

COST Exploratory Workshop

The Energy-Water Nexus: Managing the Links between Energy and Water for a Sustainable Future

19 - 21 January 2009, Le Châtelain Hotel, Brussels

Focus, Form and Function of the COST Energy-Water Exploratory Workshop

Water and energy are both indispensable inputs to modern economies but currently both resources are under threat owing to the impacts of an ever-increasing population (and associated demand), unsustainable practices in agriculture and manufacturing, and the implications of a changing climate. However, it is where water and energy rely on each other that pose the most complex challenges for policy-makers: water is needed for mining coal, drilling oil, refining gasoline, and generating and distributing electricity; and, conversely, vast amounts of energy are needed to pump, transport, treat and distribute water, particularly in the production of potable water through the use of desalination plants and water and waste-water treatment plants.

In recent years, and driven by the three imperatives of security of supply, sustainability and economic feasibility, the energy and water sectors have undergone rapid reform. In the European Union, as elsewhere, the introduction of highly developed management strategies in the energy sector has affected the structure, ownership and regulatory arrangements of that sector. In the water sector, the consolidation of decades of research and application of Integrated Water Resource Management has seen the introduction of extensive water reforms, such as the Water Framework Directive in the EU, which have reinforced the need for watershed management, full cost recovery pricing and the primacy of ecological health. Most recently, a significant groundswell of public support for “more sustainable” practices and “eco-living” has seen initiatives at the consumer and household level to reduce both energy and water consumption (with varying emphases, and varying degrees of success).

Despite the links and the urgency in both sectors for security of supply, in existing policy frameworks, energy and water policies are developed largely in isolation from one another – a fragmentation which is seeing erroneous developments in both sectors. Furthermore, policies adopted to grapple with the challenges of climate change have the potential to produce technological and management decisions that *exacerbate* the energy-water nexus. The example of bio-fuel production is the most obvious, but the inherent trade-offs in hydropower plants, desalination, and water and waste-water treatment are also examples. Moreover, incomplete information about how energy and water interact at the household level, and in industry, means policies (whether they be education campaigns, economic subsidies, stringent regulation etc.), designed to increase efficiency in one sector, may be creating additional demand in the other sector. Conversely, efforts for efficiency in one sector have in some cases had a knock-on *positive* effect in the other sector, for example, efforts to reduce the length of showers in the home, and shifts in production techniques in some private industries.

Of course, in some cases the negative trade-offs in the energy-water nexus are unavoidable, but decisions, and subsequent policies, should at least be made on sound evidence, with the benefit of a comprehensive risk assessment, and a considered approach. In order to make informed decisions which integrate the energy-water sectors, a greater understanding of how energy and water interact is essential.

However, “energy-water nexus” or “energy-water interactions” mean different things to different people. For one person it may be a simple case of “foot-printing” different technologies and production processes; for another, it may be far less quantifiable and exist in the potential impacts of the rapid expansion of hydropower production on biodiversity and ecological health. Nevertheless, as a challenge deeply embedded in our quest for sustainable development, a better understanding of the links between energy and water is essential in any attempt to formulate policies for more resilient and adaptable societies.

At the heart of the problem, in Europe and elsewhere, is a lack of policy integration: the energy, water and more recently ‘climate’ sectors are highly developed *within themselves* but only limited effort is made to account for, and manage, the links between them. Ultimately, the public sector needs to be able to answer four key questions:

1. What is the impact of water policies and regulations on energy supplies and demands?
2. What is the impact of energy policies and regulations on water demands and availability?
3. How do policies aimed at climate mitigation and adaption affect policies developed in the energy and water sectors, and, specifically, the energy-water nexus?
4. What kind of regulatory framework is necessary and feasible to minimize the negative trade-offs in the energy-water nexus in both public-sector planning and private enterprise?

Within the existing regulatory framework, the private sector, in turn, needs to be able to answer the following questions:

1. What are the energy and water footprints in our process and production techniques?
2. How can we reduce our energy and water footprints i.e. through technological innovation, altered processes, alternative suppliers, consumer education initiatives?
3. What is the likely impact of new regulations, standards and incentives related to the energy-water nexus on our production processes and how can we best plan for them?
4. What role can our company play in the development of new policies and frameworks aimed at minimizing the energy-water footprint?

The challenge for policy-makers and industry alike is to develop effective policies, processes and analytical tools which *integrate* the energy-water nexus into policy and investment decisions. However, it is highly conceivable (and, arguably, preferable) that, in some cases, *existing* mechanisms can be adapted to account for energy-water interactions (for example, the use of Strategic Environmental Assessment and Life-Cycle Analysis).

With a view to developing a comprehensive understanding of the issues and how policy-makers can best manage them, this COST Exploratory Workshop will “divide the whole into individual parts” and thus focus on four key - and inter-related - themes:

1. Scale and institutions: where is the energy-water nexus and who cares?
2. Data: needs, sources, accessibility and reliability
3. The private sector: innovation and regulation
4. Integrated management: strategies and tools

Overview of the themes and (draft) key questions

We need your input prior to the workshop to (i) identify issues of key concern to you and (ii) draft specific questions to guide the discussion and debate in the working groups. These will be distributed prior to the workshop. However, we have provided a DRAFT overview of the themes and some preliminary thoughts on the key questions to be considered. Please feel free to comment on these (criticism welcome!) and/or add to them. If there are particular case studies or references that you will like to draw our (and the group's) attention to, please provide full details and we will distribute them prior to the workshop.

Theme 1 - Scale and institutions: where is the energy-water nexus and who cares?

Chair: Jamie Pittock, Australian National University and WWF Associate

The links between energy and water exist at many different scales. At the household level, energy and water are linked most obviously through the supply of hot water for use in showers, white goods and heating systems. At a larger scale, the interactions exist in the production and distribution of both water and energy for agricultural, industrial and private use. The scale can be at the individual power plant or waste-water treatment plant level, or at a whole river-basin level, for instance to study the impact of a large hydropower plant the whole catchment would need to be examined. The scale could also be the whole life-cycle of (particular) products, from the production of the raw materials (and water and energy consumption therein) to its appearance to the final consumer.

Understanding the scale of the problem is essential in order to design effective and efficient policies to address it. Similarly, understanding which institutions and actors are relevant in the decision-making process is equally important. For the purposes of decision-making, the institutions or actors in the energy-water nexus include:

- individual consumers or households
- company engineers and R&D departments
- local governments and agencies
- river-basin and catchment level authorities
- state governments and national governments
- supranational (i.e. EU) or international (i.e. UNFCCC) organisations.

All of these actors make decisions about (i) which technologies and infrastructure to use to achieve their specific objectives (ii) which policies and initiatives to adopt within the energy, water and most recently climate sectors and (iii) how much and which products to buy/consume.

To understand and provide advice on how the currently largely unconnected water and energy management systems can be better integrated, it is important to accurately describe those systems (scale and institutions) and identify means of enhancing trade-offs and synergies across energy and water technology, management and policy.

So, key questions include:

- At what scale do energy and water interact?
- Depending on the scale, which institutions are responsible for decision-making as it relates to energy-water interactions?

- What are the key policies being driven by those institutions or actors which have an impact (either positive or negative) on the energy-water nexus?
- Having identified the institutions, how can we facilitate more effective cross-sector policy making? For example, between multilateral agreements, and sectoral policies (nationally and locally). See Theme 4.
- Are there key institutions that should be strengthened for more integrated and effective policy making on climate, energy and water?
- How does the design (including intent and objective) of key institutions affect decisions about energy and water?

Theme 2 - Data: sources, needs, accessibility and reliability

Chair: Trevor Bishop, Director, Water Resources Management, Environment Agency, UK

The use of foot-printing for water and energy use is the most fundamental information required to better understand the energy-water nexus. Put simply, “you can’t manage what you can’t measure”. Thus, over the last 10-15 years, interest in foot-printing has grown exponentially with the spiraling costs of both energy and water, the increased awareness of water scarcity and the implications of a changing climate. The availability of raw data on energy and water consumption allows policymakers and industry to make informed decisions about what infrastructure to support or invest in, or which technologies or strategies are so energy or water intensive as to outweigh any benefits. For instance, early work in the United States has mapped water consumption in all the major energy supply options, so that the water foot print (including impact on water quality) of thermoelectric power generation can be compared against biofuel and ethanol production, traditional oil and gas refining, and hydroelectric generation.¹

Some key questions to consider in relation to data include:

- is there a need to enhance the application of concepts of virtual water and water footprint so as to better inform decisions driven by the carbon footprint?
- is the necessary data accessible? In the right format for relevant analysis? What’s missing?
- do we know enough about individual technologies to make informed decisions?
- do we know enough about impacts on water quality as well as water quantity, for specific energy technologies and infrastructure?
- Do we have quantitative data measuring the impact of policies in one sector on another? For example, can we link economic subsidies for expansion of electricity generation to increase in water consumption (or even water scarcity)?
- what are the legislative and regulatory requirements of private companies to keep data relating to energy but, particularly, water consumption?
- Is there sufficient emphasis placed on *comparative* data to provide necessary *perspective* on different solutions. For example, recent work from the desalination sector has ‘graphed’ the carbon footprint of desalination plants vis à vis car mileage (energy used to produce enough water for a family for a day is the equivalent of driving a highly ‘efficient’ car just 6 miles).

¹ U.S. Department of Energy. 2006. Energy Demands on Water Resources. Report to Congress on the Interdependency of Energy and Water. December. Available at: <http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf>

- is there sufficient investment in energy and water data with good spatial discrimination to allow the past century to be described adequately and the next century projected, which will contribute to future policy-making?
- What kind of qualitative data is needed in relation to energy-water interactions, for example, the (potential) impacts of dams, desalination plants etc on biodiversity and ecological health.

Theme 3 - The private sector: innovation and regulation

Chair: Joppe Cramwinckel, Shell Exploration and Development, The Netherlands

When energy and water are considered as *inputs to production*, it becomes clear that the private sector has an enormous role to play in the interactions between the two. For industry, whether it is in the production of diesel engines or growing strawberries, both inputs are essential. Similarly, the distribution and supply of water and energy is, increasingly, in the hands of private companies. Furthermore, vast amounts of R&D relevant to the energy-water nexus (and understanding the trade-offs) is undertaken by private companies. It is also true that when it comes to innovation and “first-mover advantage” business will play a vital role in getting appropriate solutions to the market.

Key questions in relation to the private sector are:

- How “aware” is business in relation to energy and water consumption and the relationships between the two? Is there - understandably because of the huge difference in input costs - a tendency to ignore water consumption in favour of energy efficiency?
- Do businesses know what the energy and water footprints are in their process and production techniques?
- What initiatives (case studies?) have been undertaken in individual industries that illustrate best-practice in relation to energy and water? For example, the development of sustainability criteria by the small hydropower industry.
- Are there limitations in data accessibility (see Theme 2) which inhibit a business’ ability to manage the energy-water links?
- Is there a strategic advantage to low-emission and low-water consumption technologies, and is government regulation encouraging innovation? Particular case studies?
- How useful are scenario tools in testing business strategies that account for energy-water interactions?
- What is the likely impact of new regulations, standards and incentives related to the energy-water nexus on production processes and how can they best plan for them?
- What role can our company play in the development of new policies and frameworks aimed at minimizing the energy-water footprint?

Theme 4 - Integrated management: strategies and tools

Chair: Henrik Larsen, DHI Institute for Water and the Environment, Denmark

While ‘life-cycle analysis’ and the use of ‘foot-printing’ is invaluable in identifying where energy and water consumption is at its greatest (or least), data on its own will not provide the long-term strategic solutions which are required for sustainability.

However, as we've seen from Theme 1, the development of management strategies to deal with the energy-water nexus varies according to the level of government, the breadth of the plans or projects to be implemented (for instance, the introduction of a subsidy for low-water use shower heads vis à vis the development of a desalination plant as part of the expansion of a major city), and the extent to which those projects are 'stand-alone' or integral to larger, more complex developments.

An additional element relates to consumer behaviour. Demand management provides the necessary shifts in behaviour to reduce both energy and water consumption irrespective of which technology or infrastructure is used and is thus an integral part of the solution. The key is to get the policies and incentives right to illicit the right type of demand management.

For national governments and supranational entities like the EU, the challenge lies largely in (i) developing long-term infrastructure planning which incorporates the links between energy and water, and (ii) setting regulatory frameworks in which all sectors of the economy must consider the energy and water implications, whether they be regional and state governments, industry or individual consumers. How that is achieved is a momentous task, but much has been learned over the last two decades and, arguably, the solutions are not to be found in *new* strategies but rather in *getting the old ones right*.

Some key questions to consider in relation to integrated management and strategies and tools therein are:

- To what extent does Integrated Water Resources Management - as a working concept - allow for energy considerations? Can the modelling be adapted to account for it?
- What existing policies - either in the water or energy sector - exacerbate the energy-water nexus?
For instance:
 - economic subsidies provided in India for groundwater pumping to generate electricity (which result in massive over-pumping and depletion of groundwater resources)
 - the EU 20/20/20 target for climate mitigation which encourages the use of renewable energy sources, but which in turn compromises the integrity of the Water Framework Directive (see Scotland and proliferation of hydropower dams)
- In relation to demand management, is there a role for eco-labelling on products? For example, the ENERGYSTAR and 'WaterSense' eco-labels in the United States.
- Should we attempt to identify and evaluate existing integrated policy-assessment measures and, if necessary, consider the development of new or adapted ones that would enable identification, specification and analysis of the water implications of energy proposals, and vice versa;
- Following from Q.4, are tools such as Strategic Environmental Assessment & Environmental Impact Assessment currently used to account for the energy-water nexus? To what extent, and, if not, can they be?
- How can we increase coherence between decision making at different geo-political scales, and the effectiveness of subsidiary?
- How can we encourage coordination and collaboration of research, development and policy efforts in the energy-water domain, with a view to cross-learning?

A remark on technology

Interactions between energy and water coalesce in the type of infrastructure and technologies adopted for each sector. Some technologies are more or less energy/water intensive than others, depending on the context, and understanding the impact of different technologies is paramount to making sound decisions that integrate across the energy and water sectors. However, the focus of this workshop is not on which technology is better than another (because that would be useless - ultimately it depends on so many variables), but rather about how policy-makers, industry and consumers can make informed decisions and what tools can enable that. Thus, on Day 1, there will be two presentations that outline the key challenges in water and energy technology options respectively, but there are no specific presentations on individual technological solutions.

In relation to the development of *new* technologies, obviously these present both opportunities and challenges for managing the energy-water nexus. The identification and uptake of these technologies should be considered in relation to management strategies. However, the workshop proceeds on the assumption that, for the foreseeable future, decisions in the energy-water nexus will be made on the basis of traditional energy and water technologies (albeit with significant improvements in both in recent years), and the application of renewable energy solutions i.e. nuclear, hydropower, biofuels, wind, solar etc. It is worth pointing out that, even in the EU where they hope to have a 20 % renewable energy target by 2020, that still means that 80% will be sourced from traditional forms of energy generation. This is supported by the recent World Economic Outlook 2008 (November). The conclusion, therefore, is that we must explore what integrated water and energy policy-making should look like now, with the knowledge and technologies we have available to us *now*.

Format of the Workshop

Responsibilities of the Thematic Chairs

On the first day, the Chairs will “set the scene” for the four themes to be covered over the three days, including an overview, key questions to consider in the working groups, and early research and development undertaken hitherto.

After the initial presentation on Day 1, the Chairs will oversee the thematic working groups and guide the discussion where necessary. Most importantly, they will reflect on all the ideas and perspectives offered by the four working groups, as the workshop proceeds.

Overview of working groups

The whole group will be split evenly into four groups, with approximately 8 participants in each group. When the working groups first convene, they should elect:

- a group leader
- a scribe.

The Group Leader will be responsible for leading the discussion and presenting the group’s results back to the whole group. The scribe will be responsible for taking down the notes (on the white board or butcher paper) and writing them up for presentation to the group.

Workshop format

All the participants will have an opportunity to introduce themselves to the group and present (briefly) their own area of expertise and interest. This will also be captured in the 2-page submissions provided by all participants prior to the workshop.

In the morning of Day 1, two experts will provide an overview of the energy-water links in relation to technology and infrastructure design. The first 'real' session of the workshop will consist of presentations by the four Thematic Chairs, which will highlight the issues and topics to be covered, and questions to be considered by the working groups. These presentations will draw on the submissions provided by the participants.

In each break-out session, all four themes will be covered by different working groups. For example, in Break-Out Session 1, Working Group 1 will discuss Theme 1, while Working Group 2 will discuss Theme 2, Working Group 3 will discuss Theme 2 etc. In Break-Out Session 2, each working group will consider the next theme on the list i.e. Working Group Session 1 will then consider Theme 2, while Working Group 2 will consider Theme 3, and so....

This will facilitate three things:

1. each theme will be considered simultaneously and thus all themes will be addressed by everyone
2. the 'thinking' on each theme will be refined as the workshop continues, so that each working group will have an opportunity to add to the thinking of previous working groups, on the same theme
3. individuals that are not present for the whole workshop, can still participate in the theme most suited to their expertise, as each theme will be addressed simultaneously.

Following each break-out session of the working groups, the Group Leaders will present their results back to the group as a whole. This will:

- allow the other workshop participants to ask questions
- inform the participants of the focus and perspective adopted by a particular working group on a particular theme, which they can then add to, refine or develop in their own working group on said theme
- provide the workshop participants with in-depth understanding of the issues throughout the program
- give the Thematic Chairs an opportunity to draw on ideas and perspectives from other themes.

Workshop outputs

The aim of the workshop is to develop a comprehensive understanding of how energy and water are related, where trade-offs exist, how we can measure and manage those trade-offs and, ultimately, how we can make better decisions in the energy and water sectors. Thus, the principle outcome from the workshop will be a list of recommendations to enable better decision-making by policy-makers and business alike.

After the workshop, the conclusions will be published and a formal list of recommendations prepared for presentation at the World Water Forum in Istanbul, and COP15 in November 2009, as well as other relevant international fora.

In addition to the specific research outcomes from the workshop, we hope to canvass from the group interest in an energy-water network (building on partnerships with the European Water Partners and DHI), and the development of concrete research proposals. This will, obviously, be an iterative process, but this first COST Exploratory Workshop is designed to be a “spring-board” for such a longer-term initiative.

Media and communication

Understanding of the energy-water nexus is extremely limited, and policy tools to enable better decision-making in both sectors are almost non-existent. At the end of this workshop, a list of policy recommendations will have been developed which will be of relevance to policy-makers at the local, national and international levels. To ensure the outcomes of the workshop are disseminated as widely as possible, a three-pronged communication strategy will be pursued:

- Scientific journalists will be invited to participate in some or all of the workshop
- A press-conference will be held at the end of the workshop, to inform non-participating journalists of the relevance and significance of the topic
- The Policy Recommendations will be published immediately after the workshop on the COST website and elsewhere.