Large dams and their changing roles

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The importance and relevance of dams all over the world have gone through ups and downs during the past decades. Until about 1975, in general, in nearly all countries, large dams were considered to be beneficial for the social and economic development of the countries. In fact, President Roosevelt used large dams as a means of regional development for the economic revival of the country and to create millions of jobs for unemployed Americans. His 'New Deal' was to help America to recover from the Great Depression. During the late 1960s, slowly but steadily, controversies developed on the social and environmental impacts of large dams. The controversies increased during the 1990s and reached their peak during the decade of 1995–2005.

In developed countries like Canada, Japan and most of the western European countries, the construction of large dams was basically complete by 1975. Dams, by then, were built in most of the economically attractive sites in these countries. Coincidentally, in the majority of these developed countries, where there were not many preferable dam sites left to be built, vocal social and environmentalist activist groups emerged during the post-1975 period. These single purpose groups were viscerally against the construction of large dams. Many of these activists, single issue (i.e, no large dams) NGOs were well funded by the Western funding institutions, which gave them the wherewithal to work against the construction of new large dams which were almost exclusively in developing countries, and not in their own countries.

During this period, basically three groups of opinions evolved, which were mostly based on disciplines. Overall, engineers, economists and policymakers, especially in developing countries, were in favour of large dams because of their contribution to economic and other development-related benefits. Social and environmental activists mostly highlighted their adverse impacts on the people who had to be involuntarily resettled because of the construction of dams and reservoirs, with a social justice narrative. Biologists and ecologists were against the adverse impacts on fish and riverine ecosystems. These three groups very seldom talked to each other.

What was missing during these discussions was the simple fact that any major infrastructure project like large dams will always have positive and negative impacts. What was, and still is, needed, is an objective assessment of all the benefits and costs of any such large infrastructures, and to see how the benefits can be maximized and the costs be minimized, so that the net benefits to the society are maximized. Also important, as in any other field of decision-making, is who benefits, and who pays the costs, of the proposed infrastructures. Thereafter, policies should be formulated to ensure that the people who may have to pay the costs become direct beneficiaries of the project.

Countries like Bhutan and Brazil have already formulated policies so that people paying the costs, that is, those who have to be resettled involuntarily, are not only adequately compensated for their property losses and possible livelihood changes, but also receive other benefits. For example, Bhutan now ensures that all the families that have to be resettled receive free electricity perpetually. In Brazil, all upstream communities get a percentage share of hydropower sales, again perpetually.

As we approach the second quarter of the 21st century, the global discourses on hydropower are rapidly changing. As climate change has taken the centre stage in many global and national discussions, hydropower has rapidly regained strong national interest in many countries as a 'green' source of renewable electricity that needs to be harnessed as efficiently and as equitably as possible. Consequently, in 28 developing countries, with a total population of 800 million, hydro is now the main source of electricity generation.

Hydropower is a flexible and secure form of electricity generation. For example, hydro generation can be increased and decreased very rapidly compared with other types of energy generation by coal, nuclear or gas. This means power generation through hydro can be quickly adjusted to meet the changing demands of a region, or rapidly compensate for fluctuations in supply from other electricity sources. For example, solar and wind electricity generation processes vary with climatic factors like weather conditions and time of the day or year. When solar or wind generation capacities are low, hydropower can

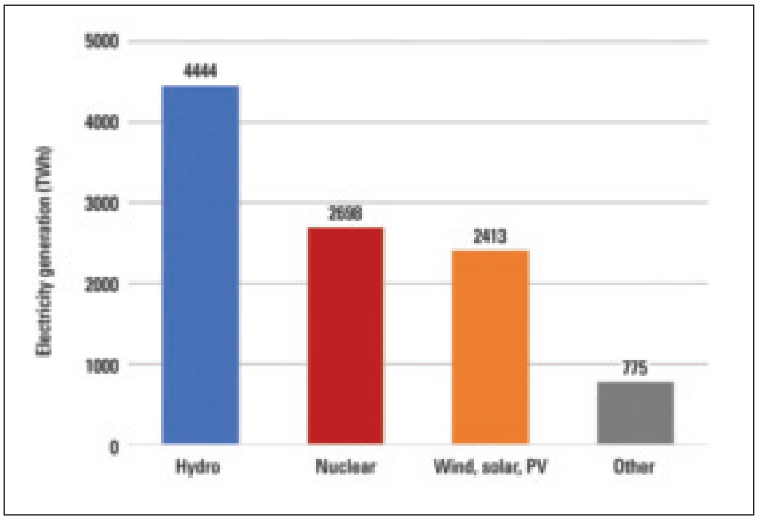

Fig. 1. Low carbon electricity generation by type, 2020 renewables [IEA, 2021].

easily and promptly fill the gap, thus making it an efficient alternative for low-carbon electricity generation whenever necessary. This flexibility and security mean hydropower can, and will, become an important means to ensure the reliability and security of any electrical transmission system. According to IEA [2021], hydropower now accounts for nearly 30 per cent of the global capacity for flexible electricity supply. Properly planned and managed, it has the potential to play a significantly more important role in the coming decades.

In terms of low carbon electricity generation, hydropower is at present the most important source. In 2020, the latest year for which data are available from the IEA, total global hydropower generation was 4444 TWh, compared with 2698 TWh by nuclear, 2413 TWh by wind and solar and 775 from others. This is shown in Fig. 1.

The future of hydropower

China has been playing the most important role in hydropower generation in the world in recent decades. For example, between 2001 and 2010, China accounted for nearly 60 per cent of the global growth in hydropower. This share of new construction has been steadily declining since then, for two important reasons. First, dams have been constructed in most of the economically attractive sites, or are under construction. Second, many of the new sites left tend to have high social and environmental costs. Despite this, China is likely to account for a lion's share, that is 40 per cent, of new global capacity growth during the period 2020–2030.

Globally, however, about half the economically feasible sites for hydropower have yet to be developed. This will provide the world with a new and important source of electricity since, over the entire lifecycle of a plant, hydropower provides one of the lowest carbon emitters per unit of electricity generated. IEA [2021] estimates that between 2020 and 2030, new global hydropower generating capacity is likely to increase by about 17 per cent, or 230 GW. This will be nearly a 23 per cent decrease compared with the 2010–2020 period. This will be primarily because of the slower rate of hydropower development in China.

Of this new growth in hydropower generation, 56 per cent is likely to come from conventional reservoirs, 29 per cent from pumped storage, 13 per cent from run-of-river plants and 2 per cent from unclassified sources (see Fig. 2).

China's role in promoting global hydropower development should not be underestimated. Nearly half of the new hydropower plants in Sub-Saharan Africa, Asia and Latin America, will have some form of Chinese involvement in terms of construction, financing and/or ownership. There is absolutely no question that China will remain the most important country in the world in terms of hydropower development for years to come.

As noted earlier, construction of new hydro projects in North America and Western Europe was largely completed by 1975. This means that by 2025, most of them will be more than 50 years old. These plants, and especially their electro-mechanical equipment, will require major overhauls. IEA (2021) estimates that modernization of all the ageing hydro plants of the world, that are more than 55 years old, would require $300 billion between 2020 and 2030, more than twice the amount that is currently estimated to be available. Thus, financing for the upgrading of existing hydro plants will become an increasingly important issue during the present decade.

Dams are built not only for hydropower, but also for other major uses, such as irrigation, flood control and navigation. A major issue which all the large dams will be facing in the future is how to operate their reservoirs optimally, when climate change is contributing higher and extended extreme events like droughts, floods and heatwaves. Managing droughts means that reservoirs should be as full as possible, so that water could be provided to downstream areas reliably, and floods will require reservoirs to be as empty as possible so that flood waters could be effectively stored in reservoirs. Intense and prolonged heat waves would mean increased needs for electricity for air conditioning, which will require more electricity generation from hydro and other powerplants. Reconciling all these diametrically opposite requirements will need a much higher level of expertise in reservoir management than was ever needed before. This will require much higher levels of rainfall and runoff forecasting than ever before in history. This could become an achilles' heel for managing hydropower plants in the future.

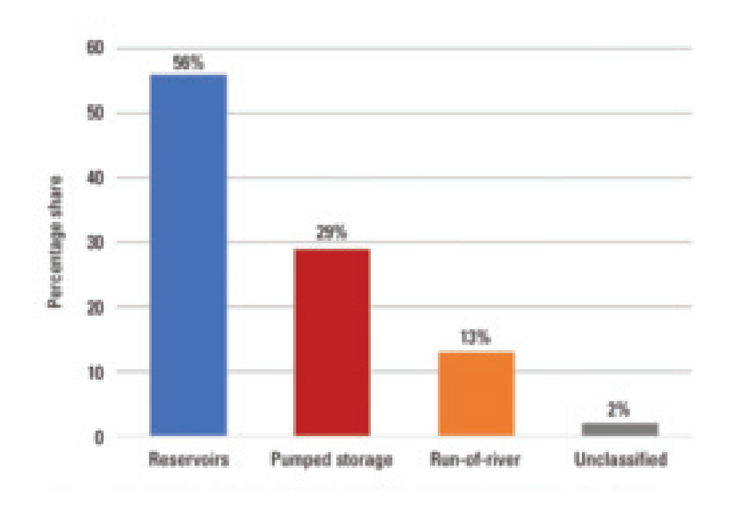

Fig. 2. Net hydro capacity additions by type, 2020-2030 [IEA, 2021].

Bibliography

Biswas, A. K., "*Impacts of Large Dams: Issues, Opportunities and Constraints*", In: 'Impacts of Large Dams: A Global Assessment'; Springer Verlag, Berlin, Germany. Eds: Tortajada, C., Altinbilek, D., and Biswas, A.K.; 2012.

British Petroleum (BP), "*BP Statistical Review of World Energy*", 71st edition; available at: www.bp.com; 2022.

IEA, "*Hydropower Special Market Report. Analysis and forecast to 2030*", International Energy Agency, Paris, France. Available at the website: www.iea.org; 2021.