Hydropower

HIGHLIGHTS

■ **PROCESS AND TECHNOLOGY STATUS –** With a total capacity of 723 GW_e (21% of the world's electric capacity), hydropower generates about 3190 TWh per year, which is equivalent to 16% of global electricity generation. Hydropower plants provide at least 50% of the total electricity supply in more than 60 countries. They also provide other key services such as flood control and irrigation. Hydropower plants consist of two basic configurations based on ■ **dams** with reservoirs and ■ **run-of-the-river** plants (with no reservoir). The dam scheme can be subdivided into ■ **small dams** with night and day regulation, ■ **large dams** with seasonal storage, and ■ **pumped storage** reversible (generating and pumping) plants for energy storage and night and day regulation, according to electricity demand.

■ **COSTS –** The investment costs of large (>10 MW_e) hydropower plants range from \$1750/kW_e to \$6250/kW_e and are very site-sensitive, with an average figure of about \$4000/kW_e (US\$ 2008). The investment costs of small (1–10 MW_e) and very small (≤1 MW_e) hydro power plants (VSHP) may range from \$2000 to \$7500/kW_e and from \$2500 to \$10,000/kW_e, respectively, with indicative, average figures of \$4500/kW_e and \$5000/kW_e. Operation and maintenance (O&M) costs of hydropower are between 1.5% and 2.5% of investment costs per year. The resulting overall generation cost is between \$40 and \$110/MWh (typical \$75/MWh) for large hydropower plants, between \$45 and \$120/MWh (typically, \$83/MWh) for small plants, and from \$55 to \$185/MWh (\$90/MWh) for VSHPs.

■ **POTENTIAL AND BARRIERS –** Important technical potential for new hydropower capacity remains in Asia, Africa and South America. A realistic figure would be from 2.5 to 3 times the current production. In the IEA Energy Technology Perspectives Scenarios, (i.e. ACT and BLUE scenarios), hydropower capacity is projected to more than double (up to 1700 GW_e) between now and 2050 and the hydro-electricity production is projected to reach about 5000-5500 TWh per year by 2050. However, future hydropower production could be affected by climate change. The potential impact is not yet really understood and must be investigated in more detail. Key issues and challenges for new hydropower projects include the general scarcity of water and land resources in most parts of the world, the social and environmental impact of large hydropower plants, and the long distances between new resources and consumers (Latin America). These challenges are likely to limit the hydropower potential.

PROCESS AND TECHNOLOGY STATUS – With a total installed capacity of 723 GW_e (21% of the world's electric capacity), hydropower generates approximately 3190 TWh per year, equivalent to 16% of global electricity generation. Hydropower plants provide at least 50% of the total electricity supply in more than 60 countries. They also provide other key services such as flood control, irrigation and potable water reservoirs. Hydropower is an extremely flexible electricity generation technology. Hydro reservoirs provide built-in energy storage that enables a quick response to electricity demand fluctuations across the grid, the optimisation of the electricity production, and the compensation for losses of power from other sources. Hydropower plants consist of two basic configurations based on **dams with reservoirs,** and the **run-of-the-river** scheme (with no reservoir). The dam scheme can be subdivided into **small dams** with night and day regulation, **large dams** with seasonal storage, and **pumped storage** reversible plants (for pumping and generation) for energy storage and night and day regulation according to electricity demand. Small-scale hydropower is normally designed to run in-river. This is an environmentally friendly option, because it does not significantly interfere with river flow.

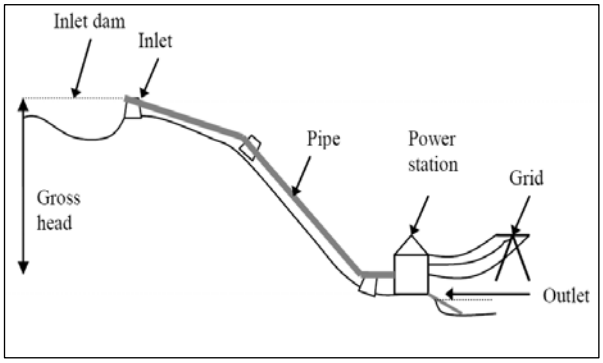

Fig. 1 - Generic scheme of hydropower plants based on a dam (Bøckman et al, 2006)

Small hydro is often used for distributed generation applications the same as diesel generators or other small-scale power plants, and also to provide electricity to rural populations. A generic scheme of a hydropower plant based on a dam and reservoir is shown in Figure 1 (Bøckman et al, 2006). OECD countries produce currently half of the global hydroelectricity. However, non-OECD share is likely to increase quickly as most of the hydropower potential still to be developed is located in non-OECD countries. China, for example, with the completion of the Three Gorges dam, is in the process of adding some 18.2

Please send comments to Paul Lako, Author (lako@ecn.nl), and to
Giorgio.Simbolotti@enea.it and Giancarlo Tosato (gct@etsap.org), Project Coordinators