



IEA Hydropower

Annex IX: Valuing Hydropower Services

Executive Summary

The IEA Hydro's recent work on Valuing Hydropower Services (Annex IX) included a multi-country review that investigated the many factors contributing to the full value of hydropower and its associated services. It is apparent that in many jurisdictions, the multiple value chains are not always appropriately recognised. As power systems transition and hydropower adjusts to new operating conditions, utilizing new or existing technologies, IEA Hydro members believe it essential that policy, regulatory and financial instruments evolve to appropriately recognise the important contributions that hydropower provides. Understanding these roles was an objective of the recently published Summary Report, which covered:

- Services provided to energy security, water security and sustainable development;
- Basic methodological concepts to assess the value of services;
- Suitable economic assessment approaches to quantify the value of services
- Preliminary valuations of key energy and water management services
- Initial assessment of the appropriate valuation methods for each service
- Basic methodologies to estimate fair allocation of costs between various stakeholders

The report, with appendices, identified methodologies useful in assessing the various value streams, broadly differentiated between hydropower production and water management and their related services. Means exist to reasonably estimate the value of water services, however, understanding the full value of hydropower energy services is more challenging. An increased level of detail is required and a handbook on international best practices was planned, as the basis for analysing the full value of hydropower. Undertaking such an analysis would help ensure appropriate levels of investment and reinvestment in critical hydropower infrastructure, which in turn would support the orderly and profitable transformation of electricity markets.

Energy Services

The role of hydropower in centralised grids is recognized as the most flexible low emissions source of electricity. However, power, energy, storage, and flexibility services are often classified and compensated in different ways in their respective markets. This report highlights the methods applied to value energy services, which can vary significantly between regions, based upon the context in which they are being assessed. For instance, methodologies applied may differ due to: the type of service being assessed; characteristics of the electricity market in which the service is assessed; the perspective and objective of the stakeholder conducting the analysis; the tools used to value the service; and the time-frame in which the analysis is being conducted. This report reviews the most frequently utilised approaches to value energy services, including: market-based valuation; avoided cost valuation; cost-based valuation; and qualitative valuation analysis.

Globally, many aspects of power system transformation are underway, including the rapidly increasing levels and sources of Variable Renewable Energy (VRE). Previously, balancing the lower levels of VRE penetration was achieved mainly through conventional sources of hydropower storage and thermal generation. With most countries having levels of VRE penetration below 30%, this is generally manageable. However, levels in excess of 30% introduce constraints to the system that can be hard to manage. The future prognosis is that energy storage will take on an increasingly important role, driving development of hydropower storage reservoirs and pumped storage schemes. Future generation investment must evolve in an orderly manner addressing the 'Energy Trilemma' of Supply Security, Affordability and Environmental Sustainability.

Water Services

It can be considered that all hydropower developments are multipurpose and that in addition to power production, consideration has to be given to water management services within the context of the water/energy nexus. Rivers and reservoirs are fundamental to sustaining life and economies. The breadth of services range from sustaining healthy ecosystems to providing water supply and irrigation diversions to enhance agriculture. In some regions, flood mitigation and drought management predominate, while in others, recreation and navigation are important. In each case, appropriate valuation of the water management services is crucial to decision making around overall development and management. Valuing a diverse range of water services is typically more difficult than valuing energy services. As such, this report considers a variety of methodologies that can be employed to determine the costs and benefits associated with various water services. For instance, the value of flood control benefits is derived from the avoided costs of flood damage, less the costs of providing storage space, whilst the value of recreational use can be based on survey results assessing a consumers' willingness-to-pay to engage in a given recreational activity on the reservoir. Services considered cover:

- Water Quantity Management
- Water Quality Management
- Regional Development
- Human Development
- Environmental Goals

Future Activities

Flexible Energy and Balancing Services

IEA Hydro recognizes the crucial role that hydropower provides for balancing power systems, as VRE penetration expands rapidly, and as an alternative to flexible operation of gas and coal fired thermal plants. This dynamic should present as a significant and profitable opportunity for producers of hydropower services. Therefore the Annex will continue into a second phase of collaboration to address the future role(s) of hydropower as a critical dispatchable renewable energy source. These will include:

- technical issues for hydro balancing and providing flexibility services
- market and commercial aspects
 - costs (capital and operating) associated with the provision of storage and energy services,

- value to the electricity network in providing these services.

This next phase will highlight the important role for hydropower in new and transitioning power systems globally. Results from R&D projects in member countries will provide input to a Roadmap, having the objective of appropriately valuing (and incentivising) hydropower balancing services. Important aspects include:

- clearly identifying the role of hydropower and the energy services provided in various future scenarios,
- addressing issues, alternatives and options for flexibility and balancing
- estimating costs and benefits for the power system

The Roadmap would conclude with the future profitable roles that hydropower can provide in providing storage and other services (such as balancing VREs) and what is required to enable this outcome. This has to be achieved within the overall market goals of providing safe and reliable energy and meeting environmental and social objectives at minimum cost of service.

Water Management Services and Climate Change

Climate change is a crucial factor in the consideration of water management services with impacts already being observed and documented through flood and drought events. Countries with large hydropower storage can help balance water flow and reduce impacts from such events. Phase II will consider designs and operational changes that mitigate these impacts. Also covered will be enhanced options for flexible operation where flood routing is strongly linked to reservoir capacity and pumped hydro schemes. The impacts of climate change on other water management services, such as irrigation, potable water supply, navigation and transportation, recreation and tourism are also issues that will be included in Phase II.