Water and Energy Efficiency

Information brief

Water and Energy: A tale of two resources

Historically, efforts to improve water and energy efficiency (W&E) have been widely pursued separately. Improving efficiency from both the supply and the demand sides would allow countries to reduce resource scarcity and maximize the benefits provided by existing W&E infrastructure.

Water efficiency is a multi faceted concept. It means "doing more and better with less" by obtaining more value with the available resources, by reducing the resource consumption and reducing the pollution and environmental impact of water use for the production of goods and services at every stage of the value chain and of water service provision.

Improving water efficiency means increasing water productivity –that is, reducing the intensity of water use for, and pollution from socio economic activities through maximizing the value of the uses of water–, improving the allocation of water among competing water uses so as to obtain greater socio-economic value per drop of water –ensuring environmental flows–, and improving technical efficiency of water services and the management efficiency of their provision over the complete life cycle.

Without efficiency gains, global demand for water will outstrip currently accessible supplies by 40 per cent by 2030 (2030 Water Resources Group, 2009). Historical levels of improvement in water productivity as well as increases in supply are expected to address 40% of this gap, but the remaining 60% needs to come from investment in infrastructure, water-policy reform and in the development of new technology (UNEP, 2011).

Today, energy uses about 8% of all freshwater withdrawn worldwide and as much as 40% of freshwater withdrawn in some developed countries (WEF, 2011; IRP, 2012). Energy demand on present trends will increase by one-third from 2010 to 2035, with 90% happening in non-OECD countries (IEA, 2012). Water needs for energy production are set to grow at twice the rate of energy demand (IEA, 2012; National Geographic, 2013). Estimated water withdrawals for energy production in 2010 were 583 billion cubic metres, out of which 11 percent (66 bcm) was water consumed – withdrawn but not returned to its source.

Challenges

Continuing current practices will lead to a massive and unsustainable gap between global supply and demand (UNEP, 2011). Reducing water use and impacts through resource efficiency, while limiting rebound effects, should be at the top of the list for every energy and water planner and a focus for policy-makers everywhere (WEF, 2011). There can be no one size fits all solution, rather a range of location-specific policies that take long-term and holistic approaches involving trade-offs.

UNEP

Enabling water and energy efficiency

The preamble of the United Nations Framework Convention on Climate Change (UNFCCC) notes: "… the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions."

1. Building a collaborative approach: Collaboration, on integrated energy and water resource planning and related technologies, is needed among federal, regional, and state agencies as well as between industry and other stakeholders. A key step is to establish mechanisms for ensuring policy coherence across the Water and Energy ministries and institutions.

2. Making the right choice among resource efficiency technologies: The appropriateness of a technology depends on the local situation and the resources available. These include: recycling and reuse of water, low water using appliances, efficient irrigation systems, decentralized sewerage systems, information and communication technologies, rainwater catchments and reclamation of nutrients. Managing the energy sector's water vulnerabilities will require deployment of better technology and greater integration of energy and water policies (IEA, 2012).

3. Spreading and speeding technology transfers: As mentioned in the Bali action plan, it is critical for sustainable development objectives to have a platform for technological innovation and transfer with a provision for financial resources and investment opportunities. Understanding the key barriers and obstacles that currently exist for the development and transferring of technologies. Developing new mechanisms or contract modules by allowing the transfer of efficient form of technologies serving at critical nodes of energy and water management systems throughout its value chain is vital for maintaining the Energy and Water nexus (UNCTAD, 2001).

4. Building Partnerships: It is important to develop platforms for launching new partnerships, activities or projects, with active participation of both public and private enterprises. Creating open innovation systems not only develops a pool of ideas but also encourages public engagement and stakeholders' participations. The Public private partnerships (PPP) and international cooperation with public and private partners creates synergies in the development of efficient and low-carbon technologies which is important for the water and energy nexus. Examples of partnerships include: Science and Industry partnerships for collaboration on water and energy efficiency; PPP for PES and rainwater harvesting programs for enhancement of efficiency of energy water systems.

5. Fostering innovations: A platform for technological advancement can be backed by strategic regional and governmental approach highlighting the social, financial and environmental incentives of innovations. Technological innovations, particularly in relation to renewable energies, can increase water availability from water savings and improve water quality through pollution control.

   A concerted effort is necessary to diversify the energy matrix in favor of renewable energy and low-carbon technologies. Technological progress can create new opportunities to harness the vast renewable energy potential. Renewable energy can replace conventional fuels in power generation, hot water and space heating, transport fuels, and rural (off-grid) energy. In developing countries, the key challenge is to bring the cost of the resultant services to levels at which they would be affordable by low income households (UNDESA, 2013).

6. Capacity building: The capacity building process is anecessity for developing countries. It sows the seed of innovation and development and serves to solve energy and water management issues. It also aids information to the decision-makers engaged in day-to-day management of water and energy technology research and development and international cooperation.

Framework for evaluation and reporting of the energy impacts on water – Water for Energy Framework (W4EF)

The main objective of this Action Group is to produce an adapted framework for energy companies in order to assess their water use and water impacts. The Action Group will develop a comprehensive approach to the water footprint of energy production. It will allow differentiating between water withdrawal, water consumption and net water consumption, and calculating different kinds of interactions between the activity and its water environment.

The underlying project assumption is that existing frameworks and initiatives do not fulfill the need of the energy sector. After agreement on the framework and its validation, a tool will be developed to help implement the methodology in a consistent way and ensure wide dissemination across the European energy industry and beyond.

This large Action Group is composed of the following participants:

- EDF (Electricité de France) will lead the group composed of:
- International Organisations: World Water Council, World Energy Council, World Business Council for Sustainable Development (WBCSD), International Energy Agency, United Nations Environment Program (UNEP).
- Representative associations of energy sectors: Renewable Energy Alliance including International Hydropower Association (IHA), World Nuclear Association, World Coal Association, IPIECA.
- Companies: GDF Suez Environment, Veolia Water, Hydro Tasmania, Statkraft, BP International.
- Consulting firms: Accenture, Limnotech, Quantis.
- NGOs: Greenpeace International.
- University and scientific institutions: Electric Power Research Institute (EPRI), University of Twente - Water Footprint Network (WFN)., Lund University, Sintef Energy Research, University of Bordeaux, Austin University of Texas, Norwegian University for Science and Technology (NTNU), Centre for Environmental Design of Renewable Energy (CEDREN).

For more information:
http://www.eip-water.eu/working-groups/w4ef-framework-evaluation-and-reporting-energy-impacts-water

Tools for improvement

With an annual investment of US$ 198 billion on average over the next forty years, water use can be made more efficient, enabling increased agricultural, biofuels and industrial production (UNEP, 2011). Investing $170 billion annually in energy efficiency worldwide could produce energy savings of up to $900billion per year (SE4ALL, 2012), and each additional $1 spent on energy efficiency in electrical equipment, appliances and buildings avoids more than $2, on average, in energy supply investments (IEA, 2012). Research into how much savings increased water efficiency has on energy needs and vice-versa would support policy-makers and investors into more resource efficient strategies and investment choices.

Economic instruments

For both the water and energy sectors, wider use of economic instruments can help to highlight the 'true cost' of water and energy services, including their respective energy component and water footprint.

- Energy and water markets coupled with efficiency regulatory measures (WEF, 2011),

- Payment for ecosystem services (PES) towards reduced sedimentation downstream, in dams and other hydroelectric power infrastructures, thereby fostering uninterrupted energy production. It also helps in arresting excess water-flow or flood situations which is important for energy security and for improving the efficiency,
- Water pricing to provide incentives for allocating water to higher value uses -in environmental, social or economic senses, coupled with regulatory measures,
- Full transparency of water prices and investments.

Policy instruments

Finally, we need policies that "decouple" economic growth from water and energy consumption, that promote both water and energy efficiency (IRP, 2012). Sustainable development is about seeing the whole picture, about managing what we have today so that it will still be there in the future. Only by fully understanding the food-water-energy nexus, and planning for its consequences, will we be able to do that.

- Enhance consumer awareness of water and energy efficiency and their interlinkages,
- Apply integrated resource efficiency planning and monitoring/evaluation tools in the water and energy sectors, by both public and private actors,
- Raise awareness and training of existing strategies and deciding in each case which is the most appropriate to apply based on a cost/benefit analysis,
- Improving the transparency and availability of data and research of the overall state and trends of water and energy resource-use efficiency (IRP, 2012),
- Institutional reforms to enhance efficiency in water resource allocation and energy use patterns (taking into account the environment as a legitimate water user),
- Fiscal reforms to develop equitable pricing and realignment of perverse subsidies respecting public goods,
- Investments in science, technology and innovations for decoupling value -including economic value but also social and environmental value, from water use,
- Better coordination between water and other resource use -energy, land and materials.

Assessment tools

A more integrated (nexus) approach will benefit public planning and private investment. A well-designed regulatory framework can define rights and create incentives that drive green economic activity as well as remove barriers to green investments. More systematic use of tools such as:

- Resource Assessments, Life Cycle Assessments, Strategic Environment Assessments, and economic valuation and other tools able to strengthen the case for improved efficiency in both the water and energy sectors, throughout the production, distribution and use phases, as well as in products and services where they are used and contribute to economic growth.
- Audits: Water and energy audits for a facility are a starting point to benchmark its status, measure usage and identify areas for improvement in both the demand and supply sides.
- Accounting: The United Nations developed a framework (system of national account) within which all the statistical information (environmental to economic) shall be integrated under a System of Environmental-Economic Accounting (SEEA). The system can help tracking water and energy consumption patterns and policy or standard evaluations.

Life Cycle Assessments

Many are the opportunities both for the public and private sector for improving efficiency performances along supply chains, both from the production and consumption sides. For example, more than 90% of a sugar-based beverage company's water footprint is in its supply chain (Ercin et al., 2010) (Figure 1). Water and energy accounting and management along life cycles –considering the environmental needs- is a crucial tool for the purpose of overall efficiency and sustainability coupled with the generation of economic assessments, alongside GDP growth and other economy-wide indicators such as greenhouse gas emissions.

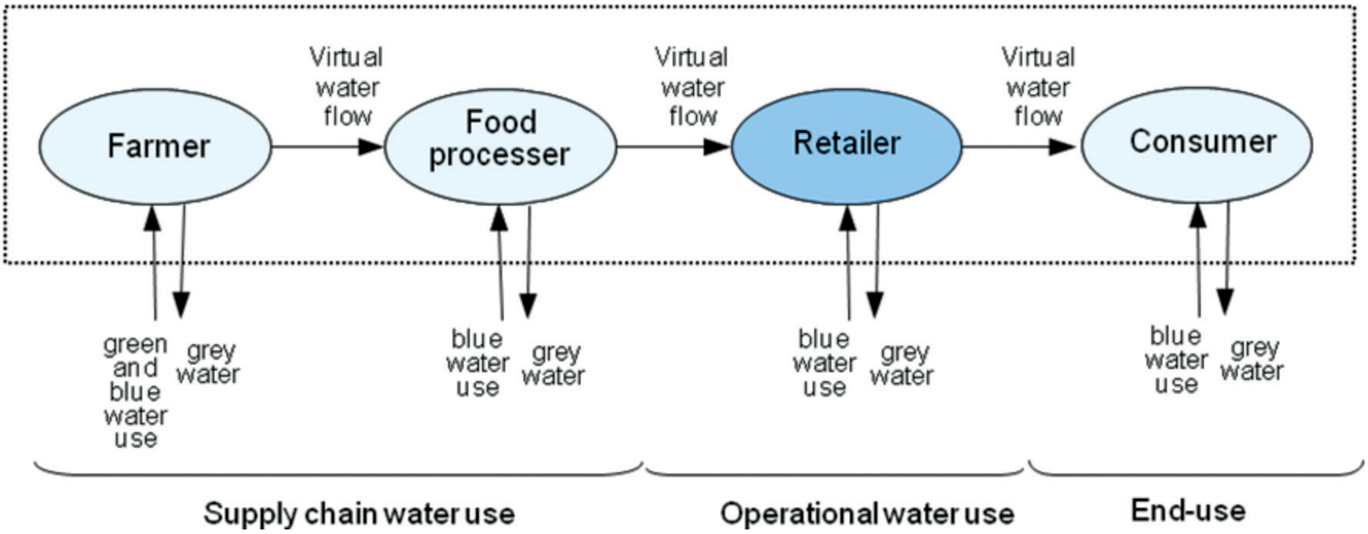

Figure 1. Water use by a retailer. Source: Hoekstra et al. (2011).

- Efficient utility management: To understand the consumer behavior and control usage of water and energy and to align the water and energy utility management systems. This not only helps in revenue collection but encourages coordination and maintenance for both energy and water management systems.
- Tools and benchmarking: Efficiency and improvement in water and energy need to be measured for benchmarking and future evaluation. The qualitative and quantitative tools for assessment have increased since last twenty years. The tools comprise of life cycle assessment, ecological footprint, environmental performance index among others.
- Indicators. Separate data and indicators are available for both water and energy use in industry. Industry is interested in measuring the cost effects on its profitability whereas governments and society are more focused on overall economic results, social benefits and the environment. Metrics comparing water and energy use to indicate the effects of one upon the other, both at plant scale and for countries as a whole, are necessary yet seemingly absent.

Technological developments

- Efficient irrigation techniques,
- Water leakage reduction (leading to more efficient management resulting in lesser energy consumptions);
- Efficient energy transmissions (leading to lesser heating and lesser use of water for cooling),

- Energy and water efficiency in supply and sanitation (reduction at source),
- Efficient energy production technology (with enhanced efficiency, the more energy can be produced with lesser consumption of electricity),
- Efficient water management for energy companies (proper channelization of water would only lead to improved process efficiency for energy production).

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