UKWIR NEWS

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BIOGAS

Maximising the value of biogas

Biogas has long been used by the industry as an energy source for combined heat and power (CHP) plants. However, advances in technologies for biogas production, treatment and application, combined with new financial incentives for different forms of renewable energy, may make the use of biogas more attractive.

Optimisation of biogas production and use will also bring environmental benefits, including helping the water industry mitigate its climate change impacts.

The UKWIR project *Maximising the Value of Biogas*, managed by **Gordon Wheale**, provides a clear appraisal of the technologies and the costs involved in maximising the potential of biogas produced from the digestion of sewage sludge. It examines the benefits arising from biogas optimisation and possible '*regulatory blockers*'.

At an UKWIR project dissemination workshop, delegates heard from **James Newton** of the contractor, Mott MacDonald, that the technology required for conversion of biogas to biomethane is well established and commercially available.

Conversion of biogas to biomethanemakes accessable all the applications of natural gas including injection into the national gas grid or use as a vehicle fuel. Such uses are already well established in mainland Europe and a number of countries elsewhere.

Whilst technically feasible, there are few examples of sewage biogas being converted to hydrogen (for combustion or use in fuel cells) as these are generally very expensive both in term of capital and operational costs. However, with advances in hydrogen technology, this may become an attractive option in the future.

This study found that the use of biogas for CHP generation for on-site use would, in most cases, achieve the best value for a water company. CHP is a mature technology with proven commercial benefits and the most efficient systems can convert up to 40 per cent of the energy contained in biogas into electricity.

The use of biogas as a fuel for vehicles also achieves a relatively high value and, in some circumstances, higher than that achieved for biogas CHP. It also brings environmental benefits compared with conventional fossil vehicle fuels.

Sensitive

However, the values that can be achieved for different biogas uses are very sensitive to small changes in assumptions. In particular, the values of the various renewable energy incentives available (which in some cases are still to be established by secondary regulation) and the impact of the '*Carbon Reduction Commitment*'.

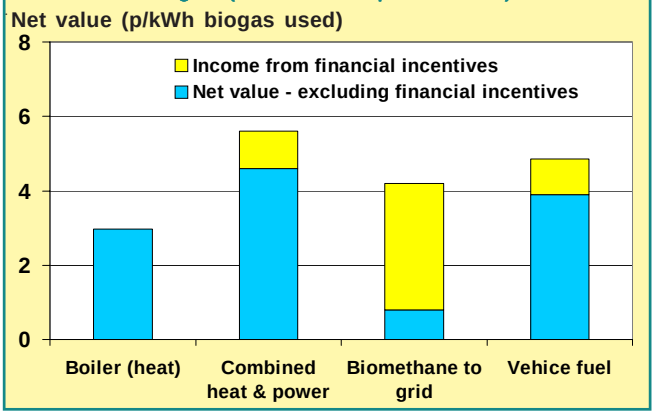
They are also sensitive to site specific factors. These include the availability of biogas for other uses, the remaining value of existing investments in CHP assets and the distance to the local gas grid. Thus a site specific survey should be carried out when considering alternative biogas applications.

The analysis for this study indicates that different biogas uses can have broadly similar values. Thus, for many sites, optimising biogas production may achieve greater financial and environmental benefits than changing the biogas use alone.

At the UKWIR workshop, **Kasia Chapman** (Mott MacDonald) described measures to increase sewage biogas production.

These include enhancing the digestibility of sludge (perhaps through co-digestion with other wastes), optimisation of digestion plant operation and, where cost-effective, provision of pre-treatment technologies, which result in significantly greater volatile solids destruction and hence greatly increased biogas production.

Figure 1. Calculated values for different uses of biogas (500m³/hour production)



Looking ahead

The UKWIR programme planning process for the 2010 programme is nearing completion.

Members generated 113 proposals during the first four months of the year and the Advisory Group meeting rationalised these to 83 in May.

During August these were prioritised by members and the most favoured proposals will be subjected to further scrutiny at the Advisory Group in September before discussion by the UKWIR Board in early November.

Roadmap workshops

The spring Advisory Group also supported a reworking of the research *RoadMaps* produced in 2007, and a series of workshops will be held before the end of the year to cover all aspects of UKWIR activity.

All the maps will have a common format and a timescale of twenty years to 2030.

The last workshop will focus on regulation and its role both as a potential enabler of research and a barrier to progress.

All the studies will be combined into one report which will be published in 2010.

GWRC project update

The biogas workshop gave the opportunity to update delegates on another energy related project *Energy Efficiency in the Water Industry: A Compendium of Best Practices and Case Studies*.

Project Manager, **Gordon Wheale** with **Malcolm Brandt** and **Roger Middleton** of Black & Veatch presented progress of this Global Water Research Coalition project involving four continents.

Its objectives are:

- incremental improvements in energy efficiency through optimisation of existing assets and operations
- more substantial improvements in energy efficiency from the adoption of novel (but proven at full scale) technologies
- a comprehensive report on best practice, comprising fact sheets and aselection of international case studies.

UK Water Industry Research Limited, 1 Queen Anne's Gate, London, SW1H 9BT, UK
tel: +44 (0) 20 7344 1807 fax: +44 (0) 20 7344 1859, email: mail@ukwir.org.uk, www.ukwir.org

Supply pipe issues

The adoption of private sewer and lateral drains by the water companies is now being implemented and it has been suggested that the adoption of customers' water supply pipes may follow suit. Indeed a number of water companies have anticipated this by including such a scenario in their long-term *Strategic Direction Statements*.

In recent years, water companies have come under increasing pressure to reduce leakage and a number have opted for subsidised supply pipe repair schemes without having legal responsibility for the ownership and maintenance of such pipes.

In 2004 UKWIR carried out an investigation *Review of Issues and Practice Regarding Supply Pipes.* To build on this knowledge and address possible developments, a further project *Issues Regarding the Potential Adoption of Supply Pipes: Costs, Customer Service and Regulatory Impacts*, managed by **Richard Kirby**, has just been completed and its report issued (see page 4).

At a project dissemination workshop chaired by UKWIR Client Manager, Bournemouth and West Hants Water's **Richard Stanbrook,** delegates heard how the contractor, Tynemarch, had examined the similarities with sewer adoption and considered that, if supply pipes were to be adopted, then unconditional, automatic and overnight transfer would be the best option.

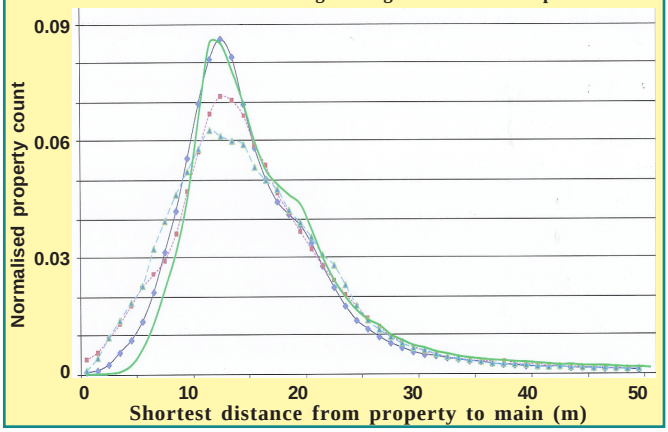
Robert Warren confirmed that, unsurprisingly, data on supply pipes was not readily available, given that water companies do not own such assets.

However four companies supplied data, which was then supplemented with other sources such as national housing stock and census data to derive a national picture on such details as supply pipe length, age of property (a proxy for age of pipe), pipe material and estimated rate of deterioration.

An analysis on the lengths supplied by the four companies showed little variation from company to company, see figure 2, suggesting a degree of national consistency.

A further complexity is that in some areas there are a large number of common supply pipe connections making it difficult to assess the scale of the problem.

Figure 2. Service pipe length
distribution of logical lengths from four companies



Adoption costs

An initial cost benefit analysis suggested that the cost to water companies of adoption would be around £4 per property a year. This would be offset by a reduction of £2 per property a year in costs to customers.

However, there were a number of adoption benefits that the project had not yet quantified:

- a more holistic approach to leakage and asset management
- adoption will allow the economic level of leakage calculations to include supply pipe replacement as a demand-side intervention
- the development of supply pipe serviceability criteria
- improved opportunities for innovation
- improved operational performance
- improved customer relations in the longer term.

Robert Warren also pointed out that current investment in supply pipes is not sustainable. Thus, for companies to meet stringent leakage targets, while supply pipe leakage continues to rise, there will be additional pressure to reduce distribution leakage even further.

The project concluded that improved data is essential so the water industry can formulate a robust view on supply pipes. This information would be of use, especially in the leakage context, irrespective of adoption.

The project also examined the regulatory issues and the complexities involved if the Cave Review's proposal for separate retail companies is enacted. A move to towards full metering, especially if incorporating smart metering, needs to be considered in supply pipe management policies.

Demonstrating the models

UKWIR, in conjunction with the Flood Risk Management Research Consortium (FRMRC), is undertaking demonstration projects to test the application of sewer pipe models to assess their application in urban flood management.

At an UKWIR Technology Transfer workshop UKWIR Project Manager, **Brian Wilkinson**, described how UKWIR is funding the demonstration projects using the models developed by the FRMRC.

The system models incorporate below ground and surface flow models with the associated GIS interface and support tools.

The work is being led by Pennine Water Group of Sheffield University with input from Imperial College, who carried out surface flow 1D modelling, and Exeter University who carried out the 2D surface flow modelling.

The system modelling on the Isle of Wight and Torbay is being carried out by Richard Allitt Associates and Torbay Council respectively.

Dave Stewart, from Torbay Council with **Joao Leitao** of Imperial College, described the model application in Torquay using 1D modelling and how its predictions compare with historical floods in the town.

The project involved considerable data collection including past flood data, gully and roof surveys, LIDAR and aerial photographs.

Richard Allitt, with **Slobodan Djordjevic** of Exeter University, described both 1D and 2D surface flow modelling in Cowes on the Isle of Wight.

The results were compared with historical storms of 2004 and 2008. There are four modelling stages:

- no overland flow
- simple overland
- enhanced, including LIDAR
- integrated, including road gullies & roofs

He explained the need for an experienced person to spend enough time in the catchment to understand the local factors such as drop curbs or missing steps. These can radically alter the flow direction as the water levels rise.

UKWIR Client Manager, Southern Water's **Barry Luck**, said that the roles of the various organisations in flood management would become clearer as the draft *Flood and Water Management Bill* progresses through Parliament.

He added that the water companies will have a vital supporting role in both understanding the issues and assist with their modelling expertise.

Feedback from the demonstration projects will help in improving the models and the accompanying guidance manuals.

The final report on the project will be published by UKWIR later in the year.

21st century distribution

UKWIR has been at the forefront of the innovation debate, by carrying out the *Barriers to Innovation* project in 2006, in collaboration with the DTI, following the 2005 DTI *Innovation in Water* conference.

This emphasis on innovation has recently been supported by the *Cave Review, Review of Competition and Innovation in Water Markets*. In 2007 UKWIR undertook the *21st Century Sewer Design* project, reported in UKWIR NEWS 46.

Now the ***21st Century Distribution Networks*** project, which is managed by **Jo Parker** and with Thames Water's **Mike Shepherd** as Client Manager (and co-funded by Sydney Water), considers the development of drinking water distribution systems in the UK to the year 2080.

At a project dissemination workshop, **Brendan McAndrew** from the contractor, Mouchel, described how the scenarios used in the project had used the DPSIR (Drivers, Pressures, State of service, Impacts, Responses) model, a concept model developed by the European Environment Agency.

Following an extensive literature search, the model was used to develop a number of 'futures' of which four were selected as representing upper and lower bounds. Secondary drivers - economic, environmental, social, innovation and regulation were applied to these, as shown in Table 1.

Key drivers

There are a number of key drivers that will have a dramatic impact on the nature and scale of responses that emerge, all of which are subject to significant levels of uncertainty.

Foremost amongst these drivers are:

- population
- behaviour
- climate change
- economic growth.

Given the set of drivers and potential future scenarios as well as a sustainability requirement, the project assessed the appropriate responses for demand management, network design and maintenance, network operation and regulation/government.

From this a set of recommendations and actions were distilled. The responses were tested as to whether they were unique or universal, those common to all four scenarios being seen as having a high probability of being realised.

The actions centred around:

- achieving a sustainable supply demand balance
- a long-term communications and public education strategy and more effective ways to engage with customers
- a water efficiency labelling scheme
- 'no-dig' inspection and repair technologies
- a shared vision of highway and utility maintenance
- addressing the current leakage challenge
- development of intelligent networks
- workforce training and development
- role of water distribution systems in fire fighting
- new standards for non-potable supplies
- establishing a national Water Strategy Group.

Looking to 2080, the UK water distribution sector should be preparing itself for a future of growing water scarcity where the need to manage demand, reduce leakage and enhance supplies, whilst delivering high quality water and high levels of service will place great demands on those involved.

Radical re-think

The project report concludes that '*radical re-thinking of the nature of public water supply may be required and although the most acute pressures may take some years or decades to emerge, it will be necessary to begin the process of identifying needs, reducing uncertainties and developing appropriate responses well in advance of the point at which they are required*'.

To meet this aim the project compiled a series of short, medium and long-term R&D '*Route Maps*'.

Table 1. Potential futures

Potential futures	Economic	Environmental	Social	Innovation	Regulation
Competitive prosperity	Global player	Very dry climate	Individual consumerist	High	Low
Prosperous stewardship	Global player	Very dry climate	Collective stewardship	High	High
Market austerity	Global spectator	Very dry climate	Individual consumerist	Low	Low
Collective austerity	Global spectator	Very dry climate	Collective stewardship	Low	High

Urban futures

The 21st Century Distribution Networks workshop provided an opportunity for Birmingham University's **Professor Chris Rogers** to outline the EPSRC project, *Urban Futures*, in which UKWIR is one of many partners.

The project comprises many disciplines including social science, engineering, geography, computing, design, chemistry, business management, environmental science and urban studies.

Of the eight work packages, the third is *Water and Wastewater* being led by **Professor David Butler** of Exeter University, while package four deals with the sub-surface built environment including water supply and sewerage.

The research has developed scenarios for the year 2050 to provide insights into the potential impacts of today's urban design decisions.

Case studies

The scenarios and attendant toolkits will be applied to case studies in East Birmingham and Lancaster with additional work in Morecambe and Worcester as well as a number of cities overseas.

If the outcomes from a proposed solution are similar, regardless of the future against which it is tested and they deliver a positive legacy, then they can be adopted with confidence.

Where there are very different outcomes the solutions can be modified to create an optimum outcome regardless of the future, or at the very least planning can be based on knowledge of the likely impacts if the future develops in different ways.

The four year £3.2m project is part of the Sustainable Urban Environment (SUE) programme and involves University of Birmingham, University of Exeter, Lancaster University and Birmingham City University

Chris Rogers concluded by asking whether "*if the future is different will our current solutions be redundant?*" adding that "*Urban Futures is about alternative ways of showing what we are doing is good value*".

Visit www.urbanfutures.org for more details.

FLOOD RISK

SAM considers the risk

The SAM (System Based Analysis and Management of Urban Flood Risks) project, funded by BERR and managed by **Richard Kellagher** of HR Wallingford, is an important element in the whole *Flood Risk Management Research Consortium* programme.

The project dissemination event, funded and hosted by UKWIR, took place at Church House in Westminster with **Dr. Jean Venables**, the ICE President, giving the keynote speech. She said the research was important and timely given the 2007 floods and 2008 *Pitt Review* and now the draft *Floods and Water Management Bill*.

She expressed concern that there must be a coherent responsibility for delivering flood management, a clear line of funding and proper training, especially on modelling skills (a sentiment supported by **Jonathan Chapman** of the Environment Agency, which is one of twelve partners in the project).

Complexity and scale

Jean Venables welcomed the risk based approach but pointed out that it was an important tool and that we must not forget the need to apply technical and engineering judgments. As the workshop progressed the complexity and scale of the project became apparent.

It encompasses a whole series of procedures and modules and tools, basically structured as shown in figure 3.

Previous modelling approaches concentrated on the hydraulic capacity of the system but now consider the risk of failure in terms of a '*level of expected annual damage*' so that planners can make informed investment decisions.

Perhaps the most impressive element of the research is the sheer scale of the volume of data collected and analysed.

Christian Onof of Imperial College described the two different approaches to modelling rainfall information that are being developed at Imperial College and Newcastle University.

Case studies have been carried out to test the procedures and tools at Dalmarnock by Mouchel and in Keighley by the University of Sheffield.

Richard Kellagher, from the lead contractor HR Wallingford, said success or failure of the new approach will depend on users and policy makers, not the technical constraints of computing tools or data limitations.

UKWIR Client Manager, Southern Water's **Barry Luck**, concluded that, given the forthcoming *Surface Water Management Plans*, the research will help all agencies to work together and create real opportunities to understand and resolve flooding problems.

RESEARCH REPORTS

This edition features a listing of UKWIR publications issued since the last newsletter.

CLIMATE CHANGE

09/CL/01/10 Carbon Accounting in the Water Industry: Non-CO_2 Emissions *(1 84057 532 8)* £100

CUSTOMERS

09/CU/01/4 Issues Regarding the Potential Adoption of Supply Pipes: Costs, Customer Service and Regulatory Impacts *(1 84057 537 9)* £250

09/CU/04/6 Debt Collection Performance and Income Deprivation *(1 84057 531 X)* £500

DRINKING WATER QUALITY

09/DW/11/3 WHO and EUREAU Support - Progress 2007-2009 *(1 84057 538 7)* £100

WASTEWATER TREATMENT & SEWERAGE

09/WW/05/4 Maximising the Value of Biogas: Vol. 1, Summary Report *(1 84057 534 4)* £200

09/WW/05/5 Maximising the Value of Biogas: Vol. 2, Technical Report *(1 84057 535 2)* *[sold with above]*

WATER MAINS & SEWERS

09/WM/07/13 Exploring the Cost Benefit of Separating Direct Surface Water Inputs from the Combined Sewerage System *(1 84057 533 6)* £100

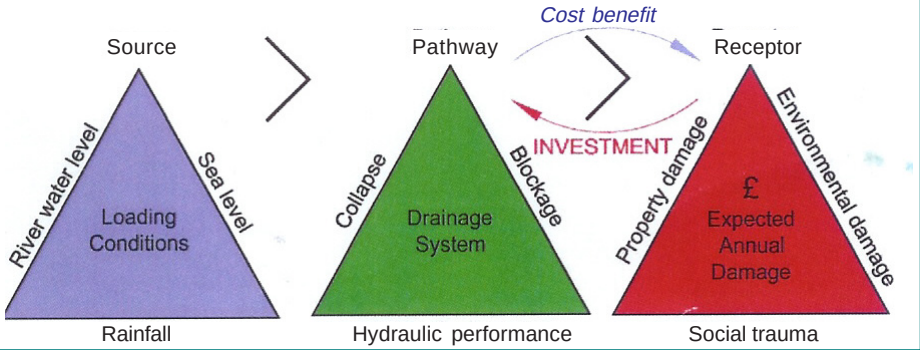
09/WM/08/40 Factors Affecting the Natural Rate of Rise of Leakage *(1 84057 530 1)* £300

WATER RESOURCES

09/WR/07/13 Code of Practice and Guidance on Water Use Restrictions *(1 84057 536 0)* £40

UKWIR research reports are available for purchase via the internet on www.ukwir.org

Figure 3. The risk method for drainage analysis



SMART PIPES

Smart sensors

The 21st Century workshop (see page 3) gave the opportunity to update delegates on *Smart Sensors for Buried Utility Location and Performance Monitoring*. This is a collaborative project between UKWIR, the US Water Research Foundation and the University of Birmingham.

The University's **Dr David Chapman** said that the project's aim is to prove the concept of a remotely interrogated 'smart' water pipe, where large numbers of small sensors (or sensor circuits) are incorporated into (or near to) the pipe. It was decided to construct a sensor 'demonstration test bed' to show current technological capabilities.

Investigations are proceeding into the best way of embedding the sensors into '*sprayed*' lining of HDPE pipes.

Both low and high frequency communication systems have been tested and have shown that communicating with a smart pipe is feasible. Communication requires power and the study is investigating '*energy scavenging*' by exploiting minor temperature differences and vibrations.

Dr Chapman concluded by saying that there is a huge opportunity to reduce costs and the potential to become pro-active in network investment and operations.

UKWIR PEOPLE

Howard Brett is the new UKWIR Client Manager for the Wastewater Programme.

Howard is currently Thames Water's Strategic Wastewater Regulation Manager and has been involved in many past UKWIR projects, especially on wastewater and climate change.

He is currently chair of the Industry's Wastewater Network as well as a member of Water UK's WFD Steering Group.

UK Water Industry Research Limited, 1 Queen Anne's Gate, London SW1H 9BT, UK
tel: +44 (0) 20 7344 1807 fax: +44 (0) 20 7344 1859 email: mail@ukwir.org.uk, www.ukwir.org
Chairman: Paul Butler Director: Mike Farrimond