Knowing the wealth of water *before* the well is dry

Learning from the environmental world on water-energy links

The expression, "*When the well is dry, we know the wealth of water*", has been attributed to various wise men over time, including Benjamin Franklin (1758). In a world where each unit of energy is becoming increasingly water intensive, many countries are already facing severe water scarcity. The energy industry can learn lessons from natural resource management approaches to value water for all uses to ensure the well does not run dry. Climate change makes effective water management even more important.

Though water is globally renewable, where demand exceeds the naturally renewable supply on a local scale, its supply is finite and competition between users can arise. In addition to energy, water also supports other economic demands. For example, over 70% of fresh water is used for agriculture. But, if the ecological and hydrological demands are not met as a minimum, then the sustainability of the water system is threatened.

Leonardo da Vinci said, "*Water is the driver of nature*", essential to everything in life. Hydrological ecosystems, which include lakes, rivers, marshes and coastlands, deliver a wide range of ecosystem services that support energy production. Maintaining flows in rivers is crucial to hydropower production, but also are needed for other energy systems including thermo-electric cooling, extraction and refining of conventional oil and increasingly the production of biofuels. Climate regulation, flood regulation and coastal protection are also important ecosystem services.

Allocating water to the environment is essential to maintaining ecosystems and their benefits, these environmental flows provide critical contributions to river health, economic development and poverty alleviation. Furthermore, it is increasingly clear that, in the mid- and long-term, failure to meet environmental flow requirements will have disastrous consequences for downstream users including reduced water availability and quality. Water scarcity (whether physical and/or economic) and reduced access to water are key factors limiting economic development in many countries. Climate-related impacts on the hydrologic cycle often pose serious variation in supply causing serious storage challenges This in its turn can cause the loss and degradation of watersheds, further threatening the societies and in turn the economies that depend on it.

In terms of energy generation and supply linked to water, climate change increases the risk of disruption as well as reduced output. Changes in rainfall patterns and hydrology will affect growth rates of biomass and cause fluctuations in hydropower, with reduced efficiencies caused by increased run-off and land degradation leading to siltation. Temperature increases will also affect the formation and melt rate of glaciers, as well as the cooling properties of water bodies.

In the US, the same amount of fresh water is abstracted from the river systems for industrial cooling as for agriculture. Though 97% is returned, higher inlet temperatures can have a significant impact on production. For example, Electricite de France (EDF) came close to disconnecting their Tricastin plant on the Rhone River as the temperature of the water discharged by the reactor cooling system surpassed 25ºC – the maximum allowed under France's environmental laws.

In Canada, the government has placed restrictions on the amount of withdrawals oil sand developers can take from the Athabasca River. In the United States, numerous communities have stalled the development of ethanol plants due to their high withdrawal needs in areas where aquifers are already threatened. A bioethanol development on the Tana wetland in Kenya

has been halted due to concerns about unsustainable water extraction, affecting wildlife and livelihoods, including of pastoralists from Ethiopia who use the region in the dry season.

The value of these marketed as well as non-marketed benefits is rarely factored into decisions around the use of water systems and their total sum will often exceed even the value of development within river basins. Beyond issues of quantity and quality of water are concerns related to access and equity. Particularly in developing countries, it is vulnerable people – especially women and children – who end up paying more for water, whether through money or time spent in collecting water from increasingly further places. Water issues are further complicated because water can be diverted to meet other demands such as high value cash crops.

In 2007, the Integrated Water Management Institute concluded that there will not be enough water and land to feed the world in 50 years if we do not change our current water management practices. Given the increasing recognition and concerns over the links between water, food and human insecurity, how does this affect energy security? Energy has alternative sources, but water has no alternatives.

IUCN promotes the implementation of *environmental flows,* which refers to the allocation of fresh water in river and lake basins to maintain ecosystems and their benefits to people. Dams (including those for hydropower) are often the most significant and direct modifiers of natural river flows and are therefore an important starting point to implement environmental flows. In future, lessons can be learned and applied to other energy projects.

In the Pangani River Basin in Tanzania*,* subsistence farmers, commercial plantations, commercial agriculture, urban areas, hydropower and fishermen are all affected by changes in flows. IUCN and other partners have joined with the Pangani Basin Water Office to implement the Pangani River Basin Management Project. Part of the project has been to develop carry out an Integrated Flow Management assessment, which included hydrology, river health, estuary health and socio-economic studies that explored the impact of changing flows on each sector including the environment. The study provides a guide to inform future water management decisions. Interestingly, the assessment found that boosting hydropower would benefit downstream development and ecology.

According to Washington Mutayoba, Tanzania's Water Resources Director, "The initial conflicts between hydropower, irrigation and general water users were an early indicator of climate change. Previous water policy was driven purely by the need to supply and deliver. Now we are looking at the bigger picture, climate change and all."

New business opportunities lie with solutions that improve water quality as well as water use efficiency, optimising the "GJ per drop" as well as the "CO2 per drop". For example, in well designed systems, the quantity as well as quality of the water that is returned to the system can help maximise overall use through re-use. Energy and water conservation will also have benefits for nature conservation.

Troubled waters lie ahead unless the multiple demands placed on water are recognised and valued – this includes the increasing water needs of the energy sector as well as ecological demands that are needed to maintain the overall sustainability of the water system. The engagement of all legitimate water-basin stakeholders in decision-making needed to maintain the overall sustainability of the water system can lead to harmonious decision-making. Innovative solutions from the energy companies based on lessons from nature can help to ensure that the well remains topped up for future generations to draw on.

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