



The water-energy nexus: a hot topic for the Middle East

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The Middle East, mostly the Arab region, consisting of countries in the eastern Mediterranean and North Africa (MENA), including the Gulf countries and Iraq, is the world's driest region. Renewable water resources are estimated at around 335 km³ per year for population approaching 400 million people; more than half of this originates outside the region and is conveyed through shared rivers. The same applies to cross-boundary water basins which are also shared among neighbouring countries. Correspondingly MENA is designated a 'super-arid region'. All this calls for water cooperation among the region's countries and their neighbours, as well as calling on energy and technology to improve future water availability prospects, mainly through developing non-conventional water resources.

Simultaneously the MENA region has one of the world's highest birth rates, approximately 2 per cent annually; it is the world's centre for producing oil and other petroleum products and is rapidly developing and improving its economic prospects.

Correspondingly, the energy-water nexus is very strong and growing. Energy utilisation in the water use cycle involves extracting and conveying water, treating and distributing it, using water in irrigation systems as well as dealing with waste water. Most important in the region is water use in the energy cycle: exploration and production of oil, electricity generation and desalination.

Electricity generation in the region, which is presently half that of world average per capita, greatly varies from one country to another. However all over the region it is growing at a rate of 6-8 per cent annually, this is three times that of world average, mainly due to subsidised electricity rates but also the harsh summer weather and growing urbanisation and population. Thermoelectric generation utilising fossil fuels is water-intensive mainly for cooling purposes. Water consumption can be halved by using wet cooling towers rather than once-through cooling but at half a cubic metre per MWh this is still high. Some new facilities are utilising air cooling which is both expensive and less efficient in energy use.

Water is intensively used in petroleum production and refining. It varies by process, geology and technology. It is mainly consumed for oil recovery. Most of the region's oil production is on-shore, necessitating utilisation of fresh water. In the region, water consumption is around half a cubic metre per barrel for production and refining. This adds to ten million cubic metres of water consumed per

day, which is quite challenging in an arid region.

Because of scarcity, water has to be withdrawn from deep wells or remote aquifers and other sources, conveyed over long distances, purified and pumped to high places. In some countries like Jordan almost one fifth of electricity is consumed by water cycle use, mainly pumping.

The scarcity of fresh water promoted and intensified the technology of desalination and combined co-production of electricity and water. The Gulf region has become the world's centre for desalination. The region now produces almost 4,000 million cubic metres of fresh water by desalination, mainly utilising the multi-stage, flash evaporation process (MSF), which is most suitable for bulk production of large quantities of desalinated sea water. However, for brackish water, the economical but more cumbersome reverse osmosis (RO) process is utilised. Both methods are energy-intensive and very costly. The MSF (with commercial energy prices) costs one dollar per cubic metre of desalinated sea water, plus another third dollar for delivery. The RO costs can be as low as US\$0.60 per cubic metre, and its prospects are increasingly improving. The dilemma is that most consumers pay only 4 cents per cubic metre.

Now, mega-projects of combined water and electricity production are being planned and executed in the region. These account for tens of billions of dollars worth of investments in energy and water infrastructure, which are straining government financial resources. Increasingly private investors are invited to invest in what is termed as independent water and power projects (IWPPs). A typical mega-project is that of Saudi Arabia's Ras Al-Zour water and power project, expected when finished at the end of 2013 to produce 2,400 MW of electricity and over one thousand million cubic metres of water per annum, at a total cost of six billion dollars.

The MENA region experience in dealing with scarce resources of water in an arid region and relying on the extensive use of energy in the water cycle is a learning example to other regions of the world. Globally, fresh water is becoming scarcer and demands are growing with increasing calls on energy consumption in all aspects of the water use cycle. Simultaneously, energy production, particularly the use of fossil fuels such as coal, oil and gas for electricity demand a lot of water consumption. With the increasing future demand for non-conventional sources (including biofuels), demand for water in the global energy business is growing and the water-energy nexus is tightening. □