UK Innovation Potential in Advanced Water Treatment: Future Directions & Strategy

2nd Participatory Workshop Program

Tuesday 6th December 2011
James Clerk Maxwell Building (JCMB), Teaching Studio 3217
King's Buildings, Edinburgh University

WORKSHOP REPORT

Workshop Organizing Committee

Prof Andrea I. Schäfer
University of Edinburgh

Konrad Bishop
Defra

Diane Duncan
HIE

George Ponton
Scottish Water

Hans Jensen
UKWIR

Ian Bernard
British Water

Kerry Thomas
Environmental Sustainability KTN

Prof Gordon Hughes
WIC

Matt Bower
Drinking Water Quality Regulator

Workshop Funding

EXECUTIVE SUMMARY

During the workshop, three sessions were assigned to allow six interdisciplinary groups to explore fourteen questions. Detailed responses can be found in the attachment. From the discussions a number of key issues from each of the three sessions:

- The first set of questions explored what the features might be of a Technology Demonstration Site, who would use it, what services it should offer, its location and how it might be funded and operated. A long list of users emerged from those who would want to undertake testing to those who would wish to access data and peer review findings e.g. the international investment/development community. It emerged that services required are available, but not in a form that is focused on water technologies, and the expertise to support innovation in the sector is scattered across a range of national silos. A hub and spoke structure was suggested by most of the groups. There was recognition that a facility could represent an opportunity to promote the sector's work to a national and international audience. Plug, Play & Pay usage of facilities with access to the appropriate raw water source(s) were key elements for success. The lack of a facility to deliver innovation is seen as a market failure and government intervention therefore appropriate, but any centre should also be industry/demand driven. Industry must therefore be part of the funding mechanism.
- A second set of questions considered the role of advanced water technologies in delivering water security and sustainability in both the UK and internationally. Almost all the groups highlighted the need for easily maintained, chemical free, low energy using or renewable energy creating technologies, with the capability to remove high levels of micro-pollutants. The groups also explored how water quality affected security and what technologies were needed to address security issues. The Research and Development Framework was the subject of the final question in this session and participants discussed what the water sector could do to contribute more effectively – engagement and taking a leadership role emerged as being key.
- A final set of questions considered the global markets that might stimulate advanced water technology development in the UK and the mechanisms to stimulate these markets. The knowledge

around current business support offerings was collated during this session. The groups were also asked to consider what new or additional support was needed to realise the economic benefits of global market. As identified in a previous workshop, water innovation is not being driven in a coherent fashion. There are current examples of technology research being funded where the technology already exists. There is therefore an opportunity for coordinated effort and ensure that the UK's knowledge base is fully exploited. Strong leadership is now required to muster industry and academia (including the supply chain and our research intensive SMEs who are clearly already major innovation drivers). The UK needs to foster closer relationships with international networks and a focused UK advanced water innovation network may provide a lens through which UK capability can be viewed by the international investment community.

FURTHER ACTIONS OF INTEREST

- George Ponton (Scottish Water) has set up a Linked In Group Further to the workshop (in a 'mad moment of volunteering') to establish the interest in forming a working group to develop the concept of some form of Northern Innovation Hub further. Please join if interested! **http://www.linkedin.com/groups?gid=4210463&trk=myg_ugrp_ovr**

- Charlie McLaren has communicated that the UK Water Research and Innovation Framework has gone online - please follow this link for the summary document and full report **http://www.bis.gov.uk/go-science/science-in-government/global-issues/environment** UKCDS are intending this to be a 'living' document and are keen to receive comments from people who haven't been directly involved in the development of the Framework thus far. Please direct comments and queries to be directed towards Charlie and I can feed them through to the secretariat.

- Diane Duncan has taken the lead on preparing this executive summary (THANK YOU!) and is progressing with TSB and SFC liaison through various activities.

- Andrea Schäfer is progressing with plans to launch a Scottish Institute for Innovative Water Technologies – SÏWAT. SÏWAT will be a sister to SISER, the Scottish Institute for Solar Energy Research at Heriot Watt University – an inclusive network to initiate collaborative research in the advanced treatment domain. Expressions of interest most welcome.

- A follow-on workshop is planned for 21 March 2012 to move discussions forward to practical action with a focus on WATER-ENERGY Nexus and participation of international speakers with expertise in energy, water reuse & desalination. Nominations of questions, activities and speakers for future workshops are most welcome.

APPENDICES

1. Workshop Program
2. Workshop Participants (Working Groups)
3. Presentation Dr Steve Lambert, TSB
4. Presentation George Ponton, Scottish Water
5. Presentation Prof Jim McDonald, Principal, University of Strathclyde
6. Presentation Dr Dan Osborne, NERC
7. Presentation Prof Gordon Hughes, WIC/University of Edinburgh
8. PresentationKonrad Bishop, DEFRA
9. Presentation Charlie McLaren, UKCDS
10. Answers to Questions by Working Group (*unedited*)

THE ORGANIZING COMMITTEE WOULD LIKE TO THANK THE WORKSHOP ATTENDEES FOR THEIR ENTHUSIASTIC PARTICIPATION IN DISCUSSIONS DURING THE DAY AND MAKING THEIR WAY TO THE 'FAR NORTH' FOR THIS WORKSHOP

Questions Set 1: Technology Demonstration Site Features

1: Who will be demonstration site users (e.g. SMEs, Water Industry, Academics, International Private Sector, etc)?

At the previous workshop on June 30 2011, the need for a national test facility was identified as a key barrier for innovation and commercialiation. It was clear from the feedback that there was distinct appetite from attendees to debate and develop a vision for such a facility.

With regard to who might use a demonstration site, there was a lot of consensus across the six groups. Apart from the usual suspects (see list below), a number of significant and highly practical suggestions were made including:

- The site may be used by those listed below, but it will also be important to consider who could use or benefit from the emerging data and information. E.g. Investment companies/retailers/wholesalers
- Extending 'ownership'/input to international stakeholders to ensure that any findings/verification of technologies was relevant, applicable and acceptable to overseas customers
- The test site could be used for operational staff training prior to installation to ensure that technologies work at an optimum level on installation
- An objective should be to deliver Public Sector efficiency, with the site acting as a conduit for data to be shared and results accepted by all water companies as valid. Testing carried out by 'independents' rather than SME's with centralised results acceptable to all.
- Barriers to fully realising the benefits of this facility may emerge as a result of different regulatory approaches; procurement schedules; culture desires to be 'different'; economies of scale

Users: The "Water" Industry; regulators; manufacturers/SME's; policy makers; NGO's; Consultancy sector; Universities; multi nationals water research bodies

2: What services should such a demonstration facility provide?

- It was clear from the responses that if a test facility were to be established it should focus on being demand driven, with its main focus on prioritized innovation and sustainability requirements of the growth industry sectors and, of course, the water industry
- Critical to success would be the genuine recognition of the facility as an international centre of excellence by stakeholders. This would mean that highly qualified, internationally respected staff were employed who would provide an independent validation and reporting service to standard international protocols. They would be connected and would be influential e.g. linkages to DWI approvals process
- An innovation knowledge Hub – making links to the services offered by the enterprise agencies and their partners easy and seamless: - to attract and promote global investment funding, International collaboration; mentoring on commercialization, patenting pitfalls; tax credit and allowances advice; be a one door stop for industry and academia. Concerns were expressed that as new technologies emerge, it will be critical to ensure that the science behind new technologies is understood and IP challenges will emerge. .
- While a Central location was anticipated, the need for hub and spoke facilities would provide a more versatile offering and sustainable offering and would allow for access/utilization of small to large existing and redundant assets mimicking "real" situations. Flexible, versatile, 'Plug and play' facilities, similar to those in the Netherlands, should be established. It was suggested that the test facility should be able to deliver technologies to a 90% proof of concept stage before trialing in the market.
- There was demand for the test facility to have the capability to provide a range of data capturing and analytical services from cost information to financial modeling and process optimization to management strategies
- The facility could bridge a skills and learning gap, by highlighting need to further and higher education providers or providing a maintenance and operational support service
- PR – The facility could raise the public perception of value of water and how it underpins the economy.
- Humanitarian brand values – the centre should as one of its strategic goals aspire to identify high science/low tech for developing countries and develop strong links and understanding of international market requirements (see also responses to question 7)
- The facility over time could also facilitate a horizon scanning/future challenge role.

3: Where should such a facility be located / should there be one or several?

A number of geographical locations were suggested, but most of the discussion around this question focused on identifying the criteria that would need to be met to deliver success – these suggestions could form the basis of a site options appraisal.

- Most suggested that the location would have some kind of 'Hub and Spoke' arrangement. Spokes would be sites for the deployment of technologies for testing and could be mobile units. The need to be located near a thriving academic, SME community, with plentiful and multiple raw water types were seen as essential to success. Others suggested that there could be a requirement to consider a north/south or urban/rural split to address specific issues which emerge from geographical location, but may also facilitate access to existing expertise
- Must be demand driven and access to a supportive and creative thinking enterprise network who makes links to other growth industry sector projects would help to deliver sustainability, e.g. aquaculture, chemical sciences, food and drink, oil and gas,
- Build on strengths identifying existing offerings if they meet the needs as new site would be expensive to establish in terms of accommodation, infrastructure and staff.
- Easy access to transport infrastructure – allowing for both domestic and international travel
    - There was discussion around the pros and cons of a fixed site and it was thought that a central location would provide for High levels of control, attraction of trained staff, and easier access to the necessary services. Some existing sites are in existence e.g. Cranfield, WRC
    - The downside to having one fixed site was access to the different water types that would be need to be transported to ensure it was representative.
    - Health and safety issues could emerge for access to live sites, but concerns were also raised regarding set-up costs, space limitations, duplication of facilities and the changing needs/prioritization of any host organization.
    - UK WIR were suggested as a central UK facilitator, with regional centres and mobile units

4: Who should fund the facility (which aspects should be user pays?)

There was pretty much a consensus across the groups on;

Set Up:

- Such a facility needs to demand lead with private sector stakeholders/large water suppliers (GE and Veolia) and users setting the pace. There is clearly market failure and a rationale for EU, UK Government, the Technology Strategy Board and devolved administrations to provide support. Research councils may also have an interest in this facility
- It was suggested that the facility could be funding via customer charges by water companies and that government should underwrite. Any profits should be reinvested for R&D into innovation priorities

Usage:

The site may be used by those listed below, but it will also be important to consider who could use or benefit from the emerging data and information. E.g. Investment companies/retailers/wholesalers

- Pay per Play by SMEs, Academics and End Users to rent time, buy consumables
- The Payment for showcasing

5: How can Technology Demonstration facilitate innovation?

The responses to this question are almost identical to the responses made to question 2 – which asked about the services that a demonstration site should provide.

There was recognition that an ambitious approach to bridge the gap between business and academia could be achieved if a more flexible and responsive approach could be taken to, for example, secondments, and industry demand was better communicated. This could leverage public sector investment into academic research by helping translate it to marketable products and services. The very existence of demonstration centre was being seen as providing a clear route from 'bench to production', with customers and investors having access to a peer review portal. Such as service could be used to attract the international investment/developmeny community to a dynamic sector, growing, learning and responding as a result of networking its shared experiences.

Other responses included that innovation would be facilitated by;

- Knowledge exchange
  - acting as a focus for networking and communication
  - accelerating innovation to commercialization up to proof of concept to regulatory approval
- Financial feasibility/business planning
  - Technical expertise and new creative/open innovation approaches e.g. “Hot Housing”
  - Efficiency optimisation of technologies
- Partnership creation/collaborations/developing potential in/with other disciplines and sectors
- Best Practice sharing/accepting data/test results by water companies to reduce R&D/validation burdens on SME’s
- Introduction of new thinking / ways of doing what we do

QUESTIONS SET 2: ADVANCED WATER TREATMENT & WATER SECURITY/SUSTAINABILITY

6: What is the role of advanced water treatment in water security/sustainability in the UK?

- For the UK market, the provision of increased certainty of water quality and quantity remains paramount. The UK and Scottish Government's aspirations to make the transition to a low carbon economy are also driving the demand for energy and resource efficient products and services. This is just an issue for the water sector but all industry sectors are being tasked to collaborate to achieve both carbon savings and explore closed loop systems for sustainable production.
- A transition to a low carbon economy is therefore creating all sorts of new opportunities for those involved in the advanced water treatment sector. Opportunity for technologies which add value to existing systems in manufacturing; advanced monitoring techniques for accurate resource use monitoring for corporate were two key areas of opportunity identified by the groups. Water scarcity was seen as a driver in creating the need to consider water supply more strategically – an eco-systems approach which joins up the thinking on solutions/treatments, as well as identifying sources not currently potable e.g. mine waters, grey water and other decentralized supplies. *(Is this strategic overview and the opportunity to identify synergies with other industries/regulators/monitoring agencies not a key benefit which could be derived from a national demonstration centre?)*
- While water security is not a particular issue in Scotland, it is however Scotland's intention to become a Hydro Nation because the Scottish Government consider that because water management is a global issue, tacking water scarcity is something that Scotland can and should plan a role in.
- Elsewhere in the UK, the groups provided a very wide range of examples where advanced water treatment has a role: These included: - water recycling rather than desalination on the Thames;- reducing capital build programmes for reservoirs; avoidance of over-obstructed groundwater; security of quality and supply by addressing, for example, methaldehyde which is not adsorbed by carbon or broken down by ozone; - delivering water fit for 'the' purpose – do we need high quality water to everyone for everything? Provision of low quality water, but localised advanced treatment could delivery of high quality, low carbon water were required and change and make more efficient, the operations and planning of public water supply delivers in both urban, rural and remote environments; water reuse will require the breakdown of public perception issues via education on the value of water; - removal of colour, turbidity, manganese, iron; predictive logic to anticipate and respond to situations (better use of data) – mitigate problems; resource recovery or value recovery from waste streams e.g. coagulant, nutrient recovery, pesticide / micro pollutant removal / remediation; New pumps, turbines, hydrosystems and Linking water systems to wind turbines and addressing the problems of having them on catchment.

7: What is the role of advanced water treatment in water security/sustainability internationally?

- Advanced water treatment should play a role in delivering robust, appropriate and cost effective solutions.
- In terms of economic benefit, as mentioned in a previous workshop and earlier in this document, it is the global market which is considered to represent the greatest market opportunity. Parallels were drawn to how Indian firms developed the mobile phone market and that much could be learned, and applied, to the advanced water sector development in order to access international rural markets.
- While many companies move to address and simplify city water provision - one size does not fit all and different solutions, as in the UK, are needed in different places.
- International solutions can learn from UK issues and build in 'fit for purpose' solutions rather UK DWD standards for everything.
- NGO's want 'best practice' – solutions need to be most effective for a given problems. In water scarce countries, it is more important to use technologies to reduce water conflicts and promote development.
- Many issues the same as UK and innovative chemistry with readily available local materials can simplify for developing countries, but must be low maintenance and consideration given to providing training. *(A central testing facility could build up a knowledge bank and 'on the ground' contacts to support product innovation for international markets in developing countries)*
- There remains a need for blue sky thinking as well as traditional approaches –e.g. alleviating water stress through sustainable desalination; groundwater recharge or treatment of contaminated / sub-standard groundwater; brackish water treatment; environmental remediation; leakage reduction; reducing chemical use and costs; recycling, rainwater harvesting.

8: How does water quality affect water security/sustainability?

Water quality was considered by the groups to affect water security/sustainability in a number of ways and a number of questions were also posed by the groups which might usefully debated at a further workshop.

There was also a mixture of responses to the question in terms of UK and international markets.

UK and general comments;

- quality influences the ability to use as a supply, and as the source quality reduces, sustainability reduces and cost increases. However, this does depend on the use of the water and consumer attitudes also need to be taken into account;
- economic development e.g. tourism /leisure sector in coastal dead zones/algal blooms affecting recreational use; there a other linkages to economic development and public health improvements that need to be explored
- a history of water vs quality of water resulting in direct water reuse;
- consumer standards may be according to what can be measured rather than actual health impact *(This is a matter of perception and to counteract it we need a positive advertising drive towards water supply - promoting its health benefits/Carbon footprint /ethical values vs bottled water!!! Starting here will hopefully make awareness creeps up the foodchain to the funders)*
- colour removal/aesthetic impacts: do we really need to remove all colour? Perception this is about health rather than being about a variety of reactions to water
- catchment management requirements a consideration
- Increase sludge disposal issue - Treatment changing raw water quality (eg desalination) - Re-consider WQ standards – are they necessary / health based (e.g 0.1µg/L pesticide standard - better environmental quality reduces energy consumption through treatment
- Deterioration in raw water quality can lead to source abandonment, therefore more advanced treatment needed
- Climate change is expected to influence catchment areas (e.g. peat bogs drying up and aged water draining out)
- Influence on sustainability as new treatments (e.g. membranes) more energy intensive
- Analytical methods improving – needs prioritised and strategic approach or leads to more intensive treatment

International;

It was recognized that for many there is no choice in water and they cannot opt out of water or food consumption. There was also debate around whether or not it was possible to get massive reductions in water consumption in developed countries by separating uses. A subject for further discussion perhaps?

As in the UK, the goal to deliver improved final water quality standards can reduce water security; the poor raw water quality can affect treatment process and also reduce security, and the higher quality requirements can often mean lower sustainability and can impact on the wider ecosystems. Quality improvements are often linked to other inequities in developing countries.

9: What advanced water treatment technologies are required to address water security?

There was a view that it would be useful to establish some underlying principles for future water technologies and some aspiration strategic goals. The need for chlorination was questioned, as was the need to use potable water when it wasn't necessary and how nano technologies might be applied. These too may be an interesting area of creative thinking at a future workshop?

(There is an interesting long list here and it would be interesting to draw up a specification on each for how these address the current demands of the water industry in the UK)

The groups also provided a list of advanced water technologies which could be used to address water security. These included integrated technologies that could deliver:

- ease of maintenance, be chemical free, use low or produce renewable energy from waste and have high micropollutant removal capability;
- combining renewable technologies and existing "energy intensive" treatment / taking advantage of natural technologies e.g. visible light catalysis
- provide better management/predication for distribution networks; and bio-desalination (biosystems rather than membrane); disinfection technologies (other than chlorine;); removal of inorganic contaminants from ground water;

- low energy / sustainable desalination; agriculture run off remediation/nutrient recovery; treated wastewater effluent for sub surface irrigation.

10: How can we contribute to the Research and Innovation Framework?

- Start by addressing the low hanging fruit - the industry must have a principle of encouraging water reuse/behaviour change at its core.
- There was low awareness of this framework across some groups, but it highlighted the need for engagement and to stop working in silos. It was thought that a national demonstration centre could be the potential glue and provide a catalyst to prioritise industry demand, focus funding, reduce duplication and leverage national expertise.
- Within the UK we need make it easier for the water sector to innovate; make processes for verification and international accreditation more transparent. The innovation cycle takes too long and the regulatory funding periods are too short. Longer term relationships are required to bring meaningful change to the water industry.
- We should mobilise our exports to provide a platform for delivering strong national and international leadership.
- We need to communicate the opportunities. Water company data needs to be available to share (online instrumentation, operational etc) with suppliers / developers e.g. source of "end-of-pipe" issues e.g. phosphates in detergent/fleece plastics from washing machines and develop technologies to remove from source and raise awareness of matters of concern; e.g. PCB/bioactive chemical bioaccumulation in the ocean despite having been banned.
- Some respondents highlighted that it was time to revisit the approach taken two and half decades ago – undertake a strategic review and re-examine needs. On this basis the need for an innovation centre was questioned – could it run out of steam if other approaches were available to deliver innovation. There is a need to identify particular points of stress in systems; remove regulatory barriers to enable more research and investment and we must challenging the assumption that all tap water needs to be treated to potable standard. Articulate the need - publicise the SME and academic capability - future visibility and smoothing of investment plans - communicate / engage - patience in development process - look to the long term - be prepared to contemplate a different model - influence funding for balanced view on pros and cons of innovation given
- More events – request that future events explore a coherent industry research theme around resource resilience in providing sustainable water services – "Breaking the Cycle" We need to understand the opportunity cost of waste stream recovery and water reuse across growth sectors and move away from energy, chemical intensive treatment as resources diminish and prices increasingly fluctuate.
- Innovate for future problems

Questions Set 3: Water Innovation & Global Market Opportunities

11: Which global markets will stimulate UK Advanced Water Treatment Technology Innovation?

- Geographical areas: water stressed locations in the UK, EU – especially eastern European and Mediterranean countries, India, Middle East, China, Brazil, Sub Saharan Africa- Low Tech e.g. slow sand filters & knowledge transfer developing world. Developed countries high- value water stressed, Australia and Singapore and Developing countries – low tech solutions.
- Academic and Voluntary sectors – attracting overseas student to study in the UK
- Energy and resource efficiency
- Luxury end; Saudi corporations
- Bespoke Industrial applications and small remote package plants/systems
- Water recycling e.g. manufacturing and water intensive/dependent growth sectors (aquaculture)
- Unregulated markets
- Water management Consultancy
- Training – skills and higher education
- Water trading – capitalize on UK's raw resource by relocating water intensive manufacturing to UK / Scotland
- Products: Advanced oxidation process ; Photo catalysis/- Bio pharmaceuticals; Sludge production / biogas technologies / P recovery (sludge as a product not a problem); trace contaminants / food safety; Risk management – e.g. security; DWSP; broad spectrum real time monitoring/closed loop manufacturing/- High growth developing countries like India and China – export expertise and products (open to new technologies)

12: What will the mechanisms of stimulation be?

- Legislation (Climate Change Act) and political influence and interest (Scotland's positioning as a Hydro Nation)
- Collaborating and challenging regulators and policy makers on 'how things need to be done'
- Adoption of environmental and health based standards
- Market need/demand e.g. public health demands/concerns re new chemical impacts on endocrine
- Financial incentives / Financial innovation
- Entrepreneurial responses to market needs
- Demonstration of benefits to wider audiences to make cost effective and feasible to innovate. SME's need to be able to demonstrative product/service potential – TSB water technology platform could provide focus.
- Supply & Demand balance of water and knowledge between countries
- Increasingly stringent water standards - Expectations of better water quality
- Economic growth and identification of water as one which could realize benefits for sector and economy
- Foreign ownership / commercial ventures
- Consumer led demand, greater prosperity
- Industrial demand / migration - Growing affluence and expectations
- Cost of chemicals for treatment
- TSB Water Competitions and other UK/devolved government initiatives
- Partnerships and networks - Revision of how companies are regulated, more ownership of risk

13: What support structures are in place to facilitate global market competition for the UK supply chain?

- The water industry is seen as being well connected to a range of international networks and in some instances is already providing support and collaborating to help access international market opportunities. The UK's universities, through the use of, for example, research council and EU funding, have built up impressive networks and collaborations with universities in many of the markets details above.
- Other sources of assistance included the Technology Strategy Board and its network of Knowledge Transfer Partnerships; British Council; UKT&I and SDI, Enterprise Networks and agencies; NGO's;

Venture Capital investor Network; Dow VC and other VC Network *(for this to be of benefit there is a need to capitalizing on technology – more spin-outs/less red tape/more simple models of IP assignation licensing deals)*

- Some of these offerings were considered to be of limited help and significantly more costly than going it alone.
- European trade can be easier than within UK due to regulation in the leisure market e.g. swimming pools. A lack of regulation means limited home markets.
- Initiatives in development – CDS and DFID?- Is there potential for a UK water research centre to coordinate/communicate?
- Some facilities through research partners can help to show proof of concept exist – but have different business models e.g. Cranfield charge (consulting style), other Uni's don't - Institutional structures like Fraunhofer that have specific research/industry links
- Research Office UK has opened offices in India
- DFID
- Political Trade Missions
- World Water forum & International conferences/Trade Shows
- European trade can actually be easier than within UK e.g. Lack of regulation in UK in some areas e.g. swimming pools means limited home market.
- More practical help is needed to get kit through customs, approaching local agencies for demo sites

14: What additional support is required for a competitive advantage of UK competitors?

- Leadership along with Government support and commitment is needed to help challenge normal thinking and encourage lateral thinking. A UK Water Industry Ambassador/Water Secretary in UK/Scottish Governments. Overhaul financial regulation to produce longer term thinking (i.e. remove 5 yr cyclical funding approach) – don't penalise innovation.
- It is also clear that the industry need to communicate the challenges it faces ensuring that the academic and business sector are clear and aware of the opportunities.
- Facilitate more inter – disciplinary / inter industry sector liaison
- More needs to be done to communicate international opportunities and deliver UK capability into overseas markets. Trade missions to develop understanding and to build effective networks should be a priority for economic growth. Being realistic - UK SMEs cannot get into UK markets due to not having regulatory approval etc but can approach overseas markets - Must be barriers in UK because other countries (Swiss, NL etc) are exporting home-grown SME skills in water treatment.
- There is an appetite for a Business Network Forum and a Champion is required to lead
- The process of international verification of technologies needs to be speeded up and standard protocols employed. ETV Scheme to be escalated.
- Baseline blue-skies research (e.g. carbon nanotubes)
- The ability for the UK research/industry skills base to remain price-competitive against other countries - Relaxation in procurement & regulatory Frameworks
- Regulatory incentives should focus on producing best possible quality rather than meet arbitrary standard
- Support genuine research EU stifle creativity through over-detailed planning.
- Diplomatic Trade agreements / networks
- Skills : A knowledge of cultural behaviours; access to language support; Global market analysis & Local market intelligence in growth overseas market / contacts / facilitators
- Showcase events - International partnering network, e.g. Airbus

UK Innovation Potential in Advanced Water Treatment: Future Directions & Strategy

2nd Participatory Workshop Program

Tuesday 6th December 2011
James Clerk Maxwell Building (JCMB), Teaching Studio 3217
King's Buildings, Edinburgh University

WORKSHOP AIMS

- Dialogue between Water Technologists, Academics & Policy Makers on Water Innovation
- Establish Bottlenecks in Advanced Water Treatment Innovation: Stakeholder Needs and Preparation of Specific Outcomes (e.g. Proposal for a technology demonstration site)
- Develop Funding Strategies & Liaise with Funding Agencies for Enhanced Concept to Market Success: UK Water Innovation

8.45 a.m.	**Welcome & Introduction of speakers, attendees and agenda** **Prof Andrea Schäfer**	University of Edinburgh
	SESSION 1: TECHNOLOGY DEMONSTRATION SITE	
9.00 a.m.	**TSB Funding Strategies for Innovation in the Water Sector** Dr Steve Lambert	TSB
9.15 a.m.	**Supply Chain needs for Technology Demonstration** George Ponton	Scottish Water
9.30 a.m.	**Technology Innovation Centre Glasgow – Showcases for Technology Innovation?** Prof Jim McDonald	Strathclyde University
9.45 a.m.	**Questions & Open Discussion SESSION 1**	All Participants
10.00 a.m.	**Morning Tea**	
10.15 a.m.	**Discussion Group 1: Technology Demonstration Site Features** • Who will be demonstration site users (e.g. SMEs, Water Industry, Academics, International Private Sector, etc)? • What services should such a demonstration facility provide? • Where should such a facility be located / should there be one or several? • Who should fund the facility (which aspects should be user pays?) • How can Technology Demonstration	*Detailed feedback from the discussions will be collected for analysis & later communication*
	SESSION 2: ADVANCED WATER TREATMENT & WATER SECURITY/SUSTAINABILITY	
11.45 a.m.	**Water Research & Innovation Partnership** Daniel Osborne	NERC
12.00 p.m.	**Water Infrastructure: Economic Opportunities for Water Innovation** Prof Gordon Hughes	WIC
12.15 p.m.	**Questions & Open Discussion SESSION 2**	All Participants
12.30 p.m.	**LUNCH – The Magnet Café**	
1.15 p.m.	**Discussion Group 2: Advanced Water Treatment & Water Security/Sustainability** • What is the role of advanced water treatment in water security/sustainability in the UK? • What is the role of advanced water treatment in water security/sustainability internationally? • How does water quality affect water security/sustainability? • What are advanced water treatment technologies required to address water security?	*Detailed feedback from the discussions will be collected for analysis & later communication*
	SESSION 3: WATER INNOVATION & GLOBAL MARKET OPPORTUNITIES	

2.45 p.m.	**White Paper on Water Innovation: Overview & Policy Implications** Konrad Bishop	DEFRA
3.00 p.m.	**International Development Opportunities for Water Innovation** Charlie McLaren	UK CDS
3.15 p.m.	**Questions & Open Discussion SESSION 3**	All Participants
3.30 p.m.	**Afternoon Tea**	
3.45 p.m.	**Discussion Group 3: Water Innovation & Global Market Opportunities** • Which global markets will stimulate UK Advanced Water Treatment Technology Innovation? • What will the mechanisms of stimulation be? • What support structures are in place to facilitate global market competition for the UK supply chain? • What additional support is required for a competitive advantage of UK competitors?	*Detailed feedback from the discussions will be collected for analysis & later communication*
5.15	**DISCUSSION: Where to from here: An Action Plan for Water Innovation**	All
5.45 latest	**CLOSE**	

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Workshop Sponsors

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Workshop Report

The Report of the 1st workshop in the Series held on 30 June 2011 is published on the Edinburgh Research Archive: http://www.era.lib.ed.ac.uk/handle/1842/5012

Registration

Please register with contact details & affiliation by 30 Nov 2011 notifying dietary requirements and requesting parking permits for King's Buildings

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Places are limited and your participation at this free event is incurring costs – please do give 48 hours notice out of courtesy should you need to cancellation your attendance.

UK Innovation Potential in Advanced Water Treatment:
Future Directions & Strategy

2nd Participatory Workshop Program – Tuesday 6th December, 2011

James Clerk Maxwell Building (JCMB), Teaching Studio 3217
King's Buildings, Edinburgh University.

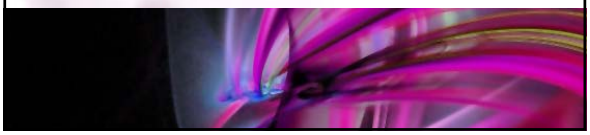
Organising Committee:
Diane Duncan, Highlands & Islands Enterprise
Gordon Hughes, University of Edinburgh
Konrad Bishop, Defra
Matthew Bower, Drinking Water Quality Regulator Scotland
George Ponton, Scottish Water
Andrea Schäfer, University of Edinburgh
Hans Jensen, UKWIR
Ian Bernard, British Water
Kerry Thomas, Environmental KTN

Group	Attendance Y/N	Registered Participant	Affiliation
Group 1	**Y**	**Diane Duncan (Chair)**	Highland & Islands Enterprise
	Y	Neil McLean	CIWEM & IRRI
	Y	Douglas Johns	Scottish Water
	Y	Nick Lyth	IRRI
	Y	Peter Brown	Scottish Water
	N	Nigel Goddard	University of Edinburgh
	Y	Luiza Cintra Campos	University College London
Group 2	**Y**	**Gordon Hughes (Co-Chair)**	University of Edinburgh
	Y	**Andrea Schäfer(Co-Chair)**	University of Edinburgh
	Y	Jim McDonald	University of Strathclyde
	N	Daniel Osborne	NERC
	Y	John Morgan	Barr & Wray Ltd
	Y	Claire Gowdy	Northumbrian Water
	Y	Ian Walker	WRc plc
	Y	Marc Stutter	James Hutton Institute Aberdeen
	Y	**Bill Sloan (Co-Chair)**	University of Glasgow
Group 3	**Y**	**Konrad Bishop (Chair)**	DEFRA
	Y	James Keating	Amec Earth & Environment
	Y	Peter Murphy	Barr & Wray Ltd
	Y	Stewart Sutherland	Scottish Water
	N	Vincent Senez	ISEN, Lille
	Y	Robert Kalin	University of Strathclyde
	Y	Kate Heal	University of Edinburgh
Group 4	**Y**	**Matthew Bower (Chair)**	**DWQRS**
	Y	Marie Hart	United Utilities plc
	Y	Howard Dryden	Dryden Aqua Ltd
	N	Devin Sapsford	Cardiff University
	Y	Kostas Minas	Robert Gordon University
	Y	Peter Cormack	University of Strathclyde
	Y	Payam Malek	University of Edinburgh
Group 5	**Y**	**George Ponton (Chair)**	Scottish Water
	Y	Charlie McLaren	UKCDS
	Y	Nicholas Thomson	CIWEM Water Panel
	Y	Tom Johnston	Microsphere Technology Ltd
	Y	Jennifer Geroni	Cardiff University
	Y	Humphrey Yiu	Heriot Watt University
	Y	Thanh Hieu Ngo	University of Edinburgh
	Y	Bryce Richards	Heriot-Watt University
Group 6	**Y**	**Steve Lambert**	Lead Strategy Board
	Y	Ian Hotson	United Utilities plc
	Y	Spela Ivekovic	University of Strathclyde
	Y	Helen Bridle	University of Edinburgh
	Y	Philip Graves	University of Strathclyde
	Y	Vanessa Kind	SEPA
	Y	Moira Boyd	ERI
	N	Yoni Dolgin	UK Israel Hub

Technology Strategy Board
Driving Innovation

TSB Funding Strategies for Innovation
Water

Dr Steven Lambert
Lead Specialist in Water



Technology Strategy Board
Driving Innovation

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Driving Innovation

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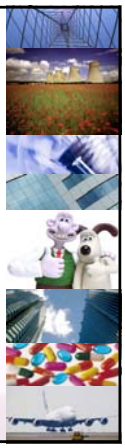

Technology Strategy Board
Driving Innovation

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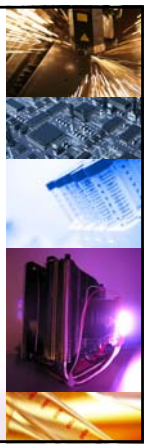

Technology Strategy Board
Driving Innovation

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Driving Innovation

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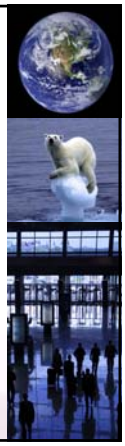

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Technology Strategy Board
Driving Innovation

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Driving Innovation

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Driving Innovation

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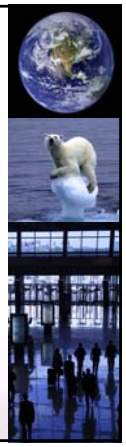

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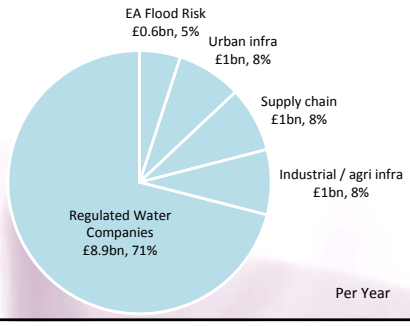
Technology Strategy Board
Driving Innovation

Estimated size of UK water market



Per Year

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Technology Strategy Board
Driving Innovation

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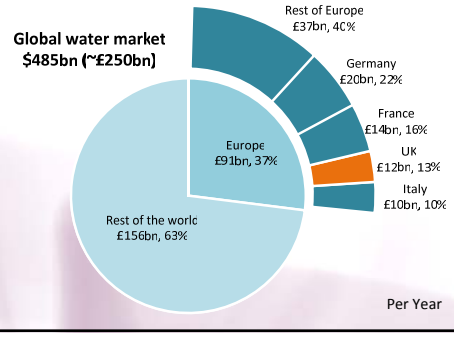

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12

Technology Strategy Board
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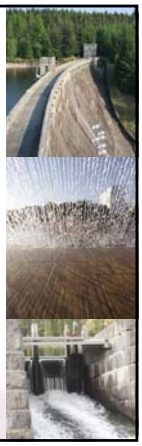

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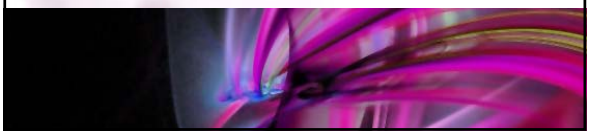

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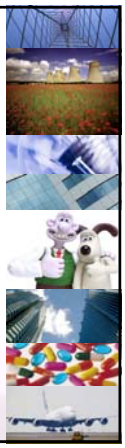

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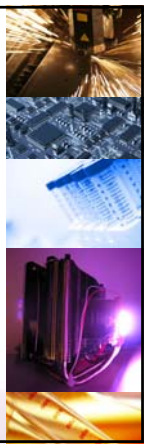

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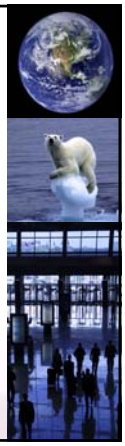

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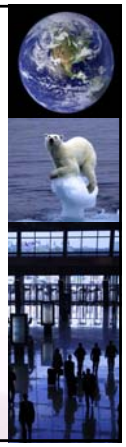

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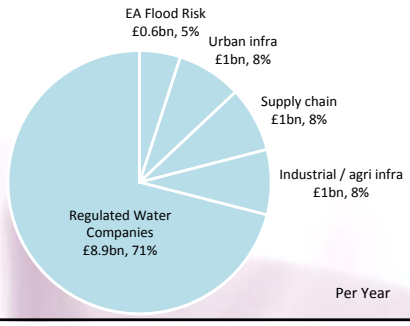

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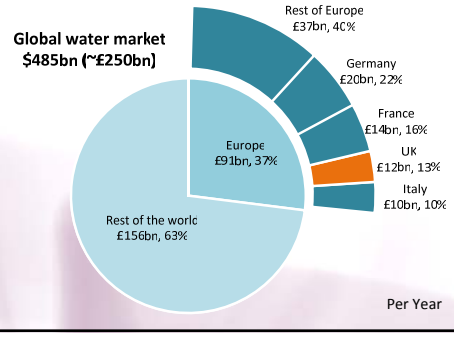

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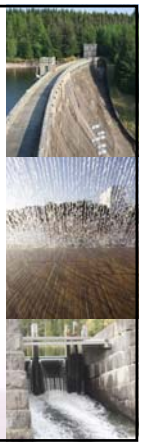

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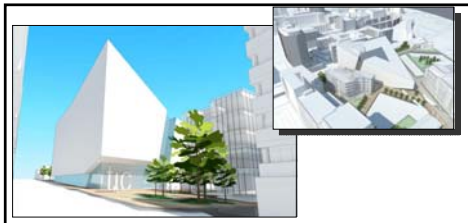
Technology and Innovation Centre @ Strathclyde:

Experience of Strategic Academic/Industry Partnerships

Professor Jim McDonald
Principal, University of Strathclyde
Edinburgh, 6th Dec, 2011



The Technology and Innovation Centre

December 2011

Industry Partnership core to mission….

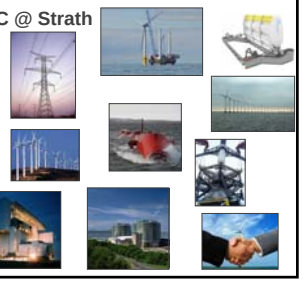
- Scottish Power Advanced Research Centre
- Scottish & Southern Energy Research Centre
- Royal Academy of Engineering Chair
- British Energy Advanced Diagnostics Centre
- Raytheon Research Partnership
- Rolls-Royce University Technology Centre
- NGC Research Framework Relationship
- GSE Real Time Simulation Centre
- The Advanced Forming Research Centre
- Weir Chair
- Weir University – professional development
- BRE Trust Centre for Energy Utilisation
- ……

The Scale and Ambition of TIC @ Strathclyde

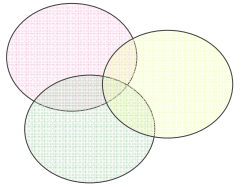
Strategic Marker:

- Research & KE "hub"
- Focussed on Industry collaboration
- *"Experiential"* Statement
- International impact
- **£100m** infrastructure investment
- **£150m** Research programme (5yrs)
- **1,000+** Research & KE staff

The Scale and Ambition of TIC @ Strath



New Innovation – "Funding Partnership & Collaboration"



'Triple Helix' Approach leads to mutual value

Technology development and readiness

TRL 1 – 3	TRL 4 – 6	TRL 7 – 9
Fundamental Technology Research	Technology Development, Demonstration & Prototyping	Technology Deployment

Industry investment, collaboration and technology acceleration

• University collaborative projects • Research Council & EU funded projects • Eng-D/PhD Centres	• Industry collaborative research programmes • TSB funded programmes • Contracted research	• Knowledge Transfer projects • Contracted development projects • Consultancy & CPD project

Focus on TRL 3 – 6 but ensuring strong fundamental research underpinning and clear mechanisms to support research exploitation.

Where have we come from?:
The Advanced Forming Research Centre (AFRC)

AFRC (£26m)
- **£15m CAPEX**
- **£5m Industry Core Income**
- **£8.5m EPSRC**
- **TIC-HVM component**

Where have we come from?
The Power Network Demonstration Centre (PNDC):

PNDC (£15m)
- **£9m CAPEX**
- **£1.5m Industry Core Income**
- **£4.5m EPSRC/OFGEM**

CMAC: meeting industry challenges through collaboration
Continuous Manufacturing and Crystallisation consortium

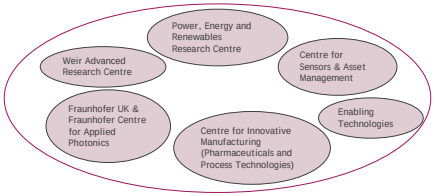
- **CMAC (£10m)**
  - **£6.5m EPSRC**
  - **£0.5m CAPEX**
  - **£2.5m Industry**
  - **AFRC-like model**

The Scale and Ambition of TIC

Power and Energy research consortium Theme

Industry investment over next 5 years:
- **£10m** core programme commitment from Tier 1 partners
- Further **£10m** in progress within next 6 - 9 months
- **£60m - £70m** Collaborative programme within 5 years

Technology and Innovation Centre



What is the HVM Technology & Innovation Centre ?

Business-focused centre that makes world-leading technical capability available to businesses to solve their manufacturing challenges

The HVM TIC Provides:

- Access to world-leading manufacturing technology & expertise
- Capability to undertake collaborative R&D projects
- Capability to undertake contract research
- Access to the knowledge base for world-class science
- A professional delivery ethos with a strong business focus
- A critical mass of activity
- Skills development at all levels

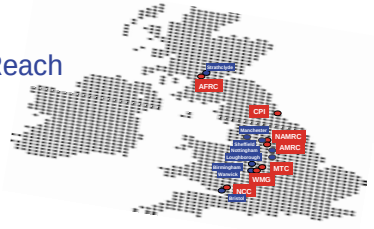
High Value Manufacturing TSB - Technology & Innovation Centre

HVM TIC is a consortium of 7 world leading research centres with £350M public & private investment and working with over 160 Industrial partners. It will receive grant funding of around £25M pa, securing sustainable leading edge technology

HVM TIC Consortium Reach

Research Centre

University Partner



Offshore Renewable Energy TIC

Ocean Energy Innovation Stakeholder Session – 24th November 2011

Offshore renewable energy represents a significant opportunity for the UK

Unrivalled offshore renewable resources
50% of Europe's wind energy resource
35% of Europe's wave resource
50% of Europe's tidal resource

If exploited, these resources can have a significant impact on the UK economy
•For example, 78GW deployed by 2050 would:
- Provide £28bn revenues and employ 70,000 people

The TIC will be focused on overcoming those challenges and achieving tangible outcomes

It will be industry-led and focused on the following outcomes:
•Accelerate cost reduction
•Create jobs in the offshore renewable industry
•Coordinated use of UK R&D test and demonstration assets
•Leverage significant public (particularly EU) and private sector investment
•Provide the preferred entry point for offshore renewable innovators
•Reinforce the UK's position as a global leader in offshore renewable energy

Strategy and programme design

The Carbon Trust is a leading authority on offshore renewables technology innovation. It brings deep understanding of the offshore wind and wave and tidal industries, and knowledge of the key actors and capabilities in the sector.

Research programme expertise and the capability landscape

Narec specialises in accelerating the development and deployment of offshore renewable energy technologies. Built at a cost of over £150m, its world-leading facilities represent the largest and most comprehensive onshore concentration of offshore renewable energy research, testing, development and demonstration assets.

Ocean Energy Innovation

Industry engagement and UK wide academic capability networks

Ocean Energy Innovation brings together partners with experience of a substantial range of innovative and successful industry networks and mechanisms originally developed to stimulate growth in the ORE sector. Plug and play UK academic networks.

General Conclusions:

- **There are significant opportunities to engage with strategic, national and international Research and Knowledge Exchange programmes**
- **The Scottish Higher Education sector has enormous value vested in the Research Pooling Frameworks – as well as in core teams**
- **An important aspect of large scale (arguably any scale) academic-industry partnerships is the clear definition of requirement – a demand statement**
- **In the Water Innovation theme, there may be value to be had by eliciting a clear industry and public sector technology and policy demand statement and map to current academic capabilities - individual groups & institutions as well as pooling entities**
- **Prospective funding sources and national/international programmes can then be identified**

Water Research and Innovation Partnership - Framework for 2030

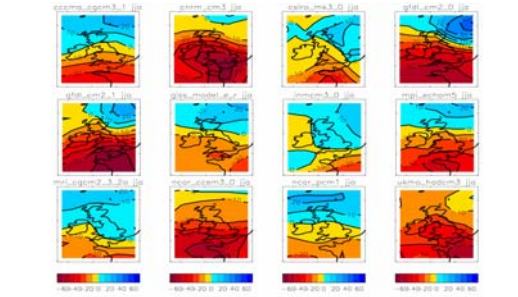
Dan Osborn
RCUK and NERC lead for LWEC

Ecosystem services from Water

Current, Existing and Upcoming Challenges

- All households, businesses and organisations
- Global market £500bn
- Abstraction exceeding sustainable thresholds
- 100s millions with limited access to water and sanitation
- **Uncertainty on future rainfall patterns**
- **Vulnerability of infrastructure and businesses**

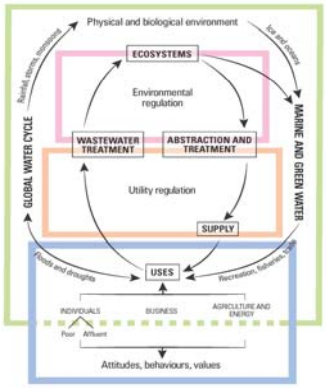
Uncertainty in UK summer rainfall



Change in summer precipitation (%), 2080-99 relative to 1980-99, SRES A2, AR4 models

Source: James Murphy, Hadley Centre

Water System



Vision

By 2030 the UK will be a key contributor in providing integrated solutions in water security and sustainability such that individuals, communities and businesses benefit from productive, equitable water systems and ecosystem services.

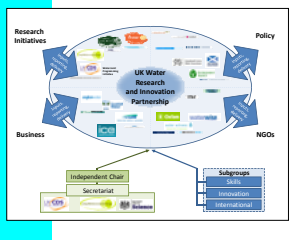
In consequence, health improves, communities develop, the green economy grows and the environment is protected and enhanced.

High level goals

- *Responsibility for water*
- *Access to water and sanitation*
- *Securing supply under environmental change and population growth*
- *Resource efficiency in the human water cycle*
- *Extreme and high impact events*
- *Developing ecosystem services*

Delivering: First steps

- Aims of the UKWRIP
- Convening stakeholders
- Strategic Overview
- Enhanced partnering
- Evidence base not decisions
- Developing integrated solutions
- Develop Framework



Skills

- Needs clear definition and case studies (e.g. through Blue Green dream)
- Must build and secure the skills base

Innovation

- Increase visibility
- KE actions (Water Security Programme)
- Wide view (not just for concrete)
- Split into embedding existing and new technology

International Development

- International development sub-group to join-up and add value to existing initiatives.
- Proposed initial 3 pillar high-level focus:

International Development Sub-Group		
Pillar 1 **Water Footprinting Methodologies**	Pillar 2 **Post-MDG Water Security Targets**	Pillar 3 **Innovation for international Water Security**

Extant views on research and innovation

- Rachwal
  - Rights
  - Values
  - Infrastructure
  - Integrated management
  - Natural Hazards
- UK NEA
  - Natural capital
  - Ecosystem trends and services
  - Local solutions

Integrated solutions

- Safe, secure, and sustainable
- Resilient
- Local
- Resources first
- Technology
- Social and economic circumstances
- Grow green economy

Water Partnership watchwords?

- **Research**
  - Dialogues to co-design, co-produce and co-deliver
- **Innovation**
  - Dialogues between policy, business and research, third sector
- **Communication**
- **Engagement**

Moving on from 1st level log frame

On paper

- Priorities
- Outcomes
- Existing activities
- Might deliver outcomes?
- Contributors

In practice

- Secretariat helps convene "variable geometries" of partners
- Check of existing knowledge, approaches, technologies
- New activity planned and done

Next steps

Help with

- international water stewardship
- UK water security
- engaging groups as diverse as consumers and researchers
- provide opportunities for integrating existing and new initiatives

International

-- Visibility and connectivity of international development water networks.
-- Belmont Forum (freshwater and coasts)
-- Exchange hydrological data
-- EU JPI

UK

- Defra evidence needs on water abstraction
- Models to predict future changes in water availability in the UK under a range of climate and land use scenarios
- Water use in business and the home
- UK NEA

Talk on: Economic Opportunities for Water Innovation

Gordon Hughes, Water Industry Commission & Edinburgh University

University of Edinburgh, 6th December 2011

1. Perspective – regulation & investment in developing countries
2. Consequences of long asset lives for water infrastructure
   (a) Conservative view of core infrastructure
   (b) Process innovation & operating efficiency for existing infrastructure
3. Who bears the risk?
   (a) Consumers or suppliers?
   (b) How do regulators and investors deal with this?
4. What is economic?
   (a) Failure to price water resources properly
   (b) Regulatory biases toward capital-intensive solutions
5. Water as a service business
   (a) Parallel with energy efficiency
   (b) Innovation bundled with provision of O&M services – suppliers as service providers rather than equipment manufacturers
   (c) Opportunities in non-residential supplies & treatment
   (d) Small and low income communities – reliability & maintenance are the primary issues – output-based aid projects

Water Innovation: Drivers and Opportunities

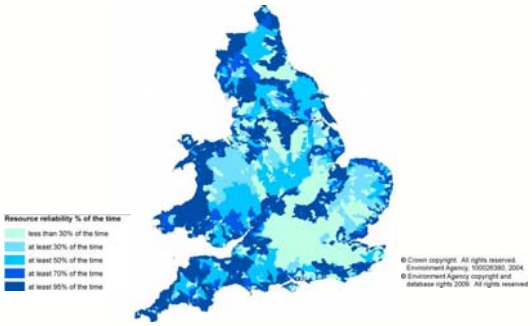
Konrad Bishop

Head, Water and Floods Evidence Team

Valuing water

- Need to value what we now take for granted.
- Pressures on water resources will only increase.

Current pressures

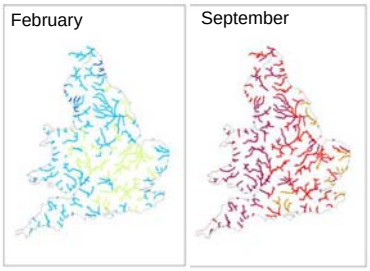


Drought

- Well recognised that water resources in parts of East and South East England are under pressure.
- But drought can occur across the country – as seen in the North West last year.
- And in the future....

Future pressures

Changes in river flow in 2050s

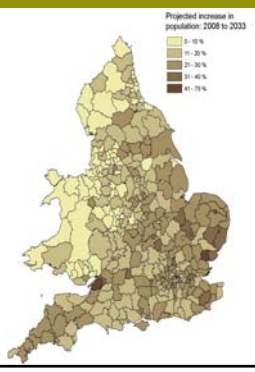


Maps based on UKCIP02

- 15% decrease in river flows overall
- 50-80% decrease in some rivers

Population

- Projected increase in population 2008 - 2033



Securing sustainable water supplies

- Need to address short term challenges around unsustainable abstraction, as well as developing a longer term vision for a system that is resilient to future pressures, and supports a strong and sustainable green economy.
- Key issues will include:
  - Reform of the current abstraction regime
  - Market mechanisms to incentivise companies to think differently about meeting future resource requirements (e.g. abstraction licence trading, bulk supplies, interconnections)
  - Ensuring system incentivises demand management as well as new infrastructure build
- Against the background of drought.....increasing focus on resilience.

Global issue – water footprinting

- 62% of UK's total water footprint is from products we import overseas (WWF, 2008)
- Given increasing demands and scarcity of water – it's important for business to understand and manage risks to water down product supply chains
- A range of "water footprinting" or stewardship tools and methods are currently in development
- Defra has commissioned research to evaluate the tools available – and provide guidance to business on how to measure, manage and reduce their water impacts

Water Quality

- Water quality demonstrates how well we look after our environment.
- Surface water quality has improved significantly in recent years
- Biggest challenge is diffuse pollution from a range of sources, particularly agriculture
- Catchment sensitive farming, agri-environment schemes and the Campaign for the Farmed Environment - partnerships for actively helping reduce the impact of farming on water environment
- We will tackle urban diffuse sources of pollution including existing and future misconnections

Affordability

- Average water and sewerage bill across England and Wales is £356
- 23% of households spend more than 3% of their disposable income on water, and 11% spend more than 5% - 2.5million households.
- Factors affecting affordability include income, size of bills and means of charging.
- Budget 2011 ministers committed to using public expenditure to support households facing water affordability pressures and households in areas with particularly high charges.
- Affordability is a key theme of the Water White Paper and will include a package of measures.
- Consulting on guidance on company social tariffs – will allow companies to create their own social tariffs with the support of their customers

Opportunities

Innovation

- Little innovation in the water industry over last few years.
- Why is this? Lack of incentive, procurement arrangements, promotion on international scene, cultural mindset?
- Innovation: New product, technology, service, tariff design, financial resources.
- Stakeholders need to work better together to improve innovative capacity in the UK water sector.

Innovation

- Innovation will have an important role to play in achieving a sustainable and secure water resource for the future.
- Many opportunities- domestic, global, water sector and supply chain
- High/low technology
- Different ways to change behaviour

Innovation- Government

- Government removing barriers
- Joining up messages- Innovation Leadership Group
- TSB
- UKWRIF

Innovation- EU

- European Innovation Partnership for Water Efficiency 2013 - stakeholder consultations

Innovation: Water White Paper

Water White Paper will recognise long term challenges:

- securing sustainable water supplies for the future;
- increasing choice and competitive opportunities, **driving innovation**, improving customer service and value;
- maximising the contribution of water to economic growth;
- creating a modern regulatory system that protects customers and minimises regulatory burdens;
- ensuing fair and affordable water charges by setting out the Government's response to the recent affordability consultation;
- ensuring an effective approach to wastewater management that contributes to improved water quality and reduced flood risk; and
- incentivising water conservation through changing attitudes and behaviours.

Thank You

International Development Opportunities for Water Innovation

Charlie McLaren

06/12/2011

Introduction to UKCDS

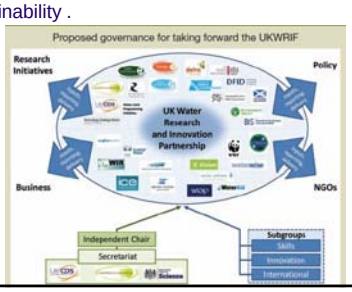
- Aim: To maximise the impact of UK scientific endeavour on international development through facilitating joined-up, collaborative research.
- UKCDS Members:

What's the Added Value?

- Provide oversight of multiple research agendas to help minimise duplication.
- Identification and communication of collaborative opportunities.
- Drawing on the existing landscape to realise greater impact from investments.
- Facilitate dialogue at multiple levels of our membership.

UK Water Research and Innovation Framework (UKWRIF)

- Vision: By 2030 the UK will be a key contributor in providing integrated solutions in water security and sustainability .



UKWRIF approach to innovation

- Innovation to be focused on in the broadest sense:
  - Technological
  - Partnership / Collaboration
  - Research Profile
  - Approach

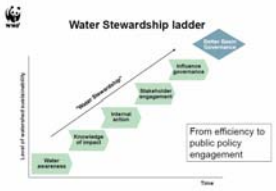
Case study: M-Water (technological innovation)

- Combines smart metering and mobile banking technology.
- Helps users save and pay for reliable maintenance, spreading risk across rather than within communities.
- Provides open-access data systems, accountability and transparency in planning and investment in handpumps.
- Attracting private sector engagement.

Source: Rob Hope – Oxford Water Futures Programme - Waterpoint Data Transmitter

Case study: WWF-SAB Miller-GTZ Water Futures Partnership (innovation through partnership)

- Facilitating action through sharing risk through corporate practice and public policy.
- Partnership aims to facilitate local action, prove business case for private sector engagement, and promote sustainable management of water resources and sharing lessons learnt.
- Water footprinting used to communicate risk.
- Also see: Alliance for Water Stewardship – international water standard.



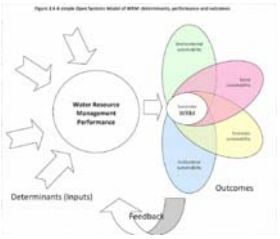
Source: Dave Tickner, UEA Water Security Short Course 2011

Case study: Netherlands Water Partnership (innovative marketing)

- NWP spent early years developing the network.
- From 2005 NWP entered a second phase:
  - Moved from network to influence policy
  - Supported Ministry of Economic Affairs
  - Focus on development of sector and export
- Supports Dutch international profile in water research and innovation.
- Similar methodology by NERC WS KE Programme, BWP, TSB, Science and Innovation Network, etc.

Case Study: Water Witness principles for Sustainable WRM (Innovative approach)

- Recommendations for a post-IWRM approach:
  - Social accountability, incentives, motivation and oversight.
  - Regulatory personality and catchment consciousness.
- Reaction limitations of the IWRM blueprint, which promotes:
  - Context specific unrealistic assumptions (data, capacity).
  - Expert bias
  - A lack of autonomy and sense of competence.



Source: Nick Hepworth, UEA Water Security Short Course, 2011

UKWRIF International Development sub-group

- Focal point for research communication, discourse and lessons learnt.
- Draw on existing landscape to provide network for collaboration, as well as identifying possible gaps.
- Forum to discuss and prioritise demand-led multidisciplinary, multi-sectoral water research and innovation.
- Minimise barriers between research providers, funders and users, and in turn provide a more collective and joined-up agenda.

Thank you

UK Innovation Potential in Advanced Water Treatment: Future Directions & Strategy
Working Group Answers

Questions Set 1: Technology Demonstration Site Features

1: Who will be demonstration site users (e.g. SMEs, Water Industry, Academics, International Private Sector, etc)?

Group 1:

- The "Water Industry"
- Regulators
- The supply chain (manufacturers)
- Government policy makers and advisers

Group 2:

- SMEs, Academics and International Suppliers

Group 3:

- All of the above
- Regulators - WIC, OFWAT, SEPA, DWQR, DWI, EA
- NGOs
- DFID
- Policymakers

Group 4:

Barriers may be;
- different regulatory approaches
- procurement / cultural desire to have common technologies / economies of scale

- Needs to be used internationally (not just Uk industry)
- Benefits in involving operational staff

Group 5:

- Water Industry (utilities and supply chain)
- Consultancy Sector, MWH, Halcrow, etc.
- New technology companies, SMEs, spin out companies
- universities
- multinational water research bodies
- instrumentation and control

Group 6:

- Innovation undertaken by academics, UKWIR rather than supply chain – need open competition to engage with SMEs
- Water Co's (research organisations / universities) to pilot trial / prove technologies
- SME's to develop and prove new products / technologies
- Public bodies / regulators (eg SEPA, DWQR, Reg 31) for approvals / accreditation / industry guidance
- Conduit for other research organisations / major water users / companies inc from abroad hoping to prove their ideas / technologies
- Retail chain / private investors

2: What services should such a demonstration facility provide?

Group 1:

- Versatile site to mimic "real" situations; supply, discharge, re-cycling and rainfall runoff/infiltration
- Provide cost information
- Maintenance and operational support
- Data capture and analysis
- Independent and confidential consultancy support and reporting
- Support for financial modelling and business development
- Management strategies – ID non-technology/process solutions

Group 2:

- Analytic facilities and laboratory infrastructure
- Access to different types of water
- Qualified staff. Plug-and-go access
- Suite of standard protocols. Independent validation and reporting of tests
- Knowledge exchange mechanisms e.g. networking etc.

Group 3:

- Energy/Economics optimisation
- Existing treatment process optimisation
- High Science Low Technology e.g. for developing countries
- Investigating fundamentals

Group 4:

- Need to consider analytical capabilities, esp low stability determinands
- Needs to be highly flexible if to be successful on an international basis – eg. Power supplies / control systems
- R&D / centre of excellence – establish predict charateristics
- Need centralised centre with credibility
- Get 90% of proof of principle / operation prior to full scale trial within market
- linkage to DWI approvals process?
- need for standard protocol for testing to ensure consistency and fairness but needs to be flexible to accommodate user needs and innovation
- ensure understanding of science behind the technology (careful use of IP etc)

Group 5:

- credible and recognised results – multi-stakeholder buy-in (regulators and industry)
- identify the innovation priorities, horizon scanning, future challenges
- test under variety of conditions
- match making service – end users and technologists
- mixture of lab to small scale pilot units leading to full on site trials
- showcase of new technologies, validation of pilot scale
- access to future investment funding, collaboration
- PR , knowledge exchange – raise the public perception of value of service – promote investment potential
- sustainability of solutions (carbon impact, life cycle costs)
- op & maintenance of solutions
- IP / Patenting advisory
- tax credit / allowances advice
- knowledge hub / industry front door / academia front door
- mentoring on pitfalls of productisation / commercialisation of research outputs

Group 6:

- Knowledge exchange / transfer / networking (oil & gas, universities) – hub for innovation
- Testing facilities - pilot for demonstration / technology proving (blue sky remain in universities eg Strathclyde; deployment on-site)
- Testing for accreditation (eg domestic products)
- Laboratory / analytical (development) services

3: Where should such a facility be located / should there be one or several?

Group 1:

- A main central facility supported by several mobile facilities
- Easily accessible road; air (for international); centre of population (Warwick/Sheffield)

Group 2:

- Targeted at technology stages 3-6
- Discussion about whether test site should be in a fixed location or should be a number of identified sites where equipment is deployed.
- Pros of fixed site: High degree of control. Ability to have trained staff. Services—electricity, lab services and analytical services. Disposal. Some such sites already exists e.g. Cranfield, WRc.
- Cons of fixed site: Transport of water. Non representative nature of the water. Expensive –permanent staff. Cost of site.
- Pros of distributed sites: Access to representative sources. Economise (perhaps) by piggy backing on existing infrastructure.
- Cons of distributed sites: Health and safety for getting onto live sites. Initial set up costs. Limited space? Subject to the whims of the host organisation. Duplication of laboratory facilities.

Group 3:

- One central UK facilitator e.g. UK WIR
- Then regional centres e.g. Cardiff, Cranfield, Imperial,
- Mobile Units

Group 4:

- May need regional centres to reflect different raw water qualities Or 1 main site + satellites
- Good transport links,
- Thriving academic / SME community
- scope for plentiful multiple raw water types
- buy in from regional development agency etc.
- linkage to other industrial sectors e.g. fish farming, effluent treatment

Group 5:

- depends on demand
- regional focus – north south split based on specific issues / expertise base
- potential for satellite sites – rural / urban split
- important point is that not all water companies face the same issues.

Group 6:

- Need Centre of gravity / focus – makes more sense to have a single location
- Satellites for demonstration / resources (e.g. specialist expertise, water types, politics)

4: Who should fund the facility (which aspects should be user pays?)

Group 1:

- UK and European Government
- Research councils
- Private sector
- User pays depends on the application and end benefits; independent manufacturer, water company, etc?

Group 2:

- Government (e.g. Technology Strategy Board) and Utilities to set it up.
- SMEs, Academics and End Users to rent time and provide consumables.

Group 3:

- Water Companies
- Big Users
- EU, UK Government

Group 4:

- varying views – Govt, Consortium of Water cos.,
- potential suppliers of technology could pay to showcase technology
- need for funding of basic infrastructure

Group 5:

- water companies (via customer charges), government
- government underwriting of risk
- enterprise community
- recycling of profit from new technologies
- technology companies – pay per play
- EU funding – Framework programmes
- large multinational suppliers (e.g. GE, Veolia)

Group 6:

- Ultimately consumer (through bills) / public (Gov't or RC grants) pays
- Beneficiaries (Water Co & SME) for specific use / subscription / fees
- Facility part centrally funded / part fee funded

5: How can Technology Demonstration facilitate innovation?

Group 1:

- Knowledge exchange
- Proof of concept
- Financial feasibility
- Technical expertise and creativity for new ideas – "Hot House"
- Efficiency optimisation
- Partnership creation – leading to …
- Early stage business planning
- Develop potential in other sectors;

Group 2:

- Technology Demonstration will facilitate the delivery of innovation. If the site was ambitious enough to second SME staff and academics to work together on site it has the potential to deliver innovation.

Group 3:

- Act as a focus for networking and communication
- Bridge the gap between research and implementation
- Discussions between water companies on best practice
- Encourage multi disciplinary interaction

Group 4:

- no response -

Group 5:

- articulate the clear need for innovation – what is the outcome desired?
- accelerate validation and adoption
- existence of demonstration centre gives clear route from bench to production
- peer review and collaboration, networking (shared experience)
- easier to publicise results
- speed up regulatory approval (e.g. DWi and EA) understanding regulatory approval requirements
- attracting investor community
- knowledge exchange
- match making / partnership formation

Group 6:

- Knowledge exchange for technology development, what water co's (or anyone else) want / need, brain-storming & ideas development
- Speeding up technology development; route to market
- Introduction of new thinking / ways of doing what we do

Questions Set 2: Advanced Water Treatment & Water Security/Sustainability

6: What is the role of advanced water treatment in water security/sustainability in the UK?

Group 1:

- Providing increased certainty of quality and quantity
- Ensure energy efficient/sustainable processes
- Ensure efficient water use
- Asset management through advanced monitoring

Group 2:

- not a lot as water security not an issue;
- allows to use resources too expensive to treat
- desalination vs recycling on Thames?
- advanced treatment instead of more reservoirs/over-obstructed groundwater
- security: quality issue that existing treatment cannot deal with (eg methaldehyde not adsorbed by carbon or broken down by ozone: needing to import water): tackle quality of source first (new methaldehyde that is treatable)
- water fit for purpose – network contraints/double amounts of pipes, retrofitting, urine separating toilets, cross-connections, energy efficiency?
- do we need high quality water to everyone for everything? Provision of low quality water and delivery of high quality – change in what public water supply does.

Group 3:

- Removal of colour, turbidity manganese, iron
- Treating saline water
- Serving isolated communities
- Allows planning of raw water resources

Group 4:

- Improve efficiency of processes to reduce waste streams
- Innovative approaches to managing changing raw water quality
- Water safety plan approach – treat problem at source
- smaller footprint (physical and carbon)
- scope to reduce manual intervention
- predictive logic to anticipate and respond to situations (better use of data) – mitigate problems
- water reuse – break down perception issues via education etc
- challenge public perceptions to water usage (value of water)
- Joined up thinking – strategic view of solutions (e.g. Lead and P dosing / removal)

Group 5:

- utilisation of sources not currently available for potable / non potable e.g. mine waters
- reuse of waste streams in industrial processes to maximise resource efficiency
- provision of decentralised sustainable supplies / suds / waste treatment
- treatment of grey water / rainwater as sources of supply
- resource recovery or value recovery from waste streams e.g. coagulant recovery
- pesticide / micro pollutant removal / remediation

Group 6:

- Methods to add value to existing systems
- Use of grey water to industry (for cooling…)
- Reducing waste
- New pump technoloogy
- Turbines and hydrosystems
- Links to wind turbines but problems of them on catchment
- Synergies with other industries

7: What is the role of advanced water treatment in water security/sustainability internationally?

Group 1:

- Ensure robust and appropriate and cost effective solutions
- Economic development, both within UK and outwith

Group 2:

- what can we learn from mobile phones? Indian firms did it very differently and made it work for rural areas
- all move to cities to simplify water provision?

- it is not one size fits all, different things in different places
- fit for purpose, not to treat better than necessary, NGO issue of 'best practise' – solutions need to be most effective for a given problem
- developing distant service – contract to maintain
- small communities/save on connection fees

Group 3:

- In water scarce countries, its more important to use technologies such as desalination
- Reduce water conflicts
- Promote development

Group 4:

- Many issues the same
- innovative chemistry based on readily available materials
- simplify for developing countries (low maint. / provide training)
- use local materials
- Use blue sky thinking as well as traditional approaches

Group 5:

- provision of drinking water supplies in developing countries
- reduce risk of conflict from water availability
- alleviating water stress through sustainable desalination
- Groundwater recharge or treatment of contaminated / sub-standard groundwater
- brackish water treatment
- environmental remediation

Group 6:

- More water stressed areas greater driver for less leakage…
- Export opportunities and growth of UK market
- Reducing chemical use and cost
- Appropriate technologies and local materials
- Learning from abroad – recycling, rainwater harvesting…
- Learning from other sectors
- Incremental change, doesn't have to be major step change

8: How does water quality affect water security/sustainability?

Group 1:

- Influences the ability to use as a supply
- As source quality reduces sustainability reduces and cost increases
- Depends on the level of use of the water; drinking, washing hand, flushing toilets
- Consumer confidence
- Economic development - tourism

Group 2:

- general purpose needs where there is significant markets around the world but not necessarily in one country; possibly driven by industrial processes
- History of water vs quality of water: direct water reuse;
- standards according to what we can measure rather than health impact
- no choice in water – cannot opt out, but one can opt out of food consumption
- aesthetic: do we really need to remove all colour: not just about health but about a variety of reactions to water
- can we get massive reductions in consumption in developed countries? Separating uses, ..?

Group 3:

- Improved final water quality standards reduces security
- Poor raw water quality can affect treatment process and reduce security

Group 4:

- Higher quality requirements often mean lower sustainability
- catchment management requirements a consideration
- Increase sludge disposal issue
- Treatment changing raw water quality (eg desalination)
- Re-consider WQ standards – are they necessary / health based (e.g 0.1ug/l pesticide standard

Group 5:

- better environmental quality reduces energy consumption through treatment

- quality improvements linked to other inequities in developing countries
- better quality water impacts on ecosystems
- linkage to economic development and public health improvements

Group 6:

- Deterioration in raw water quality – source abandonment, more advanced treatment needed
- Climate change influence on catchment areas (e.g. peat bogs drying up and aged water draining out)
- Influence on sustainability as new treatments (e.g. membranes) more energy intensive
- Analytical methods improving – can't monitor for everything – leads to more intensive treatment

9: What advanced water treatment technologies are required to address water security?

Group 1:

- Monitoring and smart technologies (quality and quantity)
- Less chemicals
- Energy efficient
- Forecasting change in use/weather/temperature/
- Remote control and automation
- Simple is advanced – less sophistication eases maintenance and cost

Group 2:

- rephrase: what are the underlying principles of future technologies?
- chemical free/low energy/high micropollutant removal processes
- do we really need chlorination? Systems without storage tanks

Group 3:

- Better management of distribution networks

Group 4:

- look at opportunities to avoid use of potable water when not necessary – low grade industrial use
- Bio -desalination (biosytems rather than membrane)
- better prediction of water demand

Group 5:

- disinfection technologies (other than chlorine)
- removal of micropollutants
- removal of inorganic contaminants from ground water
- low energy / sustainable desalination
- combining renewable technologies and existing "energy intensive" treatment / taking advantage of natural technologies e.g. visible light catalysis
- agriculture run off remediation
- treated wastewater effluent for sub surface irrigation
- nano technologies – what can they offer?

Group 6:

- Cheap!
- Point-of-use technology (but maintenance?)
- Water treated to different standards for different uses
- Sludge treatment, as a resource
- Reduced chemical (to chemical free) and energy use

10: How can we contribute to the Research and Innovation Framework?

Group 1:

- We engage!
- ID the "stars" in the necklace
- Stop working in silos
- Leadership
- ID the areas of priority and consider funding and effectiveness
- Share information/ knowledge exchange
- Provide opportunities
- Ease the ability to innovate; licence removal?
- International accreditation; environmental technology verification
- Advisory group

- Stimulate the processes by ID'ing the opportunities
- ID the source of "end-of-pipe" issues and the range of issues; phosphates in detergent and remove from source
- Raise awareness of matters of concern; e.g. PCBs in the ocean

Group 2:

- return to what we had 25 years ago, reinventing the wheel vs cycle of re-examining needs
- long term process to turn them into usefulness in water utilities, funding cycles in academic world too short
- interface between client and long term activities required to ensure pay-off comes
- are ICs a good way? Or soon to run out of steam?
- nice to have all the data of utilities but would it actually pay off? Identify particular points of stress in systems;

Group 3:

- Remove regulatory barrier to enable more R&I
- Challenging the assumption that all tap water needs to be treated to potable standard
-Encouraging water reuse/behaviour change

Group 4:

- Sharing of water company data (online instrumentation, operational etc) with suppliers / developers
- More events similar to this

Group 5:

COMMENT: Note – strong theme for coherent industry research theme around resource resilience in providing sustainable water services. Value recovery from waste streams, water reuse. Reliance on energy intensive, chemical intensive treatment – diminishing resources and fluctuating prices – break the cycle.

- articulate the need
- publicise the SME and academic capability
- future visibility and smoothing of investment plans
- communicate / engage
- patience in development process
- look to the long term
- be prepared to contemplate a different model
- influence funding for balanced view on pros and cons of innovation given – avoid scaremonger research output publicity

Group 6:

- Guidance on requirements
- KE, dialogue
- Horizon scanning – innovate for future problems
- Online calculator (like Department of Energy)
- Customer awareness
- What is the exact aim? Focus on main thing to be achieved
- Longer timescales needed
- Changes to regulations, especially the economics
- Incentives for the water companies

Questions Set 3: Water Innovation & Global Market Opportunities

11: Which global markets will stimulate UK Advanced Water Treatment Technology Innovation?

Group 1:

- Geographical areas – water stressed locations
- Voluntary sector
- Luxury end; Saudi corporations
- Small remote package plants/systems
- Consultancy
- Training

Group 2:

Q. on the basis of there being no UK market then is there overseas markets that can stimulate UK water treatment research/industry? Is that correct, that there's no UK market? Desalination potential for SE England coastal areas and Thames?? Future droughts and water shortage?

- Unregulated markets – innovation ends in profit
- Developing-world market, then learn from applications to further UK markets?
- Can we compete against other countries with strong markets in water treatment?

Group 3:

- Supply to European Countries
- In House treatment systems in India
- Sub Saharan Africa- Low Tech e.g. slow sand filters & knowledge transfer
- Academics
- Increase in overseas students in UK

Group 4:

- Industrial applications for bespoke water treatment
- Water trading – capitalise on UK's raw resource; relocate water intensive processes to UK / Scotland
- water recycling
- Advanced oxidation process , Photo catalysis
- Bio pharmaceuticals (Dundee area)
- Sludge production / biogas technologies / P recovery – see sludge as a product not a problem
- trace contaminants / food safety
- Risk management – eg security; DWSP; broad spectrum real time monitoring
- energy efficiency / carbon monitoring
- aquaculture

Group 5:

- Middle East, India, China, Brazil – developing countries
- Eastern European regeneration countries, water stressed Mediterranean countries
- water recycling, NEW water concept,
- waste water as a resource
- resource resilience

Group 6:

- Developed countries, high-value, water-stressed (e.g. Singapore, Australia)
- Developing countries – low tech local solutions
- High growth developing countries like India and China – export expertise and products (open to new technologies)
- Countries joining EU
- Middle East

12: What will the mechanisms of stimulation be?

Group 1:

- Legislation/policy
- Regulation
- Market need/demand
- Financial incentives
- Financial innovation
- Entrepreneurial responses

Group 2:

Find a good idea first:

- Development of new membrane treatment systems that are more cost-effective (less pressure, better micropollutant efficiencies etc)
- Need demonstrative ability to show technology's potential – so need technology platform in UK first.

Group 3:

- Supply & Demand balance of water and knowledge between countries
- Increasingly stringent water standards
- Expectations of better water quality
- Climate change and increased focus on carbon reductions

Group 4:

- Economic
- more collaborative working with regulators
- emerging health issues
- climate change
- Foreign ownership / commercial ventures
- Political encouragement / support

Group 5:

- Legislation, policy
- Consumer led demand, greater prosperity
- Regional political situation – where is the water?
- Industrial demand / migration

Group 6:

- Growing affluence and expectations
- Cost, timing
- Adoption of environmental and health based standards
- TSB Water Competition
- UK/government initiatives
- Partnerships and networks
- Revision of how companies are regulated, more ownership of risk

13: What support structures are in place to facilitate global market competition for the UK supply chain?

Group 1:

- The water industry
- Research councils/TSB/etc
- British Council
- UK Enterprise Network
- UK T&I
- NGOs
- Academics
- Venture Capital investor network
- EU funding programmes
- EU research platforms

Group 2:

- Limited!
- UK Dept. Trade and Investment (trade missions) - ineffective
- Practical help – getting kit through customs, approaching local agencies for demo sites
- Initiatives in development – CDS and DFID?
- Is there a UK water research centre to coordinate?
- Some facilities through research partners to show proof of concept exist – but have different business models eg. Cranfield charge (consulting style), other Uni's don't.
- Institutional structures like Fraunhofer that are specific research/industry links

Group 3:

- Research Office UK has opened offices in India
- British Council
- UK Trade & Industry
- DFID
- Political Trade Missions
- World Water forum & International conferences/Trade Shows

Group 4:

- Limited / complicated
- European trade can actually be easier than within UK
- Lack of regulation in UK in some areas e.g. swimming pools means limited home market

Group 5:

- SDI, + equivalent E&W body
- Commonwealth exchange ?

Group 6:

- TSB
- BiS
- Scottish Enterprise (Export people)
- FCO

14: What additional support is required for a competitive advantage of UK competitors?

Group 1:

- Government support and commitment
- Challenge normal thinking and encourage lateral thinking
- Awareness of opportunities
- Business Network Forum
- Find a Champion to lead
- Speedy verification of technologies

Group 2:

- Baseline of blue-skies research (eg. carbon nanotubes)
-Trade missions???
- UK SMEs cannot get into UK markets due to not having regulatory approval etc but can approach overseas markets
- Must be barriers in UK because other countries (Swiss, NL etc) are exporting home-grown SME skills in water treatment.
- The ability for the UK research/industry skills base to remain price-competitive against other countries.

Group 3:

- UK Water Industry Ambassador
- Water Secretary in UK/Scottish Governments
- Relaxation in procurement & regulatory Frameworks

Group 4:

- European Acceptance Scheme
- Regulatory incentives to produce best possible quality rather than meet arbitrary standard
- Overhaul financial regulation to produce longer term thinking (ie remove 5 yr cyclical funding approach) – don't penalise innovation
- support genuine research (ie don't stifle creativity through over-detailed planning)
- Facilitate more inter –disciplinary / inter sector liaison

Group 5:

- Diplomatic Trade agreements / networks
- Cultural behaviours
- Language support
- Global market analysis
- Local market intelligence / contacts / facilitators
- Showcase events

Group 6:

- International partnering network, e.g. Airbus