

## International World Water Day 2014, Focus: Water–Energy Nexus

The International World Water Day is observed every year on 22 March. On this day, attention is focused on the importance of water and strategies are evolved for sustainable development and management of water resources. Each year a different aspect of water is brought to focus. This year, the focus is on the nexus between water and energy. According to Sandra Postel, Director of Global Water Policy Project, ‘Energy and water are closely intertwined. It takes a great deal of energy to supply water, and a great deal of water to supply energy’. We are all aware that hydroelectric power production is from water. It may not be immediately obvious that most other forms of energy, whether it is thermal or nuclear, also utilize enormous amounts of water. Nearly 90% of the 13,113 Mtoe of energy produced in the world is water intensive and 15% of energy produced is hydroelectric. Thermal power accounts for about 80% of global electricity and 5% is accounted for by nuclear and other forms of renewable energy. Water consumed for energy production, according to International Energy Agency (IEA, 2013), will increase from 66 billion cubic metres (bcm) at present to 135 bcm by 2035. Out of this global energy-related water demand, it is estimated that more than half of this consumption will be by coal-fired thermal power plants, about 30% by bio fuel, whereas oil and gas-based production will account for 10%. Natural gas power plants use much less water than coal plants; while providing 23% of today’s electricity, they account for only 2% of today’s energy water consumption. Generation of renewable energy such as wind and solar photovoltaic power accounts for less than 1% of water consumption for energy production.

While power generation, as indicated above, requires large supply and utilization of water resources, energy itself is required for pumping, transporting, treatment and desalination of water. Agriculture including irrigation, mining of coal and lignite, fracking, manufacturing and construction industries, use as much as 37% of the electrical energy produced. The amount of water used for irrigation is directly related to the amount of water pumped. 8% of the total energy generated in the world is used for irrigation itself. It is estimated that 537–2270 kWh of electricity is required for supplying a million gallons of fresh water depending upon terrain condi-

tions (Wikipedia). Studies in the US have shown that about 4% of US electricity goes for waste water treatment. Appreciating the close link that exists between water and energy, it is essential to consider both of them together, for sustainable development.

India is a fast developing, highly populous country in the world. Current population of India is 1.27 billion. It is expected to increase to 1.52 billion by 2030 and surpass 1.66 billion by 2050. Census figures of 2011 show that 31.6% of Indian population is urban and 68.4% rural. Mc Kinsey Global Analysis 2010 shows that India will have 68 cities with population more than 1 million by 2030. Land area of India is 2,973,190 sq. km, of which 60.5% is agricultural land. 34.7% of agricultural land is under irrigation. The 2013 UNICEF report shows that utilizable surface and groundwater resource of the country is 1123 bcm. This estimate prepared by the Ministry of Water Resources was revised by Narasimhan using a worldwide adopted evapotranspiration rate of 68% instead of 40% used by the Ministry (*J. Earth Syst. Sci.*, 2008, **117**, 237). The revision brings down the utilizable water resource to 654 bcm. The present consumption of water is approximately 634 bcm, which is just a little below 654 bcm resource available, a situation that is alarming. Water resource distribution is highly unequal in the country. 71% of the water is available to only 36% of the area and the remaining 29% is in the rest 64% of the Indian land mass. Out of this available water resource,

### Key messages and slogans of the International World Water Day 2014

- Water requires energy and energy requires water
- Supplies are limited and demand is increasing
- Saving energy is saving water: saving water is saving energy
- The ‘bottom billion’ urgently need access to both water and sanitation services, and electricity
- Improving water and energy efficiency in all sectors is imperative as are coordinated, coherent and concerted policies

Source: World Water Day 2014, Advocacy Guide, UNIDO and UN University.

89% is consumed for irrigation, 5% for domestic use and 6% for industry. Groundwater contributes to 60% of water used for irrigation and accounts for 80% of domestic water supply. The Department of Drinking Water and Sanitation estimates that 90% of rural water supply is from groundwater sources. Groundwater exploitation in the country is increasing unabated. According to Shah (*Groundwater Management: Typology of Challenges, Opportunities and Approaches*, ACWADAM, Pune, 2009), in 1960s, Indian farmers owned just a few tens of thousands of tube wells, but in 2009 the number of deep bore wells had increased to more than 20 million with every fourth farmer owning a bore well. Many of the rapidly growing urban centres also have turned to groundwater for water supply. Indiscriminate exploitation of groundwater has led to alarming decline of water table in many parts of the country (Rodell *et al.*, *Nature*, 2009, **460**, 999), rendering large number of existing wells go dry. In many parts of the country, women have to walk distances to collect a few pots of water, which has contributed to gender discrimination issues. There are large slum areas in cities, which lack basic amenities of water supply and sanitation. These have led to serious infectious disease problems. While the available utilizable water resource has remained nearly constant, the demand for water is increasing influenced by steady growth of population, increasing urbanization, economic growth and changing life styles, resulting in per capita availability of water coming down from 1816 m<sup>3</sup>/year in 2001 to 1545 m<sup>3</sup>/year in 2011. It is expected to go down further to 1340 m<sup>3</sup>/year by 2025 and 1140 m<sup>3</sup>/year by 2050. A per capita consumption of water less than 1700 m<sup>3</sup>/year indicates water-stressed condition and less than 1000 m<sup>3</sup>/year as water scarcity condition. It must also be noted that Water Resources Group has estimated that demand would increase to 754 bcm by 2030, and would surpass the presently known utilizable resource.

To make water available for various sectors, electrical energy is required. Energy statistics show that installed capacity of electricity generation in India stood at 1053 TW-h as of March 2012. Towards this installed capacity, coal-based thermal power plants contributed 57.38%, gas-based plants 9.03%, oil-based plants 0.57%, hydropower 20%, nuclear 4.8% and wind 6%. So far, solar power contribution has been less than 1%. During the 11th Five Year plan, 55,000 MW of new generation capacity was created. Yet, there continued to be an overall energy deficit of 8.7%. Electricity production has to increase significantly. India has well thought out plans to address the power requirements. As against installed capacity of 182 GW power in 2009, the projected installed capacities for 2020, 2030, 2040 and 2050 are 391,

713, 1059 and 1434 GW respectively. Keeping in mind the climate change issues, India plans to bring down fossil fuel-based power generation and increase installed capacities of greener technologies like solar, wind and tidal power. While installed capacity of coal-based power is proposed to be brought down from 130 GW in 2009 to 78 GW by 2050, installed capacity of hydropower will increase from 39 GW to 67 GW, wind-based power from 11 GW to 335 GW, solar photovoltaic from 0 to 519 GW, solar thermal power from 0 to 519 GW, tidal from 0 to 47 GW. India has a three-stage nuclear energy production plan. In the first stage it plans to scale up nuclear power production to around 320 GW by 2020, in the second to 4200 GW by 2030 and in the third to 15,500 GW by 2050. An ambitious programme to generate 103 GW from geothermal energy has also been projected. However, detailed assessment of geothermal energy including enhanced geothermal resources is still incomplete. It is essential to conserve energy and cut down transmission and distribution losses which at present are estimated at 24% of the energy produced.

From the foregoing, it appears that plans for enhanced energy development seem to be in place and likely will meet the energy requirements of the country in future including the development of water resources. As fresh water resources are critically close to the rate of consumption, challenge lies in augmenting the utilizable water resources. For example, one of the ambitious programmes of the Government of India is to link the Indian rivers to bring more equitable distribution of fresh water in the country and avoid wastage of flood waters. Although implemented so far by Gujarat and Madhya Pradesh, there are serious debates about the environmental impacts of this project and also its economic viability. Another option is to explore for deeper ground water in fractured hard rock terrains. Evidence for such occurrence comes from deep mines like the Kolar Gold Mines. A third option is to look for off shore resources (Post, V. E. A. *et al.*, *Nature*, 2013, **504**(7478), 71). Cutting down on wastage of water is a necessity. Need for water harvesting, improving irrigation methods by replacing flood irrigation by sprinkler and/or drip irrigation, recycling of water in industries, from irrigated areas, power generating units as well as from municipal waste water are imperatives to meet the increasing demand for water. Time is also ripe to start seriously planning for desalination in the not too distant future and implement it when energy situation improves. Sustainable development of water resources must be executed like any other industry with all stakeholders responsible for its success.

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