

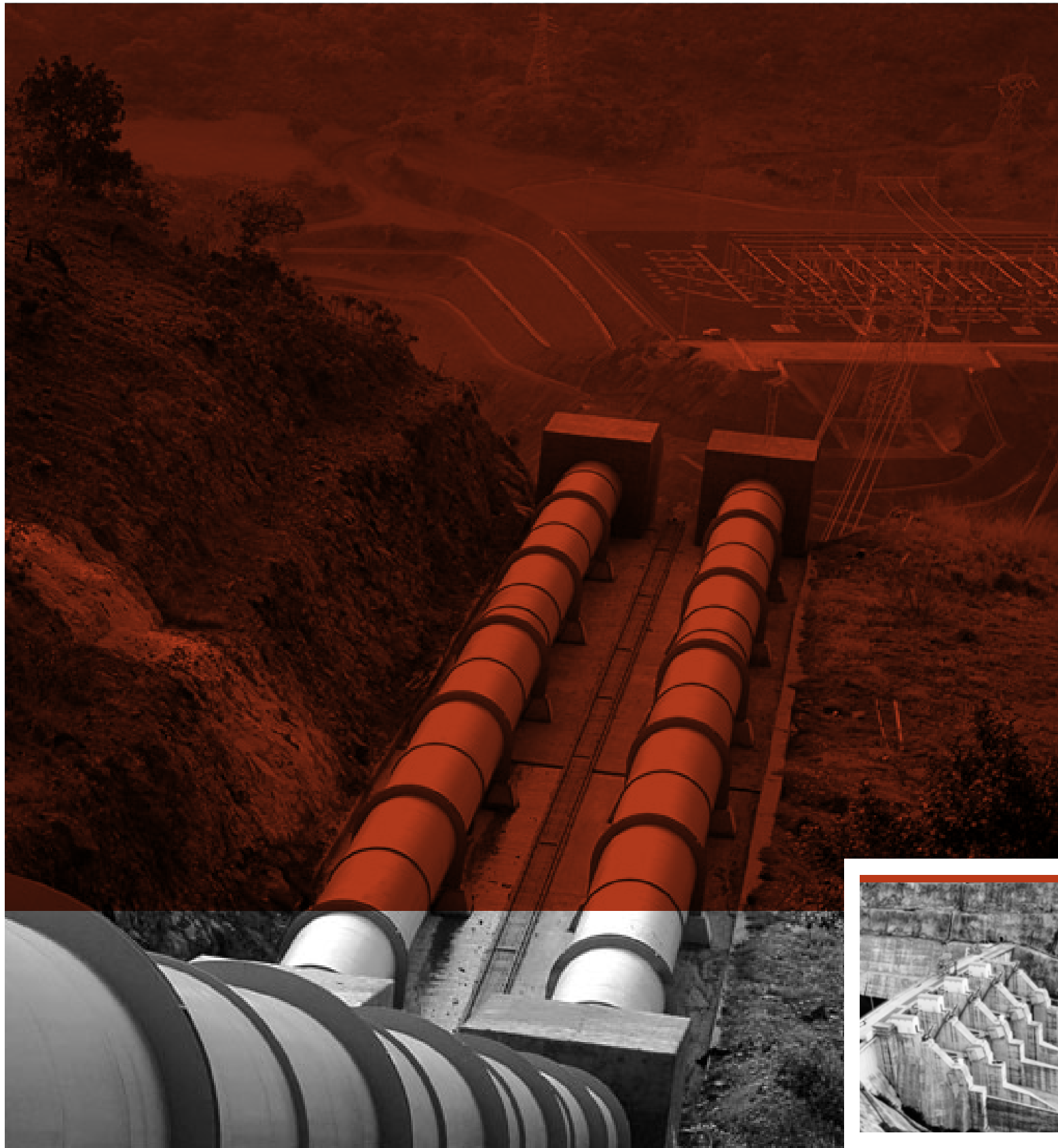


Hydropower and regional development:

case studies

2013

with the support of



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“The opportunities and benefits associated with regional hydropower development can increase in tandem with the number of countries concerned, as can the complexities and potential risks.”



Foreword

Hydropower is often a major factor in economic and social development at local, national and regional levels.

With the increasing number of interconnectors between electricity systems, and 260 of the world's rivers crossing at least one national boundary, the future development of hydropower often involves cooperation with stakeholders from neighbouring countries.

The opportunities and benefits associated with regional hydropower development can increase in tandem with the number of countries concerned, as can the complexities and potential risks. The International Hydropower Association (IHA), in collaboration with the International Finance Corporation, the Asian Development Bank, the Inter-American Development Bank, the World Bank, and other interested parties, has explored these issues through a series of regional workshops in Africa, Asia and Latin America.

Each workshop has allowed participants to share their expertise on the complex negotiations and agreements required to optimise regional development.

The IHA regional workshop held in Addis Ababa, Ethiopia (April 2011), recommended that "further emphasis be put on coordinated and harmonised regional development." The conference advised that harmonised governance was crucial for the sustainable development of hydropower in river basins crossing national boundaries. At the same time, regional power pools can increase the financial viability of hydropower development projects and deliver wider benefits.

Since 2011, regional workshops have highlighted three key areas for cooperation between groupings of

countries:

1. The potential to share cross-border electricity supply through regional power trading pools and the expansion of regional energy markets;
2. The need to minimize the social and environmental impacts on a given river or river basin through a shared strategic plan;
3. The potential to locate energy-intensive industries close to hydropower resources, to reduce the need to utilize more polluting sources of energy.

Through these workshops and its ongoing Regional Cooperation Work Programme, IHA aims to further knowledge and share understanding of the role of regional cooperation, while supporting the continuous improvement of hydropower development practices.

Building on this momentum, the most recent workshop was held in Malaysia (May 2013) in association with the IHA World Congress.

This report summarises the discussions that took place in the 2013 workshop, as well as the case studies that were presented. IHA takes this opportunity to acknowledge the organisers, speakers and participants, coming from all continents, that have helped continue this dialogue in one of the most dynamic regions for hydropower development.



Interconnection for electricity trading purposes, can result in lower energy costs, future-proofing, political will and institutional capacity, trust among all stakeholders

Regional interconnections

Regional energy market strategies vary. Some countries rely on bilateral interconnections, while others operate on the basis of broader regional-level energy trading. Regional schemes that affect a number of countries will increasingly require transnational governance to ensure that energy is efficiently and fairly distributed. As such, countries need to work together to improve system-level efficiencies, and more effectively balance supply with demand across a larger geographic region. This can reduce the need for power reserves in individual countries.

Cross-border interconnections that can be facilitated in part by hydropower development can bring about broader cooperation between nations, improving the business case for large-scale hydro developments while reducing dependence on fossil fuels.

The Kuching regional workshop explored the role of hydropower in enhancing regional interconnections through two distinct developed and developing country case studies.

Case study

Canada and the United States

Presenter: Mr. Ken Adams, Senior Vice-President, Power Supply, Manitoba Hydro

Canada and the United States are both key players in hydropower. Canada consistently ranks among the top five countries in the world in terms of hydropower generation, with over 60% of its electricity production generated from this source. Five of Canada's thirteen provinces and territories provide the bulk of the country's hydropower capacity, even though potential exists throughout the entire country. More of Canada's hydropower generation is traded across the border with the United States than within Canada, forming the basis of a mutually beneficial relationship between the countries.

The case study focused on the province of Manitoba and its export of excess capacity to the Northern Mid-Western United States. Although this imported hydropower accounts for a small percentage of the US' electricity, it plays an important regional role displacing thermal generation with renewable energy.

The importance of replacing thermal generation with a cleaner energy source has increased in recent years and has driven demand for hydropower from Canada as part of cross-border trade.

A key issue raised in the workshop was the lack of harmonised national policies on the development of cross-border transmission lines. The Canadian and American electricity systems were developed separately, but have been brought closer together as a result of cross-border negotiations shaped by shifting national and regional policies.

As a result, changing policy dynamics have reduced some of the potential efficiencies usually associated with regional interconnections. Transmission infrastructure and markets that are specifically designed for the purpose of regional trading from the outset are likely to deliver significantly greater benefits.

Regional interconnections:

Case study

India and Bhutan

Presenter: Mr. Kaoru Ogino, Principal Energy Specialist, Asian Development Bank

Bhutan has excess hydropower capacity, and is geographically situated next to India which has a high demand for electricity. While Canada and the US face similar challenges, India and Bhutan are in earlier stages of economic and energy system development.

The case study focused on the Dagachhu Hydropower Project in Bhutan, which exports 88% of the energy it generates to India, and is the first cross-border hydropower project to be financed through the Clean Development Mechanism (CDM). According to the existing power purchase agreement between India and Bhutan, the remaining 12% will be paid in the form of an energy royalty or cash to the Bhutanese government (the latter arrangement in the event of an energy surplus) over the next 25-year period. Bhutan therefore benefits from more reliable connections to its neighbours, while expanding its electricity market. The project helps to ensure that it is moving from being a “land-locked” country to a “land-linked” country.

The main factors that made regional hydropower development possible were shown to be public-private partnerships; equity sharing; financial leveraging; the Clean Development Mechanism; sound policy frameworks; and implementation of a sector-wide approach. It was noted that when project proposals are well-structured with strong legal and policy frameworks, they are more likely to be developed.

In developing countries, the lack of grids connecting regions is a common problem. Funding for hydropower development in countries similar to Bhutan is often partially provided by the neighbouring country that receives the greater share of energy generated, along with finance provided by multilateral banks such as the Asian Development Bank (ADB).

Increasingly, actors such as the ADB are providing funding for long-distance transmission infrastructure so that power generation can have a greater impact on development throughout the region as a whole. For example, a transmission interconnection between Bangladesh and India, which was commissioned in October 2013, could allow Bhutan to further extend its electricity market.

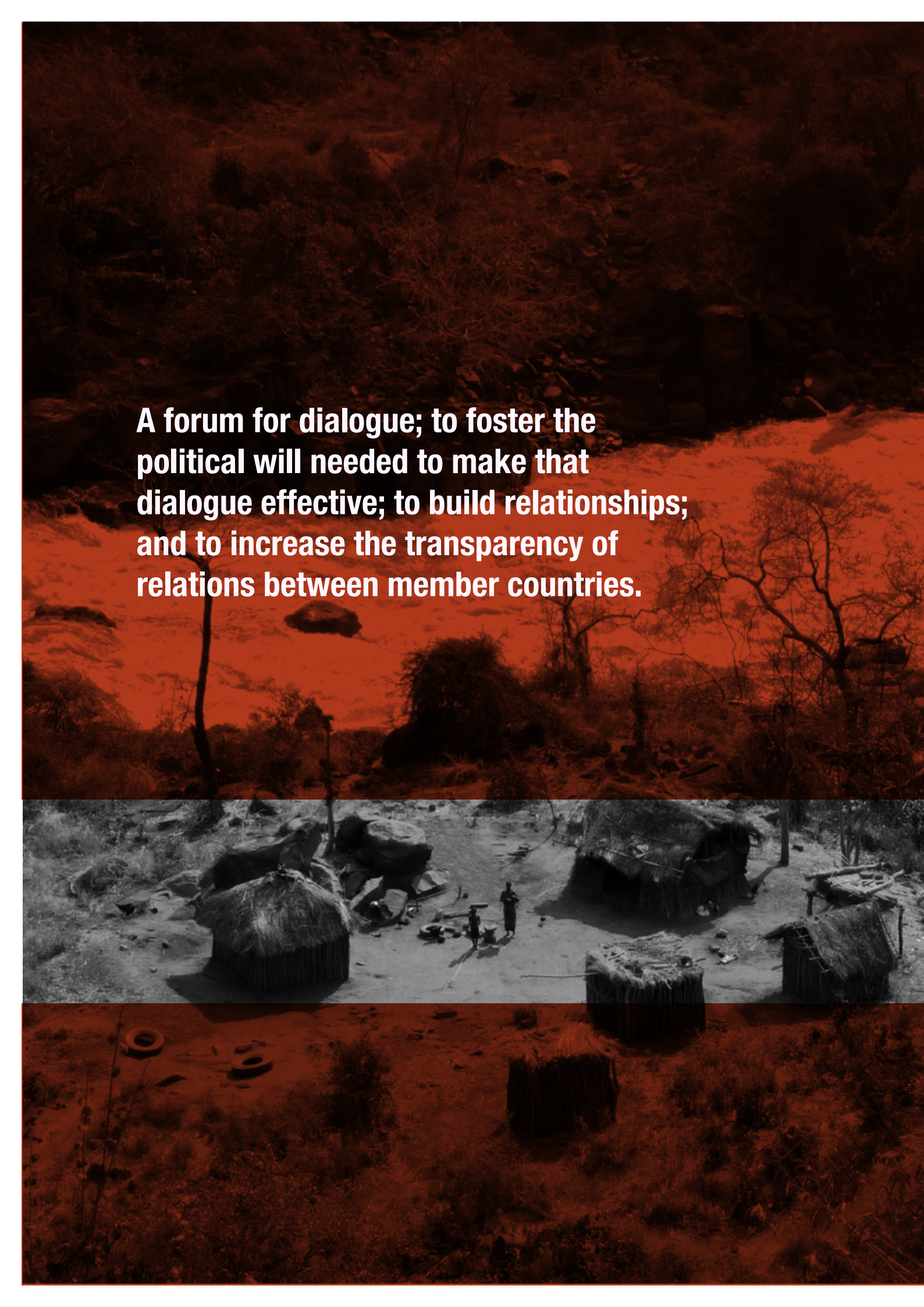
In order to secure funding for cross-border transmission assets, investors need assurances that not only will the construction of transmission infrastructure go ahead, but that the source of power generation will also be built. Strong legal frameworks and agreements, in addition to corporate goodwill, are all needed to avoid stranded assets.

Regional interconnections:

Key discussion outcomes

The key outcomes of the discussion that followed the presentations indicated that:

1. Interconnection for electricity trading purposes can increase the viability of hydropower projects that would otherwise not be feasible due to the domestic mismatch between large hydro potential and lower energy demand;
2. Interconnection can result in lower energy costs for trading partners, with the added benefit of cleaner generation. It can be significantly cheaper to import excess hydropower than to build local thermal power plants;
3. When planning interconnections, it is advisable to future-proof plans and designs to allow for growth. Adding in infrastructure later, once the region is more developed, will be complicated and costly;
4. Political will and institutional capacity are vital to navigate the complexity and cost associated with regional hydropower projects and related interconnections. National regulatory frameworks vary, and require some level of harmonisation or coordination, otherwise project proponents may be required to comply with varying approval and permitting processes in all participating countries. The burden of regulatory compliance could add to project challenges and is likely to inflate project management costs;
5. Trust must be established among all stakeholders, including international actors and the private sector, in order to manage: the political complexities associated with the allocation of power generation and benefit sharing; concerns regarding the security of water bodies; the exposure of participating countries to hydro variability risks; and the political uncertainty associated with regime change in participating countries. Stakeholders also need to cooperate to secure financing for the necessary grid infrastructure and the planned interconnections.

The image is a vertical composition. The top two-thirds are a photograph of a river flowing through a dry, hilly landscape, heavily tinted with a dark red color. The bottom third is a black-and-white photograph of a village with several round huts with thatched roofs. Two people are visible in the center of the village. The entire image has a high-contrast, somewhat grainy quality.

A forum for dialogue; to foster the political will needed to make that dialogue effective; to build relationships; and to increase the transparency of relations between member countries.

River basin perspectives

More than 260 of the world's river basins are shared by at least two countries as they have developed according to natural geography and topography, irrespective of political boundaries. People, businesses and governments that rely on rivers for their livelihoods, economic development, and cultural identity may all stake claims to them.

Development of hydropower, industry, agriculture and abstraction along rivers can create great potential for conflict. Cooperation in sharing the water and other natural resources as basins are developed is therefore critical to achieve development goals, as well as fostering regional stability and trust. There are many formal and informal actors involved in river basin development at the local, national and international levels that should be continuously engaged in the dialogue supporting this cooperation.

The case studies presented in this session explored the strategies necessary to achieve successful cooperation between riparian states and other stakeholders. This cooperation is also a crucial component in achieving satisfactory river basin development plans, and in differentiating the roles of the public and private sectors.

River basin organisations (RBOs) fulfill important functions in managing shared watercourses, in conflict avoidance, and in achieving conflict resolution. These functions include:

- Establishing legal principles and rules;
- Providing a forum for dialogue and negotiation;
- Providing technical expertise;
- Sharing data and information;
- Developing benefit-sharing mechanisms;
- Providing forums for stakeholders and dispute-resolution.

The two presentations covered the spectrum from the project and watershed level, to perspectives on the broader institutional and governance mechanisms required for effective management of hydropower development in a river basin.

River basin perspectives: Case studies

Mekong Region

Presenter: Dr. Pech Sokhem, Co-chair, M-POWER

This presentation indicated that even in cases where there are institutions in place to govern hydropower development on rivers, they need to evolve continuously in order to keep pace with a dynamic external political and economic environment, and with changing stakeholder expectations. Institutional mechanisms must be able to develop the appropriate systems, processes and procedures to address these changes.

In addition, the institutional mechanisms that are in place are often focused on one river only. Of the 57

international rivers in Asia, only 18 have river basin organisations in place.

Participants agreed that the mandate of any governance mechanism should cover the entire river basin. In addition, they should address all the various types of development occurring in the basin across all sectors, including (but not limited to) hydropower, irrigation and transportation.

Costa Rica and Vietnam

Presenter: Mr. Juan Quintero, Civil/Environmental Engineer, formerly of the World Bank

This presentation of two hydropower project case studies, one for Costa Rica and the other Vietnam, described innovative solutions used to address key impacts through a cumulative impact assessment on the entire river basin.

Cumulative impact assessment undertaken on a river basin basis is an effective tool for identifying the additional impacts from each project on the entire river basin and associated communities.

The presentation highlighted that in assessing and managing impacts on a project-by-project basis,

there is the risk that broader basin-level impacts of each new development will be overlooked. The river basin wide cumulative impact assessment, together with early-stage planning processes, such as strategic environmental assessments, can enable sustainable hydropower development.

The presentation stressed that, even with a cumulative impact assessment, effective impact mitigation measures and innovative solutions must be found and incorporated within management plans.

River basin perspectives:

Key discussion outcomes

The key outcomes of the discussion that followed the presentations indicated that:

1. River basin organisations, or similar institutions, provide an important platform for effective management of sustainable hydropower development on transboundary rivers. RBOs are often intergovernmental bodies that can facilitate ongoing dialogue, as has been the case with the Mekong. There is no single, permanent formula for success in managing shared rivers, and issues and opportunities should be continuously assessed and discussed;
2. The RBO or a given multi-stakeholder body, should be a repository of knowledge and lessons learned. This will, assist capacity building, knowledge transfer, and evidence-based analysis in support of effective decision-making, dispute resolution and equitable solutions. Knowledge should come not only from the affected river basin, but also from other river basin organisations through networks and information exchanges;
3. Multi-stakeholder groups overseeing regional energy governance should apply international industry practices, standards and tools, and ensure that these are adopted by the hydropower sector in the river basin or region. These can be applied to the assessment, planning, development and operational phases of any hydropower project in the absence of a fully harmonised cross-border policy. This is equally relevant in cases where river basins span several jurisdictions or nations;
4. The implementation of hydropower projects in developing countries should not come at an unacceptable cost to the environment or to local and indigenous societies. Tools such as the Hydropower Sustainability Assessment Protocol and the IFC's Performance Standards provide frameworks to guide the sustainable development of hydropower resources and improve standards. River Offset/Intact River is one innovative approach, where an alternative river with equivalent biodiversity value is conserved to protect a species or habitat that may be significantly impacted by hydropower development. This is relevant in situations where a river is already heavily impacted or where residual impacts are expected to remain;
5. A riverbasin-wide cumulative impact assessment is essential for sustainable hydropower development together with the use of early stage planning tools such as Strategic Environmental Assessments, and supported by an effective monitoring mechanism, to ensure implementation of agreed management plans.

In closing, the Chair noted that there was convergence on the key discussion outcomes, but that many more questions were raised that warrant further discussion. Sustainable hydropower development is complex, and it is important to have a river basin body to help resolve difficult issues. This can serve as: a forum for dialogue; to foster the political will needed to make that dialogue effective; to build relationships; and to increase the transparency of relations between member countries.

Bringing markets to the resource

Hydropower can be a powerful engine for economic growth, especially when linked with industries that seek low-carbon energy supply. Energy-intensive industries, such as metal, manufacturing, consumer goods, and internet data centres increasingly demand low-carbon energy either to offset a public perception of “dirty industry”, or to align themselves with corporate missions. At the same time, reliable energy is critical for these industries. Hydropower can meet both of these needs by providing a clean, reliable and affordable energy source for them.

Linking a country’s excess hydropower capacity or available potential to industries seeking such an energy source can be a win-win for both the companies involved, and for the economic development of the country or region. For developing countries, a secured major energy-user can help attract much needed investment to the development or expansion of hydropower. When

properly planned, that investment can benefit the local population by providing vital access to energy, driving local economic development, and creating jobs.

Connecting the hydropower resource to a national electricity grid can be a challenge given the often remote location of the resources and the lack of a robust domestic market for consumption of all of the energy produced. During the workshop, experts presented developed and developing country case studies where hydropower was used to attract industry to the point of generation, in spite of their remote locations, rather than transmitting energy over long distances. In these cases, attracting industry to remote sites served as a catalyst for hydropower development and economic development. The session explored how to successfully link generation with industries seeking a low-carbon energy supply.



Bringing markets to the resource:

Case study

Iceland

Presenter: Dr. Oli Sveinsson, Executive Vice-President, Landsvirkjun

Iceland, an island country located in the north Atlantic Ocean, operates on a 100% renewable electricity system, using hydropower (73%) and geothermal (27%). Iceland achieved this through a planned transition from fossil-fuel dependency to renewable energy, while at the same time promoting industrial development based on access to its clean energy sources.

Iceland's strategy began with the electrification of the country in the 1950s. The next phase, which continues to this day, began in the 1960s and was based on a concerted effort to attract power-intensive industries to Iceland through the offer of a reliable and affordable hydropower electricity source. Hydropower and industrial facilities were constructed simultaneously, which contributed to an increase in GDP of over 6%, the creation of 4,800 direct and indirect jobs, and some of the lowest electricity tariffs for domestic and industrial energy in Europe.

At present, 75% of electrical generation in Iceland goes to energy-intensive industries including three aluminium smelters, a silicon plant, and an aluminium foil plant. Iceland continues to engage with energy-intensive industries to encourage them to locate

in the country, including “new” industries such as internet data centres. Due to the current high share of electricity usage by energy-intensive industries, and the potential to exploit renewable energy further to meet this growing demand, key stakeholders have explored the feasibility of connecting the Icelandic electricity system to Great Britain with a submarine transmission cable. This could allow for direct export of renewable energy while also increasing the level of the energy security in both countries.

Over the past half century, Iceland has embarked on a strategic initiative to reduce its reliance on imported fossil fuels, especially oil, and to focus instead on the development of domestic resources including hydropower and geothermal. This initiative has been highly successful in that Iceland now has a 100% renewable electricity and heat system, and aims to convert its transport sector over time.

Bringing markets to the resource:

Case study

Sarawak Corridor of Renewable Energy

Presenter: Mr. Chang Ngee Hui, Economic Advisor, State Planning Unit of Malaysia

The Sarawak Corridor of Renewable Energy (SCORE) is located in the state of Sarawak in Malaysia. It is in an early, but rapidly progressing, stage of economic development and has sought to use strategic hydropower development to attract energy-intensive industry and stimulate economic growth. The aim of the initiative is to harness hydropower to help transform Sarawak into a developed state by 2030.

Within SCORE, managed by the state government, ten priority industries have been identified as potential consumers of the state's significant hydropower resources, and the government is actively working to attract these industries to locate operations in Sarawak. Samalaju is the heavy industry node of the SCORE initiative, which includes an onsite substation, the associated ICT infrastructure, a press metal works and a silicon manufacturing plant.

Sarawak's relatively remote geographic position limits opportunities for its economic and social development. The Sarawak state government

underwent a "thinking in reverse" approach, where instead of exporting a locally developed natural resource or product, it would bring these products to Sarawak for processing by establishing industrial development zones. These would serve not only as sources of direct employment, but would also stimulate the development of local capacity to provide services and equipment to these industries. Sarawak's strategy rests on the development of its hydropower resources as the foundation of the SCORE regional corridor.

Sarawak now has competitively priced clean energy to attract industry, based on the development of its hydropower resources. Hydropower is driving job growth and economic development in Sarawak.

Bringing markets to the resource:

Key discussion outcomes

Both case studies examined geographically isolated systems with sparse domestic populations. Attracting private sector foreign direct investment to these countries might typically have been considered challenging. Iceland has clearly demonstrated a development path that can be created using hydropower. Malaysia is following a similar path with early indications of success.

The key outcomes of the discussion that followed the presentations indicated that:

1. Hydropower can be a key component of economic development, particularly when taking advantage of hydropower's natural and historical links with industry;
2. Support from government is fundamental. Both cases presented at the workshop demonstrated a need for a very clear and defined strategy, commitment to success at the highest levels of government, and the use of tools to implement policy at all levels of government (municipal, regional and federal);
3. Coordination between government entities and the presence of a clear investment framework are important success factors. Non-energy sectors must be on board and represented by the government ministries responsible for industry, trade, agriculture, energy and water. These all have a role to play in attracting industry and coordinating the share of costs and benefits. These entities and others are also responsible for establishing and enforcing a strong investment framework, and in ensuring a fair approach to commercial agreements among the public and private sectors;
4. Collaboration between hydropower and industry should not come at the expense of local populations. When the market is brought to the resource, considering the impacts on local populations can make projects feasible. Projects will provide a number of national level benefits, which in turn can help to secure greater acceptance for projects if these benefits reach local populations, guaranteeing access to a new energy consumer base. At the same time, effort should also be made to manage the project trade-offs;
5. Look to the future and diversify. There is an established track record for the parallel implementation of hydropower and aluminium smelting. As a result, a number of other industries are seeking low-carbon, reliable energy sources, including internet data centres and vehicle manufacturing facilities. These bring more opportunities for hydropower development, but also for local jobs and skills development that can be built upon for further economic development.

It was noted that the topic of connecting markets to the resource – either through transmission or by attracting energy-intensive industry – is an often underrated benefit of regional hydropower development. However, countries seeking to attract industry need to have the right policy and investment frameworks in place, given the global competition among clean energy providers. Further analysis is required regarding the necessary supportive policy and financial environment in order to make this happen.

Overall conclusions

The case studies provided useful insights into the benefits of regional electricity interconnections, strategic river basin management, and the potential for clean energy such as hydropower to attract industry to remote project sites.

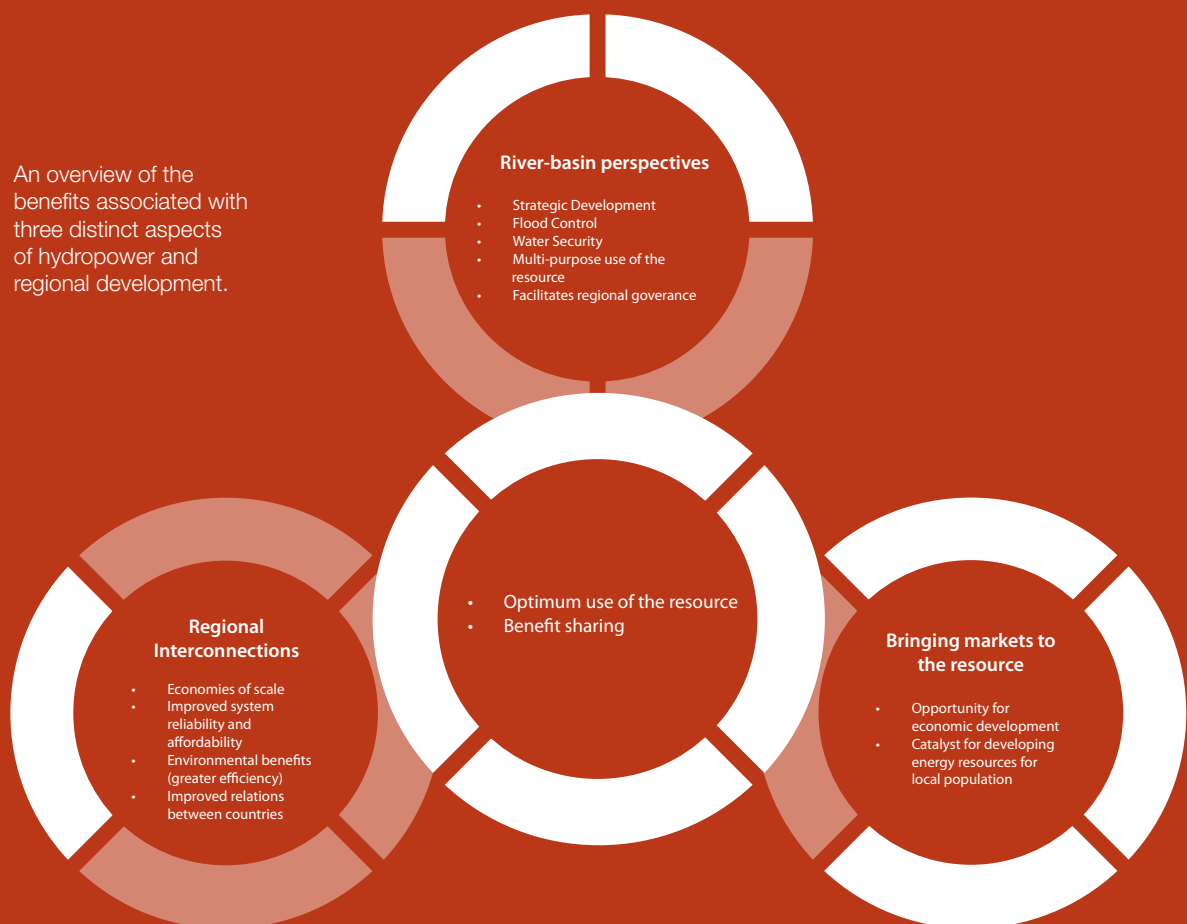
Despite the variety of regional perspectives and contrasting levels of economic development, the critical success factors appeared to be very similar. The presenters were in overall agreement on what was required to make hydropower development successful, and to maximise its value in regional development.

The case study presentations underlined the need to consider the following:

- The inherent complexity of hydropower projects that cross regional boundaries require strong government leadership and political will. The private sector should play a more collaborative role in project development, providing the necessary commercial expertise, and financial support;
- From a river basin perspective, the costs and benefits of water and electricity usage are crucial in profiling the risks and opportunities associated with given projects. Stakeholders require the appropriate tools to quantify the costs and benefits of water and electricity usage, and how these are shared among project proponents, particularly in cases where development is trans-boundary. The importance of river basin organisations in both brokering shared costs among project proponents and promoting the appropriate methodological standards should not be overlooked;
- The lost revenue from projects that fail to go ahead due to the lack of political support should be considered. This underlines the importance of international financial institutions and multilateral development banks in enhancing local capacity.
- Large-scale hydropower projects of the future will often involve multi-country collaboration. Although hydropower potential is often spread unequally between countries, all of those involved may incur different types of costs. To ensure cooperation throughout project implementation, options to encourage benefit sharing and redistribution must be considered;
- Regional cooperation engendered by regional hydropower development should be harnessed to promote political stability, economic benefits, energy security, environmental stewardship and improved water management. These should be factored into project decision-making and cost equations.

It is the intent of IHA to continue to work with its partner organisations to investigate and analyse the success factors outlined, and what may be required to implement the necessary supportive policy. We will continue to identify good practices, strategies and tools in order to make hydro work, and to optimise the value of regional hydropower development.

An overview of the benefits associated with three distinct aspects of hydropower and regional development.



Organiser



IHA

The International Hydropower Association (IHA) is a non-profit organisation, working with a network of members and partners to advance sustainable hydropower. IHA's mission is to build and share knowledge on the role of hydropower in renewable energy systems, responsible freshwater management and climate change solutions. IHA champions continuous improvement in the hydropower sector through dialogue with all stakeholders. Membership is open to individuals and organisations that support IHA's mission. IHA networks include: public and private companies, governments, NGOs, financial institutions, communities and academia.

For more information, www.hydropower.org

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ADB

The Asian Development Bank is an international development finance institution whose mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Headquartered in Manila, and established in 1966, ADB is owned and financed by its 67 members, of which 48 are from the region and 19 are from other parts of the globe.

For more information, www.adb.org



IDB

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For more information, www.ifc.org



World Bank

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For more information, www.worldbank.org