FACT SHEET

Hydropower

Hydropower explained

Hydropower harnesses the energy of moving water and converts it into mechanical or electric power for human consumption. The most well-known source of hydropower is the hydroelectric dam.

How it works

Damming relies on the potential energy of water held in a reservoir and its controlled outflow, which turns a turbine. Hydroelectric dams range in size from tiny systems with capacities of just a couple of kW to the largest electricity-producing plants in the world, with capacities well over 10 GW.

Energy can be harnessed anywhere water flows from a higher elevation (as in an artificial reservoir) to a lower elevation. Developments in "run-of-the-river" power station technology are making the capture and conversion of hydropower into hydroelectricity from undammed running water more efficient. Similar technologies are being refined to more efficiently harness marine power from ocean waves and tidal streams. Pumped-storage hydro systems, on the other hand, have more control over the flow of the water through the turbine and therefore make this type of hydroelectric power one of the most reliable sources of base load power. In these systems, however, power must be used to pump water back up into the higher-level reservoir.

Opportunities in Asia and the Pacific

- **Most untapped potential in the world:** A 2007 survey of energy resources by the World Energy Council led to the conclusion that the technically exploitable capability of hydropower in Asia and Oceania is an estimated 5,712 TWh – well over the capacity of any other region. Of that, more than 3,500 TWh was deemed economically feasible, although the reliability of measurements of potential generation from hydropower has been questioned.[1]

Trends in development

World's largest producer of hydropower: In 2009, the Asia-Pacific region accounted for 415 GW, or nearly 5 per cent, of cumulative installed hydropower capacity – more than any other region. With relative efficiency losses, these plants contributed almost 4 per cent of all hydroelectric production in that year.[2]

Largest source of renewable power in the region: Hydroelectric power totalled 861,850 GWh of electricity generation in Asia, representing around 15 per cent of the region's production. Excluding China (one of the world's leading hydropower producers), hydroelectric projects still fill a substantial portion (almost 16 per cent) of Asia's electricity supply.[3]

China: Beyond large hydro development, such as the famous Three Gorges Dam project, China has focused resources on small hydro projects, particularly for rural electrification. At the end of 2007, China boasted 47,380MW of small hydro capacity at 50,000 systems.[4] The country leads the world in small hydro power generation.

[1] World Energy Council, *2010 Survey of Energy Resources* (London, 2010).

[2] A. Kumar and others, "Hydropower", in O. Edenhofer and others, eds., *Renewable Energy Sources and Climate Change Mitigation: Special Report of Intergovernmental Panel on Climate Change* (New York, Cambridge University Press, 2011).

[3] International Energy Agency, Statistics and Balances (Paris, 2009). Available from www.iea.org/stats/index.asp (16 February 2012).

[4] United Nations Food and Agriculture Organization Water Development and Management Unit (FAOWater), "Hydropower resource assessment of Africa", presented at the Miniterial Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change, Sirte, Libyan Arab Jamahiriya, 15-17 December 2008. Available from www.sirtewaterandenergy.org/docs/2009/Sirte_2008_BAK_3.pdf (accessed 25 October 2011).

Strengths with hydropower

- **Variable size to meet utility or decentralized power needs:** The large absolute size of Asia's hydropower potential does not mean that all hydropower projects must be large. Hydropower production offers great flexibility in size and can be used for large base load power plants or small, decentralized electricity generation. Micro and small-scale hydropower systems are the cheapest renewable energy options and can be important reliable components in mini-grid projects for rural electrification.[5]
- **Use of pumped-storage hydropower to integrate other renewable energy into the grid:** Due to their large energy storage capacity and reliability, pumped-storage hydro projects are a valuable way to smooth the generation from intermittent renewable energy sources such as wind and solar.

Challenges to using hydropower

- **Land use and water use issues:** Large hydropower systems often require significant alterations to the river bed and surrounding region, which can create social and environmental pressures. Thus not all hydro power is sustainable. Often hydro projects are written off as unsustainable, based on their size alone. It is important to classify projects as sustainable or unsustainable by basing them on concrete measurements and criteria.
- **Potential transboundary conflicts:** In many areas, water resources cross national borders. Damming of rivers for hydropower projects may impact water resources in other countries. Water use issues gain a level of complexity when disputes arise between water resource users in two or more countries.[6]
- **Adapting to changing climates and water scarcity:** Changes in rainfall patterns as a result of changing climate can impact hydropower resources and the generation potential. Reduced water flows in many rivers will be the primary cause of reduced power generation. Erratic and more intense rainfall can lead to increased soil erosion; the increased sediment in water flows can reduce hydropower generation capacities and make operations and maintenance more complex and expensive.[7] Some areas are projected to see increased hydropower potential, but more intense rainfall could lead to flash flooding and landslides, which could threaten hydropower infrastructure and generation.[8]
- **Community dissent:** Large-scale land use changes can also lead to community objection to new hydro power projects.

Implementing strategies

Impose sustainability criteria for hydro projects: Standardized environmental and social sustainability criteria for hydroelectric plants at a national level can help stimulate the development of hydro projects, including large hydro projects. Such criteria may gauge: water-quality impacts, impacts on water flow and other water users, fish passage possibilities, ongoing environmental and social management programmes in place, impacts on human settlements and the degree of inclusion of local communities in the development process.[9] Projects that do not meet the set criteria should not be classified as renewable or sustainable energy projects and should not profit from policies in place to foster such developments.

[5] Alliance for Rural Electrification, *Hybrid Mini-Grids for Rural Electrification* (Brussels, 2011).

[6] Lars Christian Moller, *Transboundary River Conflicts over Hydropower and Irrigation: Can Multilateral Development Banks Help?* CREDIT Research Paper (Nottingham, United Kingdom, University of Nottingham, 2005). Available from www.nottingham.ac.uk/credit/documents/papers/05-09.pdf (accessed 30 November 2011).

[7] Government of Bhutan, *Securing the Natural Freshwater Systems of the Bhutan Himalayas: Climate Change and Adaptation Measures on Water Resources in Bhutan* (2011). Available from www.bhutanclimatesummit.org.bt/paper/Water_Paper_Bhutan.pdf (accessed 30 November 2011).

[8] Intergovernmental Panel on Climate Change, *Climate Change and Water* (Geneva, 2008).

[9] International Energy Agency Hydropower, *Update of Recommendations for Hydropower and the Environment* (Paris, 2010). Available from www.ieahydro.org/uploads/files/finalannexxii_task2_briefingdocument_oct2010.pdf (accessed 30 November 2011).