU allowances in Phase 1, from €30 t/ CO_2 to €1 t/ CO_2 in May 2006, due largely to the surplus allowances generated as a result of inflated projections and caps which were close to 'Business as usual' levels. Ellerman and Buchner (2006) believe that both abatement and over allocation led to this surplus in allowances. This over allocation weakened the efficiency and effectiveness of the Scheme.

The inconsistencies experienced from allowances allocated by member states led to a number of distributional impacts. Each member state developed its own rules, and industry sectors in each member state were allocated different levels of allowances. However, if the cap is set too low, non-trading industries will be required to reduce higher amounts in order for the member state to still be on target to reach their Kyoto targets.

2.2.2.1.2 Distributional Impacts presented by allocation methodologies

Distributional impacts are also presented by allocation methodologies, which include grandfathering, auctioning and benchmarking. Grandfathering is the free allocation of permits based on historical output, and it is argued that this approach would reduce competitiveness by favouring large organisations and disadvantaging smaller organisations. This is exacerbated further as equity concerns are raised because of the windfall gains which would be handed out to the large polluters, who were slow to react in the first place. This may also suggest that by emitting more now, participants may receive a larger permit allocation in the future; providing a counter balancing incentive to continue emitting (Edwards and Hutton 2001).

Parry (2002) adds that the costs of grandfathering are often considerably higher than usually predicted, when knock on costs are also accounted for (including unemployment, increased production costs and reduced economic activity); and attempts to analyse the extent to which environmental policies exacerbate distortions in the labour markets, created by the broader tax system.

Auctioning of allowances in an emissions trading scheme is carried out by the government, raising revenues, which can be recycled to reduce other taxes and subsidise energy efficient technologies. Cramton and Kerr (1998) argue that this is the more efficient and effective method to allocate emissions allowances *"…because it allows reduced tax distortions, provides greater incentives for*

innovation, more flexibility in distribution of costs and reduces the need for politically contentious arguments over allocation."

Parry (2002) adds that an auctioning methodology allows a *double dividend* to be achieved as revenues raised from the auctioned allowances could be refunded through labour tax cuts (i.e. income/payroll taxes), increasing employment and reducing pollution at the same time and allowing efficiency gains to be made. However, Egenhofer (2007) argues that the limited amounts of allowances which were auctioned in the EU ETS, would not allow for a significant *double dividend* impact. Stern (2006) adds that auctioning of allowances will deliver a number of efficiencies.

Grandfathered permits could leave low-income households worse off, as high income households' benefit from the revenues generated by the extra allowances. However, with an auctioned allocation format, revenues are received by the government, which can be recycled to benefit everyone, or disproportionately favour the poor, through reductions in income taxes (Parry 2002).

Benchmarking is where firms are allocated permits according to an emissions target based on a regulator's judgement of best practice for that industry, similar to the best available technology principle in the IPPC directive (Edwards and Hutton 2001). Participants would be penalised for emitting more than best practice for their company size and industry, but participants that expand can expect to receive a larger allocation. New organisations would also receive an allocation, thus reducing the disincentive effects on output in carbon intensive industries. However, Boehringer et al (1998) suggest that the free allocation of permits would prevent carbon intensive industries from moving to other countries, where they wouldn't be penalised in such a way (Edwards and Hutton 2001).

Although this seems a fairer option as all organisations will be paying for their carbon use, it has been argued that it is very difficult to define and apply to emerging and varying sectors and is also more bureaucratic. However, Egenhofer (2007) argues that the distributional impacts in the EU ETS could be overcome through allocating allowances by benchmarking. Although a few member states did adopt this methodology, the metrics used were inconsistent, and the lack of an EU-wide standard for best available technology has resulted in a lack of EU-wide benchmarks for industries.

In addition, although it was initially expected that the EU ETS would reduce distortions to competition in the EU market, due to the carbon price affecting all industries alike, inconsistencies in the allocation methods between member states have actually exacerbated this impact.

Other distributional impacts can be felt through the ability of a sector to pass on the extra costs and short-term profit losses experienced through participation in the EU ETS. For example, the power sector may invest in renewable or low carbon electricity generators in order to reduce its emissions, but these carbon costs are passed down the supply chain. In effect, the power generators are paid twice- once through the higher power prices (as the cost of carbon is passed down the supply chain) and secondly through the revenues generated/windfall profits gained from the free carbon allowances. This has a knock on effect for energy intensive industries within the scheme, which bear the brunt of the higher power prices, in addition to any additional allowances they may have to purchase. This may also result in potential losses in market share and distortions in international competition (Egenhofer 2007).

2.2.2.1.3 Investment

Porter and Linde (1995) argue that *"pollution=inefficiency and wasted resources"* and therefore efficiency gains made through investments in innovative low carbon solutions will save money as well as meeting carbon reduction targets. It is therefore important for organisations to understand that the short-term costs of making these efficiencies deliver long-term savings. This *"enhanced resource productivity"* will increase the competitiveness of an organisation, not reduce it, by allowing them to add value to and reduce the total cost of their product. This supports the argument that preserving the environment actually encourages economic growth and development. Schleich et al (2004) believe that the efficiency gains which would be realised by reaching emissions reduction targets from the EU ETS, are likely to incentivise organisations who can afford to abate their emissions through profits generated from the sale of their surplus permits to organisations with high abatement costs.

Egenhofer (2007) highlights that a successful market allows predictability for investment, by providing organisations with the certainty they need to make efficient investment decisions. A key criticism of the EU ETS is that it discourages, rather than encourages, long-term investments in new low carbon solutions. This is due in part to international indecision, which reduces predictability, but also to the fact that the certainty from current allocation periods (three/five years) is too short for investment cycles.

Phase 2 commenced on January 2008, with more stringent NAPs, which included more benchmarking and auctioning of allowances than the previous NAPs. The European Commission also adopted a methodology for all member states, to ensure equity for all, EU-wide.

The Directive anticipates the linking of the EU ETS with other emissions trading schemes. However, the designs of different emissions schemes may inhibit such linkages. Differences in allocation, sector coverage, monitoring, reporting and verification could be solved by the introduction of technical fixes to address these; however these may result in additional costs. Additionally, introducing international industry agreements could combine the similar characteristics of participants from industries on a global scale, and may help to reduce transaction costs of combining different ETSs for a global carbon market (Egenhofer 2007).

Looking ahead, there is an increased degree of regulatory certainty that the EU ETS will continue beyond 2012 and that there will be a carbon price. This could be improved for organisations looking to make long term investment decisions, through long term allocation roadmaps to draft the development of future allocation.

To realistically achieve the EU GHG reduction target of 20% by 2020 against 1990 levels, action will also be required from other industry sectors. The EU's energy efficiency and renewable energy strategies could also contribute to this target (Egenhofer 2007).

2.2.3 The UK ETS

The UK Emissions Trading Scheme (ETS) was successfully launched in April 2002, creating the world's first economy-wide GHG emissions trading scheme. The objective of the scheme was to enable business to gain practical experience with trading, and to assist in achieving the UK's climate change targets.

The results of this voluntary four year scheme included a reduction in CO_2e of 7.2million from the thrity three participants; and many lessons were learned about the standard and discipline of monitoring, reporting and verifying emissions for an ETS scheme, as well as the administration side of trading.

Although the government decided not to continue the UK ETS, the key lessons learned, including the burdensome high transaction and administration costs, issues of allocation, carbon pricing and cap setting, were fed into the design for the EU ETS and more recently, the Carbon Reduction Commitment, which is discussed in the next section. The UK ETS has introduced trading to industries in the UK, and as a result businesses are better prepared for future schemes (Defra 2007).

2.2.4 Climate Change Agreements & The Climate Change Levy

The Climate Change Levy (CCL) is a tax on the use of energy by industry and the public sector, and is paid through the energy bill (Baker 2008). It is a 'downstream' tax paid by the consumers of energy rather than generators, with the rate varying according to fuel and energy content. Electricity generated from renewable generation, waste solids and Combined Heat and Power (CHP) systems is exempt from the levy (Osbourne 2006).

George Osbourne MP (2006) from the Conservative party highlights that the CCL has a number of flaws and has been criticised for being a tax on energy and not a tax on carbon. While the need for a tax on carbon emissions by business is now generally accepted, the current structure has been widely criticised by academics, business and environmental organisations. The Conservatives believe that the Climate Change Levy needs to be replaced by a Carbon Levy to enable the UK to effectively mitigate the risks of Climate Change, highlighted by Stern. He adds that the four principles that a reformed system should satisfy include:

1. The rates of a Carbon Levy should be more closely linked to carbon emissions in order to provide the right incentives for investment in low-carbon technologies.
2. Any reforms should be revenue neutral overall for business, and should minimise the negative impact on the competitiveness of energy intensive sectors.
3. A Carbon Levy should continue to exclude the domestic sector.
4. The system should provide a stable framework over the long-term, including compatibility with the EU Emissions Trading Scheme and future schemes (Osbourne 2006).

This energy tax is supplemented by a system of Climate Change Agreements (CCAs)- agreements between energy intensive industries and the government, which set out energy efficiency and carbon reduction targets. Participants in the CCA's who meet their targets receive an 80% reduction in the CCL. Targets are negotiated at an industry level, and discounts are lost if the sector fails to meet the targets (Baker 2008). Industries with CCAs have also been able to participate in the UK Emissions Trading Scheme (UK ETS) to help meet their targets. In addition, some companies with CCAs also have obligations under the EU ETS (Osbourne 2006).

Goodall (2008) argues that a tax on energy is equivalent to a tax on carbon emissions as the use of energy from fossil fuels results in CO_2 emissions into the atmosphere. However, Osbourne (2006) argues that the key issue is that the rates paid by businesses on their energy use do not reflect the carbon emissions from that energy, presenting a little incentive for businesses to switch to low carbon sources of energy. The Royal Commission on Environmental Pollution described the CCL as a "*blunt instrument*" that would "*not be effective in reducing carbon dioxide emissions".*

Osbourne (2006) highlights that the same criticism has been made by many other commentators, including David Miliband's special adviser and long time adviser to the Labour Party on environmental policy Tony Grayling, who believes that the CCL "*does not provide an incentive to switch to lower carbon fossil fuels" (*Grayling et al (2005)*.* David Pearce, a pre-eminent environmental economist, highlighted that the CCL would not be sufficient to meet the UK's climate targets (Pearce 2005).

Several commentators have pointed out that the current rates of the CCL do not reflect the true social cost of carbon. For example, Grayling (2005) recommended that the rates should be increased the official figure for the social cost of carbon used by Defra. However, there is considerable uncertainty over the correct figure for the social cost of carbon. When considering the optimal rates of a Carbon Levy it will also be important to take into account the interaction with other policies aimed at reducing emissions, particularly emissions trading schemes (Osbourne 2006).

Several commentators have expressed concerns that the targets set out in CCAs have not been sufficiently ambitious and that as a result emissions have not been significantly lower than they would have been in the absence of the CCAs. For example, in a study for the OECD, Pearce (2005) suggested that the targets have been lenient and this argument is supported by the carbon trades in the UK ETS, which were at a low carbon price, suggesting that carbon reductions were easily achieved (Pearce 2005). In addition, differences in complex design structures, coverage and reporting will present further issues for integration with other national and international policies such as the EU ETS.

2.2.5 The Climate Change Bill

The Climate Change Bill (CCB), expected to come into force in April 2008, sets out a framework for moving the UK to a low-carbon economy. The Climate Change Bill includes a series of targets for reducing emissions- including a legally binding 60% reduction in carbon emissions by 2050 and a 26 to 32% reduction by 2020. The Scottish recently announced that they will put in place plans to reduce emissions by 80% by 2050 and many environmentalists have argued that the UK target in the CCB must aim higher, making reductions of 80-90% by 2050 to really mitigate climate change impacts (Caffoor 2007; Defra 2008).

The Bill introduces a new system of legally binding five year "carbon budgets", set at least 15 years ahead, to provide clarity on the UK's pathway towards its key targets and increase the certainty that businesses and individuals need to invest in low-carbon technologies.

A new statutory body, the *Committee on Climate Change*, will be created to provide independent expert advice and guidance to Government on achieving its targets and staying within its carbon

budgets and the bill will give the Government new powers to enable them to more easily implement policies to cut emissions.

A new system of annual open and transparent reporting to Parliament will be made necessary. The *Committee on Climate Change* will provide an independent progress report to which the government must respond. This will ensure the government is held to account every year on its progress towards each five year carbon budget and the 2020 and 2050 targets. The Bill will also include a requirement for government to report at least every five years on current and predicted impacts of climate change and on its proposals and policy for adapting to climate change (Defra 2007).

The UK government has considered a number of economic tools to reduce GHGs, include carbon taxation and the introduction of emissions trading schemes (ETS). The Climate Change Bill contains enabling powers to introduce new trading schemes, including the Carbon Reduction Commitment (CRC) to achieve the carbon reduction targets. The government is currently liaising with key stakeholders in the consultation for the CRC which is expected to be completed by summer 2008 (Defra 2008).

2.3 Carbon Taxation

Carbon taxes have been considered by government for many years; however there has been much debate over the effectiveness of a tax on the level of emissions reduction. A carbon tax has an indirect impact on emissions and assumes that an increased price will deter more consumption; however Parry (2002) argues that emissions tax puts a ceiling on economic costs, allowing firms to pay a higher tax bill if costs of abatement are too high.

Alternatively, an emissions trading scheme guarantees a direct emissions reduction, reduced year on year in order to meet global emissions reductions targets, forcing companies to prioritise abatement technologies and processes in order to reduce their emissions.

However, Lee et al (2007) review the work of other economists on carbon taxation, concluding that they have a modest impact on emissions and adversely affects GDP. They refer to the work of Bruvoll and Larsen (2004) who identify that Norway's relatively high carbon taxes since 1991 have only delivered a 2% reduction in carbon emissions; and suggest that carbon taxes should be implemented together with other economic tools such as emissions trading schemes. This argument is echoed by Stern (2006) and other environmental economists, who have argued that there are strong theoretical and practical arguments why environmental taxes should be used alongside emissions trading and regulation in a coherent policy package. Osbourne (2006) adds that taxation can play a role in applying the *Polluter Pays* principle, to offset the excessive use of grandfathering.

Parry (2002) highlights that Denmark recently introduced a number of green taxes on sulphur dioxide, carbon, fossil fuels and electricity. The revenues raised amount approximately 3% of GDP and were used to lower personal and payroll taxes and provide tax incentives for energy efficiency. However, Parry (2002) considers the conflicting objectives of government agencies, and questions the likelihood that the revenues raised would be used effectively by governments. Environmental organisations may be more inclined to use the taxes to meet particular environmental goals, where as Treasury may be concerned about the revenues. However, given that the revenue raised will be a significant sum, Cramton and Kerr (1998) argue that governments will be forced to be more transparent on how this is spent. Parry (2002) also considers other ways Treasury may spend this revenue, concluding that if revenues were used to reduce the federal budget deficit, this would provide a long term economic gain by reducing the national debt, and therefore we would assume this would imply a tax cut in future years.

2.4 Emissions Trading

There is general agreement between environmental economists that an ETS is well suited to restrict the emissions of a uniformly dispersed pollutant such as CO_2 (Tietenberg 1985). A '*cap and trade'* system applies an upper limit to the total number of annual emissions, with the intention that the cap is reduced gradually year on year, to make direct carbon reductions (Stern 2006).

Stern (2006) highlights that the 3 key issues for developing successful climate policies for mitigation include carbon pricing, technology policy and the removal of barriers to behavioural change. He adds that all climate policies must be long term to make a significant impact and allow organisations to plan

for the future; and a shared understanding of the long term goals may support and reduce the costs of mitigation.

An emission trading scheme provides GHG emitters with an opportunity to identify the most cost effective ways of reducing their emissions, by ensuring that the market price of carbon is equal to the lowest marginal abatement cost. Sarwar (2008) explains that individuals are made responsible for their carbon impact on the environment and pay the full social cost of their polluting activities, when a cost is applied to carbon. Carbon allowances are allocated by the government and some of the most common allocation methodologies are discussed earlier in this literature review (Distributional Impacts presented by allocation methodologies in 2.2.2).

Participants in the scheme will be encouraged to factor carbon reduction strategies into all aspects of their business and decision making procedures, allowing an ETS scheme to go beyond conventional environmental policies, which are often seen as an inescapable overhead. Ekins and Speck (1998) discuss the benefits of good environmental policies, which should encourage innovation and improvement through investments designed to achieve environmental improvements- by promoting a holistic approach to achieving the environmental improvements, rather than dictating to industry how they must be achieved (Sarwar 2008; Egenhofer 2007).

There are a number of uncertainties surrounding climate change and environmental policies, but Stern (2006) stresses that this is an argument for more, and not less, demanding target reductions, based on worst case scenarios. Ekins and Speck (1998) suggest that the uncertainty around investments in low carbon solutions and impacts of environmental policies should instead be viewed as an opportunity to understand and influence government regulation, by participating in key consultations and the development of new emerging environmental markets. Egenhofer (2007) explains that the uncertainty is reduced to an extent in an ETS, through the carbon price, which can the deliver long-term predictability companies require to make adequate investment decisions, to support their carbon reduction strategies.

An ETS can provide certainty for the levels of CO_2 emissions reductions, provided the overall cap is enforced at below business as usual levels; and therefore lends itself well to the targets set in the Kyoto Protocol, which are expressed in absolute terms. This supports participants' requirements for long term planning and enables them to consider investments in low carbon solutions in a long-term context (Defra 2007 and Egenhofer 2007).

Sarwar (2008) refers to Porter and Linde (1995) who highlight the need for a shift in attention to understand environmental improvements in terms of resource productivity. Regulators and managers must consider the opportunity costs of pollution- including wasted resources and effort, and the diminished product value, rather than focussing efforts on end of pipe solution to treat the pollution. Resource productivity and innovation have increased competitiveness and delivered environmental improvements by encouraging organisations to address pollutants at source; and this recent shift in attitudes has silenced many critics who believed that environmental regulation stifles economic development.

There is a common perception that emissions trading schemes promote a *"license to pollute"* and Paulsson (2003) explains that a major ethical argument against carbon trading is that it begins to recognise polluting our planet and emitting carbon or other GHGs as an approved and accepted activity, rather than something you would be fined and discouraged from doing. The permission to continue polluting reinforces the perception in some, that it is not as damaging as many scientists have predicted.

Although the EU had rejected initial discussions about emissions trading schemes, the USA insisted that they should be included in the Kyoto Protocol, which returned them to the EU agenda. It is also believed that other tools to address GHGs explored by the EU had been unsuccessful (taxation is at the discretion of member states), and hence it was somewhat inevitable for them to adopt an ETS (Egenhofer 2007). Klaasen (2005) adds that emissions trading was also incorporated into the Kyoto Protocol based on the flexibilities of international emissions trading which were expected to lower abatement costs.

There are a number of existing emissions trading schemes around the world, including those in Europe, America and Asia Pacific, and these are outlined in Appendix 1. The USA has had several ETSs since the 1970s, including the SO2 Acid Rain Programme, which has become the reference point for global emissions trading (Klaassen 1996).

Egenhofer (2007) has explored the development and future prospects of the EU ETS in his paper *The Making of the EU Emissions Trading Scheme: Status, Prospects and Implications for Business*. His comments regarding the challenges and compromises of the EU ETS were discussed earlier in this literature review.

2.4.1 Carbon Reduction Commitment

The Carbon Reduction Commitment (CRC) is a *'cap and trade'* scheme designed for non-energy intensive industries, to reduce carbon emissions from energy use (electricity, fuel, oil, gas) from large commercial and public sector organisations (including supermarkets, hotel chains, government departments, and large local authority buildings). The Scheme is currently in the planning process and is scheduled to start on 1st January 2010.

The CRC aims to reduce carbon against current levels by 8% (1.1 MtC / year) by 2020, although there are discussions that this should be increased (Smyth 2007). In order to achieve the UK's carbon reduction targets, reductions must be achieved in all parts of the economy. The CRC is based on a gap analysis of existing measures for targeting a different part of the economy, not previously covered by EU ETS and CCA. (Defra, 2008)

Prior to the consultation for the Carbon Reduction Commitment, the UK Government considered a number of other policy options for CO_2 emissions reduction within the non-energy intensive sectors, including the expansion of the EU ETS, expansion of the CCAs, extending the voluntary UK ETS and a mandatory reporting and benchmarking scheme. After evaluating all options, the Carbon Reduction Commitment (previously known as the Energy Performance Commitment) was approved by the government and Defra began the industry consultation (Defra 2007).

2.4.1.1 Inclusion Criteria

It will apply to the largest organisations in these sectors, whose mandatory half-hourly metered electricity consumption is greater than 6,000MWh per year. Defra has confirmed that 2008 will be the qualifying year for the CRC and users of half hourly meters will be sent details of the criteria for the CRC by the UK energy suppliers, during February/March of 2008.

Those potential participants who fit the criteria of the Scheme will be expected to provide details of their energy use during 2008, so that qualification or exemption from the Scheme can be confirmed by the government in 2009 (Defra 2008). Additionally, Defra (2008) has decided to include all central government departments in the CRC, regardless of whether they meet the inclusion criteria, to demonstrate strong leadership and commitment to the Scheme. Defra has outlined the CRC qualification in a timeline, which is available in Appendix 2.

2.4.1.2 Monitoring, Reporting & Verification

During the year, participants will be expected to self monitor, report and verify (MRV) their emissions, buying or selling deficit or surplus allowances. The MRV process is an auditable business process, which ensures the accuracy of emissions allowances reporting (Smyth 2007). It is anticipated that participants will benefit from selling surplus allowances while retaining a strong incentive not to have to buy additional emissions allowances on the carbon markets.

The Environment Agency (2008) highlights that participants will also have access to additional allowances from the '*safety valve'* mechanism proposed by Defra- a '*buy only'* link to the EU ETS. This maintains the integrity of the scheme, as participants still pay for an emissions reduction somewhere within Europe (Radov et al, 2006).

2.4.1.3 Revenue Recycling and the League Table

The revenues generated by the sale of carbon allowances will be recycled back to participants based on their performance in a league table at the end of the following year. This will be based on absolute

emissions reductions per year (percentage reduction in emissions per unit turnover), providing economic incentives for companies to reduce their carbon emissions.

Well performing companies will be rewarded and those at the bottom of the table will be penalised. This in effect means that well performing participants will ultimately get back the revenue they have spent on emissions allowances on a rolling 24-month cycle. At the end of each year, 20% of market participants will be audited (Defra 2007).

In order to ensure that participants remain incentivised to abate their emissions, particularly in the introductory phase where there will be no government imposed cap; the government has decided to introduce a bonus/penalty rate which would increase gradually year on year. This will be +/-10% in respect of the first year of the introductory phase, rising to +/-20% in respect of year two, +/-30% in respect of year three, +/-40% in respect of year four and +/-50% in respect of year five.

Additionally, to provide further certainty, the government will invite the views of the *Committee on Climate Change* to discuss how much further the CRC bonus/penalty revenue recycling regime should be strengthened in respect of years 6 and beyond. It is important to note that the government has not ruled out the possibility of this reaching up to +/-100% (Defra 2008).

2.4.1.4 Phases and Cap Setting

The first phase is expected to span the first 3 years (1st January 2010- 31st December 2012), and to allow participants to become more accustomed to the Scheme, allowances will be made available in a fixed price sale. This introductory phase will be a learning experience for participants, allowing them to gain experience of managing, reducing and reporting their emissions and participating in the trading scheme.

The government is keen to introduce a strong carbon price in this phase to motivate investments in abatement, whilst also trying to limit the costs. In order to maintain consistency and avoid any significant jumps in allowance prices in subsequent capped phases, allowances will be sold at £12/t CO_2, in two fixed price sales in the first year of the Scheme (Defra 2008).

2013 will see the introduction of the carbon cap and Phase 2 of the CRC. Participants will be required to submit bids for allowances, which will be allocated on the basis of a periodic auction.

The availability of allowances will be unrestricted during Phase 1, but will be restricted during Phase 2, when caps will be set in line with the UK's emission reduction targets as set out in the CCB. It will be possible to bank surplus allowances from one year to the next, with the exception that allowances purchased during Phase 1 will not be allowed to be carried into Phase 2 (Defra 2008).

The government has decided that the *Committee on Climate Change* will be asked to advise on the level at which the CRC caps should be set. To prevent price spikes in the secondary market (a black market of carbon), the *safety valve* mechanism proposed by Defra will prevent price spikes in the secondary market, via the *'buy only'* link to the EU ETS (Defra 2008).

It is expected that energy savings will be made during the first phase, due to increased management attention, and the knowledge that the subsequent phase will apply a cap (Radov et al, 2006).

Participants in the CRC will be required to undertake extensive planning to understand the internal impacts and externalities, which may impact upon their carbon footprint and therefore the number of allowances they are required to surrender in the CRC.

2.4.1.5 Key Challenges

However, there are several significant challenges for the implementation and successful participation in the CRC scheme. Some of the most significant challenges include accurate data collection, understanding and participation in an emissions trading scheme and making significant carbon emissions reductions.

Participants are expected to incur necessary expenses to ensure accurate data collection and reporting, and the CRC is expected to be a key driver for this. Data quality remains a key issue in accurate reporting and this will be significant through the audit process (Smyth 2007).

There is also a fear of change, and it is expected that the CRC will drive the much-needed behavioural change. For many participants, the CRC will be their first experience of emissions trading. Although Defra has held a number of stakeholder engagements and workshops to support companies and industries that will be required to participate in the CRC, plans are being drawn up to ensure appropriate guidance is also available. Smyth (2007) argues that despite Defra's attempts to ensure a 'soft landing', the data issues, broad cultural change and the specific process and organisational changes that participants will have to accommodate represent a huge challenge.

Participants will be required to explore methods of reducing their emissions to meet the CRC cap. Renewable energy generation and energy recovery will be key technologies to reduce participants' energy-related carbon emissions. Smyth (2007) argues that in order to deliver effective risk management and ensure the accuracy of the their position during a trading year, it is likely that most participants will need a full year of testing post-implementation to ensure compliance and accuracy of data, reporting and the financial positions taken. Participants will have monitored and measure their energy use and carbon emissions in 2009, giving them an opportunity to address any discrepancies, and the introductory phase will also provide participants with a learning opportunity of how to participate in an ETS.

Another challenge is the lack of cross-industry accounting protocols to support their day-to-day operations. Finally, there are a number of uncertainties surrounding the final design and implementation of the CRC scheme. Defra is currently consulting on the implementation of the CRC and a number of decisions are yet to be made. Finalised information is expected to be published after the final consultation in summer 2008 (Defra 2008; Smyth 2007).

2.4.1.6 Benefits of the CRC

In addition to the benefits of addressing climate change and meeting the UK's carbon reduction targets to achieve the 1MtC a year cut by 2020, Smyth (2007) has highlighted the other benefits of the CRC, which are highlighted below.

Smyth (2007) argues that participation in the CRC will increase liquidity, as approximately five thousand participants join the global carbon trading market. He argues that even if they do not actively trade or make substantial transactions, their presence will bring greater liquidity to the market and should reduce price volatility. However, economists argue that the substantial levels of additional cash, which participants would require to purchase carbon allowances, would weaken an organisation's liquidity position.

Secondly, the auctioning of allowances adopted by the CRC will bring a more accurate price for carbon, which will be less subject to the vagaries associated with allocation, as we have seen from the EU ETS.

Additionally, it should position the UK as a global capital for carbon. The UK will be first economy to roll out emissions trading on such a large scale, and will inevitably develop greater maturity and understanding of the carbon market. The new market will attract investment and will enable UK businesses to prepare for the future development of carbon markets. Finally the link with the EU ETS will allow participants with access to the global carbon market, allowing them to buy additional allowances from other markets to make up for deficits (Defra 2006; Smyth 2007).

2.4.1.7 Long Term Future

There is scope for expanding the CRC coverage in the future, given the stated intentions in the Energy White Paper (2007), which may result in the CRC inclusion threshold being lowered from the current level of 6,000 MWh/year (Defra 2008).

2.4.2 The CRC and EU ETS

There are a number of similarities between the EU ETS and the CRC, and efforts are being made to adopt a similar design to ensure smooth linkages between the two schemes.

The Environment Agency is producing the registry for the CRC, which will be a means of allocating and tracking allowances as they change accounts, and for the reconciliation of allowances at the end of each compliance year. Similar to the compliance cycles for the EU ETS, participants of the CRC will be required to report their aggregated energy use and associated emissions and surrender sufficient allowances at the end of each compliance year.

The CRC will built upon lessons learned from the UK ETS and EU ETS, to minimise the cost burden of participation, and the regulators are agreed that the scheme will therefore be '*light touch'* in its approach. It will therefore be based on self reporting, as opposed to 100% verified like the EU ETS, in order to reduce the burdens of participation.

For the purposes of registry reporting, participants will need to submit high-level information, including aggregated energy use, and will be required to maintain an evidence pack to support this data. An audit regime will be integrated; auditing up to 20% of participants in Phase 1.

3.0 The UK Water Industry

The UK water industry supplies around 15 billion litres of water per day to the population of England and Wales. It also collects and disposes of over 10 million tonnes of wastewater every day. In order to do this the industry has over 350,000km of sewers, 6,000 discharges from sewage treatment works and 25,000 intermittent discharges (Environment Agency 2008). As a result, the water industry has the potential to have a great impact on the environment and is a heavily regulated monopolistic industry. To understand the structure of the water industry, it is useful to explore the history and regulatory framework.

3.1 History of the UK Water Industry

The Water Act 1945 brought together previous water legislation and introduced a waterworks code. It encouraged the amalgamations of water companies and boards to reduce inefficiencies. The Water Act 1973 created the ten water authorities that were later privatised. They took over from the local authorities and water boards and their role was *"to plan and control all users of water in each river catchment area"*. Their responsibilities included water conservation; controlling pollution of inland and tidal waters; land drainage and flood control; fisheries; and supply of water and sewerage services. The ten water companies were subject to government targets and financial control like nationalised industries (Ofwat 2002).

The Water Act 1989 led to the privatisation of the water authorities and gave rise to ten water and sewerage companies, all owned by parent companies. The water companies were responsible for supply of clean water and treatment and disposal of sewage (Environment Agency 2008). The Director General of Water Services (the Director) was appointed to be the economic regulator of the industry. He was responsible for setting price limits to control the revenue companies can collect from their customers in bills, and protecting customer interests; and set up ten regional Customer Service Committees (CSCs). These are independent of the water industry and they serve to represent customers. In order 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*" (Ofwat 2002).

The present water industry is made up of ten main water and sewerage companies. They deal with clean water and wastewater. In addition, 17 water only companies deal with just clean water. Water UK represents all UK water suppliers and wastewater operators at a national and European level (Environment Agency 2008).

Since the privatisation of the UK water industry, the water companies have been faced with managing shareholder expectations, whilst operating in an environmentally sustainable manner and delivering a high quality service to customers. The UK water companies are subject to regulation by three primary bodies; Ofwat, the Environment Agency (EA) and the Drinking Water Inspectorate (DWI) (Dixon 2007).

Robinson (2000) has argued that privatisation has been less effective in the water industry than it has in other industries, and this lies in the monopolistic nature of the industry. He stresses the need for increased levels of competition, something which Ofwat are driving though a number of initiatives; adding that *"competition can drive dynamic efficiency and spur innovation in a way that regulation generally cannot."*

3.2 Regulation

The *Environment Agency* (EA) is the environmental regulator for the water industry. The EA analyse, inform and advise on the water industry's environmental performance in the delivery of existing environmental requirements by monitoring compliance with their consents; recording the number of pollution incidents; and taking and monitoring enforcement action. Another water quality regulator is the *Drinking Water Inspectorate (DWI),* which regulates the quality of water supplied to customers.

The *Office of Water Services (Ofwat)* is the economic regulator of the water industry. It sets limits on prices the water industry can charge its customers. They are responsible for ensuring that consumers receive reliable services and value for money, and that each company is able to meet its environmental obligations now and in the future. Price limits are reviewed every five years, and prices were set at the previous price review in 2004 for the 2005 – 2010 (Weatherley 2008).

As part of the price review in 2004, Ofwat decided how much water companies can charge their customers for providing drinking water and dealing with sewage from 2005 to 2010. The price limits are set for each company by forecasting the minimum revenue that it is likely to need to run its business efficiently. This is compared with the revenue the company is expected to receive, and the percentage change needed after allowing for inflation is calculated. Ofwat set out the minimum service that is expected from each company, and methodologies for how to deliver these are decided at company level (Ofwat 2008).

The water companies extract vast amounts of water from our environment, to provide enough to supply our everyday use. After suitable treatment, they discharge most of this into rivers or the sea, and it is important that companies must protect the environment, promote the efficient use of water, and meet legal requirements. The Environment Agency plays a significant role in deciding what environmental improvements the water industry should make. The environment programme is needed in the water companies' five-year Asset Management Plans (AMP), which are part of the Periodic Review process (Environment Agency 2008).

The environmental improvements expected to be delivered by water companies over a 5-year period are decided by Ministers as part of Ofwat's reviews of price limits (Periodic Reviews). Periodic Reviews take place every five years. The Environment Agency, English Nature and the Countryside Council for Wales advise government ministers on the environmental priorities for the Periodic Review. The next Periodic Review (PR09) takes place in 2009 and covers the five years from April 2010-2015 (Ofwat 2008).

3.3 Water Strategy 2008 – Future Water

Future Water is the government's strategy for how they want the water sector to look by 2030, and identifies some of the steps needed meet the plans. It highlights the need for reductions in water wasted by industry, highlighting that savings of up to 30% can be achieved on water and effluent bills. In addition, savings could increase to 50% by investing capital in long-term water saving projects (Defra 2008).

The Food and Drink Federation (FDF) has responded to the challenge of saving water with a partnership agreement to reduce consumption by 20% by 2020 compared to a 2007 baseline. In addition, amendments to the Building Regulations - which include a minimum standard of efficiency for new homes - and the new Code for Sustainable Homes will help act as drivers.

In addition, manufacturers, builders and designers can help their business customers to become more water efficient by using the government Water Technology List (WTL), which promotes more sustainable use of water. The Water Technology List is a list of products, which meet predefined criteria for water efficiency, and businesses investing in such products and technologies can benefit from accelerated tax relief by claiming the Enhanced Capital Allowance (ECA) on their capital investment (Defra 2008).

The water companies already promote water efficiency measures. The strategy highlights that although improvements have been made from leakage reduction, and leakage rates are now comparable with the lowest in Europe, the water companies must continue to realise improvements in this area, to realise further water and energy (and hence carbon) savings (Defra 2008).

The strategy has highlighted that agriculture uses 1% of water resources, although there are significant seasonal variations. In some regions, agriculture uses as much as 16% of abstracted water, and significant abstraction in the summer months can damage habitats. The agricultural industry has a significant polluting impact on the water environment, particularly from nutrients such as phosphorous and nitrates. *Future Water* (2008) highlights that about 60% of nitrates and 25% of phosphorous in our water bodies comes from agriculture, principally through manure and fertiliser. The introduction of legislation to control this is important and Defra is considering a number of measures to educate farmers, including regulatory, advisory and supportive initiatives; and highlights that existing initiatives to support and advise farmers have been in operation since 2006 (Defra 2008).

3.4 Climate Change and the UK Water Industry

The UK water industry is responsible for approximately 4.15 million tonnes of greenhouse gas emissions (CO_2 equivalent) every year (see Table 1). Although, this is less than 1% of total UK

emissions, it is rising gradually year on year. Whilst the industry is increasingly making efficiency gains with abstracting, treating and supplying water and wastewater services, rising population and consumption levels and increasingly stringent quality and environmental standards are driving up energy use (Horton 2007).

The Stern Review (2006) highlighted the risks of water scarcity, also echoed in a recent UN[3] report, which claimed that climate change will lead to a 20% increase in global water scarcity. Stern (2006) stresses that our changing climate will also increase the occurrence of extreme weather events such as storms, floods and droughts, presenting a number of challenges for the water industry and its infrastructure. The UK water industry invests over £4bn per annum, which reflects the capital-intensive nature of the water industry, with assets valued at £200bn (Water UK 2007).

Water UK (2007) has identified how climate change is already impacting on the UK water industry with respect to its operations (both water and wastewater), asset serviceability and maintenance, and its long-term strategic planning and investment decisions.

Firstly, an increase in the intensity, severity and frequency of extreme weather events such as droughts, storms and floods would threaten water supply; and storms and floods would threaten the existing sewerage systems, which were not designed to withstand climate change impacts. More intense rainfall is likely to exceed the capacity of parts of the network and cause local flooding. A likely increase in demand for water, particularly at times of reduced availability, such as droughts, would also exacerbate supply issues.

Reduced availability of water in rivers, reservoirs and aquifers, would also reduce the quality in some cases, due to reduced dilution of pollutants. More treatment of water supplies is therefore required due to lower quality of water in the environment, which costs more and uses more energy. In addition, problems with water quality caused by run-off taking nutrients and pesticides from agricultural land and transferring them into rivers and lakes would again increase the requirements for water treatment (Water UK 2007).

The structure and operation of dams and reservoirs would be affected by increased siltation and slippage; and pipe systems for both drinking water supply and sewerage treatment are likely to become more prone to cracking as climate change leads to greater soil movement, as a consequence of wetting and drying cycles. There is an increased risk to assets on the coast or in flood plains from flooding, storm damage, coastal erosion and a rise in sea level.

Discolouration and odour problems resulting from higher temperatures and more intense rainfall events will also cause concern, and the industry is likely to experience financial and economic impacts as well as environmental and social consequences (Water UK 2007).

Having understood the potential impacts of climate change, the industry is implementing a number of strategic changes, including raising awareness of water efficiency, exploring sustainable water and wastewater solutions and energy efficiency projects. Water UK is the industry representative body and work closely with government, regulators and stakeholders to develop policies to support the UK water industry, and strive to raise environmental awareness of water regulation, such as the Water Framework Directive (WFD). It is argued that the WFD will increase CO_2 emissions to achieve the ambitious water quality targets it sets for the water industry. Such conflicting environmental targets have stimulated much debate in the industry, and this project aims to explore this further. Additionally, there has been limited discussion among academics about the impacts of climate change of the UK water industry, and this study attempts to contribute to this debate.

3.5 The Water-Energy Relationship

The water industry is energy intensive and consumes around 3% of total energy used in the UK. Most of this is used to abstract, treat and distribute drinking water; collect, treat and discharge sewage, and manage sewage sludge ensure our water meets strict environmental and health quality standards (Slater 2007; Water UK 2007).

The UK water industry uses 7,703 GWh/year in energy (see Table 1), which represents 28% of operating costs of the UK water industry operations, with aeration representing 55% of sewage

[3] UN report 2007- *"Coping with Water Scarcity- challenge for the 21st century"*

treatment operations and pumping representing 60% of water treatment operations. Water companies use 1% of the total UK electricity usage, which represents 0.4% of the UK's carbon footprint. Water companies are forecasting a 60-100% increase in energy use to meet new EU Directives (including the Water Framework Directive) and believe the continued emergence of difficult to treat toxic contaminants will drive up energy usage significantly higher (Caffoor 2007).

Table 1: Water Industry - Energy Use and GHG emissions. Reproduced from Water UK – Towards Sustainability – 2005/06 (Cited in *Energy Efficient Water and Waste water Treatment*, Caffoor 2007)

Indicator	Result 2002/03	Result 2003/04	Result 2004/05	Result 2005/06	Progress towards sustainability
ENERGY AND CLIMATE CHANGE					
Use of Energy					
Energy used • total	8,160 GWh	8,030 GWh	8,110 GWh	7,703 GWh	↑
• to supply 1Ml water	602 kWh	663 kWh	663 kWh	586 kWh	↑
• to treat 1Ml sewage	814 kWh	645 kWh	663 kWh	634 kWh	↑
Renewable energy • used	6.4%	6.1%	8.45%	14%	↑
• generated	343 GWh	345 GWh	392 GWh	493 GWh	↑
Emissions of greenhouse gases					
Greenhouse gases emitted • total			4.14 m tonnes	4.15 m tonnes	↔
• in supplying 1Ml water			0.249 tonnes	0.289 tonnes	↓
• in treating 1Ml sewage			0.641 tonnes	0.406 tonnes	↑
• CO2 from fixed site	0.059 tonnes/ person	0.057 tonnes/ person	-	-	
• CO2 from road transport	0.0017 tonnes/ person	0.0026 tonnes/ person	0.0018 tonnes/ person	0.0017 tonnes/ person	↑

A total of 493 GWh/year of renewable energy is generated on water industry sites, representing 6.4% of total energy used to treat water and wastewater. Renewable energy generation is at the heart of the government's strategy for reducing the UK's carbon emissions and reducing energy use. The government has set a number of challenging targets in recent years, (including the Renewables Obligation) in a bid to increase the energy generated from low carbon, renewable sources; and there will also be targets for onsite renewable generation in the new Climate Change Bill. Slater (2007) highlights however, that although there are a number of well-established renewable technologies, options and novel technologies, many will require further investment and research before they will be adopted by this risk-averse industry (Caffoor 2007).

Caffoor (2007) claims that the main ways of realising energy efficiency in water and wastewater treatment include making water savings, reduced operational usage and renewable generation to offset grid energy usage.

Additionally, as climate change is likely to result in more frequent droughts over the mid to longer-term, society must make significant changes to water management and water use. Slater (2007) introduces a number of water efficiency options, including:

- Metering. In 2005-06 approximately 28% of households in England and Wales were on metered water charges; allowing the water companies to monitor input, usage and leakage. Caffoor (2007) explains that metering also encourages water users in the UK to be between 10-15% more water efficient.
- Incentive Programmes- such as the Enhanced Capital Allowance scheme, which enables businesses to recover some of the capital spent on energy saving or water conservation technologies.
- Re-using water. Using *grey water* from bathing, laundry and washing dishes, to flush WCs could provide savings of around a third of daily household water demand. However Caffoor (2007) highlights lack of nationally accepted quality standards, health risks, public attitudes, installer

capability and the associated risks; and the availability at household scale are a few of the barriers associated with the implementation of *grey water* technologies.

Caffoor (2007) adds that increasing water efficiency in industry (by understanding process inefficiencies), reducing household demand, leakage reduction, water recycling (grey water and rain water harvesting), as well as increasing usage of more water efficient goods, will also lead to energy savings, through reduced demand.

Slater (2007) highlights that using low carbon treatment technologies and processes, replacing inefficient machinery and components and optimising processes using sensor technology, such as adjusting pumping according to flow; would increase the energy efficiency of water treatment.

3.6 Water Framework Directive (WFD)

The WFD is the most comprehensive piece of water legislation produced by the European Commission, and will provide the major driver for achieving sustainable management of water in the UK and other EU member states for the future. Defra (2006) explains that it provides an ideal opportunity to manage and control the impact of society's activities at source, and to collaborate in finding long-term strategic solutions.

It requires that all inland and coastal waters within defined river basin districts must reach at least *'good'* status by 2015, and defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters. The result will be a healthy water environment achieved by taking due account of environmental, economic and social considerations.

However, Caffoor (2007) argues that the WFD sets more stringent quality and environmental standards for water companies. This inevitably means the industry would have to increase treatment of wastewater, resulting in an increase in energy use of up to at least 100%. He argues that this increase in energy use would inevitably increase the industry's carbon emissions and would therefore conflict with any carbon policies aimed at reducing emissions, such as the Climate Change Bill.

3.7 Innovation and Competition

Ofwat (2007) has highlighted the key challenges the water industry faces (including increasing consumer expectations, impacts of climate change, volatile weather and the demands of a growing population), and stresses the urgent need for the industry to adopt innovation and creativity, to address the challenges and maintain a high quality service; at a price which consumers regard as value for money[4].

Competition is a key driver of efficiency, choice and value, and a new methodology highlighted in *'Setting the price limits for 2010-15: Framework and Approach- a consultation paper'* aims to mimic the pressures of a competitive market for the water industry. The report promotes long term planning and highlights that the water companies have completed Strategic Directional Statements (SDSs) to set out their company strategies over the next 25 years, which sets the long term context of their five-yearly business plans (required for the Periodic Reviews). Ofwat understands the significant benefits gained from long term planning, and extending the timescale beyond the immediate five year period will give each water company and its supply chain further certainty about future activities. The SDSs are discussed further in the next section.

Ofwat (2007) considers the issue of sustainability and asks each water company to address the issues of adaptation and mitigation (and their impacts on their operations), taking into account the UKCIP scenarios, in the next Periodic Review. Companies will also be required to audit and quantify the GHG impact of their proposed strategies, and develop a clear analysis of the balance between local environmental improvement and the wider impacts of GHGs.

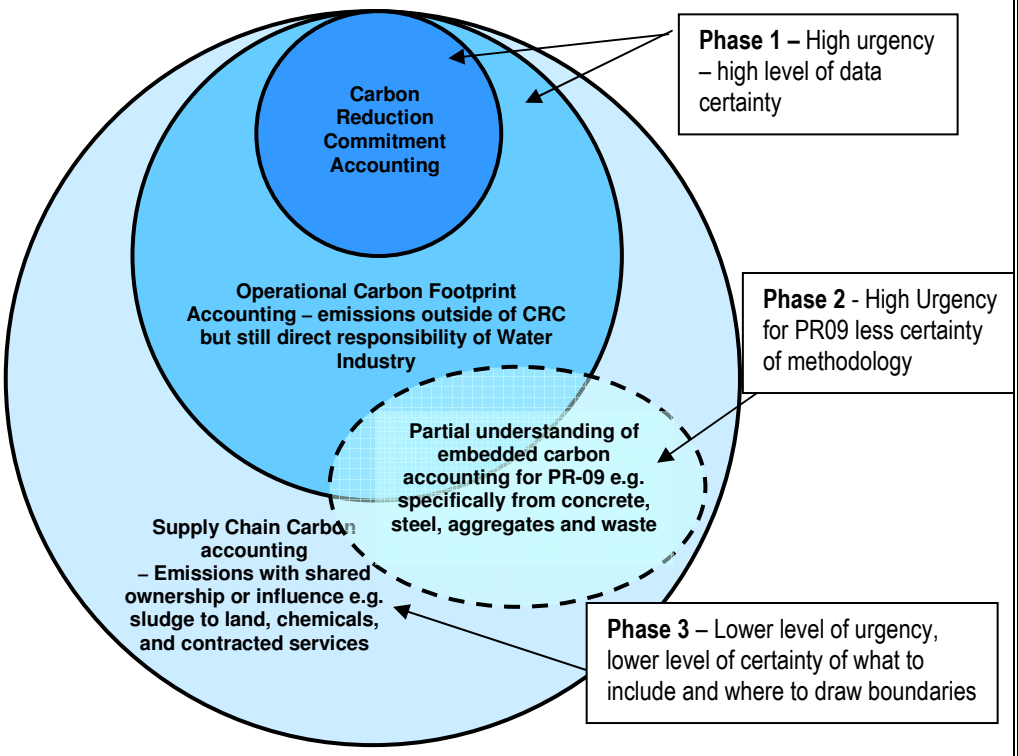
Ofwat have pledged to support more work on comprehensive carbon accounting, and stress that companies must include the price of carbon in carrying out cost benefit analysis (CBA) across their business plans, to enable the industry to select the best mix of interventions to mitigate the impacts of key climate change risks (Ofwat 2007).

[4] Ofwat- Setting Price Limits for 2010- 2015: Framework and Approach – a consultation paper (2008)

3.8 Water UK initiatives

Water UK has developed a common approach for assessing climate change adaptation risks for inclusion in asset management planning, allowing planners to assess the strategic, design, planning, operational or other options available and their associated timescales[5].

The initiative aims to suggest a decision making framework to evaluate options and determine a preferred adaptation strategy, which is achievable within the timescales, and will consider climate change scenarios, assumptions and uncertainties.



Water UK's climate change steering group has commissioned a project to develop a common carbon accounting tool for the water industry. This will allow the industry to calculate and report carbon emissions in a consistent way, and will be designed to be consistent with national reporting guidelines, including those of the CRC (Water UK 2007).

The project will cover operational and embedded carbon accounting, and supply chain emissions and will take a phased approach, expected to be complete in April 2008. The diagram above highlights the linkages between the projects and the initiatives or policies which they impact, and identifies the key priority levels for current activities (Water UK 2007).

3.9 R&D in the Water Industry

UK Water Industry Research (UKWIR) commissioned a report to identify the specific R&D needs required by the UK water companies in order to meet legislative targets and encourage long term planning. R&D roadmaps were developed to provide a coherent view of the water sector's research needs and ensure R&D is better targeted to meet them.

The report[6] also leveraged work from the *Research Foresight Partnership*, which involves the 6 major UK water companies focusing on the research needs to address their business drivers. Theme specific roadmaps were developed to give direction to the supply chain and research community about the shared long term needs of the water companies. Five maps were developed, including underground assets, sustainable leakage, intelligent customer metering, energy efficiency and chemical free treatment- some of most important long term issues facing the water companies.

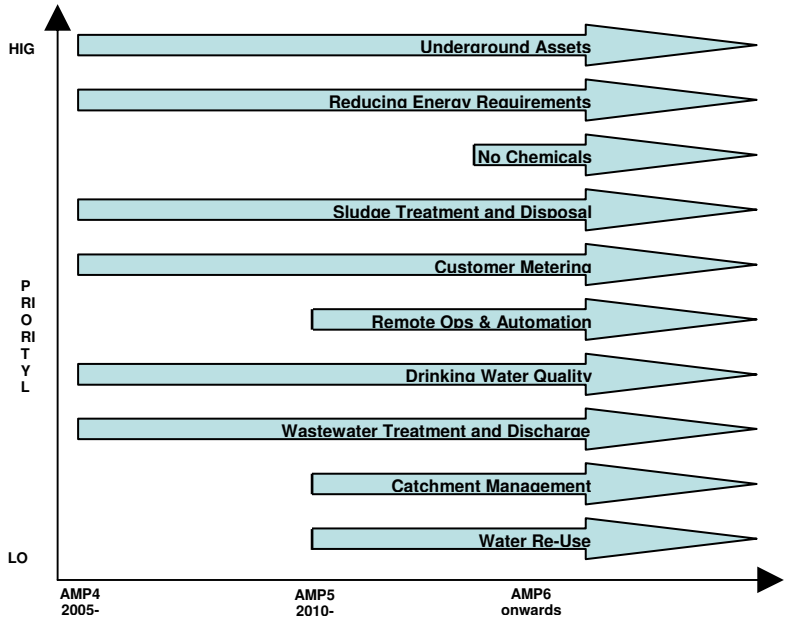
The maps provide a methodology to address and tackle the key industry drivers, including customer satisfaction- balancing supply and demand; climate change and sustainability; water quality and public health; emerging environmental legislation; asset stewardship (capital maintenance) and capital and operational efficiency (UKWIR 2007).

UKWIR (2007) predict the joint vision, promoted by the R&D roadmaps could deliver:

[5] A Climate Change Adaptation Approach for Asset Management Planning
[6] UKWIR – A Roadmap of strategic R&D needs to 2030

1. **A 25% reduction in per capita "Water Footprint" by 2030-** achieved through improved repair of leakage, use of intelligent metering and water re-use and re-cycling schemes.
2. **A 30% reduction in the water sector's carbon footprint by 2030-** achieved through improved pumping, repair of leakage, renewable energy generation and energy efficient treatment processes.

Additionally, Envirolink NW's technology study, which consulted with United Utilities, Northumbrian Water and Yorkshire Water, identified that regulatory compliance was the key driver for investments in new technology. The key technological drivers include capital and operational efficiency, environmental sustainability and customer satisfaction; and the key technology requirements for the northern water companies are highlighted in the graph below, which also identifies their priority levels (Envirolink 2007). Risks to underground assets**,** reducing energy requirements**,** chemical free processes and customer metering were identified as the highest priority areas.



Graph 1: Priority Drivers for Technology, adapted from Envirolink NW (2007)

3.10 Strategic Directional Statements

The economic regulator, Ofwat, commissioned the UK water companies to publish their strategic long term business plans for the next 25 years, in order to allow them to address the five year business plans (for the Periodic Reviews) within a longer term context; and to promote long term planning among the water companies.

Table 2 outlines the key targets set by the water companies from their Strategic Directional Statements, including the levels of carbon reductions they aspire to achieve, and the baselines against which these are set. Further discussion regarding some of the largest water companies follows below.

Company	Target	Baseline	By when
Anglian Water	Reduced emissions by at least 60 per cent in line with the Government's stated target. "To achieve this, we expect to have reduced our emissions by around 50 per cent" 20 per cent of our energy needs from biogas and wind power	 2010 2010	2050 2035 2035
Bournemouth Water	Align with Climate Change Bill		
Bristol Water	50% reduction in emissions		2050
Cambridge Water	10% reduction in energy use	2007	2020
Dee Valley Water	No specific targets		
Folkstone and Dover Water Services	1% reduction in energy carbon use annually A minimum of 20% renewable energy		2020
Mid Kent Water /South East Water	No specific targets but committed to reducing emissions		
Northumbrian Water	20% of energy to be produced from self-generated renewable resources "Ultimate aspiration" to move as far towards carbon neutrality as possible		2015
Portsmouth Water	Clearly identify and reduce the level of carbon emissions from our processes.		
Severn Trent	Working towards being carbon neutral, achieving the government's carbon reduction targets		
Southern Water	10% reduction in emissions		2020
South Staffordshire Water	long-term objective is to reduce carbon footprint		
South West Water	Meet Government targets		
Sutton & East Surrey Water	In line with Govt targets		
Thames Water	Target of 20% reduction in emissions Meet Government Climate Change Bill targets	1990	2015
Three Valleys Water	No specific targets		
United Utilities	Halve GHG emissions No specific renewable generation targets.	2007	2035
Welsh Water	At least 50% reduction in carbon footprint. 25% reduction in carbon footprint.	2007 2007	2035 2015
Wessex Water	Making our activities carbon neutral		2020
Yorkshire Water	To meet whatever targets the government sets for us to reduce our greenhouse gas emission		

Table 2. Company Carbon Reduction Targets as set out in SDSs, Adapted from B.Horton, Water UK

3.10.1 United Utilities

United Utilities has adopted targets to cut GHGs by 16% in the short term- including an 8% reduction in carbon, and a further 18% from sourcing more green energy. They have pledged to reduce their carbon emissions by 50% from their 2007 levels by 2035, and expect to operate their wastewater operations in an energy neutral manner in order to achieve this. United Utilities will also work closely with key stakeholders to contribute to the 60% reduction target by 2050, proposed by the government.

The utility will identify renewable sources to offset the energy requirements for the expected rise in energy use for the pumping of water, as a result of their drive to reduce inefficiencies by running (up to) 25% fewer wastewater treatment works by the 2030s.

3.10.2 Yorkshire Water

Yorkshire Water have pledged to meet GHG emissions targets set by the government, and have already invested in energy efficient equipment; CHP plants; hydro power generation; wind power generation and significant leakage reduction by 2035, to enable them to do this.

They plan to develop effluent and sludge treatment technologies with a 'low carbon' footprint and carbon sequestration, using their land to capture carbon.

YW believe that all environmental legislation should have a carbon impact assessment and *"environmental improvements should only be proposed where their benefits exceed their carbon impacts"*

3.10.3 Northumbrian Water

Northumbrian Water aspires to move towards carbon neutrality by 2035 and is exploring areas for carbon and energy reduction across their whole business activities. They will contribute to the CCB 60% reduction target and aim to have 20% of energy use from renewable sources by 2015.

The utility understand their carbon footprint and continue to find ways of reducing it; promoting demand reduction amongst customers; utilising energy recovery from the anaerobic digestion of sludge; and are also introducing ways of factoring in carbon management into every stage of their decision making process.

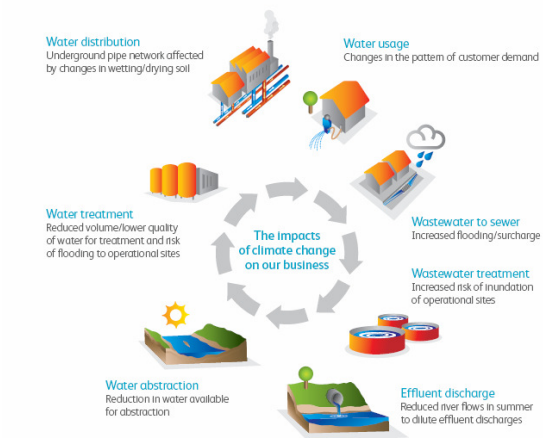
3.10.4 Severn Trent Water

Severn Trent Water has pledged to implement key strategic responses to the challenges of climate change, and support and participate in climate policies such as the Climate Change Bill and the Carbon Reduction Commitment. They will reduce their carbon emission by generating more renewable energy, driving efficiencies through their pumping and treatment processes, increasing the energy efficiency of their offices and reducing fuel use for transport.

Severn Trent believes there is scope to reduce their net energy use by about one third (compared with current use) from efficiency savings and on site renewable energy generation. They will explore options for energy generation at treatment plants from sewage sludge treatment, as well as other renewable options including wind turbines and hydroelectric power.

3.10.5 Thames Water

Thames Water aims to contribute to the 60% carbon reduction target from the Climate Change Bill, and seek to reduce their emissions by 20% (against 1990 levels) by 2015 to support this. The utility will explore opportunities for generating energy from renewable sources and increase efficiencies in order to reduce their carbon footprint.



The diagram illustrates the key challenges presented to Thames Water, as highlighted in their Strategic Directional Statement.

3.10.6 Anglian Water

Anglian Water will reduce their carbon emissions by 60% by 2050, in line with the government's target in the Climate Change Bill. To support this target, Anglian Water strives to reduce its carbon emissions by 50% of 2010 levels by 2035. They expect to reduce their energy costs by 10% by 2010,

at which point in time they expect to reduce their carbon emissions by almost 20%, through increased use of biogas and wind power.

The utility has also pledged to incorporate carbon accounting into their business processes and identify ways of influencing consumer and supplier's emissions. They aspire to generate renewable energy and purchase green energy to cover 75% of their energy use; reduce water use and increase metering of domestic users.

Anglian Water will also research other areas for emissions reduction, such as process emissions. They will work to understand the financial, social and environmental costs of new initiatives and standards proposed, and challenge the level of environmental improvements they deliver, compared to their carbon emissions. Anglian Water will also implement Biodiversity Action Plans to support and protect the regional biodiversity and heritage.

3.10.7 Welsh Water

Welsh Water aims to reduce their carbon footprint by 50% by 2035, by adopting a low carbon approach throughout all of their business activities and factoring in carbon into their business planning and investment decisions. They also intend to invest in renewable energy technologies, including wind power and hydroelectric.

3.11 The CRC & the UK Water Industry

Although, Taylor (2007) argues that the CRC is not a suitable scheme for the UK water industry, and a more sector-specific agreement, embedded into the industry's regulatory framework would be more appropriate; she stresses that companies would have to adopt changes to make it work. She adds that the water industry must factor carbon into all business decisions in preparation for the CRC, and the regulator also has a key role to ensure it is factored into all new environmental legislation (Taylor 2007; Mair 2007).

There is debate amongst the water companies regarding the industry's performance in the Scheme, and the majority remain concerned that the industry is likely to find itself at the bottom of the league table, as most economically viable emissions reductions have already been realised. The price of carbon will determine the level of financial impact of this position, and this will be explored further in this research project.

Water UK and the Defra have highlighted the importance of incorporating carbon into water companies' business and investment decisions, to ensure they are adequately prepared for participation in the scheme. The Environmental KTN (2007) highlight that investments in R&D for the development of low carbon technologies and solutions is crucial for reducing the water industry's emissions to meet future targets and reduce costs associated with carbon trading. However some industries are faced with a number of barriers to innovation and long-term investments, which must be resolved first.

3.12 Summary of Literature Review

Climate change presents significant risks and in order to mitigate these, the UK government has decided to implement a new mandatory emissions trading scheme- the Carbon Reduction Commitment (CRC), which will support the UK to achieve the mandatory carbon reduction targets (60% reduction by 2050) as outlined in the Climate Change Bill.

The CRC will apply to the largest organisations whose mandatory half-hourly metered electricity consumption is greater than 6,000MWh per year. The Scheme design has been influenced by the lessons learned from the UK ETS and the EU ETS. As a result the regulators will take a "*light touch*" approach to participants, who will not be 100% verified, but will be required to provide aggregated energy data and reconcile sufficient allowances at the end of each year.

The carbon price will be crucial to the *cap and trade* scheme, and to ensure the effectiveness of the scheme, it is important to ensure that the market price of carbon is equal to the lowest marginal abatement cost. The water industry has highlighted concerns that the CRC would not adequately

incentivise the water companies to make carbon reduction, and this project will attempt to explore the reasons for this in the next section.

The water industry is an energy intensive industry and the government's introduction of new environmental policies such as the WFD and the CCB present a challenge of potentially conflicting targets, using technologies and processes available today. The WFD is driving up energy use through the additional treatments required to meet the increasingly stringent water quality standards. The additional CO_2 emissions make meeting the carbon reduction targets set out in the CCB increasingly difficult. Environmental economists highlight the importance of striking a balance between the reduction of CO_2 emissions and the increase in water quality, to ensure efforts to protect the environment do not become counterproductive. The next section will explore this issue further to understand the key impacts on the water companies.

Water UK has undertaken work to support the water industry to adapt to and mitigate the key risks of climate change. In addition UKWIR and Envirolink NW have identified the key R&D needs for the future, and technological drivers, to support the industry's strategy for future investment and long term carbon reduction. This research project will explore the barriers to innovation and long term investments in low carbon technologies by the water companies.

The water companies have produced Strategic Directional Statements (SDSs) for Ofwat, to set out their long term plans to 2035. As part of this plan, they have considered their plans to address climate change and sustainability and many have pledged to move their operations towards carbon neutrality, whilst the majority have pledged to contribute to the CCB carbon reduction targets. This project will explore some of the company level carbon reduction activities and strategies to identify how the targets set out in the SDSs will be achieved.

4.0 Methodology

The literature review has identified a number of key themes, which will form the main objectives for this research project. The main aim of this project is to consult with key stakeholders to:

1. ***Understand the impact of key national carbon reduction policies (such as the Climate Change Bill and the Carbon Reduction Commitment) on the UK water industry*** *– including regulatory drivers and areas for development*

2. **Identify company level carbon reduction strategies and planning for the future –** to address c*urrent and future challenges for the Water Industry in adapting to the increasing demands of climate change*

3. **Explore the key challenges of the CRC for the UK water industry and make some recommendations for further development**

Although this study has no formal hypothesis, it has been initiated as an exploratory research project to understand how companies in the UK water and wastewater treatment (WWT) industry are responding to the environmental challenges presented to them – including both adaptation and mitigation of climate change risks, and responses to the new wave of environmental policies introduced by the government.

4.1 Methods of Research

There are a number of methods of data collection, and in order to identify the most appropriate and effective methodology, both quantitative and qualitative methods have been explored below.

4.1.1 Quantitative

Questionnaires

Remenyi et al (1998) highlight that it is usually obvious what evidence is required and how it may be collected within a tight structure for quantitative research. The use of questionnaires is therefore widespread, particularly when carrying out surveys to quantify data results.

Other quantitative techniques include psychological tests, activity sampling and the use of interviews. Although the latter is often associated with qualitative research techniques, structured interviews are often used in market research or opinion polls, where interviewees answer precisely worded questions, or select a multiple choice answer. Statistical samples are often used and analytical packages such as SPSS can quantify final results, which may lead to further qualitative research (Easterby-Smith et al 1991).

4.1.2 Qualitative

Observations

Mahoney (1997) identifies this qualitative technique, a method of primary data collection through studying behaviours, programmes or processes to capture a variety of interactions and understand the subject within the appropriate context. Although this method has several advantages- it provides a good opportunity for unanticipated outcomes, allows the researcher to enter the natural environment and evaluate the subject in context and provides direct information, it also presents a number of issues. Firstly, it can be very expensive and time consuming, the researcher's presence may influence participants' behaviours, the researcher's subjective interpretation may distort the information and it requires well qualified and highly trained observers to be carried out effectively (Mahoney 1997).

As the CRC is not a fully implemented Scheme yet, and there are no similar ETS schemes in existence in the UK where participants may be observed this method is not appropriate for this study. A larger study may however, embark upon making observations of EU ETS participants and analysing the impacts participation in the ETS has had on the organisation.

Interviews

Using interviews to collect data is important if the participants' perspectives are meaningful, knowledgeable and able to significantly contribute to the subject area and the success of the research

project (Mahoney 1997). An interview is preferred over a paper survey when interpersonal contact is important and an opportunity for follow-up of interesting comments is desired. This is particularly the case for this research project, as stakeholders with the appropriate level of knowledge about the effectiveness of an ETS and its impacts on the UK water industry tend to be in high-level positions within key organisations; and the complexities and considerable debate around this emerging topic would benefit from individual interaction and follow up opportunities with individuals who are qualified and are stakeholders in this area.

There are two types of interviews used in evaluation research: structured interviews, in which a carefully worded questionnaire is administered; and in-depth (also known as semi-structured) interviews, which are more flexible and allow the interviewer to follow key themes, although the questions may vary for each participant (Mahoney 1997).

For structured interviews, interviewers deviate only minimally from the question wording to ensure uniformity of interview administration. However, the semi-structure and in-depth interviews encourage free and open responses. Mahoney (1997) argues that as a result there may be a trade-off between comprehensive coverage of topics and in-depth exploration of a more limited set of questions. In-depth interviews also encourage capturing of respondents' perceptions in their own words, a very desirable strategy in qualitative research (Saunders et al 2007).

Focus groups

Focus groups combine elements of both interviewing and participant observation. The focus group session is actually an interview (Patton, 1990) and not a discussion group, problem-solving session, or decision-making group. At the same time, focus groups capitalise on group dynamics. The hallmark of focus groups is the explicit use of the group interaction to generate data and insights that would be unlikely to emerge without the interaction found in a group. The technique inherently allows observation of group dynamics, discussion, and firsthand insights into the respondents' behaviours, attitudes and language (Mahoney 1997).

This research project aims to explore the views of key industry representatives on the effectiveness of an ETS and the impacts of climate change on their companies. As many of the participants may discuss personal views or confidential company information they would prefer to protect from their competitors, focus groups may not be the most appropriate data collection method. Many participants may feel reluctant to discuss or make particular comments in the presence of other competitor organisations or individuals and this may limit and distort the data.

Qualitative vs. Quantitative Research

The table below compares both quantitative and qualitative methods, identifying the objectives, samples, data collection and analysis methods and the final outcome of each method. We can see that an exploratory and complex study similar to this one would fit best with qualitative research methods to enable the results to effectively explore the key underlying issues and concerns of the climate change risks and impacts of environmental policies.

	Qualitative Research	**Quantitative Research**
Objective / purpose:	To gain an understanding of underlying reasons and motivations. To provide insights into the setting of a problem, generating ideas and/or hypotheses for later quantitative research. To uncover prevalent trends in thought and opinion	To quantify data and generalize results from a sample to the population of interest To measure the incidence of various views and opinions in a chosen sample Sometimes followed by qualitative research which is used to explore some findings further
Sample	Usually a small number of non-representative cases. Respondents selected to fulfil a given quota	Usually a large number of cases representing the population of interest Randomly selected respondents
Data collection	Unstructured or semi-structured techniques e.g. individual depth interviews or group discussions	Structured techniques such as on-street or telephone interviews
Data analysis	Non-statistical	Statistical; data is usually in the form of tabulations Findings are conclusive and

		usually descriptive in nature.
Outcome	Exploratory and/or investigative Findings are not conclusive and cannot be used to make generalizations about the population of interest Develop an initial understanding and sound base for further decision making	Used to recommend a final course of action

Source: www.snapsurveys.com

Due to the nature of this research project, the complexities of the subject and the high level consultation responses required, the research method deemed most appropriate for accurate data collection is that of in-depth, semi-structured one-to-one interviews. This would allow for the necessary interaction to understand the key and complex arguments, which individuals may be reluctant to voice in a larger group. Many of the responses may be individuals' personal reflections and not company perspectives, and a one-to-one interview format would allow interviewees to discuss the issues freely.

The three key themes identified at the beginning of this section will form the framework of this research project, which will carry out 19 individual semi-structured, in-depth interviews with a structured sample, representative of the water industry (see Table 3), which will be 1 hour (or less) in length.

4.2 Sample

The research uses a structured sample, inviting a wide range of stakeholders to influence the consultation. Table 3 sets out the consultation invitees, and participants in the consultation are shaded below.

Table 3: Candidates for Interview

Organisation	Type of Organisation	Position	Meeting Date
16. Defra	Government Dept	Water Regulation Manager	
17. Water UK	Industry Representative Body	Policy Advisor	19-12-07
18. British Water	Industry Representative - Trade Organisation	Technical Director	19-12-07
19. Ofwat	Regulator	Head of Climate Change	07-02-08
20. Environment Agency	Regulator	Emissions Trading Manager	07-02-08
21. UKWIR	Research Body	Director	
22. Yorkshire Forward	RDA	Head of SD	09-01-08
23. Envirolink NW/N8	Business Support Agency	Director	04-01-08
24. Environmental KTN	Business Support Agency	Knowledge Transfer Manager- Water (Ex-YW R&D Dir)	11-12-07
25. Carbon Trust	Business Support Agency	Utilities Manager	13-02-08
26. United Utilities	Utility	Carbon Manager	03-01-08
27. Severn Trent	Utility	Environmental Regulation Manager	
28. Yorkshire Water	Utility	Energy Manager	10-01-08
29. Northumbrian Water	Utility	Carbon Manager	13-02-08
30. Anglian Water	Utility	Energy Manager	25-02-08
31. Biwater Treatment	Large WWT Company	Regional Manager/ Engineering Manager	28-01-08
32. Earthtech	Large WWT Company		09-01-08
33. Arup	Large WWT Consultancy	Head of Environment	
34. Atkins	Large WWT Consultancy	Principal Consultant- Regulatory Compliance & Research	14-01-08

4.3 Key Questions

A range of key questions were developed for the interviews, in order to explore the areas highlighted in the above themes, discussed below.

Theme 1: Impact of key national carbon reduction policies (such as the Climate Change Bill and the Carbon Reduction Commitment) on the UK water industry

This theme explores the industry-level strategic direction of the water industry by understanding participants' responses to carbon reduction policies and how this impacts upon the water industry's structure. It considers regulatory drivers, which was identified as a key driver for the water industry in the literature review.

Government Policies- including the Water Framework Directive and Carbon Policies

The literature review highlighted the potential contradictions in government policies, such as the conflicting targets from the Climate Change Bill and the Water Framework Directive, which highlights a lack of joined-up thinking. The first two questions are designed to recognise the knowledge of participants and explore their views on the challenges potentially conflicting targets could present for the water industry.

1. *What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?*

2. *What are your views on the targets set for industry in the Climate Change Bill recently introduced by the government, and how do you think this may impact your company, and the water industry?*

Questions 3 and 4 are designed to understand the key challenges that climate change presents for the water industry and the key barriers to reducing emissions in line with government policies and targets. The barriers highlighted here will need to be addressed for significant carbon reductions to be realised, as promoted by the CCB targets, and something which the CRC will aim to achieve.

3. *What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?*

4. *What are the barriers to reducing emissions in the water industry?*

5. *What strategic measures should the industry be taking, in order to adapt to climate change?*

6. *What support is needed from government and/or regulators to reduce the water industry's carbon output?*

Questions 5 and 6 are designed to understand the flaws in the current structure and identify the strategic direction required to support effective carbon reduction in an energy intensive industry; with targeted support from the government and regulators. These questions will not be part of the interviews with Ofwat, the Environment Agency or Defra, as they have been designed to get an industry perspective.

Instead the regulators will be asked the following 3 questions.

7. *How does Ofwat/Environment Agency work with the industry to support them to adapt to a changing climate?*

8. *What do you feel are the barriers to reducing emissions in the water industry?*

9. *What do you feel are the major challenges for the industry, presented by environmental policies, such as the CCB and WFD? Does Ofwat/Environment Agency recognise the conflicts these policies present to industry?*

The following two questions ask participants to consider the issues of water scarcity, a key risk of climate change. A recent UN Report[7] claimed that climate change will lead to a 20% increase in global water scarcity and the Stern Review (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like those experienced in the UK in 2006 and 2007) and droughts. By asking participants to consider how these issues may be handled in the future, and consider low carbon solutions and recommendations for the long term, their knowledge and perceptions of long term planning and R&D can be understood.

10. *What challenges do water scarcity and the increase in extreme weather events present to the water industry (including consumer and regulator expectations) and how can the industry plan for its management in the long term?*

11. *What recommendations would you make to support and drive the WWT industry to invest in new technologies and adapt to climate change, in order to reduce carbon emissions?*

R&D, Planning and Investment

The next four questions will explore the issues and requirements for R&D and investment, and long term planning. They ask participants to consider water and energy efficiencies to address water scarcities and long term requirements at an industry level to stimulate R&D for the development of low carbon solutions.

12. *What are the most important/significant areas for development or investment in order to increase water and energy efficiency and reduce emissions in the water industry?*

13. *What are the major challenges and risks associated with investments in new, more energy and water efficient, long term technologies?*

For example technologies to increase water capture when it is available during rainfall and flooding events.

14. *What are the incentives to increase water efficiency and awareness of water efficiency, through water re-cycling and re-use schemes? Does your organisation demonstrate any water efficiency methods?*

15. *What are the incentives to innovate, build sustainable infrastructure and to develop more carbon efficient technologies? or What incentives exist for companies to invest in R&D and water and energy efficiency, with a view to reducing their carbon emissions?*

Theme 2: Company level carbon reduction strategies and planning for the future

This theme is concerned with exploring company level carbon reduction strategies. The Strategic Directional Statements (SDS) published by each water company sets out their plans for addressing climate change and sustainability in the long term. All of the water companies have pledged to meet government carbon reduction targets, such as those set out in the CCB; whilst many have aimed to move their operations to carbon neutrality. The aim of this section therefore is to identify how such reductions in CO_2 will be achieved by the water companies, despite the challenges discussed in Theme 1.

Questions 16 to 21 will explore the carbon reduction strategies of the water companies and the supply chain, by asking them to identify initiatives expected to make such reductions and highlight any internal targets embedded into their company strategies.

16. *What are the long and short term challenges faced by your company?*

17. *How is your company affected by or adapting to changes as a result of climate change?*

[7] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

18. *How is your company responding to changes in the climate? Have you considered an environmental or emissions reduction targets in your company strategy? (If not, why? - risks, uncertainty, cost, other?)*

19. *What is your company doing to reduce its carbon emissions/energy consumption? Has your company invested or developed in any renewable energy generating technologies?*

20. *Has will your company achieve the carbon reduction targets set out in the SDSs?*

21. *Are you aware of your company's carbon footprint and emissions?*

Questions 22 to 27 will explore the strategies of the business support organisations and identify their role in supporting the industry to reduce its emissions. They will address the conflicting legislation requirements from the WFD and the CCB, which stakeholders believe, put the water industry in a difficult position, highlighting the lack of communication between the water industry and government. They also explore their influential role in raising awareness of the impacts of other sectors, and influence other low carbon projects to ensure a more co-ordinated and joined up cross sector response to climate change.

22. *How is your organisation supporting the industry to adapt to climate change by reducing its emissions, whilst at the same time meeting increasingly stringent quality standards set by the regulator?*

23. *What research or demonstration initiatives have been developed to encourage the industry to innovate make long term plans and investment, to be better prepared for the effects of climate change; and support the deployment of new innovations?*

24. *How is your organisation supporting the water industry by promoting collaborative working to improve communications and eliminate the contradictions in policy faced by the water industry?*

25. *Have you considered the significance of a sustainable WWT (infrastructure) system for new housing developments/ energy parks and other government developments?*

26. *How is your organisation influencing and preventing housing developments on flood plains?*

Leeds has just signed up to the government's Low Carbon Cities Programme (along with Manchester and Bristol), working with the Carbon Trust and the Energy Savings Trust to slash its carbon emissions.

27. *How is your organisation supporting this scheme by ensuring a water and wastewater management strategy is also considered as part of this initiative?*

Theme 3: Key challenges of the CRC for the UK water industry

The literature review identified that the Carbon Reduction Commitment (CRC) provides a number of challenges which led industry bodies to deem it as an inappropriate policy for the water industry, and this research theme aims to explore the nature of these challenges.

Questions 28 to 33 are designed to explore the views and understanding of the water companies, supply chain, industry representatives and business support agencies of the impacts of an ETS, or the CRC on the UK water industry, and as an economic tool for GHG emissions reduction.

28. *What are your views on the carbon reduction measures proposed by the government- particularly the Carbon Reduction Commitment?*

29. *What is your awareness and understanding of an emissions trading scheme? Are you aware of the UK ETS, an ETS already piloted by the government, and its outcomes?*

30. *What challenges do you feel a 'cap and trade' ETS would present for your company and its operations, and more broadly the WWT industry?*

31. *How would a 'cap and trade' system impact the WWT industry and its ability to meet increasingly stringent quality standards set by the Water Framework Directive? Do you feel it would be the necessary legislative requirement to push the industry to make the appropriate strategic decisions to cut their emissions, in order to remain competitive?*

32. *What recommendations would you make for the water industry to reduce its emissions, in line with an emissions allocation, as part of an ETS?*

(Introduce ETS allocation methods- grandfathering, benchmarking and auctioning.)

33. *What do you feel would be the best permit allocation method for the ETS, to support the water industry's entry into the scheme?*

More detailed questions developed at a later stage as a result of initial consultation with the water companies and the supply chain were designed to obtain a response to different arguments and viewpoints. The following 5 questions for Ofwat below were designed to explore Ofwat's role, understanding of the key challenges and their understanding and expectations of the CRC.

34. *What is Ofwat's role in current CRC consultations and discussions?*

35. *A key issue highlighted by industry is one that suggests that the 5 year AMP cycles inhibit investments in R&D and present issues for long term planning. What are your views on this?*

36. *Innovation seems to be the key element- how will Ofwat ensure the industry is developing and investing in R&D? Demonstration projects etc?*

37. *How is Ofwat supporting the industry to understand its carbon balance?*

38. *How is Ofwat supporting the water companies to prepare for participating in the CRC?*

The following 9 questions were developed for the Environment Agency and the Carbon Trust, to achieve a better understanding of the proposed design and details of the CRC Scheme.

39. *What stage are developments and final details at for the implementation of the CRC?*

40. *2008 is the qualifying year- what does this mean?*

41. *How will the CRC work?*

42. *How will emissions be monitored/measured?*

43. *What are the expected challenges of the scheme?*

44. *How will revenues be recycled and by who? Will all participants have a position in the league table?*

45. *Other than understanding, planning for and participating in the Carbon Reduction Commitment, what can the water industry do to meet the cap?*

46. *Funding the scheme and key costs of the Carbon Reduction Commitment*

47. *What are the key decisions yet to be made for the scheme?*

4.4 Boundaries of this Research Project

This study is attempting to explore a large and emerging area of discussion. There is little academic debate on the impacts of the CRC on the UK water industry to date and this research project aims to stimulate further research and contribute to the existing debate.

However there are a number of boundaries to this research, including the author's time, funding and other resources, which have limited this study to the UK, hence the focus on the CRC.

4.5 Responses to the Consultation

Responses to the consultation were received from Yorkshire Water, Northumbrian Water, Anglian Water and United Utilities; Water UK, the industry representative body; British Water, a national trade organisation; Ofwat; the Environment Agency and the Carbon Trust. By understanding both regulator and water company perspectives, a coherent argument can be developed. The Carbon Trust carry out activities to support different sectors to make carbon reductions, and it's important to recognise their understanding of the key challenges and issues for the water industry, and any actions taken to address these.

Business support agencies such as the RDA (Yorkshire Forward), the Environmental Knowledge Transfer Network (KTN) and Envirolink North West (an RDA funded environmental business support function) were insightful contributors, and highlight the key challenges of both the water companies and the supply chain, with a view to the wider impacts upon the economy; whilst maintaining an understanding of key government legislation. Finally, Earthtech Ltd, Biwater Treatment Ltd and Atkins Ltd were some of the large supply chain companies, which contributed to the consultation process.

Unfortunately interviews were not carried out with Defra, UKWIR, Severn Trent and Arup due to the lack of resources, which remain a key constraint of this study, as highlighted in *Boundaries of this Research Project*.

The findings are presented in the next section, and full consultation responses are available in Appendix 3.

5.0 **Key Findings & Discussion**

There is universal agreement that the biggest challenges for the future lie in addressing how to respond to the increasing demands of climate change, through adaptation and mitigation. There is an ongoing debate among industry representative about how to respond to changes in our climate and the government strategies to support this.

The key challenges and results of this research project are discussed below, within the previously defined themes.

5.1 National Carbon Reduction Policies and their impact on the UK water industry

5.1.1 Regulatory Drivers - *Climate Change Bill vs. Water Framework Directive*

The water companies have a statutory duty to treat wastewater and supply clean water to stipulated water quality standards, regulated by the DWI, Ofwat and EA. However, meeting current and future water quality standards imposed by the regulators, whilst reducing prices for customers presents an ongoing challenge, and there is much debate about how this could be addressed in light of carbon reduction measures proposed for the future.

The Water Framework Directive encourages higher quality standards, including a "*good*" standard for all rivers and lakes to be achieved by 2015. On the other hand, carbon reduction targets such as the 60% reduction set by the Climate Change Bill will become increasingly difficult to achieve, as regulation forces the industry to confront the challenge of improving water quality, whilst reducing CO_2 emissions. There consensus view amongst all participants in the consultation for this research was that the resulting higher emissions from the increased energy (predicted as at least a 100% increase in energy use; and 240% as worst case (Environmental KTN 2008)) and additional treatment costs, are not worth the small environmental (aquatic) benefits they deliver.

The 60% reduction target set by the Climate Change Bill will become increasingly difficult to achieve, as regulation forces the industry to confront the challenge of improving water quality, whilst reducing CO_2 emissions. Industry representatives, business support organisations and the supply chain have all highlighted the need for CO_2 emissions to be illicitly included in all WFD objectives; a Directive, which it is widely believed, does not have an over-arching environmental aim, as it does not primarily consider the carbon impacts of making aquatic improvements.

The water companies argue that meeting the increasingly stringent water quality standards set by the Water Framework Directive would produce negative environmental and ecological impacts by having a proportionately higher carbon footprint, and therefore negate any environmental improvements, as well as presenting difficulties for meeting the carbon reduction targets set by the CCB and CRC. Research participants also highlighted that the tertiary treatments required to meet the additional WFD standards may also generate wastes, which would need management in different ways, likely to be energy intensive themselves; further strengthening the need for investments in R&D to develop more energy efficient technologies.

In addition, it is widely believed by representatives from the water companies that the water industry will be penalised in the CRC for meeting other environmental obligations, such as the water quality obligations enforced by the regulators, government and the EU.

In contrast, the regulators and Water UK contest that there will be no such conflict if a holistic approach is taken to address pollutants at source, and develop low carbon solutions. They highlight the importance of raising awareness of, and taking action against, the significant carbon impacts of the activities of other sectors on the water industry, and legislation is needed to mitigate this.

Ofwat encourage companies to carry out a cost benefit analysis for all initiatives designed to reduce carbon or increase water quality; and include carbon in their economic assessments, allowing companies the freedom to decide how they will plan for adaptation and mitigation. The Environment Agency stresses the need for innovation and investments in low carbon technologies and solutions, believing that the industry is capable of doing this. Ofwat add that investments in low carbon technologies and infrastructure increase the value of the water company's asset base and efficiencies made would allow companies to increase their profits and provide a more efficient service to customers, and therefore it is in their interest to invest. The CRC and CCB are likely to be the key drivers for such investments in the water industry.

However, this debate about whether achieving what the water companies and supply chain have argued as small, and potentially insignificant aquatic improvements are worth their consequent carbon emissions, is ongoing and the regulators highlight the need for ensuring the industry is aware of the significance of carbon accounting and impacts of other sectors. To cleanse water is an end of pipe solution, and the industry must concentrate on removing the pollutants at source through collaborative work with other industries. This presents a major task for the water industry, almost like a huge pollution clean up operation.

Cross over with other sectors and knowledge exchange is very crucial for the water industry and the *Committee on Climate Change* will be set up to advise the government of the key challenges for different sectors of the economy, for emissions reduction as part of the CCB. The government aims to make significant carbon reductions across all sectors of the economy, and there is consensus amongst all research participants that a holistic approach is crucial for addressing the challenges presented to the water industry by other sectors.

5.1.2 Energy Use

Energy is a major operational cost for the UK water industry, which is responsible for approximately 3% of total UK energy use, and it represents an overwhelmingly large percentage of the industry's CO_2 emissions. Although this level of energy use is not a significant amount in terms of other heavier energy using industries, it remains a significant amount for the CRC sector.

The water industry is unique in terms of its impact on the CRC, as it will be the biggest player in terms of energy use and emissions. The CRC is designed for non-energy intensive industries, where energy is 1-2% of their operations. In the water industry, energy consists of around 10% of its operations is the largest operational cost after labour. According to calculations made by the water companies, over 20% of all emissions traded in the CRC are likely to be in the water industry; making it a significant and influential participant.

As a result, the water industry believes that as the CRC is not designed for large energy intensive industries, it is not appropriate for the water industry, which *is* energy-intensive. However, suggestions of a separate agreement have not been successful. Water UK has completed the CRC consultations on behalf of the water industry, and has influenced the design of the Scheme, in the absence of a separate agreement.

The water companies believe that energy requirements for meeting WFD targets will rise by at least 100% by 2013, threatening the ability of the industry to continue to reduce their CO_2 emissions. The water companies and representatives from the supply chain have highlighted that there has been no reluctance to use energy in the past because it has always been so cheap and affordable, and this has resulted in more energy intensive processes. However, new legislative targets and the depleting global supplies which have driven up the price of (oil and) energy, present significant challenges to reduce energy use for the industry, which would like to be less dependent on it.

Business support organisations have identified some important options for offsetting energy use and carbon emissions, including renewable energy technologies and land management[8] for sequestering carbon. The water companies accept that energy will play a crucial role and believe that renewable energy generation and energy recovery will be key for reducing carbon emissions for all sectors, particularly for meeting CCB sectoral targets for energy efficiency, on site renewable energy generation, combined heat and power (CHP) and micro generation. Issues of security of supply and increasing costs of energy (both environmental and economic) are also driving a shift towards more renewable energy and the industry is generating increasing amounts on site.

However, the water companies highlight that the income streams generated from the Renewables Obligation Certificates (ROCs) make reducing emissions from the generation of on site renewable energy economically viable, and this remains something the water companies continue to invest in.

[8] Land can be managed to sequester carbon- a carbon bank to offset emissions. Water companies drain their land into reservoirs, drying it out into a bog, which releases methane and carbon from the organic material-contributing to climatic change. If land is allowed to recover and re-instate itself as wetland, you can lock up the methane and carbon and start to absorb carbon (several tonnes/hectare). Water then percolates through this, which acts as a filter, making it easer to treat and get to potable water standards.

They add that many of the companies are likely to have already met the 20% target for on-site renewable generation set by the CCB, in their aim to reduce their energy costs.

The water companies are aware of the numerous opportunities for generating renewable energy on site, particularly CHP, producing biogas from the anaerobic digestion of sludge and organic wastes, small scale hydro, wind energy, solar, geothermal and more. Energy can also be recovered from treatment processes, such as the heat generated from incineration, which can be used to generate energy for another process.

5.1.3 Investing in R&D

The water industry is a very risk-averse and conservative industry, largely due to the strict regulatory framework, issues of public health and impacts upon company reputation. As a result the water industry doesn't invest heavily in R&D- only 1% of turnover is invested into R&D, compared to 14% in the pharmaceutical industry.

The water companies believe that there is little incentive to innovate and are reluctant to adopt new technologies, until there is evidence of them being proven on site. There are a number of new technologies, which have been developed by the supply chain and academia, but there are limited demonstration funds or sites available to test and demonstrate their effectiveness, in order to encourage their uptake. Despite this, R&D will be crucial for developing energy efficient and low carbon technologies to meet regulatory targets and responsibilities. Companies from the supply chain highlight that in order to increase the priority of R&D and investment on the water companies' agendas, it is important to influence the stakeholders to invest in measure to adapt to climate change and mitigate the risks.

However, there are a number of barriers to innovation, which have been identified by the stakeholders. Most significantly, it is widely believed that the Ofwat AMP framework cycle inhibits innovation, R&D and long term planning, as the efficiency baseline is re-set after each 5 year cycle.

R&D and investment cycles are often longer than 5 years, and the 5 year AMP cycles do not provide a long enough payback-period for many investments. This also presents a planning challenge, and many stakeholders have argued that the 5 year cycles do not encourage long term planning. As a result, several water companies have set up subsidiaries, which may invest in different initiatives, without prior permission from Ofwat.

Water companies' are valued by their asset base, and Ofwat allows companies enough funds to finance their regulated business based on how much their company is valued at. In response to the above point, Ofwat argue that although efficiency savings may have to be returned at the end of each 5 year cycle, to allow customers to benefit from them in lower prices, the added value companies gain from their investments in more efficient technologies and solutions, results in Ofwat allowing them to retain more funds to run their business – an increase in their Regulatory Capital Value (RCV).

Ofwat highlight the close link between innovation and competition, adding that the water industry is a monopolistic market, which has resulted in apathy to change. The regulator believes that companies must innovate, and are incentivised to do this due to the added value from increasing efficiencies. Ofwat continue to invest in initiatives to stimulate competition in this market, adding that water companies can invest their profits without Ofwat's permission, and an increasing amount of this should be in R&D initiatives to develop low carbon technologies and solutions to meet future legislative requirements. However, companies must accept that investments in R&D are risky and not all developments are successful.

Research participants from business support agencies argue however, that '*innovation responds to pressures'* and the CRC could be the necessary legislative push required to drive the water industry to invest more heavily in R&D to develop more low carbon solutions, which also meet future sustainability targets. However, the water companies add that their R&D budgets are usually first hit when the companies find themselves under financial strain, and budgets have decreased for all water companies (except Yorkshire Water) in 2008.

There are further issues with the deployment of new technologies. The water companies are reluctant to adopt new technologies developed by the supply chain, unless these have been tested on site. However, the lack of demonstration sites and industry confidence has hampered efforts to date. Many

supply chain companies have instead exported their products and technologies to different international markets, before returning to the UK. This is a major barrier for the supply chain and has impacts for the wider economy too.

5.1.4 Addressing Pollutants at source

There is an inherent need to address pollutants at source, and avoid using end of pipe solutions for pollutants, in order to make significant CO_2 reductions. Discussions with industry representatives have highlighted an urgent need for a holistic approach to mitigate the risks of climate change.

There is general consensus that there is a need to build capacity in cross sectoral partnerships to address the challenge of understanding and tackling pollutants at source; and strong government lead is required to facilitate this. The industry must consider ways of addressing the challenges presented by environmental policies, and consider ways of working with, and educating other sectors of their carbon impacts through the water treatment cycle. The water companies recognise the opportunities for cross sector working which must be realised- including the anaerobic digestion of sludge and organic wastes, which would reduce the load to landfill.

Mike Keil, Head of Climate Change at Ofwat, highlights that

"Although more demonstration projects are needed to encourage the uptake of new technologies, a holistic approach is crucial. The cross over with other sectors and knowledge integration is very important for the water industry going forward, as the Polluter Pays principle become increasingly difficult to apply."

Water UK and organisations such as Waterwise, are already engaged in raising awareness of the impacts of other industries on water treatment. It has been suggested that there is an important role for the *World Business Council for Sustainable Development* and the *European Partnership for the Environment* to raise these issues and generate a Europe-wide understanding of the issues; to encourage legislation to ban substances and practices which pollute water, and our environment (through the additional CO_2 emissions).

Agricultural practices which cause sediments, chemicals and pesticides to wash into the water; and industries using heavy metals (such as the car industry) that can leak into water systems are particularly recognised as key contributors to the issue. It is important for these industries to work more closely with the water industry, nationally and internationally to implement key initiatives and actions to reduce their pollution of the water system.

5.1.5 Priority of the Climate Change and Sustainability Agenda

Most of the UK's water companies have now appointed a carbon manager to address the climate change and sustainability agenda, and allocated resources to develop their plans, as outlined in their strategic directional statements.

However, research participants form key business support agencies argue that this is not a significant enough commitment and reflects the priority level of this agenda. Representation at board and stakeholder level is crucial, in order to influence the board's decisions and customers. The UK government has recognised the issues of water scarcity, yet whilst they exist for other sectors, there are little government demonstration funds made available to test and demonstrate new low carbon, or more sustainable technologies or solutions for the water industry. As earlier discussed, this is a barrier which must be overcome to ensure innovations from the UK supply chin are not all lost to export markets.

5.1.6 Impacts on the Economy

The water companies are conscious that issues of water availability and the price of water in the UK, may influence business decisions for many organisations in the future. As a result of rising energy and water prices (due to depleting supplies) there are likely to be heavy job losses, and a loss in the knowledge economy, as companies start to re-locate abroad, where water prices are cheaper and an increased supply is available.

This would have a negative impact on the UK economy, with fewer organisations choosing to locate and trade in the UK, and a loss of local skills and trades could limit choice for the consumer, and exacerbate skills gaps in the industry. It could also lead to an increase in foreign imports to the UK, however, the government would experience losses in tax revenues and heavy social payouts from the loss of jobs. This decline in such a crucial industry could lead the UK to a deep recession.

5.2 Company Level Carbon Reduction Strategies and Planning for the Future - *Current and future challenges for the Water Industry in adapting to the increasing demands of climate change*

5.2.1 Carbon Accounting

The water industry must consider its carbon consumption, and identify where carbon savings could be made across their organisational activities. Many of the water companies use the *Carbon Accounting Tool* produced by Water UK to support their efforts to identify and target key areas of their business, which they can address to reduce CO_2 emissions.

It is imperative that the water companies understand their carbon footprint and carbon balance, to ensure they can implement ways of reducing these to meet the CCB targets and purchase sufficient allowances in the CRC. This includes measuring the embodied carbon of new infrastructure, buildings and equipment, as well as the operational footprint of new processes and activities; an area which has been highlighted by the supply chain as one that is increasingly difficult to quantify and manage in the absence of a common carbon footprinting tool which sets the necessary boundaries.

There are numerous carbon footprint calculators available for measuring and understanding an organisation's carbon footprint, including those provided by the IPCC, Defra, Envirowise, UKCIP and many more. The lack of universal carbon footprinting methods can result in inconsistent and subjective carbon measures, which dilute policies and hamper efforts to make a significant enough impact. Water UK is currently working with the Carbon Trust to develop a common carbon footprinting tool for the water industry.

There was a general consensus amongst participants in this research that the industry and governments must consider the carbon balance and ecological costs of any environmental improvements, particularly in the implementation of the WFD, which it has been argued, does not have an over-arching environmental aspect. Achieving this balance is even more crucial with the introduction of the CRC, as participants from the water industry are presented with the challenge of reducing emissions, whilst improving water quality.

Northumbrian Water has highlighted the significance of carbon reductions across all sectors. For example, the average 160 litres of water used per person, per day in the North East would produce 130g of CO_2 per person. However, if we consider a packet of Walkers crisps produces 75g of CO_2 per person, the water industry's footprint is equivalent to half a packet of crisps. Although this does not seem huge in relation, it highlights the need for all sectors to significantly lower their carbon consumption.

5.2.2 Planning

Long term planning and investment in R&D and infrastructure requirements will be crucial to address the future challenges of climate change which have been identified earlier in this report. Stern (2006) highlighted the significance of urgent adaptation and mitigation, and ensuring such climate change risks are factored into long term investments and plans is essential for meeting emissions reduction targets.

Planning for adaptation and mitigation

Although carbon has been a factor in previous planning and decision making processes for the water companies, the priority concerns have tended to include the increasing quality and regulatory standards, reducing costs or reducing demand. Ofwat comment that the next AMP framework will oblige the water companies to consider the carbon impacts of their activities and their long term plans to address them. The Carbon Trust believes that the CRC will be the driver to push carbon emissions to the top of this priority list. The Strategic Directional Statements (SDS) completed by the water companies, set out their strategic direction for the next 25 years, and many of the water companies have used the UK Climate Impacts Programme's (UKCIP) rainfall scenario to aid their future planning.

The water companies have pledged to meet the government's energy and CO_2 reduction targets, whilst reducing their carbon footprints to move towards carbon neutrality.

Strategic planning will ensure that companies are suitably prepared for participating in the CRC, and can make informed decisions about how they will respond to and prioritise the key challenges. Investments in low carbon infrastructure and R&D for more efficient processes and technologies are important. The regional development agency (RDA) has highlighted that due to the potential long lead times of new renewable energy technologies and infrastructure, it is important that they are considered as early as possible, as part of a strategy on how to mange the CRC, despite any lack of investments up till now.

The water companies are considering changes to their existing asset base to enable them to meet future quality standards, and regulators must be aware of the carbon footprint of both dismantling existing infrastructure, but also the embodied carbon of new assets and infrastructure. The water industry must also liaise with the construction industry to ensure they are building water efficient homes and buildings, and considering the water treatment and water supply issues in their designs. The industry must also ensure building on flood plains is reduced, as many flooding defence solutions still cause many other environmental problems.

Infrastructure for treatment works naturally occurs next to rivers, to reduce pumping requirements for discharges to the environment; and the industry must also plan to implement better defences for the electrical protection of this infrastructure, to ensure assets are protected from future flooding events caused by climate change.

Planning for the CRC is also important and this is discussed in more detail in the 5.3.1.

5.2.3 Making Efficiencies

An important method of reducing current emissions is by increasing the efficiencies of current infrastructure, technologies and processes. Energy efficiencies can be gained through the improvement of pumping and aeration technologies. Better design of treatment plants could also reduce the pumping requirements. Water efficiencies can also deliver significant energy and carbon savings and reduce the impacts of water scarcity in the South East of England, through demand management and leakage reduction.

Key business support organisations highlight that the water industry must understand it's potential for making efficiencies and take action to ensure waste is minimised. The water companies believe that it is unlikely that they can make efficiencies gains of more than 15-25% on existing processes, and new low carbon solutions will need to be introduced and implemented. However these require time and investment, and this reflects the urgent need to address attitudes and barriers to innovation now.

Efficiencies gains can be realised through a number of methods, including leakage reduction, which can help to address water stresses. The water companies work to '*economic levels of leakage'* to calculate the economic case for recovering and preventing losses in their distribution systems. Representatives from the water companies highlight that efficiencies made on leakage to date have reduced the amount of water to be treated, which has reduced the cost of (and use of) energy for water supply. Leakage reduction is very costly, and the water companies argue that further funding would need to be made available in order to achieve more sustainable levels of leakage. Companies recognise however, that efficiencies can only be increased up to 25% on existing leakage reduction standards before new processes and infrastructure requirements arise.

In addition, a significant amount of the water companies' energy is used for pumping water. Although there are some efficiencies that can be made to existing infrastructure and design, pumping of water to customers is essential and remains an energy intensive process. Many companies have initiated water desalinisation to address the issues of water scarcity in the UK. However, this is a very energy intensive process, and does not provide a low carbon solution.

Methods of increasing water efficiency include the introduction of water re-use and recycling schemes such as grey water recycling and rain water harvesting, could support strategies to address water scarcities. Dual water systems could be introduced into new and existing homes (requiring re-

plumbing), in order to re-use and recycle grey water. However, public perceptions and consumer behaviour may present challenges, and fiscal incentives may be required to encourage their uptake. Additionally, research participants suggested that different grades of water for different uses would ensure 'clean' fully treated water is used more efficiently.

Water efficient housing is key and the water industry must influence the construction industry to consider water efficient designs, particularly for new developments. It has been recognised that 50% of an individual's water use has energy use associated with it, such as heating water for example. This demonstrates an urgent need to influence the construction sector, and highlights one of the potential impacts of successful cross-sectoral partnerships.

Additional efficiency gains can also be made through procurement and the supply chain, although there are no R&D budgets within SMEs, which are often very small and fragmented themselves.

Demand Management

Demand management is an important area for attention for the water users and there is a need for collective effort by individuals and industry to make significant reductions in water use. Reducing demand is a key task for the government and the water companies; and raising awareness of water scarcities and efficient water use would enable the public to consider efficiencies they could make and the financial incentives of this effort.

It is widely recognised by the water industry that metering increases water efficiency by 10-15%. Currently 21-28% of the UK population is on a water meter, and this is something the water companies are keen to increase. Intelligent metering is particularly crucial for the domestic market, to allow consumers to understand their water use and the associated cost, so they can make economic judgements of their water use, and identify their potential for making efficiencies. Additionally, raising environmental standards to enable consumers to buy more efficient equipment; increasing the supply and awareness of water efficiency devices; and carrying out water audits of processes and water usage, with penalties for waste, would also support demand reduction strategies. However, water companies believe that additional support from industry representatives will be crucial here, and additional funds may be required for their success.

5.2.4 Impacts of Global Changes

Global changes in population, demographics, and key resources such as oil and water present difficult challenges for the water industry, particularly regarding the security of supply.

Increases in global population are putting a growing strain on water supplies as consumption patterns increase and issues of water scarcity are exacerbated. Plans for building additional homes and small flats in the South East of England has further increased the water stress experienced by this region; and this further strengthens the argument for a holistic approach, and cross sectoral partnerships with other sectors.

Fluctuations in global oil and energy prices also presents risks and higher operational costs for the water industry, and has driven their move towards generating more on site renewable energy to offset grid energy use, reducing the water industry's risk and dependency on energy from fossil fuels.

Water efficiency measures have been introduced to address the issues of water stresses in key geographical areas. Water re-use and recycling schemes are very effective ways of reducing water treatment costs and the water companies have a role to raise awareness of the significance of water efficiency measures, as discussed earlier.

5.2.5 Company Level Carbon Reduction Activities and Initiatives

The water companies are involved in preparing detailed plans for adaptation, for the next 5 years, to start in 2010, with a long-term mitigation strategy for the next 25 years. In addition, the water companies have also considered offering water audits and providing efficiency provisions for consumers to support water efficiencies, although they consider this to be outside their remit and would therefore require further funding, agreed by Ofwat. Furthermore, consumers can calculate their carbon and water footprints through water calculators provided by the water companies online.

A majority of the water companies already monitor their energy use and carbon emissions and are putting in place projects to increase meter coverage across their sites, in preparation for the CRC. Additionally, many have also invested in R&D to develop innovations for low carbon and low energy using technologies. United Utilities are currently developing a project related to activated sludge processes, which could provide an alternative to reduce 80,000 tonnes of carbon a year.

In addition, changing attitudes and behaviours is a key aim of the Carbon Trust's *Low Carbon Culture Programme*, which has been adopted by a number of the water companies to educate their employees on the impacts of carbon and GHGs, to enable them to effectively communicate the message externally.

Additionally, Water UK has produced a checklist for companies in the water industry to help them to reduce their GHG emissions. Water UK's ten ways to reduce GHG emissions is available in Appendix 4.

The water companies are also in discussions with Defra, in partnership Water UK, regarding the CRC scheme design, ensuring there are provisions for the increase in emissions due to the WFD, in order to highlight the key issues and challenges for the industry.

5.2.5 Supply Chain Initiatives

The water industry supply chain is waking up to the challenges presented by climate change and the impacts of key environmental policies. Many have invested in sustainable construction projects, both as demonstrative initiatives designed to educate and illustrate low carbon design to industry; and to reduce their water and carbon footprints.

Corporate social responsibility has a higher priority for many companies within the water supply chain now, who are focusing on reducing their corporate carbon footprints through more effective communication, such as teleconferencing, to reduce the need for overseas travel; by using recycled or recovered materials; by adapting carbon (including embodied carbon) into the whole design and product life cycle process and considering the increasing role of renewable energy generation.

The Regional Development Agency (RDA) has also invested in measures to encourage the private sector to develop low carbon initiatives and understand and mitigate their carbon footprints. They have introduced a *Carbon Management Club*, where companies are trained on how to measure and save energy, and make fuel efficiencies, with funding opportunities for energy efficiency projects. Yorkshire Water is involved in this. In addition, they have also developed a *Climate Change Adaptation Toolkit* to support companies to develop their emergency responses to, and adapt and prepare for flooding events. The RDA is also involved in flood mitigation and adaptation projects on the Humber Estuary and in Doncaster.

Furthermore, the agency will introduce a *GHG Emissions Budget* in 2008, to fund demonstration projects for carbon reduction technologies, which water companies and companies from the supply chain can bid for. The agency's latest programme, *Carbon Action Yorkshire*, aims to accelerate development of a low carbon economy in the region, by engaging private and public sectors to cost effectively reduce carbon emissions in line with national and regional targets. The programme will also work with its partners to stimulate the development and take up of low carbon products and services. This could support the supply chain's needs for demonstration funds to prove the effectiveness of their innovations to the water industry.

5.3 Key Challenges of the CRC for the UK Water Industry

The UK water companies will be captured by the Carbon Reduction Commitment, and will therefore be required to participate in this mandatory emissions trading scheme. As already identified, industry representatives believe that the CRC is not a suitable scheme for the water industry, as it is designed for non-energy intensive sectors, unlike the water industry. However, plans for a separate agreement have been unsuccessful and it is therefore important to identify the key challenges the water industry will face, and lobby government to make provisions for these in the CRC design.

Although the representatives from the water companies are aware of the Scheme, and many of them are on the CRC steering groups and working closely with Water UK and Defra, it is evident that many organisations and representatives from outside the water companies are unaware of the significance of the scheme and how it may impact upon their daily business. There is a key role for raising awareness of the Scheme, and this report attempts to contribute to this effort.

The CRC only covers carbon emissions from energy use, and therefore emissions from methane and other carbon equivalents, which amount to around a third of the water industry's emissions, are not controlled or monitored. Ofwat are currently in discussions about initiatives which could be introduced to address this gap.

5.3.1 Planning for the CRC

Planning for the CRC will be crucial to ensure the industry is suitably prepared for participation in an emissions trading scheme, including the financial implications and long term assets and infrastructure for adaptation and mitigation. Water UK is liaising with Defra on key consultations on behalf of the UK water industry. The details of the scheme are still being finalised and this presents a number of uncertainties, which the water companies must continue to consider in their long term plans.

Planning for participation in an emissions trading scheme

This project has identified that the water companies have little, if any, experience of emissions trading and this will present a number of challenges. Firstly, participants of the CRC will be required to submit details of aggregated energy use and surrender the associated carbon allowances at the end of each financial year. Accurately monitoring energy use from each site will present challenges for the water companies, who will need to ensure that all sites are metered and monitored.

The water companies must also understand the Scheme design and the requirements for participants, to ensure they can put in place knowledgeable teams to manage their efforts for participation and effective carbon reduction. Understanding the number of allowances required and how to purchase these in an auction would also support companies' efforts in bidding for sufficient allowances.

Thirdly, understanding the financial implications of a carbon price and the penalties associated with poor performance is crucial, and this is discussed in more detail below.

5.3.2 Financial Implications of the CRC

Defra assumes that the CRC is cost neutral, as reducing carbon saves companies money and energy, whilst adding value to the company; and the revenues raised are recycled back to the best performing companies. However, it is unlikely that the CRC will be cost neutral for the water industry due to the implications of other environmental legislation (such as the WFD).

Participants of the CRC will be required to submit details of aggregated energy use and surrender the associated carbon allowances at the end of each financial year. Accurately monitoring energy use from each site will present further challenges. The water companies must ensure that all sites are metered, to ensure energy use and CO_2 emissions can be measured and monitored for the CRC. At present many sites are not metered, and energy use is estimated, so water companies will need to consider the cost of fitting new intelligent meters to all their sites, and consider the costs of monitoring and managing these. Administration and transaction costs will also need to be incorporated, as well as the additional labour costs for managing the CRC.

Although Ofwat agree that CRC may not be cost neutral for the water industry because of the associated administration costs and large capital investments, they believe that investments of company profits in R&D should not impact the cost of the existing water treatment and water supply service. Furthermore, the regulator adds that all investments in R&D are risky and not all are successful, but the water companies must consider the benefits of successful innovations and their financial rewards (through the payback of capital investments) and the potential efficiencies they could deliver. It would therefore be unfair to pass these costs on to the customer.

The Environment Agency highlights that if the CRC drives through the anticipated efficiencies, translated into emissions reductions, there is a high level of confidence that most participants will economically benefit from participating in the scheme. Although there are some costs of participation,

the industry will actually financially benefit overall by being covered by the CRC, through the added value of investing in low carbon solutions.

5.3.3 Impacts of Carbon Pricing

Ofwat has encouraged the water industry to consider the cost benefit analyses for all initiatives and include carbon in their economic assessments, through the price review process. The water companies highlight the significance of building carbon into the whole life costing of their efficiency programme, to understand and plan for the economic implications of their carbon output. Although there is still a lot of uncertainty about the price of carbon and how this may rise in the future, the water companies are liaising closely with Water UK and Defra, to understand the forecasts and projections and establish plans to address them.

The Stern Review (2006) has positioned the current social cost of carbon at £25 per tonne of carbon. A water company representative highlighted that this was not a hugely significant figure for the water industry and is unlikely to be enough to encourage major changes in the behaviour of the water companies. He adds that their

"…current operational costs are in the region of £350m; and at Stern's rate of social cost of carbon, this would add another £6m. This is only a small proportion of the total operational costs, and may be one that the water companies are willing to absorb. However, this is predicted to grow for the future…"

The cost of carbon is therefore the key element for all participants of the CRC, as this will be in addition to the existing energy bill (which is also expected to rise); and will influence each participant's decision to invest in carbon reduction measures. If the cost of abatement technologies is more than the price of carbon, participants would be more likely to pay the penalties- the more economic cost in this instance. The water companies expect that the cheapest abatement technologies will be introduced first. Administration and transaction costs will also need to be considered, as well as the additional labour costs for managing the CRC.

Although it was initially expected that the price of carbon would remain fixed for the first three years of the Scheme, after which it would be allowed to escalate, Defra has proposed a new approach which would allow the cost of carbon to increase by 10% a year, for the first 5 years. Representatives from the water companies understand that this could significantly increase the value of carbon, and trading could be in millions of pounds by 2015- a significant amount for the water companies, and the associated penalties of being at the bottom of the league table could also have significant financial implications. Discussions are still ongoing and final details will be released in summer 2008.

5.3.4 Emissions Trading

Although the EU ETS is based on free allocation for most participants, the CRC will be based on the requirement to purchase allowances in a fixed price auction for the first three years, after which a cap will be applied. Phase 1 of the scheme will be a trail phase, allowing participants to understand their annual energy usage and put the appropriate management controls in place (including accurate forecasting) to meet the cap when this is applied in Phase 2 (Year 4 of the scheme). In Phase 2, participants will be subject to market conditions on reducing energy usage in the CRC market, presenting financial incentives to deliver emissions reductions.

The Carbon Trust appreciate that most participants of the scheme will be new to carbon trading, and are likely to have little experience of bidding for allowances in an auction, or trading in the secondary carbon market. Understanding the emissions trading mechanism and how revenues will be recycled will be a significant advantage for all participants. Administration arrangements will be important and Defra is putting in place adequate guidance to ensure a high level of participation without a high number of queries.

5.3.5 Double Counting Renewables

A key challenge presented by the scheme is that of the double counting of emissions reductions through renewable energy generation. Defra has highlighted that reductions made by renewable energy for which ROCs are claimed will not also count as reductions made for the CRC, as Defra will not count this effort twice.

As energy is the largest source of the water industry's emissions, renewable energy generation is likely to be one of the easiest ways for the water industry to reduce its costs and emissions. The water companies argue that the income streams generated by the ROCs are what make such low carbon initiatives economically viable, and therefore investments in renewable energy projects without these income streams will be higher risk. However, Defra has highlighted that financial incentives for renewable energy generation still exist, as companies have the potential of receiving bonuses through the revenue recycling mechanism if their investments reduce their emissions and strengthen their position in the CRC league table.

Despite this, the water companies believe that by not counting the renewable energy (for which ROCs are claimed) as reductions made for the CRC, targets set by the CRC will be increasingly difficult to achieve for the water industry. Additionally, it is argued that electricity is double counted- through both the EU ETS and the CRC- and it would therefore be unfair to not count electricity generated by a water company. Discussions with Defra are ongoing.

5.3.6 Expected Performance of UK Water Industry

The water industry is likely to be one of the most prominent participants in the CRC, due to its size and energy consumption, and its performance is therefore likely to influence and shape the way the league table develops.

The expected position of the water industry in the CRC league table is hotly debated amongst key industry representatives. Many companies believe that the water industry is likely to be at the bottom of the league table due to its significant energy use, which is expected rise due to increasingly stringent water quality targets set by the WFD. Energy use and carbon emissions will therefore be higher for the same amount of water due to regulatory requirements; and the water companies believe that they will not be adequately incentivised to reduce emissions due to their statutory requirements to supply water and treat wastewater, which limits their control over levels of production to meet the CRC cap. Additionally, they argue that any economic reductions in energy which could have been achieved, will have already been realised in an attempt to reduce energy costs.

However on the other hand it is also argued that the water industry is likely to be at the upper end of the league table due to the capacity of larger organisations to absorb any penalties or overheads of the scheme; and as the water companies are large emitters, they are likely to have more capacity for making larger reductions. This is a minority view however, and the uncertainties around how the Scheme will pan out are yet to be seen.

The value of carbon is therefore particularly significant, as it will influence the size of any penalty or reward for participants. The water companies will need to consider how this may be incorporated into their strategies and how they may respond to changes in the carbon market.

Striking a Balance

Understanding the size of the cap and how quickly this may be squeezed is important for effective planning and the water companies will need to strike a balance between reducing emissions and increasing quality. There is a significant role for key industry representatives here to work closely with government and regulators and the *Committee on Climate Change*, to ensure an adequate balance can be achieved.

Understanding the potential for carbon reductions will be essential, particularly in response to the issues of double counting, which will mean that significant carbon reductions realised by the water companies cannot be counted.

5.3.7 ETS or Carbon Tax?

A personal view expressed by an industry representative from a water company described the emissions trading scheme as an indirect taxation for customers. He explained that when the government places a target on carbon through the implementation of the CRC, additional costs are incurred.

The water companies are therefore forced to identify ways of reducing these costs by putting in place new processes- capital to reduce carbon emissions; or by paying for the additional carbon. This

results in a higher cost to supply the same amount of water, and is inevitably passed on to the customer in a higher water bill, subject to approval by Ofwat. In this case, the government has taxed the customers through a higher water bill, in order to subsidise the good performance of those companies that can reduce their carbon emissions.

6.0 Recommendations

6.1 Impacts of Key National Carbon Reduction Policies on the UK Water Industry

6.1.1 Strong Government Lead and Direction

The results of this research have identified an inherent need for strong legislation and direction from the government to support the water industry's strategies to reduce emissions whilst increasing water quality. The CRC will be a key incentive for participants such as the water companies to reduce their emissions, but it is important that provisions for increasing water quality are also considered. It is crucial for all new environmental policies to be harmonised with existing policies and regulation to ensure successful reductions in CO_2 emissions.

Striking a Balance

Industry representatives and regulators must work together to ensure a balance is achieved between targets set in the WFD to increase quality, and the CCB to reduce emissions. New low carbon technologies may need to be deployed, but the regulators must be fully aware of the ecological costs of such regulation, to ensure it does not become counterproductive.

6.1.2 Cross Sector Partnerships

Programmes to promote cross sector opportunities and partnerships for emissions reductions are crucial to address the future risks presented by our changing climate. Significant government lead is essential to identify the challenges, reduce any barriers and put in place the necessary incentives.

The water industry must be represented on the *Committee on Climate Change.* Additionally, the Committee could form working groups to address cross sectoral policy requirements, such as banning the use of some chemicals used in industry, or disincentivising their use to promote R&D for the innovation of more low carbon solutions.

Such partnerships could deliver significant reductions in UK wide CO_2 emissions, not only in the water sector. They could influence the construction industry to reduce building on flood plains, and ensure water efficiency measures are considered for all new (and existing) buildings. Additionally the water industry could support the reduction of wastes to landfill by treating organic and fish wastes through anaerobic digestion, utilising the excess capacity from their existing assets.

6.1.3 Investments in R&D

Programmes to encourage investments in R&D in the water companies will be essential to support the industry to meet carbon reduction targets and participation in the CRC. Low carbon technologies and products must be developed for all sectors, to increase energy and water efficiencies and reduce carbon consumption.

Incentives and legislation for energy efficient technologies, and low carbon investments, will be key in order to make investments in low carbon initiatives more economically viable for the water companies. Supply chain efficiency programmes run by the government or industry bodies will also encourage efficiencies and carbon reductions throughout the industry, ensuring the water companies can procure lower carbon and more energy efficient equipment and technologies.

6.1.4 Demonstration Funds

The promotion of demonstration projects and initiatives to demonstrate the effectiveness of new, low carbon technologies and products, would reduce the associated risks and support and stimulate the adoption of new technologies and processes by the water companies, increasing efficiencies and making CO_2 reductions.

Making these opportunities more easily accessible by the water companies and their supply chain may also support a change in the companies' priorities for investments in R&D.

6.1.5 Enhanced Capital Allowance Scheme for Energy Efficiency

The introduction of an Enhanced Capital Allowance (ECA) scheme (similar to existing schemes which allow capital spend on qualifying products to be claimed back) would incentivise energy efficiency

among participants from the water industry. This may stimulate energy efficiency activities amongst the water industry, which is likely to be the largest GHG emitter in the scheme.

6.2 Company Level Carbon Reduction Strategies and Planning for the Future

6.2.1 Water Efficiency and Demand Reduction

The introduction of carbon labelling for water bills and intelligent metering for all customers, will be a positive step to educating water users on the level of their usage and its carbon and economic impacts. This empowers the customers to make decisions about reducing their water bill and carbon emissions, by identifying the incentives of these.

The water companies could also provide a water auditing service for customers. This would ensure that water use is recorded and monitored, making it easier to the potential for efficiencies. The water companies must also promote efficiency provisions, which customers could adopt to reduce their water bills, through reducing water use. Additionally, the water companies must promote water efficiency measures such as water re-use and recycling schemes to support emissions reduction, reducing the amount of water treatment required.

By ensuring that the water companies are operating at the optimal efficiency levels, energy savings and therefore carbon reductions can be made more easily. The water companies must explore different methods of reducing pumping requirements and consider more sustainable levels of leakage reduction, with support from the regulators.

6.2.2 Increase in on site Renewable Energy Generation

By increasing the amount of renewable energy generated on site, the water companies can offset their grid electricity use, and reduce their dependencies on energy from fossil fuels whilst making significant CO_2 emissions. Such efforts would also contribute to significant targets set by the water companies in their strategic directional statements, and those outlined in the Climate Change Bill.

However, discussions between the water industry and Defra are still ongoing around the issue of double counting emissions reductions in the CRC. If these emissions reductions are counted, they would enable the water industry to continue to invest in renewable energy generation and effectively meet government targets.

Alternatively they could be counted for the initial phase to allow companies to get accustomed to the Scheme and identify other methods of emissions reduction. Further details will be available after the final CRC consultation in summer 2008.

6.2.3 Company level initiatives to raise awareness of mitigation and adaptation

Additional mitigation and adaptation activities and projects must be developed in the short term to prepare for and make the CO_2 emissions reductions which companies have committed to in their SDSs.

Business support organisations and industry representatives must support the water industry to make these steps towards CO_2 emissions reductions, by implementing programmes and initiatives to reduce the barriers. This includes education to make water users more carbon aware and enable and empower them to make the necessary changes to realise carbon reductions.

6.3 Key challenges of the CRC for the UK Water Industry

6.3.1 Keep it Simple

The CRC Scheme design must be kept simple to ensure participants understand it and can effectively participate.

The key concerns highlighted by the water industry must be addressed by Defra, which will also have to consider how the Scheme will be harmonised with other policies, including the increasing demands for increases in water quality from the Water Framework Directive.

6.3.2 Effective Planning for the CRC

The water companies will be new to carbon trading and can increase their chances of success in the Scheme by increasing their understanding of how the CRC will work.

It is essential that they are fully aware of the scheme design; data requirements and how these may need to be monitored, managed and provided; how to bid for allowances; the revenue recycling mechanism and how to trade emissions in the secondary market.

The water companies will need to put in place knowledgeable management teams to ensure they are effectively participating in the Scheme, in order to avoid any penalties for non-compliance; and to prepare for the carbon cap, which will be introduced in Phase 2.

Ongoing discussions with Water UK, the Carbon Trust and Defra should be maintained to support this.

6.3.3 Extending the CRC Coverage

The CRC scheme could be extended to also include emissions from other carbon equivalents (CO_2e) to ensure more comprehensive coverage of pollutants contributing to climate change.

These carbon equivalents amount to around one third of the water industry's emissions, and Ofwat are currently in discussions about initiatives which could be introduced to address this gap.

6.3.4 Influencing the Carbon Price

The price of carbon will be increasingly significant for decisions made by the water companies and other participants in the CRC. It will impact the level of penalties/bonuses and the cost of allowances which participants will be required to buy from the government in an auction.

There are opportunities for the government to influence the price of carbon to maintain the optimal carbon value; ensuring participants remain incentivised to reduce CO_2 emissions.

The water companies must continue to make investments in low carbon solutions to ensure a better performance in the CRC league table, which ranks companies in order of good performance. A good performance in relation to other (non-energy intensive) participants in the CRC would reduce the financial impact of the penalties.

7.0 Further Research

There are a number of opportunities for further research, which have been identified throughout this project, and these are discussed below.

Firstly, the industry has highlighted a need for identifying more economically viable low carbon innovations designed to translate investments into energy and carbon savings, and there is scope for further research to identify the most (cost) effective methods.

It is also important to consider the impacts of the CRC on the water companies' supply chain and procurement methods to understand where changes and efficiencies may need to be introduced; and additionally understanding what the CRC will mean for water customers will also be significant.

Finally, identifying what technologies are already out there, and understanding how they can be proven and commercialised on a large scale will be vital for the water industry in the future to encourage the deployment of more low carbon solutions. Government support and direction will be essential and there is scope for further research to identify how this may be addressed for the future.

8.0 References

- Aitken, M (2007) *Public Opinion on Electricity Options*, London, Published by the Parliamentary Office of Science and Technology
- Anglian Water (2007) *Strategic Direction Statement: 2010-2035*, Cambridge; Anglian Water
- Baker, Y. (2008) *Climate Change Levy and Emissions Trading* [online] Available at http://www.netregs.gov.uk/netregs/275207/1018642/1749607/?lang=_e [Accessed on 22nd February 2008]
- BBC News 24 (2005) *Q&A: The Kyoto Protocol* [online] Available at http://news.bbc.co.uk/1/hi/sci/tech/4269921.stm [Accessed on 22nd February 2008]
- Boehringer, et al (1998) *Global* CO_2 *emissions and unilateral action: policy implications of induced trade effects*, Int. J. Global Energy Issues 11Ž1_4., 18_22.
- Bruvoll, A., Larsen, B.M., 2004. *Greenhouse gas emissions in Norway: do carbon taxes works?* Energy Policy 32 (4), 493–505.
- Caffoor, I. (2007) *Energy Efficient Water and Waste Water Treatment*, Environmental KTN
- Clarke, B. and Horton, B. (2007) *Worst climate impacts will be caused by water IPCC predicts* [online] Available at http://www.water.org.uk/home/news/press-releases/ipcc-says-water-in-front-line-?s1=underlines [Accessed on 28th December 2007]
- Climate Change Bill (2006) *The Climate Change Bill* Published by Authority of House of Commons, London
- Cramton and Kerr (1998) *Tradable Carbon Permit Auctions: How and Why to Auction Not Grandfather* Discussion Paper 98-34
- Department for Environment, Food and Rural Affairs (2008) Action in the UK - Carbon Reduction Commitment [online] Available at http://www.defra.gov.uk/Environment/climatechange/uk/business/crc/index.htm [Accessed on 3rd January 2008].
- Department for Environment, Food and Rural Affairs (2006) *Appraisal of Years 1-4 of the UK Emissions Trading Scheme*, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2006) *An effective Carbon Levy for the UK: A Consultation,* London; (Osbourne Report) Conservative Party
- Department for Environment, Food and Rural Affairs (2006) *Climate Change, The UK programme 2006: Tomorrow's Climate, Today's Challenge*, CM6764, SE/2006/43, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *Comparison of Policies to Reduce Carbon Emissions in the Large Non-Energy-Intensive Sector*, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *Design of Auction, 'Safety-valve' and Revenue Recycling within the Energy Performance Commitment (EPC)*, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2006) *Energy Efficiency and Trading Part II: Options for the Implementation of a New Mandatory UK Emissions Trading Scheme*, London, (Radov et al); Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2008) *Future Water: the Governments water strategy for England*, Cm 7319, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2008) *Future Water: Factsheet- What the strategy means for business & industry*, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2008) *Implementation proposals for the Carbon Reduction Commitment: Report on the public consultation (June 2007) and Government's policy decisions,* London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *Measures to Reduce Carbon Emissions in Large Non-Energy Intensive Organisations: Review of Consultation Responses*, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *Summary of responses to the consultation on the draft Climate Change Bill from 13 March - 12 June 2007*, London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *UK Carbon Reduction Commitment Stakeholder Seminar London*; London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *UK Carbon Reduction Commitment Stakeholder Seminar Manchester*; London; Published by Department for Environment, Food and Rural Affairs
- Department for Environment, Food and Rural Affairs (2007) *Updated Partial Regulatory Impact Assessment on the Carbon Reduction Commitment*, London; Published by Department for Environment, Food and Rural Affairs
- Department of Trade and Industry (2007) *Meeting the Energy Challenge: A White Paper on Energy*, CM 7124, London; Published by Department of Trade and Industry
- Des Jardin, J. R. (2001) *Environmental Ethics, an Introduction to Environmental Philosophy* Third Edition, Wadsworth/Thomson Learning: Belmont.
- Dixon, R (2007) *Northern Water Utilities Technology Study: Executive Summary*, Warrington; Envirolink Northwest
- Doble, C. and Gluckman, R. (2007) *The Carbon Reduction Commitment* Enviros Briefing Note
- Easterby-Smith et al (1991) *Management Research, An Introduction*, London: Sage Publications

- Edwards, T. and Hutton, J. (2001) *Allocation of carbon permits within a country: a general equilibrium analysis of the United Kingdom* Energy Economics 23Ž2001.371_386
- Egenhofer, C. (2007) paper *The Making of the EU Emissions Trading Scheme: Status, Prospects and Implications for Business* European Management Journal Vol. 25, No. 6, pp. 453–463, 2007
- Ekins. P & Speck, S (1998) *The impacts of environmental Policy on Competitiveness: theory evidence*. In Barker and Kohler (eds) International Competitiveness and Environmental Policies. Pub. Edward Elgar pp.33 - 69
- Ellerman, D. and Buchner, B. (2006) *Overallocation or abatement? A Preliminary Analysis of the EU ETS Based on the 2005 Emissions Data*, Nota di lavoro 139.2006, Fondazione Eni Enrico Mattei, Milan.
- Grayling, et al (2005), *Climate commitment: Meeting the UK's 2010* CO_2 *emissions target*, Institute for Public Policy Research
- Grub, M. (2007) *Economic dimensions of technological and global responses to the Kyoto Protocol*, Journal of Economic Studies, Vol 27, No. 1/2, 2000 pg 111-125
- Horton, B (2007) *Company SDS targets as set out in the SDSs*, Water UK
- IPCC (2007) *Intergovernmental Panel on Climate Change* [online] Available at http://www.ipcc.ch/ [Accessed on 24th December 2007]
- Klaassen, G. (1996) *Acid Rain and Environmental Degradation: The Economics of Emissions Trading*, Edward Elgar, Cheltenham, UK and Brookfield, US.
- Klaasen (2005) *Testing the theory of emissions trading: Experimental evidence on alternative mechanisms for global carbon trading* Ecological Economics 53 (2005) 47– 58
- Kolk and Hoffmann (2007) *Business, Climate Change and Emissions Trading: Taking Stock and Looking Ahead* European Management Journal Vol. 25, No. 6, pp. 411–414, 2007
- Lee et al (2007) *Analysis of the impacts of combining carbon taxation and emission trading on different industry sectors* Energy Policy 36 (2008) 722–729
- Mahoney (1997) *Qualitative Research Methods* [online] Available at http://www.ehr.nsf.gov/EHR/REC/pubs/NSF97-153/CHAP_3.HTM [Accessed on 7th January 2008)
- Marks and Spencer (2007) *About Plan A* [online] Available at http://plana.marksandspencer.com/?action=PublicAboutDisplay [Accessed on 26th March 2008]
- Moorcraft, N. (2007) *What is the Carbon Reduction Commitment?* Birmingham; The Energy Consortium: Sustainable Energy Focus, Issue 3
- Northumbrian Water (2007) *Looking to the Future: Strategic Direction Statement*, Durham; Northumbrian Water
- Office of Water Services (2007) *Setting price limits for 2010-15: Framework and approach – a consultation paper,* Birmingham, Published by the Office of Water Services
- Ofwat (2002) *Privatisation and the history of the water industry* [online] Available at http://www.ofwat.gov.uk/aptrix/ofwat/publish.nsf/content/privatisationhistory [Accessed on 22nd February 2008]
- Parry, I (2002) *Are Tradable Emissions Permits a Good Idea?* Issues Brief 02-33
- Patton, M.Q. (1990). *Qualitative Evaluation and Research Methods*, 2nd Ed. Newbury Park, CA: Sage.
- Paulsson (2003) *Emissions for Sale: The Ethics of Emissions Trading* Masters Thesis, Centre for Applied Ethics, Linköpings universitet
- Pearce, D. (2005), *The United Kingdom Climate Change Levy: A study in political economy*, Organisation for Economic Cooperation and Development
- Porter, M. and Linde, C. (1995) *Green and Competitive: Ending the Stalemate*, Harvard Business Review
- Remenyi et al (1998) *Doing Research in Business and Management*, London: Sage Publications
- Robinson, C (1998) *A 'crisis' in water? The wrong sort of privatisation* Institute of Economic Affairs
- Saunders et al (2007) Research Methods for Business Students 4th Edition, London; Harlow : Financial Times Prentice Hall.
- Sarwar, N. (2008) *Using relevant examples and links to academic theories discuss the issues involved in developing successful environmental policies* Environmental Policy Assignment, University of Huddersfield
- Schleich et al (2004) *Banning banking in EU emissions trading?* Energy Policy 34 (2006) 112–120
- Severn Trent (2007) *Focus on Water: Strategic Direction Statement 2010-2035*, Birmingham, Severn Trent
- Severn Trent (2005) *The Carbon Management Programme*, Birmingham; Tayburn
- Slater, F. (2007) *Energy and Sewage*, London, Published by the Parliamentary Office of Science and Technology
- Smyth, I. (2007) *Carbon clampdown* Utility Week, 13565532, 10/5/2007, Vol. 27, Issue 23
- Snap Services Ltd (2008) *Qualitative vs. Quantitative Research* [online] Available at http://www.snapsurveys.com/techadvqualquant.shtml [Accessed on 26th March 2008]
- Stern, N. (2006), *Stern Review on the Economics of Climate Change: Final Report*, HMRC
- Taylor, P. (2007) *The water industry in 2007 - challenges and priorities* [online] Available at http://www.water.org.uk/home/news/chief-executive-speeches/city-conf-8-feb-07 [Accessed 22nd January 2008]
- Thames Water (2007) *Taking care of Water: Our plans for a sustainable future*, Swindon; Thames Water
- Thirteen ed online (2008) *Qualitative and Quantitative Data* [online] Available at http://www.thirteen.org/edonline/lessons/data/b.html [Accessed on 25th March 2008]
- Tietenberg, T. (1985) *Emission Trading: An Exercise in Reforming Pollution Policy*. Resources for the Future, Washington.
- United Utilities (2007) Un*ited Utilities Strategic Direction Statement 2010-2035: Where we are heading*, Warrington; United Utilities

- Vibeka, M. (2007) *No 'special treatment' on carbon reduction.* Utility Week, 13565532, 10/5/2007, Vol. 27, Issue 23
- Walker, I. (2007) A *Roadmap of Strategic R&D Needs to 2030*, Regulatory: Innovation in Water RG/10, Report Reference No 07/RG/10/3, UKWIR
- Water UK (2007) *About the Water Framework Directive* [online] Available at http://www.water.org.uk/home/policy/water-framework-directive/about-wfd [Accessed 29th November 2007]
- Water UK (2007) *Carbon Accounting*
- Weatherley, N (2008) *Water industry planning - an introduction* [online] Available at http://www.environment-agency.gov.uk/subjects/waterquality/289209/?lang=_e [Accessed on 6th February 2008]
- Welsh Water (2007) *Welsh Water: Our Sustainable Future*, Treharris, Welsh Water
- WFD (2007) *The Water Framework Directive* [online] Available at http://www.euwfd.com/html/wfd_-_a_summary.html [Accessed on 24th December 2007]
- Yorkshire Water (2007) *Strategic Direction Statement: Striking the right balance for Yorkshire*, Bradford, Yorkshire Water

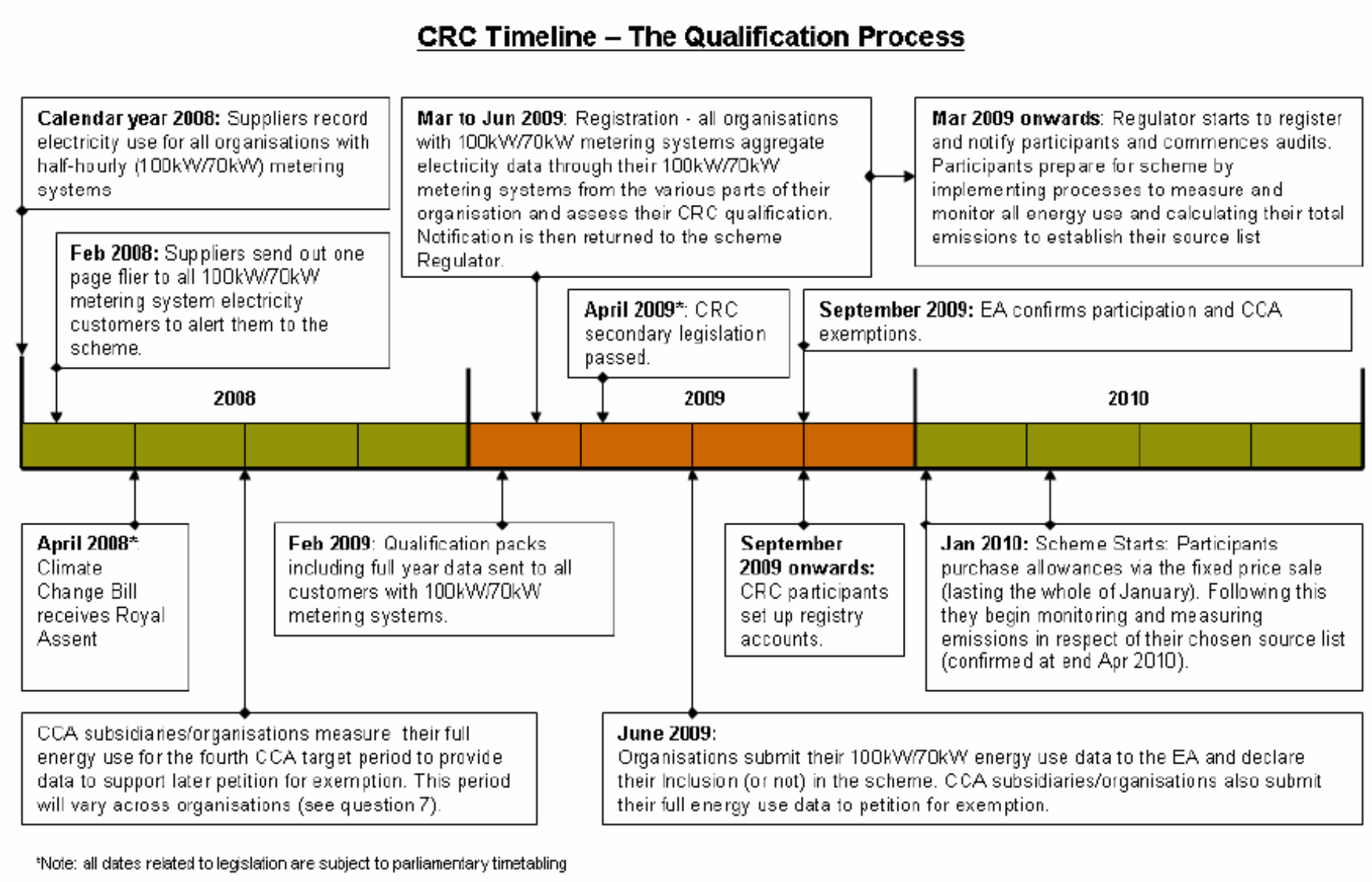
9.0 Appendices

9.1 Appendix 1 - Overview of Some Main Policy Schemes and Initiatives, Per Region

	Main Characteristics
Europe	
EU Emissions Trading Scheme (EU ETS)	Main instrument of the EU to reduce greenhouse gas (GHG) emissions. Started trading in 2005, with two phases until 2012. EU plans beyond 2012 are to reduce GHG emissions by 20% by 2020 and 60-80% by 2050.
UK Emissions Trading Scheme	First domestic economy-wide trading scheme, based on voluntary participation of companies with absolute reduction commitments, launched in 2002.
North America	
Chicago Climate Exchange (CCX)	Voluntary, but legally binding commitment of member organisations to meet greenhouse gas emission reduction targets of 6% by 2010, compared to average 1998-2001 emissions. Started trading in 2003.
Regional Greenhouse Gas Initiative (RGGI)	Cooperative effort by 10 Northeast and Mid-Atlantic states in the US to discuss the design of a regional cap-and-trade programme. Initially planned to cover CO_2 emissions from power plants, but may be extended to other GHG (sources).
California Global Warming Solutions Act	Mandates state-wide greenhouse gas emissions cap for 2020, based on 1990 emissions. Equals a 25% emission reduction compared to business as usual. Triggered formation of California Climate Exchange (CaCX) in 2007.
Mayors' Climate Protection Agreement	Agreement signed by 600 mayors in all 50 US states and Puerto Rico in July 2007, which includes commitment to reduce CO_2 emissions by 7% below 1990 levels by 2012. Initiative was first launched in 2005.
Western Regional Climate Action Initiative	Agreement that directs 7 US states and 2 Canadian provinces to develop regional target for reducing greenhouse gases by August 2007. Will devise market-based programme, such as a load-based cap and trade programme to reach the target.
Canadian Regulatory Framework for Air Emissions	Successor to an earlier plan (2005) launched by the previous government. The current set-up aims at 20% reduction of greenhouse gas emission by 2020 compared to 2006. Mixed approach with emissions trading and contributions to a technology fund.
Asia-Pacific	
Asia-Pacific Partnership on Clean Development and Climate	Announced early 2006 by the US, Australia, China, India, Japan, and South Korea. Focuses on creating a voluntary, non-legally binding framework for international cooperation to facilitate development and deployment of clean technologies.
Japan	Adopted Kyoto Protocol Target Achievement Plan in 2005, which implies awareness raising, dissemination of technology, emissions reporting and voluntary use of the Kyoto mechanisms. In May 2007, Japan's prime minister announced an initiative to halve global emissions by 2050, using new technologies, and nuclear and renewable energy.
Australia/New Zealand	Australia has announced its intention to move towards a domestic, nation-wide emissions trading system, beginning no later than 2012. In June 2007, Australia and New Zealand announced to join forces in the development of carbon-trading systems that would be compatible.
Australia Climate Exchange (ACX)	Launched Australia's first emission trading platform in July 2007, providing a mechanism to trade emission allowances and the Australian Greenhouse Office accredited Greenhouse Friendly approved abatement.
New South Wales Greenhouse Plan	Australian state initiative to bring GHG emissions back to the level of 2000 by 2025 and envisions 60% reductions by 2050. Applies various initiatives in different sectors.

Source: Kolk and Hoffman (2007) - *Business, Climate Change and Emissions Trading: Taking Stock and Looking Ahead*

9.2 Appendix 2 - CRC Timeline – The Qualification Process



9.3 Appendix 3 – Consultation Responses

Research Interviews

Interview A

Date: Tuesday 11th Dec 2.30pm
Job Title: Knowledge Transfer Manager- Water
Organisation: Environmental KTN
Org Type: Business Support Agency

Key discussion points:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

- Contradictory regulatory drivers
  - Environment Agency and EU is implementing WFD (EU wide) and daughter directives (including dangerous substances directive which will require further tertiary treatment, increasing energy use and carbon) will increase energy and carbon use, by at least 100% in energy usage up to 2013. If the Dangerous Substances Directive comes into force, this could go up to 240% as the extraction of the specified compounds will require tertiary treatment processes.
  - On the other hand, carbon reduction targets: 20% by 2010 and 60% by 2050.
  - Water companies/utilities have to put forward strategic directional statements for PR09 review (available on Ofwat website). United Utilities have committed to some CO_2 targets, but Yorkshire Water has not committed to a %age reduction, but will strive towards a carbon reduction.
  - Ofwat is now also responsible for sustainable development, which presents more contradictions, as many existing processes which they are regulating to maintain may not be sustainable methods
  - WFD- strategy is now in place, and the details are being developed.

- Long term assets
  - Many of the requirements of WFD and other directives are making existing infrastructure and plant obsolete by not meeting the higher standards. Therefore more intensive assets are required on a much smaller scale (which means they have a smaller footprint).
  - Modular processes are being developed- so they can be added to, in light of new policies and requirements
  - Global changes- oil prices are driving up energy prices. Can the industry become more sustainable and less energy dependent? This can be achieved on a smaller scale (for 100-200 homes) but will require a larger physical plant. Drawbacks: less robust, more staff, larger scale so harder to manage and therefore companies are reluctant to invest.

What are the barriers to reducing emissions in the water industry?

- Efficiency
  - Can't decentralise without compromising efficiency. Smaller plants demand more energy, and larger plants demand less energy.
- Land costs are at a premium
- Technical barriers- the technologies haven't been developed, and as this is such a risk averse, conservative industry, they will only invest in proven technologies. They cannot afford the cost of failure. There are no R&D budgets within SME's which often tend to be fragmented organisations; and no demonstration funds from government, which exist for other sectors (inc energy). WWT may not be seen as a priority.
- No fiscal incentives in place and as waste to energy is not their core business they will not pursue it. The increasing cost of the landfill directive is causing more solid waste disposal in sewers, which causes a number of problems for the water industry: increased load to WWT works (which it is not designed for), increased energy use to separate, rats and infestations and more. However, although the WWT companies have the infrastructure and technology to use FOGS

(fats, oils and greases) and this solid waste to create energy from biogas to offset energy use, the industry is only awarded ¼ of a ROC for digesting sewage sludge, but local authorities are awarded 2 ROCS for treating municipal waste- even though they have to undergo the carbon footprint of getting all planning permission and building new infrastructure. Lack of joined up thinking here as this is something the WWT companies could do as part of their existing processes. Note: A waste treatment licence is also required for treating solid wastes.

- Lack of holistic approach- we need to work across sectors to really reduce our emissions

A recent UN Report[9] claims that climate change will lead to a 20% increase in global water scarcity and the Stern report (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like the one we have experienced recently) and droughts. What challenges does this present to the industry (including consumer and regulator expectations) and how can the industry plan for this?

- Government recognise the issues with water stresses, especially in the South East. There was one proposal for a Water National Grid, but this is questionable. Yorkshire Water set up a regional grid in 1995 when the Yorkshire region experienced a drought-pumping from East to West.
- Water Stresses
  - Thames Water are building a plant, where they will use desalination technology, converting sea water to freshwater. A technology used in the Tropics and Arab countries, although not the most cost effective in the UK due to high energy costs. Ken Livingstone asked them to put in more renewables to offset their energy use- first time a politician has become involved.
- Reduce Demand
  - Leakage- current leakage is up to 30%. YW leak around 250 Mega litres per day (equivalent for water requirements for city of Leeds). There are 30,000 km of pipes underground, many of which are up to 100 years old. Utilities can only afford to replace 10-15% per year without affecting prices for customers too much. Also need to assess economic level of leakage- is it worth it in monetary terms to fix leakages. What about sustainability terms? The water industry invested £1.3bn in AMP 4 for leakage reduction of 10% (this would achieve reduction of 300 mega litres per day for whole industry). An extra £2.8bn was required to reduce it by a further 10%. The whole capex for water industry over AMP 4 was £16.4m, so leakage reduction was 15% of this.
  - Metering- currently on meter 21-28% of population. Metering increase reduction in demand by 10-15%. We need intelligent meters (for water, electricity, gas) so consumers can understand how much they are spending and how much they can save.
  - Recycling grey water (washing up water from sinks) - using it for toilet flushing. Many hotels in China/Japan have a grey water treatment plant in the basement of building. This technology can be easily transferred to the UK, dual water systems could be integrated into households but public perceptions and attitudes may be a problem.
  - Industry wastes a lot of water- waste minimisation activities/ audits of their processes and penalties would reduce their water usage.

What strategic measures is/should the industry be taking, in order to adapt to climate change?

- Holistic approach needed across sectors. For example WWT could diversify into municipal waste and support the reduction of waste to landfill.

What recommendations would you make to support and drive the WWT industry to invest in new technologies and adapt to climate change, in order to reduce carbon emissions?

- Main energy using components are: Pumping, aeration and renewable energy sources. Addressing these could reduce their energy use/carbon output.
  - Pumping- this needs to be used more efficiently/optimised, during off peak periods and at variable speeds. The higher the pressure the more leakage is created too.
  - Aeration- More efficient diffusers, aerators, and process control. Tune to the load expected.

[9] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

- Renewables- increase amount of renewables on site. Small scale hydro, wind energy, solar, geothermal, virbrational.

What are your views on the targets set for industry in the Climate Change Bill recently introduced by the government, and how do you think this may impact the water industry?

- Sectoral targets are based on historical carbon usage, but they need to take into future requirements of WFD as this will increase emissions. Targets should be equal for all industry rather than rewarding their previous inaction with an allocation reflecting their historical output. There should be financial punishments to monitor this, ensuring companies will conform.

What are your views on the carbon reduction measures proposed by the government- particularly carbon taxation or emissions trading schemes? Which of the two would you prefer?

- Don't know a lot about emissions trading schemes, but aware of UK ETS pilot. Water industry will be at bottom of league table due to WFD. Allocation of permits should be based on historical output, but reflect future standards set by the WFD.

What are the most important/significant areas for development or investment in order to increase water and energy efficiency and reduce emissions in the water industry?

- Leakage
- Demand reduction
- Increasing renewable energy

What are the major challenges and risks associated with investments in new, more energy and water efficient, long term technologies?

- Ofwat only allows efficiencies for a 5 year period before the baseline is re-set (AMP framework). R&D often takes longer than 5 years, and this regulatory regime inhibits companies as payback may not be long enough for many technologies (due to this strict 5 year price review regime)
- Efficiencies can also be gained from procurement, R&D and the supply chain
- UKWIR report- Barriers to innovation
- Environmental KTN will produce a business case for the technology strategy board to influence funding calls, report to Ian Pearson MP, and to influence Defra, Ofwat and EA.
- RCUK- Applied research
- Carbon neutral developments under way in Ashton Hayes, near Manchester www.gocarbonneutral.com

Interview B

Date: Wednesday 19th December 2007
Job Title: Environmental Policy Advisor
Organisation: Water UK
Org Type: Policy Organisation

Discussion

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

Mitigation and adaptation.

Mitigation:

- Emissions are increasing. Many companies' emissions have risen by at least 50% since 1990 levels- due to better emissions measurement and monitoring technologies, but also an increase in

quality and environmental standards which are driving up the cost of treatment and amount of emissions.
- Emissions have also increased due to growth in consumption. Water companies have a statutory duty to supply water to all households/industry and therefore have to deal with this additional demand.
- CCB- 60% reduction by 2050, applicable to all sectors.

Adaptation:
- Many of industry's assets are close to sea/rivers or on flood plains, putting them at risk
- Water shortages- scarcity, particularly in South East England
- Extreme weather events, such as flooding, storms etc- current sewerage infrastructure is not designed to carry storm water

EA publish Water Resources Planning Guidelines- next one out in Spring 2008.
Includes details on climate change and asks companies to forecast demand, consider security of water supplies etc

SDS set out a company's strategic business direction, and many companies will plan based on intensity of rainfall e.g. sewerage infrastructure.

Water UK is a policy organisation. We communicate with government and facilitate the information exchange between industry and government. We also facilitate and chair a number of climate change groups and have developed a carbon accounting tool. Water UK has also developed an adaptation tool which will act as a checklist for water companies to assess the potential impacts of climate change on the water industry.

- Growth- Consumption is increasing as population grows, and changes in demographics mean that more people are living on their own in smaller houses, which again increases consumption.

- WFD- the revised drinking water directive and others are increasing requirements and need for treatments are driving up emissions.

- Climate policies- CRCs capture many water companies. The qualifying year will be 2008 (emissions will be monitored) and a cap will be set when the scheme starts in January 2010. Water UK co-ordinated the response to CRC- looking at how it will impact the industry and the design of the scheme. Government has accepted many of the suggestions and recommendations made in the consultations.

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

- WFD gives water companies more flexibility on how they will achieve the outcomes- 'good standard' rivers etc. These may not be end- of –pipe solutions, but companies can look at other aspects of the process to reduce emissions.
- The legislation doesn't necessarily provide conflicting targets as there should be low carbon solutions developed to address the standards set in the WFD- carbon must be illicitly included in all WFD objectives.
- This legislation would be conflicting if everything was left to water companies. A more holistic approach is needed, requiring all water users/anyone with an impact on the water environment to contribute to lower carbon/ more environmentally friendly and efficient methods.

Increase in innovative low carbon solutions

- WI is a risk-averse industry due to the strict criteria and issues of public health. Many companies may be over treating the water, to be safer and avoid fines and reputational damage.
- OFWAT often fund research on water quality outcomes

- Need a more holistic approach. The regulatory framework has made industry more risk averse. WI needs to move away from end of pipe solutions and look at other ways of reducing emissions.

For example, can we change some chemicals in shampoos or work with farmers to reduce use of certain fertilisers?

What are incentives for other industries to work with the WI?

- Farmers and other industries are not aware of their impact on water treatment process- we need to raise awareness of this- organisations involved in this include Waterwise, EA, Energy Savings Trust, Water Savings Trust
- Maybe there is a role for the government here- to identify who impacts on the WI and take action to prevent damaging impacts- e.g. ban substances/tax/trading schemes/ voluntary industry agreements etc.
- Voluntary codes of practice with other industries include Water UK's FOG campaign- working with F+D industry to increase efficiency.
- Guidance of social costs of carbon is provided for water companies- calculating economic value of carbon footprints- social/environmental cost of carbon.

Renewable Energy generation

- CCB has a 20% target for renewables on site- many water companies are doing this already, particularly with CHP.
- There is a big potential for reducing emissions with renewables, however companies need to strike a balance between reducing emissions vs. drive to increase quality. It is suspected that a cap for CRC will become very stringent.
- Committee on Climate Change will be set up to advise government on activities in different sectors, including achievements of different economic tools.

What recommendations would you make to support and drive the WWT industry to invest in new technologies and adapt to climate change, in order to reduce carbon emissions?

- CRC will have a league table based on absolute emissions reductions in a year. Companies will be rewarded or punished dependent on their position within this league table every year.
- The WI has already taken many actions early on and these must be recognised, but energy still remains the 2nd largest operational cost (after labour).
- Increase in renewable energy will help to offset industry emissions. We need to look at the purchasing of green energy from CHP too. Consumption is expected to continue growing, as the water industry has a statutory duty to supply water to all households/organisations.
- Transaction and labour costs will also need to be considered for the ETS scheme
- Cost of buying carbon permits need serious consideration too.
- CRC requires sites to be metered too. Currently many sites are not metered and energy use is estimated so there is a cost involved in fitting the new meters.

Interview C

Date: 19th December 2007
Job Title: Technical Director
Organisation: British Water
Org Type: Trade Organisation

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

- Energy Use

All WWT companies are energy driven. Processes such as aeration and pumping are big energy users and could be developed to be more efficient (although pumping has geographical limitations)

- Resources

Difficulties lie with maintaining supply to cope with events such as droughts
Energy use
Renewable options- waste to energy anaerobic digestion.

- Efficiencies of equipment and processes.

There are many processes and pieces of more efficient equipment available, but these must be tested and proven for water companies to adopt- as it is a risk avers industry.

Government is asking for longer term plans- Defra, OFWAT, EA.

Barriers to innovation

- OFWAT 5 year period is inhibiting innovation.
- UKWIR has published a report on the effects of regulation on the water industry supply chain. BW has highlighted this issue to Defra/OFWAT.
- We need to increase energy produced from renewables. Newer techniques will also produce less sludge.
- More expensive to treat water- innovation responds to pressures- industry may develop more energy efficient processes.

What is your understanding of government policies such as the Climate Change Bill? What challenges do you feel they present for the industry and what are your views on this?

Awareness of CCB and CRC but not the details.

A recent UN Report[10] claims that climate change will lead to a 20% increase in global water scarcity and the Stern report (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like the one we have experienced recently) and droughts
What challenges does this present to the industry (including consumer and regulator expectations) and how can the industry plan for this?

Water Efficiency

- Water scarcity is a major issue for the industry. Water re-use and desalination are options, but are very energy intensive.
- Industry can recycle water to be more efficient- balance of treatment cost and environmental benefit.
- Other options include grey water re-use and rainwater harvesting- something many companies are already involved in.

Awareness of Water Efficiency

- The water utilities are responsible for raising awareness for water efficiency- part of their remit. Water wise is also involved.
- Industry and agriculture need to be more efficient too- cost driven.
- Water audits of the WI may increase efficiency.

Sustainable Developments

- Bedsed development.
- Many examples in Singapore/Australia. BW have taken trade missions here.
- Barriers in the UK have included payback time, which is too long and the cost of replumbing. Need fiscal incentives.
- Metering is important to raising awareness of individual water use- public acceptance. This will ensure people understand what they are using and what it will cost them.
- New developments may not be considering whether there are enough water supplies for them.

[10] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

-

- There are currently discussions among companies about climate change and sustainable development but we need a legislative push- regulation for more energy efficient equipment- something which impacts upon financial return. Demonstration projects are also needed to develop innovative technologies- so the risk-averse utility companies will adopt the proven solutions. Ofgem allows companies a certain %age of their turnover which must be invested back into R&D- maybe Ofwat could follow same route?

- This presents supply chain opportunities for more efficient processes and technologies, and environmental friendly construction, such as the Arup building in Sollihul.
- There is a need to raise environmental standards to enable consumers to buy more efficient equipment.

Key issue is planning:
- Building on flood plains needs to be reduced- as many flooding solutions still cause many other environmental problems.
- Better defence for treatment works/assets, as moving these away from rivers causes more pumping requirements.
- Currently, many treatment plants (sewers) are built underground- should they be built from overground? Industry needs to consider how we can protect the treatment works from climate change?

British Water
- Is a parliamentary lobby
- Route to Ofwat to modify financial regulation to encourage innovation and longer term view- industry will need a longer return on investment to spend money on R&D etc.

Interview D

Date: 3rd January 2008
Job Title: Carbon Manager
Organisation: United Utilities
Org Type: Utility

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

Adaptation and Mitigation.

Adaptation
The expected drier summer and intense rainfall events will:
- Impact on water resources
- Will lead to an increased demand for water (due to warmer climate). More rainfall is expected in winter, and less in summer- resulting in a change in rainfall patterns.
- Flash flooding events of houses (as sewer systems struggle to cope with amount of water) and there is an increased need to vulnerable treatment assets.
- UU use UKCIP rainfall scenarios to plan for impacts on treatment facilities.
- The options for addressing the problem with the sewers include increasing the size of the sewers; or demand management. UU have explored water recycling (grey water) and re-use schemes, and sustainable urban drainage systems.

A recent UN Report[11] claims that climate change will lead to a 20% increase in global water scarcity and the Stern report (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like the one we have experienced recently) and

[11] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

droughts. What challenges does this present to the industry (including consumer and regulator expectations) and how can the industry plan for this?

- It is the role of the utilities and hence part of UU's role to promote water efficiency, which is a challenge. There are boundaries for UU's remit and water efficiency is part of that. But they are not funded to do this.

Mitigation

- Recovering energy from WWT plants-this is something that UU do.

Methane gas can be capture and combusted from sludge. Along with other CHP technologies this creates 80GWh electricity per year.

- Increasing efficiency of pumping

What are the barriers to reducing emissions in the water industry?

- Money and people, but long term activities should pay for themselves
- 5 year AMP cycles- which inhibit innovation
- Good housekeeping- every little helps
- Achieving a balance between aquatic improvement and airborne pollution (WFD)- carbon footprints have doubled since 1990 levels, to meet consent standards. The EA have not understood balancing aquatic environment and other environmental pollution caused.

What are the incentives to increase water efficiency and awareness of water efficiency, through water re-cycling and re-use schemes? Does your organisation demonstrate any water efficiency methods?

- UU have leakage targets for water efficiency, as part of their regulatory contract; and work on basis of economic levles of leakage. However, this may be unacceptable for climate change. We may need a sustainable level of leakage instead- but funding will be needed to achieve this.

Builders have a role here too, particularly for new developments. 50% of individuals' water use has energy use associated with it- e.g. heating water etc. There is a potential to incentivise here.

There are also products on the market, such as saver flush devices and pressure reducing valves which domestic customers can install themselves. Consumers could be incentivised to put in water efficiency measures.

UU could do water audits and provide efficiency provisions for consumers, however this is not part of their remit, and would require further funding. There is a water calculator on UU's website however, to allow consumer to calculate their water and carbon footprint.

How is your company responding to changes in the climate? Have you considered an environmental or emissions reduction targets in your company strategy? (If not, why? - risks, uncertainty, cost, other?)

R&D is an important part of UU's activities. Particularly developing innovations for low carbon/energy using technologies. One project related to activated sludge process at the moment could provide an alternative to reduce 80k tonnes of carbon a year.

Changing attitudes is another task- behavioural change. UU has introduced a low carbon culture program internally, which provides education on understanding carbon and GHGs and how to communicate the message externally.

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

CCB is quite high level. There is a 60/80% carbon reduction target for 2050, but this has not been specified by sector.

WFD is EU wide legislation, promoting a holistic, rather than end of pipe solutions. It also has a long time period of 15 years, which is good from a planning perspective. But has anybody assessed the aquatic benefits vs. the airborne pollution- is it worth it? What are the environmental costs and benefits of these more stringent standards? Water UK and government have a role to lobby the EU. However, if legislation is imposed, the industry will find ways to meet the standards, even if they are more sustainable and increase emissions.

What are your views on the carbon reduction measures proposed by the government- particularly the Carbon Reduction Commitment?

UU would fall under the CRC. UU measure their emissions and energy usage, and have done for the last year. Currently putting in place a project to increase their meter coverage, across their sites. UU are liaising with Defra and Water UK, to ensure there are provisions in the CRC due to the rise in emissions to the meet WFD standards. Felt initially that this is not the appropriate scheme for the water industry as it is designed for large non-energy intensive industries. The water industry uses 1% of UK's total energy use- large consumer, but arguments were lost. UU highlighted that WFD would increase the industry's emissions, and through the CRC would therefore be penalised. However these are not increases the industry would make willingly- how is that allowed for in the CRC. Does the growth metric in the CRC adequately take into account that UU's space will grow as a result of investment, and will that compensate for that increase in emissions.

CRC will try to reduce 1m tonnes out of the 14m tonnes of carbon of the 5-6000 participants. The water industry counts for 3-4 million mtc – of which the 23 companies in the CRC will account for 2.5mtc. The water industry could therefore skew the market.

Double counting issues

What challenges do you feel a 'cap and trade' ETS would present for your company and its operations, and more broadly the WWT industry?

- Lots of uncertainty around CRC. There will be administration issues with CRC implementation- measuring carbon and metering energy use.
- How quickly will the cap be squeezed- issues with the price of carbon and how this will be affected. In the EU ETS- the cost of carbon is cheaper than the abatement technologies- this has the opposite effect.
- There will be problems with being at the bottom of the league table- there will be a reputataional hit. This is a likely result for the water industry as they are the biggest energy user in the CRC. Don't think the CRC will adequately incentivise the water industry when it is implemented.
- CRC only covers CO_2. not other GHGs/ CO_2e.

Interview E

Date: Friday 4th January
Job Title: Manager
Organisation: N8/ Envirolink
Org Type: Business Support Agency

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

For both water companies and utilities:

- Pressure to keep prices down, whilst at the same time increasing water quality.
- To adopt to climate change, companies must invest in innovative technologies to address CO_2 emissions
- Reservoirs are very low due to changing rainfall patterns
- Water usage is increasing
- There are a number of conflicting agendas, price sensitivities (due to Ofwat), companies are not rewarded for investments

What are the barriers to reducing emissions in the water industry?

Stakeholders expect a return on investment (ROI). The long term payback of R&D is not seen as quick enough due to the AMP framework. There are no incentives for R&D. UU's CEO has highlighted that there priorities are their stakeholders, ad then their customers. Therefore we need to influence stakeholders to invest and adopt to climate change- this may help to shift the focus within the utilities.

Energy is a major operational cost in the water industry, and therefore in order to reduce this cost they have invested in on site renewable energy generation- a financial incentive which also helps from a climate change point of view.

Climate change and carbon emissions still aren't high enough up on the agenda of water companies and utilities. Many of the utilities have a carbon manager, but one person managing the carbon agenda, from 5000 employees may not be a big enough commitment. We need someone at board and stakeholder level to have the authority to influence the board and customers on key decisions.

The Co-operative group have 15+ people looking at environmental issues in their Manchester office. Many other organisations are ticking the box, but don't have a significant enough effort to make a difference. We need a top-down approach if shareholders want to make an impact.

Richard Branson is a good example of someone who prioritises his staff first, as they will then look after the customers and this will keep the shareholders happy.

R&D manager at UU has commented that new housing developments will need to have their own small scale water systems, as existing sewer networks would not manage. Utilities could diversify into small scale community developments.

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

Aware of WFD but not details of CCB and CRC.

How is your organisation supporting the water industry by promoting collaborative working to improve communications and eliminate the contradictions in policy faced by the water industry?

The rising energy costs of to meet the WFD objectives, and the challenges of reducing carbon, which are major drivers for the N8 agenda.

- We need to look at more low carbon technologies and products for all sectors
- SMEs within the supply chain will have to come up with technologies and solutions which would impact their core business
- There is a risk businesses (including big manufacturing companies- Heinz, unilever etc) may start to re-locate overseas, based on the availability and price of water. 7% of food and drink manufacturing companies' profits are spent on water.
- This presents an impact on not only the utilities and their demand, but also on the economy, through loss of jobs, and knowledge economy.

N8 universities are trying to come up with low carbon solutions to mitigate the effects of climate change. It is important however, to change attitudes, to inform people, and ensure shareholders see value in investing in R&D for mitigating technologies.

Interview F

Date: 9th January 2008
Job Title:
Organisation: Earthtech Ltd
Org Type: Water Company

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

- Energy

Conflicts of cost of treatment to meet stringent environmental standards imposed by the regulator (EA) and energy use and the environmental cost. Energy Use vs. Environmental benefit.

The Water Framework Directive imposes more stringent standards which presents such conflict, and the footprint of both the process, implementation and equipment should be considered.

What are the barriers to reducing emissions in the water industry?

- No accredited standard for estimating carbon footprints
  - There are lots of schemes- introduced by IPCC, Breeam, Envirowise etc
  - But carbon footprinting is very objective. There is no universally accepted referencing carbon footprinting model.
  - Earthtech use processes and equipment from all round the world- how would carbon footprint of those be considered?

Ofwat are responsible for driving costs down for customers. The WFD is encouraging higher standards, which results in higher emissions due to higher energy and treatment costs. This presents a conflict which needs to be addressed at government level.

Earthtech provide designs for treatment plants through the utilities and sub contractors. In order to remain commercially competitive, we have to produce more and more efficient designs in terms of energy use and carbon footprint and looking at different methodologies which we can adopt to identify and quantify carbon footprint of designs, so we can provide clients with a number of solutions- including low carbon options although it might not be cheapest.

Earthtech are involved in research, innovation, trade organisation-lobbying, academic institutions (links with Sheffield university), committees, CIWEM, ICE, IME, IEE- professional organisations which will lobby through to government.

A recent UN Report[12] claims that climate change will lead to a 20% increase in global water scarcity and the Stern report (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like the one we have experienced recently) and droughts
What challenges does this present to the industry (including consumer and regulator expectations) and how can the industry plan for this?
The South West is an arid area, and will need to increase its water efficiency. There are projected increases in population and building growth, yet we still use Victorian housing and infrastructure. We will need to design more water efficient houses and this needs to come through the planning process.

[12] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

Consumers will also need to recognise that there may be different grades of water, for flushing toilets, washing cars etc. In the UK, we do not have any recognised standard for different qualities of water (after potable water) and the point of use for all of those, such as the grey water used for toilet flushing.

BW are lobbying on this. If there were standards in place, companies could be more aware of the level of treatment required for each grade of water.

Infrastructure for sewage treatment works naturally occur next rivers, and there are health implications if these plants are flooded. There may be a need to adopt different standards for electrical protection in the future- again this has a cost implication.

What are the incentives to increase water efficiency and awareness of water efficiency, through water re-cycling and re-use schemes? Does your organisation demonstrate any water efficiency methods?

Purely market driven- if utilities can reduce costs and increase profits they can keep shareholders happy.

Positive PR from being environmentally friendly.

How is your company affected by or adapting to changes as a result of climate change?

Respond to market needs- commercial business.

- Sustainable 'green building' project in Canada
- Sustainable practice working group- internal group looking at what we can do to adapt our designs to climate change.
- CSR department

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

- Improving efficiency
- Reducing demand of water and carbon footprint
- Wider implications of how CCB will also impact other industries. Holistic approach is needed to address this.

Aware of timeframes of WFD and when things might be implemented.

Water companies are involved in putting together water management plans for the WFD. Earthtech provide the equipment for the water treatment works, so we are part of the process for providing low carbon solutions.

The next AMP framework will have more references to the WFD and climate change legislation and targets.

Aware of the CRC but not details, we should be.

What challenges do you feel a 'cap and trade' ETS would present for your company and its operations, and more broadly the WWT industry?

How to quantify those emissions- we need a universal method to measure carbon footprints. Earthtech source equipment worldwide- this will presents challenges when calculating carbon footprints.

Emissions are not only form power, but also from chemical usage. Companies may not want to give away details of how to calculate their carbon footprint. Issues of commercial confidence confidence- we need transparency throughout the supply chain.

Interview G

Date: 9th January 2008
Job Title: Head of Sustainable Development
Organisation: Yorkshire Forward
Org Type: Government Regional Development Agency

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

- New legislation- (including WFD and other directives which require higher standards than potable water) which is driving up energy requirements for small environmental benefits.
- To cleanse the water is an end of pipe solution. We should be removing the pollutants at source. This presents a major task for the water industry- almost like a huge pollution clean up operation, which it shouldn't be.

What are the barriers to reducing emissions in the water industry?

- It requires a country wide activity and substitution of materials.
- Agricultural practices- which cause sediments to wash into the water, which causes results in costly treatment of the water (requiring large amounts of energy) by the water industry. Action from farmers is required- for changes in agricultural practices, ensuring there is a divide between the ploughed areas and potential run off points like roads, which can transfer sediments, chemicals and pesticides to the water systems- which cause numerous problems for the water industry.
- Industry—particular those causing heavy metals to be leaked into the water systems, which are difficult to remove. Problems with the car industry, and its use of catalytic converters which presents problems which chemicals ad metal pads (which drop of the cars and into roads) to get into the water systems. Requires major governmental change.
- Chemicals used in foods- bio accumulate in and are purged form the human body and enter our water systems. Requires huge national and international action.

A holistic approach is required, to ensure every industry that impacts the water environment is taking action to reduce this impact on the water systems, resulting in a reduced need for end of pipe treatments.

A recent UN Report[13] claims that climate change will lead to a 20% increase in global water scarcity and the Stern report (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like the one we have experienced recently) and droughts. What challenges does water scarcity present to the industry (including consumer and regulator expectations) and how can the industry address this?

Water Efficiency
- Irrigation is a very inefficient method, but still widely used in the UK.
- Transfer of water via open systems, millions of tonnes of water is lost to evaporation
- Types/scales of water used- In UK we use good, clean freshwater to wash our cars, which shouldn't be allowed. We need legislation to ensure the right type of water is used for the right purpose across the world. Currently scales of water including- fresh water and boar hole water (which can be used for community watering of gardens, public stand for washing cars etc). This could be formalised to have different scales of water.

- Grey water and rain water harvesting are examples of what we should do- they should be compulsory not voluntary. Rain water harvesting may need very minor treatment, but would be fine as washing water. Grey water can be re-used for toilets or others etc. Currently not practise in the UK because they are too expensive in terms the UK economic systems which don't value the

[13] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

resource- until this resource becomes scarce when the economic system will start to value it more).

What recommendations would you make to support and drive the WWT industry to invest in new technologies and adapt to climate change, in order to reduce carbon emissions?

- Need to build capacity in cross sectoral partnerships and strong government lead to understand the issues and to start the water industry in tackling them at source.

Do you think water scarcity is recognised as a major challenge of climate change by the UK Government?

- Water Scarcity is recognised as a critical issue in world politics. In the UK, water scarcity is not yet that bad, except the south east and Anglia. However, the UKCIP graphs show underwater stress by the next decade or so in the North West and Yorkshire.
- They are aware, but not top of the priority at the moment.

What are the most important/significant areas for development or investment in order to increase water and energy efficiency and reduce emissions in the water industry?

- Using WWT sites to process organic and non organic waste to create methane gas which can be combusted- anaerobic digestion. This will also reduce the material they will have to treat.
- Utilising water flow and using micro hydro wherever possible, and the industry are starting to see this.
- In terms of capturing water, micro reservoirs provide freshwater and also energy generation on a local level
- Lobby Europe to ensure legislation has reasonably good quality standards and not 'excessively good' quality standards (such as those aspects currently proposed in the WFD). Need to get support for a standard which is good and safe, but not something which is pure. For example, Malvern bottled water is at a lower quality than tap water, yet people are still happy to drink this.
- Better use of natural systems for treating water- including water filtration and reed bed technology, using underground aquifers to filter and clean water- this requires time rather than energy.

What are the incentives to innovate, build sustainable infrastructure and to develop more carbon efficient technologies?

- All comes down to the AMP negotiations under Ofwat- which do not allow water companies to invest in environmental or efficiency programmes.
- Many set up subsidiary companies, like Kelda, who can approach the RDA to fund areas that Ofwat won't- this is what we're looking at now with Yorkshire Water.
- Ofwat are responsible for keeping the price of water down for the customers. DWI are responsible for keeping water quality up, and EA are responsible for keeping water clean and reducing impacts of floods, however these remits are often conflicting!
- CCB could influence this if allocation of carbon to come down to a regional level and water was given a carbon allocation. Ofwat would have to change to reflect policies with any carbon budget. But progress to this stage with the CCB may be slow.
- YF is working with YW. Kelda (as a subsidiary) are in a position to spend money without Ofwat permission. Considering investments in a biomass plant to offset their energy use.

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

Conflicting legislative targets. Industry can address this by:
- reducing quality standard reduced- through legislation
- increasing use of renewable/brown energy sources (such as waste to energy)
- increasing efficiencies

Is the water industry suitable prepared for this?

Yes, but whether they can deal with it is another matter!

What are your views on the carbon reduction measures proposed by the government- particularly the Carbon Reduction Commitment?

- Many water companies are captured by the CCL- those that aren't will fall under the CRC.
- They will be required to increase their efficiencies and use of renewable sources to better prepare for the CRC
- It is the role of Water UK to raise the awareness of water efficiency, and to promote the impact of different industries on the water industry.
- World Business Council for SD, European Partnership for the Environment and presence in Brussels will be needed to highlight impact of other industries on water treatment- to impose legislation to ban substances which pollute the water.
- It is currently permissible to put anything down the sewer and legislative change is needed, but this is often a slow process.

What do you think the water companies need to do to prepare for an emissions trading scheme (such as the CRC)?

- Understand their carbon footprint and carbon balance
- Understand potential for efficiencies throughout their business and take action
- Build carbon into their whole life costing of their efficiency programme- which might result in more projects to counteract the programme
- Consider viable renewable energy technologies
- Consider land management- which sequesters carbon- so they can use that as a bank to offset their own emissions. Water companies drain their land into reservoirs, drying out their land into a bog, which releases methane and carbon from that organic material-contributing to climatic change. If land is allowed to recover and re-instate itself as wetland, you can lock up the methane and carbon and start to absorb carbon (several tonnes/hectare). Water then peculates through this, which acts as a filter, making it easer to treat and get to potable water standards.
- Regional land management offsets or technology offsets

Is there is a universal way for companies to measure their carbon footprint?

- UKCIP, Defra, IPCC, all have slightly different ways of looking at it, hence the different carbon calculators.
- CAY will attempt to provide a universal carbon calculator, probably following the Carbon Trust or UKCIP or CRED models. Climate change committee and forum for the future also have their own carbon calculators.
- Companies may also be able to understand their supply chain's efficiencies they can run efficiency programs for those suppliers and claim that carbon themselves.
- Many products also now have carbon labels. (E.g. with IS14001 some companies won't deal with other companies who don't have ISO 14001- this may emerge through carbon labelling too)

Have you considered the significance of a sustainable WWT (infrastructure) system for new housing developments/ energy parks and other government developments influencing and preventing housing developments on flood plains?

No. There was a flood clean up program, but only preventative action taken has been some investments in flood defences in cities.

Leeds just signed up to the government's Low Carbon Cities Programme (along with Manchester and Bristol), working with the Carbon Trust and the Energy Savings Trust to slash its carbon emissions. How is your organisation supporting this scheme by ensuring a water and wastewater management strategy is also considered as part of this initiative?

- YF is supporting the programme in Yorkshire. YF has taken buildings (such as ITC, TC, York Eco Depot and more) and showed them how to design, orientate and build to reduce carbon throughout the whole production of the building- many by as much as 70% reductions.
- There is a 2050 vision for sustainability in Leeds

What is the RDA doing to encourage all industries to mitigate against the effects climate change, to put in preventative measure and understand the effects on their business?

- Carbon Management Club- companies are recruited into a process run by Enviros and trained on how to measure and save energy and make fuel efficiencies. There are funding opportunities for energy efficiency work. Yorkshire Water is part of this.
- Climate Change Adaptation Toolkit- helping companies to look at their emergency response to and adapt and prepare to flood events- will soon be available to all companies through CAY.
- GHG Emissions Budget- demonstration projects for carbon reduction technologies
- Flood Mitigation/Adaptation work- on Humber estuary/Doncaster
- May Day Summit- with HRH. Aimed at regional companies – how to mitigate and reduce carbon
- CAY- will be up and running by end of March 08.

Interview H

Date: 10th January 2008
Job Title: Energy Manager
Organisation: Yorkshire Water
Org Type: Utility

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions? What are the long and short term challenges faced by your company?

Adaptation
- Sewerage Network - How we deal with flooding of sewer systems
- Water resources- wetter winters, drier summers, longer droughts

Mitigation
- Reduction of emissions. There is a pressure to improve water quality- both river water (effluent) and drinking water quality. Improving quality is more energy intensive, requiring more processes and more equipment, which results in an increase in emissions.

For example, we are re-building a large part f the sewage treatment works in Bradford in order to meet the requirements of discharges to the river, which requires doubling in energy use for the treatment, due to the move towards an activated sludge process.

- +20% rise in energy every 5 years in WWT- doubled in 15-20 years
- Although improved water treatment quality has required more energy intensive processes, this has been off set by treating less water largely due to the success of our Leakage Control programme. So energy use has been roughly stable for water supply.

- Pumping requires a lot of energy to transport water- could either reduce the amount of water which is pumped, or using different energy sources.

How is your company responding to changes in the climate? Have you considered an environmental or emissions reduction targets in your company strategy?

- Preparing detailed plans for adaptation, for the next 5 years- next AMP, to start in 2010, with a long term strategy for the next 25 years.
- Also considering options for carbon reduction – for the CRC
- Utilities are concerned that they should reduce emissions, and are searching for the best options.
- Interesting debate around whether small improvements in water quality are worth the carbon emissions.
- For planning process- how do we meet the CRC? And How do we see an overall reduction in emissions, in order to be sustainable in our development?

- WFD and Fresh water fish directive, causing utilities to do work which is using more energy.
- YW in favour of emissions reductions initiatives. Defra is against the water industry having a separate agreement to the CRC.
- CRC doesn't include non-energy emissions. 66% of YW's energy emissions are from electricity. Approximately One third of emissions is from wastewater- electricity, one third is from water supply- electricity and one third is methane and nitrogen dioxide, emitted from sludge and sewage treatment processes. 30% of YW carbon emissions are not covered by the CRC.

- Defra is not counting non energy CO_2e emissions and it is difficult to measure
- Difficult to incentivise them, as they can't be measured

- CRC is actually an energy reduction commitment (electricity, fuel, oil, gas) - formerly called the Energy Performance Commitment.

- CRC is for non-energy intensive companies, where energy is usually 1-2% of their operations. However for the water industry, energy is over 10%! WI is likely to be largest individual sector in the CRC.
- CCA are for energy intensive companies. Companies with a CCA or involved with EU ETS are excluded from CRC.
- Our calculations suggest that over 20% of all the emission traded in the CRC will be in the UK water industry. Water UK are in discussions with Defra about this and YW is participating with the debate.

League Tables
- Regulatory requirement to improve water quality, causing the industry to use more energy, is not a turnover issue. Water companies are still producing same amount of water, but just having to treat it more, causing the increased energy use. Other companies in the CRC may productive more and therefore emit more- there is a difference here. As far as we understand it, the CRC does not distinguish between these two scenarios, which penalises the water industry for their statutory requirements. Should there be an allowance for increasing quality? Ongoing discussions with Defra on this.
- Water industry is likely to fall to bottom of league tables, as they cannot make energy savings similar to the supermarkets for example.

- Government wants an overall reduction in carbon. The CRC is pushing those companies who can economically reduce carbon emissions to do so.
- Also the cap and trade system requires both 'buyers and sellers'; the Water Industry may play the part of the 'buyer' in this market.

<u>Making Reductions</u>
- Renewables- can't count buying renewable energy from a supplier. It must be generated yourself on site, otherwise it is seen as a way of buying ways out.
- Some companies produce as much as 20% (Severn Trent) of renewable energy on site, particularly CHP- biogas- coming off the sludge- methane is burned to produce electricity. Heat is used to war up digesters and methane is converted to CO_2.
- Many companies also doing hydroelectric generation
- YW also using wind turbines- power used to drive on site operations.
- However as Renewables Obligation certificate (ROCs) are claimed- which have a value of 4p/kwh and make these renewable energy generation viable, companies can't claim these as reduction in the CRC- double counting. Also raised by other industries. Ongoing discussions with Defra- answers will be needed by Summer 2008, when CCB will be introduced. The CRC will form the secondary legislation for this.

<u>Cost</u>
- Fixed price cap and trade for the first 3 years, and then it will gradually escalate price of carbon. Originally thought Impact of CRC on YW would not be huge. The costs may be fairly significant but not large, so even if we got it wrong, this wouldn't be a huge issue, we would still be able to cope.

- However, it seems Defra is now proposing a different approach so that the value of carbon be allowed to rise by 10%/year, for 5 years. This will significantly increase the price of carbon- by 2015, trading carbon could be in millions of pounds. If the WI were at the bottom of the league table, the penalty associated with this could be a few million pounds a year, particularly in the next 10-15 years. This would be an issue for the utilities.
- This will become a significant part of the energy costs for utilities in the next 10-15 years. YW current energy bill is $ £40m/year- 15% of operating costs. Potentially adding a significant %age on top of that. Government predicting that it won't change the energy bill by more than 5%, but we think it could be slightly more than that.

What can we do about it?

Energy Efficiency

- 10-25% maximum improvements can be achieved in process
- 10-15% maximum improvements on pumping of water.
- It will be difficult to increase efficiencies any more than this unless we implement different, less energy intensive processes- but these require investment and time; or if we treat less water- reducing demand.
- Other alternative is to generate own electricity- those that account for ROCs (CHP) and those that don't (energy recovery) - Generation and energy recovery.
- YW are involved in energy recovery. For example heat from incinerator in Leeds is captured, and used to generate electricity. It is not renewable energy, as the incinerator is partly fuelled by fuel oil, which makes it energy recovery- not always autothermic. However, as this is not eligible for ROCs, energy recovery much les economic- CRC could change this.
- There are lost of energy recovery schemes. There is a limit to number of efficiencies, you have to change processes to go further, or change the amount of electricity used and generate own electricity used.
- I can forsee a substantial reduction in amount of grid electricity used by the water industry in the future.

Funding

- Government assumes that CRC is cost neutral- persuades companies to reduce carbon- saving them money and energy, plus the recycled value of the carbon they are buying.
- Water industry will struggle for it to be a cost neutral process. If cost of carbon rises to what is perceived to be the social cost of carbon- the economic cost of carbon to the country, then it will become economic to reduce it by that amount.
- Supposing this costs money to the water industry (and we perceive it is likely to) that cost will have to be passed through to the customer, in a higher water bill
- In effect, government puts targets on the carbon, causes additional costs through the CRC, that additional cost is passed to the customer, so we have to put in place processes to stop that cost- this can be either capital to improve reduce the amount of carbon emissions, or we pay for the carbon we produce. Either way, the customer will pay for it, which means this is in effect an indirect tax, because that money is being recycled to the good performers in the economy who are reducing carbon. In effect, the government has taxed the customer to subsidise the good performance of those companies that can reduce their carbon. Not against this but it is not as clear as the public.
- The system is designed to recycle funds to those people who will achieve the best reductions.
- Ofwat will have to allow utilities to pass this cost on to customers. But the CRC, which is supposed to be a company scheme, they are actually funding it as an indirect water bill of the individual customer.

What is your organisation doing to prepare for the carbon reduction commitment?

As part of the AMP process, there is a *willingness to pay* section. Regulator requires us to investigate what are customers are willing to pay for. We have included questions about renewable energy and sustainability. Currently in this planning process.

Pulling together strategies for carbon reduction and renewable energy; mitigation, what to do about flooding and water resources. Based around what we expect the potential impacts of climate change, price of carbon and costs of carbon reduction to be.

Major sewage effluent improvement in Bradford- the carbon footprint of saving the fish is not justified

Ofwat claim that renewable energy is a non-regulated business unless it is part of the actual WWT process of water, such as CHP. They are suggesting that wind turbines are not and therefore they shouldn't be part of regulated business. However as a high energy user, the water industry is trying to be more environmentally responsible.

Historically Ofwat would agree the consent level- including discharges into rivers- aquatic issues and atmosphere issue- and price at which they would be delivered, and the industry has a track record for achieving this. So in this sense, the CRC is not best method for the water industry, but Defra disagrees so we need to focus our efforts on how best to adapt to it.

Interview I

Date: 14th January 2008
Job Title: Regulatory Compliance and Research Manager
Organisation: Atkins Global Ltd
Org Type: WWT Consultancy

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

- Adaptation- responding to climate change (collection networks for sewage/water supply)
- Meeting current and future obligations whilst still reducing carbon footprint.
- Energy is biggest challenge for reducing emissions- understanding energy supplies; what opportunities there are for using renewable energy, or being self generators of energy.
- Opportunities include, using assets for CHP for sludge digestion systems, using wind turbines, using organic waste in co-digestion to generate energy (local authorities encouraging maceration o put it to the sewer- which causes issues with blockages etc)- there are opportunities to identify and optimise new energy sources.
- New environmental requirements including WFD- risk of looking at new technologies to treat to tighter standards. Need to ensure the standards are not too stringent otherwise these new technologies could end up being very energy intensive and generate wastes that will need management in different ways and will need energy themselves.
- We need to consider carbon equivalent- need to consider methane, nitrogen dioxide and their equivalence effect of carbon dioxide and include this into costing and investment plans for the future.
- Critical issues will be sewer designs- in terms of how to carry additional loads of water in events of flash floods, managing surface water run off. These are particular planning issues and the water companies to interact with the planning authorities for where infrastructure is put into place, but also opportunities for sustainable drainage.
- Water Resource- issues in the SE. Demand management is important in times of increased consumption- both human and environmental (to meet 'good' ecological status for rivers- abstraction of drinking water might be too significant for the environment)
- The water industry represent approximately 4% of greenhouse gas generation in the UK, but its unlikely that even if the water industry were to reduce its emissions, that the predicted problems of climate change would go away.

What recommendations would you make to support and drive the WWT industry to invest in new technologies and adapt to climate change, in order to reduce carbon emissions?

- Industry is motivated by economics of business- less energy= more money. However the water industry is an regulated body, and its economics are also regulate. It is important to consider how to compare companies' efficiencies and how they can then make a profit.
- Companies define what they will achieve, at what price and within specified timeframes in any AMP cycle. If they can outperform that, they can claim this as profit. There is limited gain. The relationship has to be developed to look at the long term least cost and environmental impact of approach to planning. The current 5 year cycles don't help companies to plan for the long term impacts which climate change is likely to present. The assets that are currently built often have long lifecycles (e.g. we are still using Victorian sewers) so question is, how do you encourage long term planning, in a short term, competitive, economic-controlled environment? We need to consider relationship management- what is the environmental benefit vs. economic cost.
- How do you manage risk for an investment scenario that may or may not occur? Future rainfall patterns are still very uncertain, and risk management has an important role here.
- It is important to inform the EA and Ofwat about the relationship between long term planning and risk management.
- Water companies are aware of these issues, but it is a difficult thing to act on.

What are the incentives to innovate, build sustainable infrastructure and to develop more carbon efficient technologies?

- The water industry is at a very early stage of the process.
- We need to consider the carbon footprint of our operations first- do we understand what this is for current technologies and infrastructure? How much do we need to reduce this by with future technologies, infrastructure and processes. Water companies must first increase their awareness of their current carbon footprint and plan for their optimum level.
- Companies are only just beginning to consider carbon management and their carbon footprint for PR09, and what impact they could have. They have developed a carbon accounting methodology- and are beginning to apply that in order to have a better view of their position.
- In discussions with Defra, EA, Ofwat and Europe, the water companies have used the concepts of how much and carbon and waste generation these new concepts could require, which has thrown up questions for the regulators on how to manage regulation, looking boundary-less-ly, looking at the complete carbon footprints.
- They are encouraged to develop more carbon efficient technologies, but there is a lack of understanding of how to go about doing this.

What are the most important/significant areas for development or investment in order to increase water and energy efficiency and reduce emissions in the water industry?

- Companies work towards an economic level of leakage – is it worth investing in recovering and preventing losses in distribution systems compared to how much it would cost to treat that water.
- Carbon and energy accounting has enhanced more on water supply than WWT side. There is a better understanding of what the carbon losses are.

How is your company affected by or adapting to changes as a result of climate change?

- Atkins is a global environmental and engineering consultancy, affected by:
    - Reducing corporate carbon footprint by increasing communications such as teleconferencing/video conferencing etc to reduce need for flyng.
    - Awareness of environmental and climate change issues and the importance of renewable energy generation to reduce grid energy consumption- e.g. Bahrain Tower project which generates 20-30% of the energy for the tower.
    - Involved in framework agreements with large UK companies, looking at future planning for PR09 and other environmental programmes- developing models to help companies account for their carbon at a site and company level and
    - Calculating embodied carbon- considering it in design.
    - Also working with WRAP- using recycled or recovered materials to reduce carbon footprints.

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

- WFD does not have an over-arching environmental aspect to it.
- Concept of disproportionate cost- want to achieve x quality, and what does it cost in term of finance. But we also need to consider environmental and ecological costs.

- Many substances will be banned. Companies could either put treatment in now to achieve a 'good' standard sooner, or they could wait and monitor; to consider addressing the pollutant and source.
- Need to design, plan and deliver improvements and consider the risks and costs (financial and environmental) involved, and means of control that are proposed.
- Timing is key- the 2 policies could be harmonised.

What challenges do you feel the carbon reduction commitment would present for your company and its operations, and more broadly the WWT industry?

- The water industry cannot cut production to meet the cap and therefore wouldn't have some of the options that other industries would- like capping production etc. They cannot stop supplying water or stop treating sewage.
- Important factors will be the level of the cap and how it is analysed.
- This would be a bigger driver to utilise on site energy- would this be discounted off the cap?

Have you considered the significance of a sustainable WWT (infrastructure) system for new housing developments/ energy parks and other government developments?

- Atkins- there is an internal debate about sustainability- What is it?
- Sustainability- socio economic and other aspects- it is a bit wider, which makes it hard to call any design or infrastructure sustainable- where do you draw the boundaries?

- Water companies treat a lot of trade and industrial waste- if water companies stopped doing this and stipulated that they treat it themselves- what are the socioeconomic implications of this, job losses etc?

- Key issues raised include energy- GHGs and security of supply (international level, and nuclear position etc), but infrastructure issues are also critical. The uncertainties continue to drive massive investment and planning issues for the future, and the impacts of the current 5 year AMP cycles need to be reviewed for the future.

Interview J

Date: Monday 28th January
Job Title: Engineering Director
Organisation: BiWater Treatment Ltd
Org Type: WWT Consultancy

Discussion:

What do you feel are the biggest challenges faced by the WWT industry to adapt to a changing climate and reduce carbon emissions?

- Top level debate lies with the EA- what are the global benefits of increasing standards.
- Most drivers for improving water quality have environmental benefits, however, many more require more energy and we need to find a balance between water quality improvement and environmental benefit- we need to balance environmental benefits and their corresponding emissions.

Other issues of carbon:
- Carbon isn't a huge operational expenditure driver for carbon in the last AMP. Most companies use capex for investments focusing on waste and infrastructure, rather than operational costs
- AMP 4 focused on capital costs, rather than the whole life costs. Focus on more efficient machinery, changing processes to reduce emissions of existing treatment works.

What are the barriers to reducing emissions in the water industry?

- Threat of rise in energy prices due to carbon levy- energy has always been so cheap so companies have not been as reluctant to use it.
- Cost- CHP plants were not economically viable 2 years ago, due to the payback period, but companies are now starting to look at carbon footprint of their processes. Biwater are now calculating the carbon footprint off all projects, infrastructure and services to consider the carbon outputs.

A recent UN Report[14] claims that climate change will lead to a 20% increase in global water scarcity and the Stern report (2006) adds that our changing climate will also increase the occurrence of extreme weather events such as storms, floods (like the one we have experienced recently) and droughts. What challenges does water scarcity present to the industry (including consumer and regulator expectations) and how can the industry address this?

- Improving infrastructure- if we can capture downpours, these could be used throughout the year.
- Desalinisation is another option- but this is very energy intensive
- Consumption levels have been fairly stable over the last 10 years, so that is not a major factor.
- Leakage- can calculate the carbon footprint of this. Energy loss would count as carbon leaks
- Its important to consider planning issues for managing surface water and looking at how new infrastructure will cope- In recent floods, older sites were left untouched. In recent times building on flood plains has caused flooding issues. EA are assessing flood risk areas
- Better maintenance of infrastructure is vital- including drains for carrying surface water etc
- We need to influence globally to reduce the global carbon footprint.
- Low carbon technologies make business sense- particularly for global exports. Businesses will start acting when it affects their profits- saving carbon saves money!

What are the most important/significant areas for development or investment in order to increase water and energy efficiency and reduce emissions in the water industry?

- Wastewater- moving aerobic to anaerobic. Looking at aeration technologies to reduce energy
- Trend towards reducing footprint of WWT plants- inc removing trickling filters etc
- Membrane technologies are also becoming more viable

What is your understanding of government policies such as the Climate Change Bill and the Water Framework Directive? What challenges do you feel they present for the industry and what are your views on this?

- WFD- currently planning, processing of its requirements. This covers a huge area, having an effect slow but is woven through the AMP process. Not as talked about now as it was a few years ago.
- CCB and CCL are high on the agenda now. There are penalties for energy use and carbon- a financial incentive for companies to take action.

<u>WFD vs. CCB</u>

- Need lobbying from the EA and Water UK to get more joined up thinking for these policies
- Will meeting WFD targets have a detrimental effect on the environment?
- Organisations are striving for energy efficient technologies to reduce the cost of energy (and hence carbon) but some new methods have higher maintenance or labour costs- costs must be balanced
- There is also positive PR to be gained form investments into low carbon technologies
- Funding and grants would encourage more spend on R&D- although there is some that exists already.

What challenges do you feel a 'cap and trade' ETS would present for your company and its operations, and more broadly the WWT industry?

Not aware of CRC.

Interview K

Date: Thursday 7th February
Job Title:
Organisation: Environment Agency
Org Type: Regulator

<u>Discussion:</u>

[14] UN report 2007 *"Coping with Water Scarcity- challenge for the 21st century"*

What stage are things at now with the CRC?

- EA and Defra are working in tandem. Defra have held 2 consultations to date, and will be publishing the outcomes of the second- around the scheme design at the end of February.

- They will hold a further consultation in summer 2008, around the actual regulation to implement the CRC. This will include penalties for non conformance.

Preparing for the CRC

- Critical path is the development of the registry for the CRC. The EA is project managing this aspect, but are yet to be formally approached to the scheme administrator/regulators.
- This IT project kicked off in Sept 07 , which replicates the EUETS registry.
- The registry is a means to allocate allowances and track them as they change accounts, the reconciliation of energy use and emissions at the end of each compliance year. There is a compliance cycle for EU ETS participants where they must report their emissions and surrender sufficient allowances, and the CRC will adopt a similar compliance cycle. Final reconciliation date would be at the end of April.
- Companies will be required to look at energy usage, and energy usage will be given a carbon output. Participants will have to reconcile these emissions by surrendering sufficient allowances.
- Allowances will be made available in a fixed price sale of allowances for the first 3 years (Phase 1). Thereafter it will go into a capped phase (Phase 2). Allowances will be allocated on the basis of an auction. Participants will have to submit bids for the allowances. Allowances can also be bought in the secondary market- there is a mechanism which has been proposed to prevent price spikes in the secondary market. People will also be able to access additional allowances from the safety valve- a 'buy only' link to the EU ETS. This maintains the integrity of the scheme, as in theory participants are still paying for an emissions reduction somewhere within Europe.

Look at consultation documents published last Summer.

How will the CRC work?

- The CRC aims to achieve 8% reductions by 2020, although this is subject to change- EA believe this should be higher. The CCB will make carbon reduction targets statutory rather than aspirational.
- The CC Committee will advise on challenges for different sectors of the economy.

- The CRC needs to be 'light touch' and based on self reporting. It is not designed to be 100% verified like the EU ETS.
- EU ETS is a much bigger scheme in terms of emissions coverage. The average energy usage emissions in the CRC, for participants in the scheme will be in the order of 10,000 tonnes (based on initial estimates). In the context of EUETS, you would be in the category of small emitter.
- EA did some work on looking at the cost of compliance of EUETS. That information was used to influence both Defra and the EC to look at some sort of emissions threshold for the EUETS.
- Profile of emissions from EUETS participants showed that 50% of participants account for 2% of th emissions.
- Cost of compliance per tonne of CO_2, shows that the small emitters pay a disproportionate level once we start normalising that information per tonne of CO_2.
- CRC are trying to built upon lessons learned from the UKETS and EUETS, to minimise the cost burden of participation, and EA and Defra have decided that therefore the CRC will not be based on 100% verification, but on voluntary reporting. There will be penalties akin to EUETS and an audit regime- auditing up to 20% of participants per year in phase 1.
- For the purposes of registry reporting, participants will be submitting high level information, including aggregated energy use. Thereafter to support this information, they must maintain an evidence pack. The regulator would request this evidence pack when the participant is audited to do a desk based audit. If there are any discrepancies come to light, there will be follow up action. Underreporting will be an offence. If discrepancies are not within 5% it is considered much more serious.

- Most on decisions of scheme design will be taken on the outcomes of this current consultation- at the end of this month. The next consultation is principally about the regulations, including the offence and penalties. Defra have already identified that the further stakeholder workshops in March to address any gaps.

What are the expected challenges of the scheme?

- The large number of participants. Only 1000 UK participants for the EUETS, but the
  - In order to achieve the targets that have been considered by government, ultimately reductions must be achieved in all parts of the economy- the CRC is based on a gap analysis of existing measure for targeting a different part of the economy, not covered by EU ETS and CCA.
  - Estimated number of participants could be as high as 5000 parent organisations. This could cover up to 50 000 sites- this is why we need aggregated data is needed to do this, and this has reflected on the proposed scheme design.

- Most participants will be new to carbon trading, and will not have experience in bidding for allowances in an auction. Admin Arrangements will be important and Defra is hoping to put in place adequate guidance to ensure high level of participation without a high number of queries.

- Defra has held a number of stakeholder engagements (series of workshops) to support companies and industries who will fall into the CRC scheme and have engaged sector representative bodies. Managing this support is important and plans are currently being drawn up to ensure appropriate guidance is available- help desk support (emails), customer call centre etc

- Phase 1 (first 3 years) will be a trail phase. Although the EUETS is based on free allocation for most participants, the CRC will be based on the required to purchase allowances in a fixed price auction for the first three years, after which a cap will be applied. This allows them time to understand their annual energy usage and put appropriate management controls in place (accurate forecasting) to meet the cap when this is applied in Phase 2 (year 4 of the scheme). In phase 2, participants will be subject to market conditions on reducing energy usage in the CRC market. There are financial incentives to deliver these emission reductions.

Funding the scheme and key costs of the Carbon Reduction Commitment

If the CRC drives through the anticipated efficiencies, translated into emissions reductions, there is a high level of confidence that most participants will economically benefit from participating in the CRC. Not just cost of participation, but they will actually financially benefit overall by being covered by the CRC.

Consultation documents refer to this as Net Present Value. Not just about cost neutrality, but there will be an overall benefit for the CRC sector. See Regulatory impact assessment and consultation documents.

Challenges for the Water industry

- "Necessity is the mother of invention"
- The WI must innovate to help mitigate increasing carbon output linked to increasing quality.

- To achieve 60% CCB reductions we must make massive reductions and changes. The water industry can invest in renewables, water efficiency measures, minimising amount of water needed to be treated and amount to pump.

Interview L

Date: Thursday 7th February
Job Title: Head of Climate Change
Organisation: Ofwat

Org Type: Regulator

Discussion:

What is Ofwat's role in current CRC consultations and discussions?

The WI is unique in terms of their impact- they will be the biggest players in terms of their emissions. Ofwat supported the view that the water industry might need a different scheme, or certain exemptions. Ofwat was sympathetic to this and supported Water UK.

Ofwat are keen not to add anther layer to the CRC which would complicate things.

How does Ofwat work with the industry to support them to adapt to a changing climate?

Ofwat's role is to ensure that companies have enough money to carry out their function as a water company, and to monitor prices for customers' interests. How prescriptive should they be with defining how water companies spend their money?

Water companies operate in a wider environment. They have to respond to any government legislation which affects how they do their work, and in some ways the government's climate change strategy affects all industry. Allow companies to respond in the best way they see fit, and try to be a light touch operator.

On the one hand, we're aware that we operate in a competitive market, whilst on the other hand we're aware that it is in companies interests to add value to themselves (eg by spending money on building new infrastructure etc), and there is a need to strike a balance to protect the consumers to ensure companies are spending money wisely whilst also being sympathetic to external pressures water companies face to meet government targets.

Document- including carbon in economic assessment- cost benefit analysis. Details about PR09 process.

Ofwat does not dictate to companies exactly how they should prepare for the CRC, but they encourage companies to do a cost benefit analysis and include carbon in their economic assessment. Companies then have the freedom to decide how exactly they will plan for this.

CRC is supposed to be cost neutral, but it may not be because of the administration costs. This uncertainty should not stop companies preparing though. Instead companies should actually start putting plans in place to meet carbon reduction targets which are being proposed by the government.

What do you feel are the major challenges for the industry, presented by environmental policies, such as the CCB and WFD? Does Ofwat recognise the conflicts these policies present to industry?

The WFD didn't primarily consider carbon impacts- why? – Question for Defra! YW was the first to highlight the carbon issues with the overall global impact of the WFD.

Companies must innovate, and are incentivised to do this due to the added value gained by increasing efficiencies- companies are allowed to keep the profits.

R&D-No real competition for the water utilities, which leads to an apathy to change.
Innovation and competition are closely linked- there is less innovation in less competitive and the most harsh competitive markets

Its not Ofwat's role to encourage R&D. In a real environment consumers will be charged for the R&D. Water companies are free to spend their profits on anything and they must invest their profits (in R&D) to make more profits. Water companies shouldn't pass on this cost to customers as it should be taken

from the water company's profits. Investing in R&D is a risk, and companies must realise this and it would be unfair to pass this onto customers.

A key issue highlighted by industry is one that suggests that the 5 year AMP cycles inhibit investments in R&D and present issues for long term planning. What are your views on this?

Efficiency saving of £10m in AMP 1- some of this must go back to customers eventually in lower prices, as customers must benefit from efficiencies.

Water companies are valued by their asset base. Companies are allowed enough money to finance their business based on how much their company is valuate at. New low carbon assets would add value to their company, and therefore ofwat will allow them more money to finance their business. Efficiency savings may have to be returned as customers must eventually benefit from efficiencies, but as the value of the company increases due to it new assets, they are allowed more money to run their business. This is called the Regulatory Capital Value (RCV).

Barriers to innovation

- Water companies change hands very often- there is a high turnover of their boards- many are therefore not motivated by long term gains.
- There have not been many drivers to change in the past, and the CRC may be a major one. Ofwat will start monitoring CO_2 emissions from water companies annually.
- Ofwat doesn't incentivise the industry because the CRC does this. However, ofwat is considering whether it should be implementing a separate scheme/initiative to address the 20% CO_2e emissions from the industry which are from methane and NOx and therefore not covered by the CRC.
- Ofwat could incentivise good behaviour through financial rewards, and set published voluntary targets, which companies may achieve for additional PR and reputational advantages. Could also name and shame them in the league table- this is what the CRC will do.
- It is important to consider whether Ofwat's role as economic regulation, should be straying into this territory, or whether this should be left to Defra.
- Demonstration projects would be good to encourage the take up of new technologies, but an holistic approach is crucial. The cross over with other sectors and knowledge integration is very important for the water industry going forward, as the polluter pays principle become increasingly difficult to apply. It is important to raise the awareness of the indirect carbon impact of the activities of other sectors, and address pollutants at source. Legislation is needed, but who is monitoring this? EA/Defra (environmental regulators)?
- Carbon Trust may take the role of knowledge transfer between sectors.

Document- suggests a common approach to carbon footprint calculation.

Interview M

Date: Wednesday 13th February
Job Title: Carbon Manager
Organisation: Northumbrian Water
Org Type: Utility

Discussion:

Key Challenges:

- Understanding the science, relevance and importance of climate change
- The water industry must understand how its
    - Carbon consumption- the average 160 litres/person/day would produce 130g of CO_2/person. However, if you consider a packet of Walkers crisps produces 75g of CO_2/person, the water industry's footprint is equivalent to half a packet of crisps!

  - Energy use- 0.6% of total UK emissions are from the water industry's energy use. This is not a huge amount in relation to other heavier users, but in the context of the CRC the water industry would become one of the more prominent participants.
- There is a need for a collective effort by individuals to make significant reductions. Much of this will be achieved indirectly through use of cleaner energy and different fuels and technologies used in cars.
- We need to consume less to produce/emit less- this requires a change in social behaviour; and the more power people have, the more influence they also have- e.g. the Water Industry in the CRC.

- It is important to understand where emissions are within the organisation and looking at where biggest carbon reductions can be made. Water supply and distribution, and sewerage and sewage treatment are the most significant areas for the utilities, and we are looking at different ways of handling these to reduce our emissions. For example, anaerobic digestion, which re-uses the calorific value from the waste.
- NWL use the Carbon Accounting Tool from Water UK/ UKWIR and are concentrating efforts on identifying areas to target and considering ways of addressing them directly.

NWL Activities
- Very early stage- only just started formulating plans.
- Supporting PR09 methodology
- Focus on carbon mitigation, by identifying areas to increase efficiencies; reducing demand, allowing customers to have more direct feedback of what they are consuming through intelligent/smart metering.
- Reducing energy would deliver biggest return, and raising awareness and allowing customers to be more aware of their annual consumption will help to reduce demand, and consequently emissions.
- 4 stage plan- Engagement and Education, Enablers and Encouragement. This method promotes behavioural change and CC Water have also done some work on this.

CRC
- The Stern review puts the current social cost of carbon at £25 per tonne of carbon- this is not a hugely significant figure for industries and won't be enough to encourage major changes in behaviour.
- Current operational costs are £350m, and at Stern's rate of social cost of carbon, this would add another £6m. This is only a small proportion of the total operational costs, and may be one that the utilities are willing to absorb. However, this is predicted to grow for the future.
- Not sure there would be benefits for being at the top of the league table
- The price of carbon is crucial, as industry will be reluctant to invest in abatement technologies if it is more economic to pay the penalties. Those abatements which are the cheapest will be introduced first.
- The water industry will be a significant player in the scheme and therefore will be influential in shaping the way the league table develops- most likely to be at upper end of the table. This is because, the larger organisations, such as the utilities, will be more able to deal with the overheads of the scheme, could absorb the penalties and also because the larger emitters potentially have more capacity to make larger reductions. As the league table is based on relative emissions reductions in a given year, the water companies are likely to appear in the upper end of the table.

- Current priorities are not about understanding the CRC, but understanding and planning for how the reductions can be made.

Interview N

Date: Wednesday 13th February
Job Title: Regional Manager- Water
Organisation: Carbon Trust
Org Type: Business Support Agency

Discussion:

What do you think the key challenges will be for the water industry, with regard to the CRC?

- It's the first time the water industry will have to pay attention to carbon- as this will be a key priority now. In the past the priority has been quality, cost, reducing demand
- Carbon Trust and Water UK did some work on measuring the carbon footprint for all industry which gives global and indirect emissions
- 3.9 million tonnes of carbon a year from water industry- direct and indirect. This includes handling clean water and waste water and treating sludge.
- Bulk of this is indirect emissions, through the supply chain, and use of chemicals etc
- Carbon Trust focuses on mitigation
- Opportunities-identifying companies' wastewater treatment costs, nitrates from farmland. Bigger issues which affect them including carbon equivalent issues- methane, nitrates going through the supply chain- although this is a feature of life and there may not be a lot that can be done about them. Carbon Trust is working with Water UK to create a universal tool for water utilities to monitor GHGs- this will be available at the end of March 08.
- Key activities include identifying whether companies have right technologies in sludge plants, correct pumping equipment treating technologies.
- The water industry is driven by increasing quality – it is not yet clear how the CRC will account for this regulatory requirement.

How can the water industry plan for participating in the Carbon Reduction Commitment?

- Water industry is a fully regulated industry- they need to lay out long term plans. Need to forecast 5 years ahead in accordance with the regulatory cycle, which presents a difficult task. It is difficult to forecast so far ahead for the CRC, especially as the industry has only just started thinking about carbon as a priority.
- Understanding of the emissions trading mechanism and how revenues will be recycled will also be important.
- It is clear that there are opportunities for companies to reduce their carbon footprints and reduce demand. Demand Reduction is one way of reducing emissions to meet the CRC. Metering on domestic properties is seen as a key tool for driving down emissions.

What can we do in the water industry to meet the cap?

- There are enough ideas out there- for pumping efficiencies, sludge treatment (although most of these are capital intensive, which means this would need to be put in place now)
- UU are quite forward thinking about this. NWL are also rising to the challenge.

Costs of the scheme? Will it be carbon neutral as Defra has said?

- Capital costs for CRC participants are likely to be recovered through prices, although this is limited for the water industry. CRC will not be carbon neutral at a company level- companies will have to spend money, and capital schemes will have their payback periods.

What are the key decisions yet to be made for the scheme?

- There is a consultation response due at the end of Feb 08. Good news is expected and key decisions will be finalised.
- Definition of boundaries. 6000mwh- are all participants within the scheme aware of this?
- Mechanism for revenue recycling

Interview O

Date: Monday 25th February
Job Title: Energy Manager
Organisation: Anglian Water
Org Type: Water Utility

Discussion:

What does the water industry need to do to prepare for the CRC?

- Ability to carry out accurate data collection in order to provide aggregated data as required by the CRC.
- The utilities have not purchased carbon allowances in an auction format before- this will provide key learning. Defra guidelines are not yet 100% clear.
- Monitoring energy- how to monitor 100s of meters accurately.
- Willingness of companies to invest in energy saving to reduce 1 carbon allowance- companies will have to consider their energy strategy. There are very few large reductions that the water industry could make to reduce carbon that hasn't already been made. The nature if the water industry is different to the rest of the largely office-based CRC participants, and this presents challenges for the industry
- Anglian Water had pledged to reduce 20% of its energy cost in 3 years- very challenging.
- Unexpected environmental impacts are very significant, such the summer floods last year which resulted in 80% more electricity use in one quarter.

Renewables

- Majority are not business viable without ROCs.
- ROC claiming renewable energy would have to be counted like energy from fossil fuels in the CRC- disincentivises the CRC
- Electricity is double counted- it is counted in the EUETS through the electricity company, and then again in the CRC
- If electricity can be counted when it is generated from an electricity company, why not when it is generated from a water company?

What are the key concerns for the water industry?

- WI is by nature embedded into the environment and environmental consequences
- WI will be penalised in the CRC for meeting other environmental obligations, such as the quality obligations enforced by the regulators, govt and the EU
- Quality vs. Carbon Footprint – Impacts of CC mean more floods, rain and infrastructure requirements, more pumping.
- Overall impact of existing low carbon technologies is still very small. Pumping is crucial to water utilities operations and is very carbon/energy intensive- there is only so much that can be reduced here
- Ofwat stipulate that companies must prove their CBA of new initiatives for more funds
- Carbon- may not be enough carbon in the scheme for the WI, or price of carbon could plummet because of the surplus. Significance of carbon will depend on the price of carbon
- Utilities AND government have a role for raising awareness of water use and price of water.

- Need more economically viable low carbon innovations for translating investments into energy savings.

9.4 Appendix 4- Ten steps to reducing carbon and other greenhouse gas emissions – a Water UK company checklist

1. Involve others early
Non-Government Organisations, regulators, customer groups and others need to be on board. They can in help the company reduce emissions in many different ways; for example: better land management; and variable discharge consent regimes

2. Appoint a carbon manager
This person should be able to take a strategic view of carbon across the business and be directly accountable to the Board. A first task is to develop a Carbon Strategy covering drivers, barriers and opportunities in all parts of the company. Creating awareness and enabling good practice among staff is an essential requirement

3. Understand your green-house gas emissions
This requires an understanding that it may be hard for a company to obtain on its own. In the water sector Water UK and UKWIR are working with companies to develop and implement common accounting methodologies and frameworks

4. Cost of carbon
Ensure that your business plan takes account of the full cost of carbon

5. Be energy efficient
There will always be opportunities for the company to increase its carbon efficiency in managing every process from pumping, treatment and capital schemes to logistics and customer relations

6. Water efficiency
Most energy in the water sector is used for pumping, so working with others to promote water efficiency and leakage reduction will help the company become less energy intensive and reduce its emissions

7. Renewable energy
It is essential to optimise and maximise use of renewable energy whether generated on-site or imported. This means exploring: combined heat and power schemes, hydro power, sludge incineration, solar, wind, low head hydro, and energy recovery

8. Source controls
Working with others to reduce pollution at source and reduce pressure on drainage systems will reduce emissions associated with treatment and pumping

9. Carbon trading
Either through the Carbon Reduction Commitment or other carbon offsetting schemes

10. Supply chain
Water companies have significant purchasing power and can influence the emissions of others through procurement practices and building carbon reduction into contracts.