world hydropower congress

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Delivering on the Paris Agreement and the Sustainable Development Goals

The Power of Water in a **Sustainable, Interconnected World**

Organiser

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MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE

2019
Report

PARIS | 14-16 MAY

In this report

World Hydropower Congress Secretariat
International Hydropower Association (IHA)

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Introduction

The seventh World Hydropower Congress held in Paris in May this year, proved to be our most successful yet, with more than 750 delegates from a record 77 countries.

The theme for 2019, 'The Power of Water in a Sustainable, Interconnected World', highlighted hydropower's role in delivering on the Paris Agreement and the Sustainable Development Goals.

The congress engaged a diverse group of speakers and delegates from industry, government, social and environmental NGOs, academia, finance, and the United Nations.

There were 200 speakers, who addressed 40 focused sessions and workshops on topics such as sustainability, climate resilience, data solutions, working with indigenous communities, and supporting growth in other renewables.

Delegates addressed ways to promote sustainable projects, through financing and development, operations, maintenance and modernisation, and announced a range of initiatives to ensure hydropower projects and assets can bring maximum benefits.

Through knowledge sharing, capacity building and stakeholder dialogue, they shared views on how hydropower should be used to support broader social, economic and environmental goals.

In this report you will read the outcomes of discussions and proposed priorities for future action which emerged from the congress sessions.

The International Hydropower Association (IHA) is committed to promote collaboration across and beyond the hydropower industry to ensure that renewable energy can be provided to all in a sustainable way. We will continue to share solutions which support the delivery of climate and development goals.

IHA is a network of organisations and individual members active in more than 100 countries. If you believe in the sustainable development of renewable energy, we encourage you to join our organisation.

Organising partners

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Executive summary

Commitments underpin the renewable energy transition, manage climate risks and champion good practice

The World Hydropower Congress in Paris, 14-16 May 2019, drew more than 750 participants from 77 countries. The high-level event was organised by the International Hydropower Association (IHA) together with 50 partner organisations.

The congress brought together leading decision-makers, innovators and experts from industry, government, finance, civil society and academia to share their unique perspectives on hydropower and to set priorities for the sector's future.

Under the theme 'The Power of Water in a Sustainable, Interconnected World', the sessions focused attention on hydropower's role in delivering on the Paris Agreement and the Sustainable Development Goals.

On the eve of the congress, IHA published the 2019 edition of the Hydropower Status Report, showing electricity generation from hydropower achieved a record estimated 4,200 TWh in 2018, as worldwide installed hydropower capacity climbed to 1,292 GW.

UN DESA Assistant Secretary-General for Economic Development Elliott Harris addresses the opening session on 14 May 2019

Opening session

Ken Adams, President of IHA, opened the World Hydropower Congress with a call for greater collaboration across and beyond the hydropower sector. "The largest community which we are all a part of is the human community, living on a planet facing unprecedented stress and having to build consensus and achieve action to build a more sustainable future.

"We support the Sustainable Development Goals and believe the targets set by the Paris Agreement require us all to work harder to ensure that renewable energy can be provided to all in a sustainable way," he said.

The opening session saw speeches from representatives of the United Nations, business and non-profit organisations, and ministers and senior officials from Guatemala, India, Nepal, Norway, Sarawak (Malaysia) and the United States.

Maria Donoso, Director of Water Sciences at UNESCO, said her organisation was proud to be associated with the World Hydropower Congress. "This an opportunity to showcase the critical contribution of hydropower in addressing sustainable development challenges," she said. "There is a need to reduce emissions, notably by limiting the production of energy from coal sources and by embracing renewable sources of energy such as hydropower."

"This World Hydropower Congress in Paris is a fantastic opportunity to meet all the major international hydro players gathered to talk about the role of hydropower in the energy transition and water resource preservation."

– Jean-Bernard Levy, CEO, EDF

Focus sessions and workshops

Over the following days, more than 200 speakers exchanged experiences and examples of good practice across 40 sessions as well as a series of preparatory workshops. These sessions were co-convened with knowledge partners who brought a depth of understanding to each topic. Partners included United Nations agencies, financial institutions, intergovernmental agencies and research institutes.

Delegates addressed ways to promote sustainable projects, through financing and development, operations, maintenance and modernisation, and announced a range of initiatives to ensure hydropower projects can bring maximum benefits.

"The 2019 World Hydropower Congress is a valuable opportunity to share experiences and promote the benefits of interconnections in developing regions of the world."

– Leslie Chai, General Manager of System Planning, Sarawak Energy

Enhancing climate resilience

On 15 May, the World Hydropower Congress saw the launch of a new IHA Hydropower Sector Climate Resilience Guide. The guide will help investors, owners and developers make informed decisions about how to plan, build, upgrade and operate hydropower systems in the face of increasingly variable climatic and hydrological conditions.

The guide was developed with technical and financial support from the European Bank for Reconstruction and Development (EBRD) and the World Bank Group (WBG) and its Korea Green Growth Trust Fund (KGGTF). These institutions committed to continue working with IHA and the hydropower sector to help ensure widespread adoption of the guidance.

Building a global network

The Global Network of Sustainable Water and Energy Solutions, an initiative established by Itaipu Binacional and the United Nations Department of Economic and Social Affairs (UN DESA), and supported by IHA and a growing community of governmental and non-governmental entities, was presented to the World Hydropower Congress.

Elliott Harris, Assistant Secretary General for the United Nations Department of Economic and Social Affairs (UN DESA), said "the potential of hydropower in its contribution to both the Paris Agreement and the 2030 Agenda on Sustainable Development is huge," but stressed the importance of hydropower developers taking measures to "maximise benefits and compensate for any costs."

"The World Bank Group welcomes the international hydropower industry's Hydropower Sector Climate Resilience Guide. There is an urgent need to actively prepare for the resiliency of hydropower assets in the face of increased frequency of extreme weather events and rapid changes in hydrological patterns to reduce the risk of climate-related disruptions."

– Pravin Karki, Global Lead Hydropower

"The World Hydropower Congress brings together a unique network of hydropower operators from all over the globe. This creates an unparalleled opportunity to bring together leading hydropower practitioners, and to address emerging challenges and opportunities across the hydropower industry – including those driven by climate change."

– Craig Davies, Head of Climate Resilience

Mr Harris pointed to the example of Itaipu Binacional, which operates the Itaipu power plant, as an example of good practice.

"The experience of Itaipu Binacional shows how it is possible to promote the conservation of biodiversity and local cultures while at the same time harnessing the power of hydropower resources for energy, economic development and climate action."

Recognising excellence

At the World Hydropower Congress awards ceremony, Costa Rica's Reventazón project received the 2019 IHA Blue Planet Prize for sustainable hydropower development.

The IHA Blue Planet Prize is given to a hydropower project which demonstrates excellence across a range of social, environmental, technical and economic performance criteria. A judging panel awards the prize on the basis of an independent project assessment made using the Hydropower Sustainability Assessment Protocol, an internationally recognised performance measurement tool.

Reventazón is the largest hydropower project in Central America with 305.5 megawatts of installed capacity. Since it came into operation in 2016, the project has led to Costa Rica achieving a target of generating 100 per cent of its electricity from renewable energy sources.

The prestigious 2019 IHA Mosonyi Award for Excellence in Hydropower was jointly awarded to three leading members of the hydropower community, at the awards ceremony. The award went to: Karin Seelos, Statkraft Vice President (Power Generation and International Affairs), Refaat Abdel Malek, Former President of IHA and Vice Chairman of MWH Global, and Yan Zhiyong, Chairman of Power Construction Corporation of China.

In addition, the 2019 IHA Young Researcher Award was jointly awarded to two rising stars from universities in Switzerland and China. Martina Botter, a PhD student at ETH Zurich in Switzerland, and Weijia Yang, a Research Associate Professor at Wuhan University, were recognised by IHA for their research studies.

"We are grateful to the International Hydropower Association in awarding the IHA Blue Planet Prize to the Reventazón project. This proves what 70 years of acquired expertise by the Instituto Costarricense de Electricidad can do, developing sustainable hydropower projects that comply with international good practice in all the facets of development."

– Irene Cañas Díaz, President, ICE, Costa Rica

Sharing experiences

Proposed knowledge-building and sharing initiatives covered hydropower safety, pumped storage technology, policy and markets, and emerging hybrid technologies, such as floating solar at hydropower projects.

Empresas Públicas de Medellín (EPM) CEO Jorge Lodoño was among the hundreds of delegates who benefitted from participating in the 2019 World Hydropower Congress. Reflecting on a challenging year for the Ituango hydropower project in Colombia, he commented: "The opportunity to share our experience with so many players in the World Hydropower Congress has been extremely valuable to us. The key to overcoming the gigantic challenges that EPM has faced since the incidents at Ituango has been transparency and our company's willingness to engage and discuss all the issues. This has galvanised broad-based support."

"The World Hydropower Congress provides a platform for global leaders to share experiences and focus on hydropower's role in delivering sustainable development and an interconnected world."

– Tammy Chu, Managing Director, Entura, Hydro Tasmania

Low impact and low carbon

The Nature Conservancy, a strategic partner to the World Hydropower Congress, released a joint statement together with WWF and other non-governmental organisations, on the closing day as part of an initiative to promote collaboration to deliver low cost, low impact and low carbon energy.

"Hydropower can help balance power systems and facilitate the integration of a higher share of wind and solar generation – both through reoperation of existing hydropower and through strategically designed new projects, including pumped storage, that avoid the significant trade-offs associated with past development," states the declaration.

Sustainable water and energy

IHA pledged to continue its work to advance sustainable hydropower and share solutions which support the delivery of climate and development goals. "Every hydropower project is an ambassador for the whole sector," noted IHA Chief Executive Richard Taylor in the closing session. "There is no hiding place for bad practice or projects that are deemed to be a loss to society or the planet."

New initiatives announced at the World Hydropower Congress will help the sector bring forward solutions to enhance hydropower's flexibility and deliver clean, efficient storage for integrated electricity grids, involving a mix of hydropower, solar and wind power and other renewables.

Mr Taylor made a commitment for IHA to work closely with the UN, civil society, business, governments and investors to achieve a common understanding of good practice for hydropower projects affecting protected areas, and when working with indigenous communities. Representatives of indigenous communities were among the stakeholders who addressed the event.

Priorities for action

Future priorities that should be addressed by the hydropower sector, governments, financial markets and other stakeholders were proposed during the seventh World Hydropower Congress.

Delegates tabled priorities covering clean energy systems and modernisation, sustainability and strategic planning, and climate change and resilience.

Clean energy systems and modernisation

- Investment in hydropower will deliver reliable, affordable and sustainable clean energy systems.
- Hydropower, both conventional and pumped hydropower storage, provides low carbon flexibility services for maintaining power system reliability under increasing penetration of variable renewables.
- The value of hydropower is not well recognised. New policy, regulatory and market frameworks are needed to build investor confidence, by appropriately compensating hydropower for the myriad of energy and water services provided.
- Responding to this need for policy discussions, IHA will convene the "International Forum on Pumped Hydropower Storage" to expound the role of pumped storage in future clean energy systems.

Ruslana, singer and renewable energy advocate

- Hybrid renewable energy systems, especially floating solar photovoltaics (floating PV) on hydropower reservoirs, present a significant opportunity to scale up renewable energy deployment.
- There is a need for industry, government and regulators to work together, share lessons learned and cooperate on developing innovative solutions in hydropower **modernisation.** Long-term planning is essential for hydropower assets reaching their end-of-life.
- **Digitalisation** is becoming integral to hydropower planning and design, construction, operation, maintenance and management, but transformation projects need to be carefully planned and implemented in stages.
- To establish a framework for success in data sharing, innovative data solutions are needed through the creation of new open access platforms. Robust cyber infrastructure will enhance **cyber-security.**
- **Regional interconnection** through hydropower grids can improve electricity access, reduce prices, increase system security and firm up other renewable sources, while helping meet climate targets.
- In emerging markets, interconnections can unlock investment and support growth. Collaboration and communication of benefits is needed to overcome a reluctance to share energy resources across borders.

"It will be important for the credibility of the industry to adopt best practices, to evaluate potential impacts and ensure they can be avoided."

– Guy Debonnet, Programme Specialist, UNESCO World Heritage Centre

Sustainability and strategic planning

- There was a strong consensus that **integrated planning** to develop hydropower alongside solar and wind power will help deliver low cost, low carbon renewable energy systems with minimal impact.
- Integrated river basin management involves coordinating a range of priorities including electricity generation, sustainable water quality and sediment management. Hydropower developers and operators should responsibly manage impacts on natural resources and communities while maximising project benefits.
- **Financing hydropower** remains a challenge, particularly in emerging economies, where public funds are scarce. **Risk mitigation** mechanisms, such as guarantees and political risk insurance, are available to reduce a project's risk profile and leverage private sector investment.
- For **small-scale power systems** to play a critical role in achieving development goals, the sector requires a transformation of how projects are planned and designed. Standardisation and modular components can significantly reduce costs.
- The **benefits of hydropower** will be better understood and demonstrated with the development of new tools.
- There is a need to increase awareness of potential risks and synergies between hydropower projects and **world heritage sites**. IHA made a commitment to work with UNESCO, WHC, WWF, IUCN, civil society, business, governments and investors to achieve a common understanding of good practice in protected areas.
- As hydropower is a local resource, local expertise must be developed through adapted training and **capacity building** programmes to utilise the resource.
- Internationally recognised Hydropower Sustainability Tools can be used for **sustainability assessments** and to drive improvements in project performance. This helps to expand internal capacity, enhances the impact of development interventions and contributes to wider sustainable hydropower development.
- When setting up hydropower projects, delegates said it was important to involve **indigenous people** at every stage of the process.

Climate change and resilience

- The **carbon footprint** of reservoirs has received increased attention, however, due to their unique nature, it is important that they be assessed on a case-by-case basis. There are ways to reduce the greenhouse gas (GHG) emissions of a reservoir during design, development and operation phases.
- The G-res Tool, launched at the World Hydropower Congress in 2017, provides a cost-effective way to assess carbon footprint of reservoirs and it should be used to strengthen confidence in hydropower's mitigation potential.
- Governments, lending institutions, and asset owners will require assurances that hydropower projects – greenfield developments or rehabilitations – are **climate resilient** amid increasingly variable climatic and hydrological conditions.
- The newly launched Hydropower Sector Climate Resilience Guide should be used to identify, assess and manage climate risks and enhance the resilience of hydropower projects.
- Hydropower projects should have greater access to **climate finance** climate finance, particularly through the **green bond** market. The release of the Climate Bonds Initiative's proposed sector criteria for hydropower was welcomed as an important milestone towards using **green bonds** to finance hydropower development.
- **Sediment management** is vital to maintain storage capacity, reduce operating risks and minimise river connectivity impacts. UNESCO, IHP, ISI and IHA will continue to work together to promote cooperation in sediment management and advance
- **Hydropower safety** continues to be the number one priority for the hydropower sector globally. Operators must ensure that staff are properly trained and ensure robust safety measures in design, construction, operation and maintenance of hydropower facilities.

"With today's climate challenges renewable energy is the way to go. Renewable hydropower gives a baseload that in addition to sun and wind will guarantee households and businesses a stable supply of energy. In my part of the world we take stable energy for granted. Why should the rest of the world expect less?"

– Torger Lien, Chief Executive Officer, SN Power

Advancing sustainable hydropower

The International Hydropower Association (IHA) is a non-profit membership organisation committed to sustainable hydropower.

IHA's vision is a world where water and energy services are delivered to all in a sustainable way.

Our mission is to advance sustainable hydropower by building and sharing knowledge on its role in renewable energy systems, responsible freshwater management and climate change solutions.

We achieve this through monitoring the sector, advancing strategies that strengthen performance, and building an open, innovative and trusted platform for knowledge.

Knowledge building

IHA's programmes increase awareness of hydropower's value to clean energy systems and sustainable development, promoting collaborative, adaptive approaches to river basin development and regional interconnections.

We provide practical advice and support to members on operations and maintenance and have developed tools for dealing with new challenges such as assessing reservoir carbon emissions and building climate resilience.

Sustainability

IHA is a champion of good practices and continuous improvement in the hydropower sector.

We support project assessments and training as the management body for the Hydropower Sustainability Tools. These tools are used to guide and assess performance against a range of environmental, social, technical and economic criteria.

Find out more:
www.hydropower.org

Download our 2018-19 Activity and Strategy Report:

hydropower.org/activity2019

Introducing Hydropower Pro, IHA's new online community

In early 2019, IHA launched Hydropower Pro, an exclusive new online community and mobile app for individual and corporate members.

Hydropower Pro brings together hydropower professionals to connect, exchange experiences and collaborate.

Online:

hydropower.org/pro

The platform offers:

- **Online groups** - forums for IHA knowledge networks and regions of interest
- **Resource libraries** - essential reports, publications, briefings and case studies
- **Member directory and messaging** - allowing members to network
- **News and blogging** - announcements and articles by IHA staff and members
- **Multi-platform access** - via desktop and mobile apps (iOS and Android)
- **Email alerts** - instant alerts and a weekly digest

"Hydropower Pro is a rich source of knowledge for the international hydropower community. It provides up-to-date, authoritative coverage of a broad range of news, events, issues and facts for the sector."

Colin Clark, Chief Technical Officer for Brookfield Renewable and IHA Vice President

"Hydropower Pro offers a new link into the extensive world of hydropower. It helps me stay updated with the latest issues and events and network in my areas of interest."

Roger Gill, consultant and IHA Vice President

CTG

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We spearhead river protection for sustainable environment.

5

out of the 12 largest hydropower stations in the world to be under CTG's management and operation by 2022

40+

countries and regions with CTG's business presence

128

gigawatts of installed capacity globally (including minority-equity based and under construction) as of 2018

1

new major role in Yangtze River protection and rehabilitation

Opening session

The 2019 World Hydropower Congress opened in Paris with 750 delegates from more than 70 countries, representing civil society, international organisations, science, finance, business, academia and government.

Venue: Espace Grande Arche, Paris

The theme of the 2019 congress, organised by the International Hydropower Association (IHA) was 'The Power of Water in a Sustainable, Interconnected World,' which focused on hydropower's role in delivering on the Paris Agreement on climate change and the Sustainable Development Goals (SDGs).

Ken Adams, IHA President, welcomed delegates, stating the organisation supported the SDGs and believed the targets set by the Paris Agreement required everyone to work hard to ensure that renewable energy could be provided to all in a sustainable way.

Mr Adams thanked the diverse group of participants for their attendance and stressed the importance of collaboration between the hydropower sector and wider communities to build a more sustainable future.

"The spirit of IHA has always been to engage in dialogue with stakeholders from different countries, sectors and backgrounds," he said. "We believe that stronger outcomes are ensured when objectives are shared and dialogue is open."

Maria Donovan, of UNESCO, said her organisation was proud to be associated with the World Hydropower Congress as one of the co-convenors. "This is an opportunity to showcase the critical contribution of hydropower in addressing sustainable development challenges," she said. "To reach Article 2 of the Paris Agreement there is a need to reduce emissions, notably by limiting the production of energy from coal sources and by embracing renewable sources of energy such as hydropower."

The World Bank's Riccardo Puliti stated that his organisation backed the sustainable development of hydropower for three main reasons: "We believe that hydropower is key to reaching the Paris Agreement, we view hydropower as essential for increasing the integration of renewable energy into the world's power systems, and we support hydropower's role in improving regional integrated water resource management."

However, the International Energy Agency (IEA)'s Fatih Birol warned investments in the renewable sector have slowed down. "Hydropower - why are we so keen? Because of its potential, especially in Africa," he said. "Today in Sub-Saharan Africa two out of three people have no access to electricity. Morally, it is a shame for all of us."

Speakers:

Ken Adams
President, IHA

Maria Donovo
Director of Water Sciences, UNESCO

Riccardo Puliti
Global Directoy, Energy and Extractive Industries and Regional Director (Africa), Infrastructure, World Bank

Dr Fatih Birol
Executive Director, International Energy Agency

Elliot Harris
Assistant Secretary General, UN DESA

Jean-Bernard Levy
Chief Executive, EDF

Giulio Boccaletti
Chief Strategy Officer, The Nature Conservancy

Plenary hall

"We think hydropower can provide a lot of benefits to our societies, ranging from electricity access in emerging economies, reduction of CO2 emissions, reduction of air pollution, and we can nicely integrate it with solar and wind," Dr Birol added.

Elliott Harris, Assistant Secretary General for UN DESA, agreed, but said the development of hydropower does not come without potential environmental and social costs. "It is critical that hydropower developments take measures to maximise benefits and compensate for any costs," he said.

Jean-Bernard Levy, CEO of EDF, spoke about the flexibility and storage capabilities of renewable, rechargeable hydropower. "Hydropower is today the most efficient technology to store significant energy quantities, especially pumped storage plants (PSP). This is why PSPs are a key part of our EDF Storage Plan which aims at developing 10 GW of energy storage capacity worldwide by 2035, among which 2 GW will be fulfilled by PSPs," he said.

Earlier this year, the Indian government approved measures to promote hydropower development, including declaring large hydro projects as renewable. Aniruddha Kumar, Joint Secretary of Power, said in future "hydropower undoubtedly has a major role to play" in achieving renewable targets and committed to a rigorous approvals process for new projects.

"We do not want to push development at the cost of the environment or the people. Projects are only going to be approved for construction after rigorous environmental impact studies and implementation of detailed environment management plans," he said.

The opening plenary concluded with an intervention from renewable energy cultural ambassador and former Eurovision singer, Ruslana, who spoke about her efforts to widen public awareness of the goal of achieving 100 per cent renewable electricity generation.

WE PLACE HYDROPOWER AT THE HEART OF THE GLOBAL ENERGY TRANSITION

Sustainable operation is the DNA of our hydro engineering

For over 70 years, our hydrotechnical experts have been working for and on our hydraulic fleet in France.

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Our 4 types of service offerings

CONSTRUCTION
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Pumped Storage

O&M
O&M audit and optimization
E-monitoring
Training, E-learning

REHABILITATION
Refurbishment
Upgrade
Technical Expertise

SUSTAINABLE RENEWABLES
Hybrid Systems
Floating PV
E&S studies and implementation

EDF Hydro invests 400 million euros in France per year to operate and maintain its assets, and to increase its installed capacity through several upgrading projects.

Hydropower has great potential ahead both for large and small projects. Therefore, EDF will continue to work and invest in new hydro projects in France and worldwide.

The great storage capacity of hydropower is key for the development of other renewable energies and will therefore be at the heart of tomorrow's global electric system. Within its electricity storage plan, EDF has the ambition to build 2 GW of pumped storage power plants by 2035 on top of our 5 GW already in operation.

Water resource preservation is central to EDF Hydro's strategy for power capacity development. Multi-purpose water management is in our DNA.

Yves GIRAUD
SENIOR VICE PRESIDENT OF EDF HYDRO

contact-hydro@edf.fr

Clean energy systems and modernisation

Focus session:
Clean energy systems

Co-convenor

IRENA

Focus session on Clean Energy Systems

All the systems that have succeeded in providing 100 per cent renewable electricity rely in some way on hydropower. Hydropower, where available, plays an essential and vital role in creating and maintaining energy systems that are reliable, affordable and sustainable.

Hydropower's flexibility can help balance variable renewable supply by ensuring firm power output to the grid and reducing reserve requirements. Hydropower has traditionally provided flexible power generation and large-scale energy storage by storing water in reservoirs. The success of variable renewable energy (VRE) sources is driving change in power systems around the world. New approaches are needed to fully utilise hydropower's unique characteristics and to compensate hydropower for the flexible services it provides to power grids.

Key discussion points:

This session highlighted hydropower's contribution to enabling the energy transition, especially in fostering more rapid deployment of wind and solar. Panellists discussed how renewables working together can help ensure the provision of reliable, sustainable and affordable energy and water services for all, and how they could help meet and achieve global sustainability and climate goals.

In order to keep the global temperature rise to well-below 2°C, as outlined in the Paris Agreement, IRENA's published scenarios show that annual energy-related GHG emissions would need to be reduced by 70 per cent by 2050. This would require replacing thermal generation with renewables on a massive scale. Under this scenario, annual hydropower generation would nearly double, while the proportion of the energy mix would remain roughly the same. With the expected increase in variable renewable generation from wind and solar, flexibility becomes very important to ensure grid stability and enable VRE integration.

Linn Emelie Schäffer, in her keynote address, identified hydropower as a possible backbone for a renewables-based society. Both hydropower with reservoirs and pumped hydropower storage can deliver a wide range of flexibility services across all timescales. Hydropower's capacity for long-term energy storage potential, i.e., seasonal and interannual, is especially unique. Other flexibility options, including thermal generation or grid expansion are often significantly more expensive or work to counter to carbon mitigation goals.

The energy transition poses both opportunities and challenges for the hydropower sector, including new operational regimes, business models, market designs and policy incentives. Today's markets currently are unable to correctly reward flexibility services. This has a significant impact on hydropower, as a long-term investment which requires confidences from investors and developers. Without suitable market design or policy incentives, investment in hydropower remains difficult under changing energy landscape and fluctuating political environments.

> *"There is a consensus that the clean energy system transformation is much needed and on its way. To make it happen we need more flexibility and hydro can play key role"*
>
> – Dolf Gielen, IRENA

Inspiration could be drawn from the three country case-studies highlighted by the panel. In Norway, hydropower provides energy time-shifting for Danish wind systems and provides large scale balancing services for years to come. Norway is also building interconnections to Europe to help balance the European energy system. In Australia, the political commitment to decarbonise its energy system could be achieved through Tasmania's 'Battery of the Nation' program, which aims to double the region's hydropower capacity from 2.5 GW to 5 GW and helps balance new deployments of wind and solar on the Australian mainland. It provides a strong favourable policy signal for hydropower investment. In China, national renewable energy targets of increasing hydropower capacity from 350 GW today to 540 GW by 2030, including 130 GW of pumped storage, provide a clear incentive for developers and investors.

Speakers:

Dolf Gielen
Director, Innovation and Technology Centre, International Renewable Energy Agency (IRENA), moderator

Linn Emelie Schäffer
Master of Science, SINTEF Energy Research

Markus Rieck
Chief Sales Officer, Voith Hydro

Tammy Chu
Managing Director, Entura, Hydro Tasmania

Xie Hongwen
Deputy Chief Enginer, China Renewable Energy Engineering Institute (CREEI)

Outcomes and priorities:

There was strong consensus among the panellists that hydropower deserves greater visibility in public awareness and the political arena. In the last decade, there has been growing awareness and public and political advocacy on climate change. The sector needs to communicate to the public and policy-makers that hydropower has an essential role in the clean energy transition.

A new market design that reflects the value of flexibility is needed, which will help make the business case for revenue regime and create confidence for investment. A carbon levy was also suggested to accelerate decarbonisation in power sector.

To move the sector forward, collaboration will be key. This collaboration should extend to the whole renewable energy industry, identifying synergies among various renewable energy forms. CREEI said it was willing to share China's experience in clean energy transition through IHA's platform. IRENA will also focus on the functions of hydropower and pumped storage and will release a brief on pumped storage in September 2019.

> *"Hydropower is the backbone for a renewable society"*
>
> – Linn Emelie Schäffer, SINTEF

Further information

Hydropower professionals can join the Clean Energy Systems Knowledge Network on Hydropower Pro, IHA's online member community. The network supports members to build and share knowledge on hydropower's role in clean energy systems.

Focus session:
Pumped hydropower storage

Co-convenor

U.S. DEPARTMENT OF ENERGY

Pumped hydropower storage (PHS), like no other technology, can provide the flexibility and ancillary grid services at the full range of temporal scales needed, i.e. seconds to seasons, at scale and low levelised cost.

It is widely recognised that the transition towards cleaner and more sustainable energy systems will require a significant increase in the use of wind and solar power. By their very nature, these resources make power supply more volatile, reflecting the varying availability of wind and sunlight, and require a corresponding increase in power system flexibility. Flexibility in this context refers to the ability of a power system to maintain a reliable and continuous service when faced with potentially rapid changes in supply or demand.

However, despite its clear value proposition, it remains difficult to build new PHS projects. The new technologies driving the need for increased system flexibility are at the same time undermining traditional PHS business models, while also exposing the cost and timelines of building new pumped storage projects.

Key discussion points:

This session discussed how to return confidence to PHS investors and developers in the face of uncertainty. PHS is most cost-effective at large scale energy storage, and is characterised by very high large upfront capital costs which need to be amortised over their very long lifetimes. In addition, new PHS projects are not likely to start operating until 10-15 years after initial conception and financing. Without market or regulatory certainty, investors and developers are understandably reticent to lock-in large-capital investments in a rapidly evolving power system with a highly uncertain future composition.

In the European context, EDF Hydro in France, Voith in Germany and Alpiq in Switzerland shared the view that the European policy environment does not allow a profitable business case for new PHS investments, and the lack of adequate and stable reward mechanisms constitutes a major barrier to further investment. Meanwhile, China demonstrated the importance of government commitment and stable policy framework for pumped hydro development. Having already built 30 GW of pumped hydro capacity, China plans to add 100 GW by 2030. In Israel, the government supported pumped hydro development by the private sector with the use of 20 year long availability contracts. With a government guaranteed revenue regime, project owners can access financing at a much lower cost.

Panellists also spoke with some concern about the perceived competition of chemical battery storage and PHS. They stressed that batteries and PHS serve different functions: batteries are on very short time-scales and are better suited to decentralised application. However, it was noted that policy and decision-makers were hesitant to support PHS as they expect the arrival of very low-cost batteries. Panellists agreed that the sector as a whole needs to improve communications around the different roles of storage technologies, noting they can work in concert.

> *"What investors want most of all is stable policy that they can plan investment against. We need stable policies to make long term investments for the benefit of our children and grandchildren"*
>
> – Bill Armstrong, GE

Looking forward, there are a number of new opportunities in pumped hydro development. To satisfy the increased need for flexibility, upgrading existing pumped hydro plants with variable speed turbines and ternary solutions, as well as retrofitting existing rservoirs, offers opportunities without the need for new civil infrastructure. Digitalisation will offer intelligent monitoring and control systems for predictive maintenance in order to reduce significantly O&M costs to allow for better market participation, especially as the new energy landscape requires more frequent starts and stops, and higher and faster ramping. PHS could be modified to provide desalination and irrigation services at affordable costs enabling revenue stacking. Seawater pumped hydro is also another opportunity, especially when combined with desalination.

Speakers:

Alejandro Moreno
Director, Water Power Technologies Office United States Department of Energy

Bill Armstrong
Managing Director, Hydropower Europe, GE Renewables)

Yann Baros
Managing Director, Hydro Engineering Centre, EDF

Amédée Murisier
Head of Business Projects and Development, Deputy Head of Hydropower, Alpiq

Norbert Riedel
Chief Technology Officer, Voith Hydro

Yang Yongjiang,
Senior Consultant, China Society for Hydropower Engineering

Gil Doron
CEO Star Pumped Hydropower, CTO Hutchinson Water

Outcomes and priorities:

There was a strong consensus about the long term value of pumped hydro as an essential asset for power system reliability, as the need for flexibility and energy storage will only increase. However, this value is not well recognised by policy-makers, and the ancillary services of pumped hydropower projects are not properly rewarded. There is also a need to explain that chemical batteries will not change the role of pumped hydro in the power system.

It is necessary for the hydropower sector to come together to send the above messages, so that it can be heard by all national and international decision-makers. Yann Baros from EDF expressed appreciation to IHA for publishing the latest study on pumped hydro, and announced it would support IHA in setting up an International Forum on Pumped Storage for further advancing policy discussion around pumped hydro development.

For utility owners and developers, there is a need to recognise that the business case may change throughout the projects' development stage and we need to be flexible in adjusting the business payback strategy. For equipment suppliers, there is a continued need for research and development (R&D) in improving flexibility.

Focus session on Pumped Hydropower Storage

Further information

Hydropower professionals can join the Clean Energy Systems Knowledge Network on Hydropower Pro, IHA's online member community. The Clean Energy Systems Knowledge Network supports members to build and share knowledge on hydropower's role in clean energy systems.

IHA working paper (2018) *The world's water battery: Pumped hydropower storage and the clean energy transition*

IHA Pumped Storage Tracking Tool: hydropower.org/pumpedstoragetool

GE Renewable Energy paper Implementing Sustainable Business Models for Hydro Storage

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gerenewableenergy.com

Focus session:
Hydropower and solar hybrids

Co-convenor

WORLD BANK GROUP

Hydropower coupled with solar photovoltaics (PV) presents a significant opportunity to scale up renewable energy deployment around the world.

Combining solar and hydropower can smooth the variability of solar output, thus supporting renewable energy deployment in grids that lack the flexibility to incorporate large injections of variable renewable energy.

In particular, floating solar PV technologies, or 'floatovoltaics', have seen rapid growth in the past four years, from a worldwide installed capacity of 10 MW at the end of 2014 to more than 1.1 GW by the end of 2018 (World Bank). Based on increased interest in hydropower and solar hybrid systems, this World Hydropower Congress session elaborated on the opportunities and challenges in hydro-solar hybrids, the tools available to identify hybrid opportunities, and industry experience in implementing these systems.

Key discussion points:

The interest in combining hydropower and solar, especially floating solar PV, builds on four major benefits for both technologies. Shared transmission infrastructure reduces project development costs, while hydropower can also provide flexibility to balance the variability and intermittency of solar. When treated as a single generation source, coupling hydropower and solar can guarantee a stable and dispatchable output, allowing solar PV to achieve a better market price. Solar augmentation can effectively boost hydropower installed capacity and conserve water in water constrained areas, especially those experiencing the impacts of climate change.

Today floating PV has a prohibitively difficult business case, as its capital expenditure (CAPEX) is 15-20 per cent higher and its operating expense (OPEX) is 30-50 per cent higher compared with land-mounted PV plants. This could be mitigated by accessing concessional finance as well as utilising modular designs for maximum output. However, there exists a 'chicken or egg dilemma' between installation costs and the scale of market adoption, and there is a need for better market design to ensure stability and offtake.

Concerns were raised about the reliability and environmental impacts of floating PV, concerning biodiversity impacts, water contamination, anchorage, end-of-life treatment, resilience to humidity and extreme weather conditions, as well as bird soiling and debris damage. It was recommended that developers should conduct site surveys and bathometry studies to identify the best floating PV installation location and use bird deterrence systems. Research and development (R&D) and pilot tests are needed to build the evidence base.

To identify potential for scaling up and improving the siting of floating PV hybrids, the Natural Heritage Institute (NHI) is in the process of developing a rapid assessment tool based on experience learned from research on Cambodia and Laos. The preliminary results estimate a global potential of 3 TW of installable capacity by covering 10 per cent of the surface area on 1,500 hydropower reservoirs.

Statkraft is developing a pilot test of a 2 MW floating solar farm at Banja project in Albania, using experience from fish farming in Norway and innovative material applications to deliver a system with a zero degree tilt angle cooled through a thermal connection with water.

EDP shared its experience from the pilot Alto Rabagão project commissioned in 2016. The floating solar panels withstood demanding site conditions with 1m high waves and a 30m water level variation, while maintaining an efficiency gain of 3-5 per cent in solar output. The studies for future floating PV farm forsee an levelized cost of energy of EUR 70 per MWh, whereas onshore solar farms cost only EUR 30 per MWh.

> *"When solar hybrids are planned, developers should push for grant financing and add the evidence base for what are the impacts and how to quantify them."*
>
> – Oliver Knight, ESMAP, World Bank Group

Focus session on Hydropower and Solar Hybrids

Speakers:

Oliver Knight
Senior Energy Specialist, ESMAP, World Bank Group

Miguel Patena Forte
Director for Innovation and Technology, EDP Gneration

Gregory Thomas
Executive Director, Natural Heritage Institute

Liu Haohui
Research Fellow, Solar Energy Research Institute of Singapore (SERIS)

Anri Lushnjari
Business Development Manager, Statkraft

Outcomes and priorities:

There is continued need for research and development in the design and operation of floating solar hybrids to address challenges in operations and maintenance and reliability issues. One recommendation is to conduct pilot tests and build an evidence base quantifying project impacts.

Every reservoir is context specific so, when planning for new solar hybrid projects, developers need to adopt a holistic approach to ensure the project is environmentally, technically, and economically feasible. From the market perspective, there is also a need to develop the right market design that would support the business case for solar hybrids.

The World Bank ESMAP and SERIS recently published a report entitled 'Where sun meets water' which helps policy-makers, private developers and practitioners understand the market potential, costs and policy implications of floating solar, as well as the challenges to overcome to get this emerging technology off the ground. The practitioner handbook will also be released soon.

Focus session on Hydropower and Solar Hybrids

Further information

Hydropower professionals can join the Clean Energy Systems Knowledge Network on Hydropower Pro, IHA's online member community. The Clean Energy Systems Knowledge Network supports members to build and share knowledge on hydropower's role in clean energy systems.

Focus session: **Modernisation**

Co-convenor

International Energy Agency

The International Energy Agency (IEA)'s 'sustainable development scenario' projects that hydropower production will grow from around two thirds of low carbon electricity to become the second largest electricity source, out of all technologies, by 2040.

For this to happen, existing hydropower capacity will need to be retained and modernised, especially as energy systems undergo rapid changes with increasing penetrations from wind and solar. Under this backdrop, the IEA co-convened a session at the World Hydropower Congress on hydropower modernisation. It looked at innovative strategies being implemented around the world to ensure the existing fleet is well prepared for its role in the future energy mix.

Key discussion points:

During the session, the IEA made clear that hydropower, including storage, will play an increasingly important role for low carbon generation and power system flexibility. With one third of today's hydropower capacity over 40 years old, Paolo Frankl, IEA's Head of Renewables, called on governments to "not take existing capacity for granted and recognise the need to revamp and modernise ageing assets". Key questions introduced were: What happens when hydropower plants arrive at the end-of-life? Should they be modernised? What regulatory conditions can make this happen?

The Swiss Federal Office of Energy (SFOE) noted there are a wave of concession renewals in the pipeline over the next 10 to 20 years for its hydropower fleet, offering opportunities to invest in modernisation. However, concession agreements between the asset owner and local authority will, in many cases, first need to be renewed before investments can be made, and decisions will need to be made on how capital costs will be amortised.

In its Energy Strategy 2050, the SFOE included measures for larger scale hydropower modernisations, especially where production was increased. However, uncertainty around electricity prices still remains a significant risk for utilities in liberalised markets. Christian Dupraz from the SFOE made clear that "the most important thing we can do from the government's side is to create stable frame conditions" including long term legislation and tax regimes.

Examples of capital programmes being implemented were presented. For example, EDF invests around €500 million a year on the maintenance, safety, modernisation, and the development of hydro stations in France. Southern Company is also modernising its hydropower fleet in the USA's south-east, with a 10 year CAPEX programme totaling US$ 1.8 billion. Salto Grande, a 1,890 MW binational hydropower facility at the border of Uruguay and Argentina, has developed a short, medium and long-term modernisation investment plan – with financing secured from the Inter-American Development Bank for the initial phase.

Improving performance standards is another key part of modernisation, with Pierre Marx from GE Renewables stating "when it comes to refurbishment, restoring the initial capabilities of the asset or extending the life, is not enough". EDF explained that projects should optimise power services and preservation of water resources, and in some cases, functional redesign may be necessary.

The impact of variable renewables on hydropower operations was further raised. Salto Grande's Gabriel Rodriguez described how increasing wind power in Uruguay means they are now required to retain more energy in reservoir storage to provide balancing reserves for the country's grid. Similarly, Southern Company (SoCo) motor their hydro generating units for spinning reserve, as solar power comes onto the network. During peak/wet seasons, SoCo has been spilling water more frequently at its hydro stations to retain sufficient reserve capacity, requiring new spillway gate design and replacements.

> *"The IEA calls on governments to not take existing capacity for granted, and recognise the need to revamp and modernise ageing hydropower assets."*
>
> – Paolo Frankl, IEA

Focus session on Modernisation

Speakers:

Paolo Frankl
Head of Renewable Energy Division, IEA

Christian Dupraz
Head of Hydropower, Swiss Federal Office of Energy (SFOE)

Pierre Marx
Hydro North America General Manager, GE Renewable Energy

Jean-Daniel Mattei
Deputy Director, Hydro Industry EDF

Herbie Johnson
General Manager, Southern Company Hydro (SoCo)

Gabriel Rodríguez
President of the Delegation of Uruguay, Salto Grande

> *"Currently hydro is not compensated for the ancillary services and flexibility it provides. If we don't fix that, we won't be able to modernise the fleet."*
>
> – Pierre Marx, GE Renewables Hydro North America

From a supplier's perspective, GE sees that hydropower customers are increasingly looking for turbine-generator upgrades designed for increased operating range, stop/starts, and faster ramping, reflecting how hydropower's role is moving from baseload to more flexible operations on many systems. Digital technologies for asset performance and to support decision-making are also an integral part of modernisations today.

Outcomes and priorities:

In summary, long-term planning for hydro assets reaching their end-of-life is essential. The panel agreed on the difficulty in predicting, with accuracy, the shape of the energy market in the future. However, it is crucial to go beyond simple life-extensions and enable hydropower to meet future system needs through robust, high-quality equipment. There is a need for industry, government and regulators to work together, to share lessons learned and cooperate on developing innovative solutions in hydropower modernisation.

The panel unanimously agreed that the current market conditions are not appropriate to bring about the necessary investments in hydropower modernisation. This can be achieved by valuing hydropower for the low carbon and flexibility services it provides, adapting regulations and appropriately compensating hydro generators. In the absence of this, existing hydro assets approaching end of life may be at risk and miss opportunities for cost-effective upgrades.

In 2020 the IEA's annual five-year Renewables Market Forecast will focus on hydropower, with policy guidance to unlock its considerable untapped potential.

Further information

Hydropower professionals can join the Asset Management Knowledge Network on Hydropower Pro, IHA's online member community. The network shares knowledge and updates in O&M and modernisation in hydropower.

www.hydropower.org/pro

Focus session: **Digitalisation**

Co-convenor

IDB

In the hydropower sector, digitalisation is becoming an integral element of all stages of development, from planning and design, construction, operation, maintenance and the management of hydro assets.

The session focused on how digitalisation will enable hydropower to adapt to a more diverse role in the future energy mix, improving operations and maintenance (O&M) practices through improved condition monitoring systems and automated maintenance practices, enhanced control systems and through advanced decision-making tools to optimise decisions around modernisation.

The session addressed several issues the hydropower sector is dealing with on the path towards digitalised processes, equipment and operations including: change management, incentives and strategies to implement digitalisation across their businesses.

Key discussion points

Arturo Alarcon of the Inter-American Development Bank (IDB) opened the session, pointing out that exponential growth in data acquisition and management, in parallel with declining costs for data storage, is one key driver for digitalisation. A recent survey conducted by IDB revealed that most companies recognise the strategic importance of this ongoing trend, but were concerned about the economics of digitalisation, and the potential for technological obsolescence.

Representatives from the manufacturer's sector (Voith and GE) agreed that digitalisation is key to enabling growth in the hydropower sector, by capturing the value of data. By implementing diagnostic services, acoustic monitoring and remote expert support, hydropower maintenance can not only be improved but can be made more cost-effective through remote monitoring and expert support. Digital twins offer the opportunity to replicate operations under a broader range of conditions, without the need for an extended outage.

Industry experts (Itaipu, CTG, EDP Portugal) brought examples of what motivated their organisation to move forward on digitalising their assets. Itaipu saw the need to digitalise assets reaching their end-of-life in order to address technical obsolescence. CTG introduced digital systems at a system-wide scale, for example, by building in basin-level GIS, basin-sharing platforms, digital representations of all assets and even a digital resettlement program. EDP Portugal was motivated by the need to introduce greater operating flexibility to manage their operations more efficiently, with a major influx of variable renewables in their region. Common to all three utilities was the need to enhance cyber-security through digital control and protection systems.

Some of the discussions in the digitalisation session underscored the outcomes of the survey undertaken by IDB. For example, digital transformation is strategic for most companies; human resources are not a barrier but continuous learning is needed; digitalisation must be cost-effective and demonstrated by a proven track record; and, it is important to engage policy-makers and regulators.

> *"Digitalisation is about changing how companies think, work and plan"*
>
> – Arturo Alarcon, Inter-American Development Bank (IDB)

Digitalisation will enable hydropower to operate more efficiently, with increased penetration of variable renewable technologies, such as wind and solar. EDP Portugal summarised this by stating: variable speed pumped storage can enable more efficient operation of conventional hydro; digital control systems will need to consider flexible operation; and monitoring is important to optimise dispatch of hydropower units.

When considering the impact of digitalisation on human resources, it was agreed that with an appropriate change management strategy, organisations need not be resistant to the implementation of digital processes. In fact, most organisations find the transition to digital to be a positive experience.

Focus session on Digitalisation

Speakers:

Arturo Alarcon
Senior Regional Energy Specialist, Inter-American Development Bank

Daniel Menebhi
Vice President & Chief Technology Officer, GE Renewable Energy

Joerg Lochschmidt
Vice President Digital Hydro, Voith Hydro

Bruno Marins Fontes
Electronic Engineering Division Manager, Itaipu Binacional

Nuno Martins
Head of Monitoring & Diagnostic Center, EDP Portugal

Zhou Jingliang
Deputy Director, Department of Information Technology, China Three Gorges

Outcomes and priorities

The Inter-American Development Bank (IDB) and IHA have signed a partnership agreement to support sustainable development involving hydropower across Latin America and the Caribbean. Under the partnership, the two organisations will expand opportunities for the exchange and adoption of good industry practices, with the goal of enhancing the technical, social, economic and environmental performance of new and existing projects.

One of the challenges facing some organisations is gaining corporate buy-in for implementing digitalisation programmes in a strategic and timely manner. Several strategies were suggested: for example to demonstrate the value of digitalisation to management, start small with pilot programmes to understand the potential for improved operations or reduced maintenance. Digitalisation also needs to be carefully planned and implemented in stages.

Cyber-security ranks as one of the top digitalisation issues for the hydropower sector. The advent of 'big data' and more complex IT systems to support digitalisation can create the need for greater security measures; however, digitalisation can also be an enabler for enhanced cyber-security.

IHA will continue to work with members and experts through the Asset Management Knowledge Network, to gather more case studies illustrating how digitalisation is an essential ingredient towards preparing hydropower for its future role in clean energy systems.

> *"Digitalisation will allow companies to transform their productivity, their customers' productivity and overall reduce their risk"*
>
> – Danielle Merfeld, GE Renewables

Further information

Hydropower professionals can join the Asset Management Knowledge Network on Hydropower Pro, IHA's online member community. The network focuses on exchanging experiences and best practices on operations and maintenance or modernisation programmes.

Focus session:
Innovative data solutions for hydropower

Co-convenor

FIU FLORIDA INTERNATIONAL UNIVERSITY

Data management has been a cornerstone of every successful hydropower project. Many organisations develop their own internal databases for hydrological data, energy statistics and market information.

In least developed countries, there is a greater dependence on publicly accessible data for planning and operating hydro facilities.

Advancements in digitalisation in the water and energy sector have the potential to offer tremendous opportunities for real-time data processing that were not available in the past. Emerging technologies such as artificial intelligence (AI), neural networks and the advent of block chain technologies all stand to move the water and energy sector into an advanced regime of data management.

Key discussion points

This session at the World Hydropower Congress illustrated how advanced data management systems and data sharing can positively impact the hydropower sector. Examples were shared of information systems developed for improved decision making, enhanced cyber-security and improved access to baseline climate and watershed data.

The session addressed three distinct themes: data sharing, data and cyber-security, and innovative technologies. A range of factors related to the modernisation of ageing hydro plants and new builds - digitalisation, condition monitoring using digital sensors, AI, predictive analytics and refurbishment - will all contribute to the need for enhanced capabilities to process so-called 'big data'.

Leonel Lagos of FIU, a leading US research institute in cyber-security, described how cyber attacks can disrupt business processes and critical operations. It is therefore critical to develop robust security systems.

Two examples were given from internationally acclaimed organisations that illustrate positive change in data sharing:

Firstly, UNESCO-IHP supports a data platform (WINS) that is accessible, geo-referenced (GIS) and employs a networking hub for sharing information online.

Secondly, the World Bank's Spatial Agent & Hydroinformatics Platform is a multi-sectoral data sharing tool designed to improve data transparency for developing countries. The Spatial Agent technology is a free downloadable app that accesses thousands of types of data from more than 300 web services from major institutions.

> *"Advancements in digitalisation in the water and energy sector have the potential to offer tremendous opportunities"*

Professor Francois Avellan of EPFL introduced innovative solutions aimed at improving the safety and efficiency of hydropower generation under a variety of test conditions that simulate future operating conditions. The EPFL lab uses a systematic approach, addressing not only turbines and waterways, but also mechanical and electrical engineering, going from microscale to prototype size.

Leonel E. LAGOS, Director of Research, Florida International University

François AVELLAN, Professor Hydraulic Machines Laboratory, EPFL Laboratory for Hydraulic Machines

Speakers:

Youssef Filali-Meknassi
Science Program Specialist with UNESCO-IHP

Nagaraja Rao Harshadeep
Global Lead (Watersheds/ Disruptive Technology), World Bank

Francois Avellan
Director, EPFL Laboratory for Hydraulic Machines, Lausanne, SW

Leonel E. Lagos
Director of Research, Applied Research Center (FIU-ARC) Florida International University

Outcomes and priorities

To establish a framework for success in data sharing, there is a need for enhanced training and capacity building. Training the next generation workforce for hydropower industry and providing them with the right set of skills and tools will be essential.

New open access platforms will establish a new culture for data sharing in countries where data was often contained and confidential.

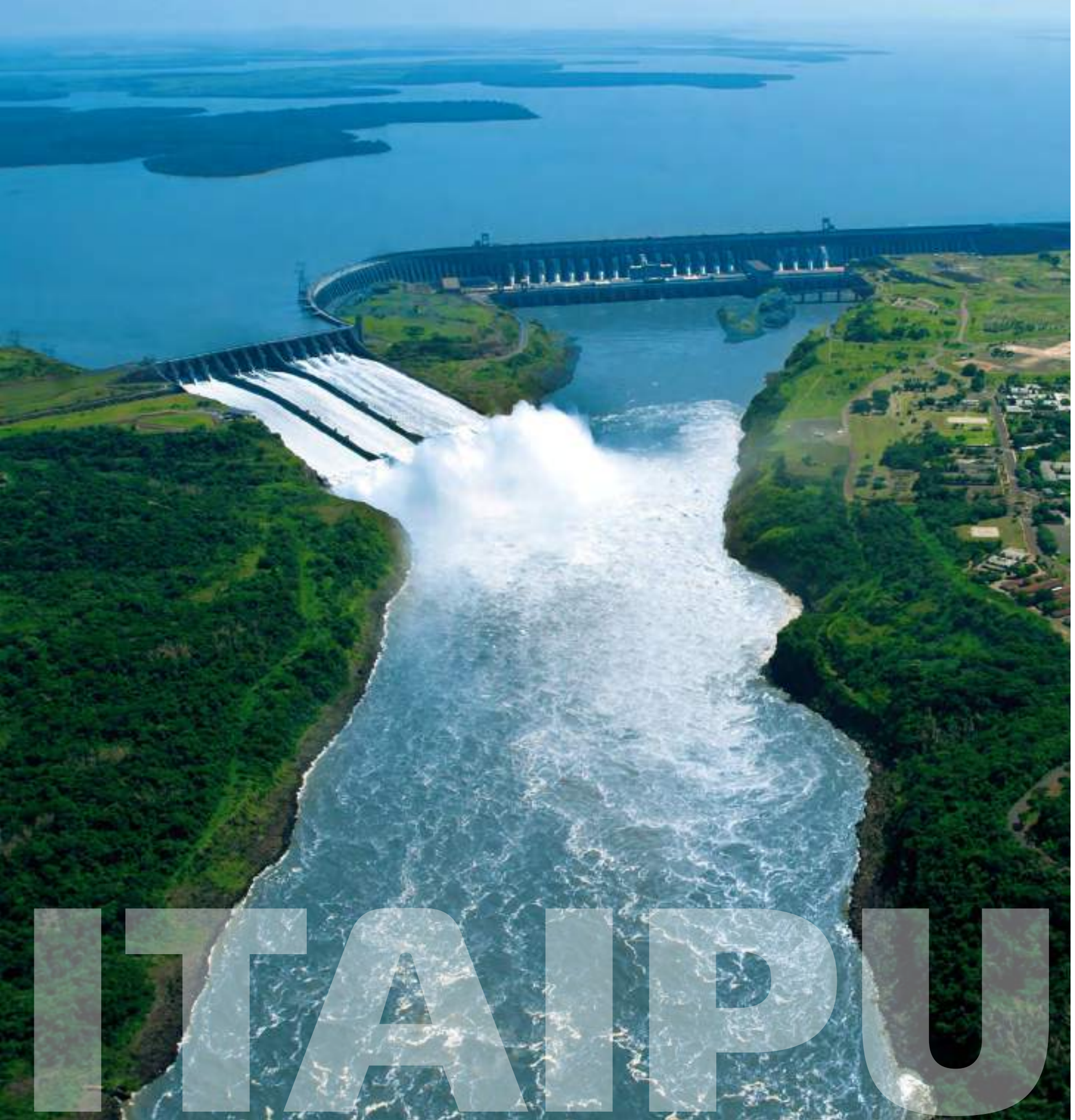
To support enhanced cyber-security, there is a need to implement robust cyber infrastructure which draws on innovations across a spectrum of emerging technologies.

One of the best opportunities for improving hydropower operations will come from bringing deep knowledge from the OEM manufacturers' design right into operations. Potential technical solutions can perform synchronised and independent multiple decision-making.

Nagaraja Rao-Harshdeep, Global Lead (Disruptive Technology), World Bank

Further information

Hydropower professionals can join the Asset Management Knowledge Network on Hydropower Pro, IHA's online member community. The network focuses on exchanging experiences and best practices on operations and maintenance, including hydropower safety and modernisation programmes.



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Focus session:
Regional interconnection

Co-convenor

Universal access to affordable, reliable and sustainable energy services will require international cooperation and an increasingly important role both for grid connectivity and hydropower.

Regional interconnections, which often involve cross-border transmission, have been developed throughout the world and in many cases improve access to hydropower's low carbon, low cost and flexible energy services. Focusing on these issues, this World Hydropower Session gathered representatives from South America, Africa, Europe and Asia to discuss existing interconnection schemes, planned projects, and power pools. A key objective was to understand the economic benefits and barriers of regional interconnections involving hydropower, while sharing experiences and lessons learned from around the world.

Key discussion points

The opening presentations showed how regional interconnections can help connect hydropower to major markets. Marcio Szechtman, from CIGRE, showed how high voltage direct current (HVDC) links south, west and northern hydropower bases in Brazil to major demand centres in the country, stating that "hydro resources in different regions may be used in a complementary manner through suitable transmission interconnection projects".

In South Asia, cross-border interconnection and hydropower potential are essential for economic growth, with R.V. Shahi from the World Bank describing the "huge opportunity" for developing hydro and cross-border trade on a bilateral, multi-lateral, sub-regional and regional basis. Regional schemes would help raise the electricity consumption per capita for South Asia, while also driving a shift away from fossil fuels.

At the global level, Global Energy Interconnection Development and Cooperation Organisation (GEIDCO) presented its vision for global energy interconnection (GEI), as a platform for energy cooperation and sustainable development. The case for growth in hydropower, wind and solar transmission in Africa was highlighted, with GEIDCO's Yibin Zhang stating "a key bottleneck to economic and social development in Africa is lack of electricity" and "the solution is to develop clean energy such as hydropower in a bigger market based on the GEI framework".

In Africa, the Southern African Power Pool (SAPP) has nine of 12 member states interconnected and has seen increased trading over recent years. Stephen Dihwa from the SAPP Coordination Centre cited the 2,075 MW Cahora Bassa plant in Mozambique, which in addition to its domestic market can export hydropower via an interconnection to South Africa.

Multi-stakeholder cooperation in large-scale projects is vital. Dr Shaofeng Wang, from CTG, as a lead partner in the major Inga project in the Democratic Republic of the Congo (DRC), made clear that "connections to end users are extremely important for generators and investors in hydro, to realise any project".

The role of interconnections in solving operational challenges was addressed, especially for systems with increasing renewables. Nord Pool, which runs the Nordic market, balances hydro generation in Norway, wind power in Denmark, and access to conventional reserves at the regional-level. Investments into new HVDC interconnectors are moving forward.

Lessons learned from implementing the first bilateral interconnection in Borneo were discussed, after the line from the Malaysian state of Sarawak to the Indonesian province of West Kalimantan was completed in 2016. A robust business case was key to success, in which Sarawak exports surplus hydropower and enables West Kalimantan offset use of expensive diesel generation. Leslie Chai from Sarawak Energy remarked "this interconnection has benefited both sides and has brought us closer together with Indonesia to become good neighbours".

> *"Going forward, hydropower and interconnections will go hand-in-hand"*
>
> – Hans-Arild Bredesen, Nord Pool Consulting

Focus session on Regional Interconnection

Speakers:

Marcio Szechtman
Vice President Technical, CIGRE

RV Shahi
World Bank Energy Advisor and former India Power Secretary

Yibin Zhang
Deputy Director General Development Bureau, GEIDCO

Leslie Chai
General Manager in System Planning, Sarawak Energy

Wang Shaofeng
Deputy Chief Economist, China Three Gorges

Hans-Arild Bredesen
Chief Executive Officer, Nord Pool Consulting

Stephen Dihwa
Coordination Centre Manager, Southern African Power Pool

Outcomes and priorities

The economic benefits of transmission, bilateral interconnection and power pools involving hydro are clear. From Brazil to the SAPP in Africa and Nord Pool in Europe, interconnected grids with hydropower supply can: improve electricity access, reduce prices, increase system security and firm up other renewable sources, while helping to meet climate targets. In the emerging markets of Africa, South Asia, and others, interconnections will also unlock investment and support growth through regional cooperation.

Despite benefits observed, new interconnections can be challenged by real or perceived risks from project impacts, and often a reluctance to share energy resources across borders. In turn this can deter investment into potential hydropower sites. Building a clear case for an interconnection and ensuring all economic drivers as well as concerns are understood by partners, is a key success factor. This requires continued efforts to facilitate cooperation and communication of the benefits to wider audiences.

> *"Hydropower projects in synergy with interconnections can actually bring benefits not only to one country but to a region"*
>
> – Stephen Dihwa, SAPP Coordination Centre

Further information

Hydropower professionals can join the Clean Energy Systems Knowledge Network on Hydropower Pro, IHA's online member community, to access further updates and briefings on the topic.

Sustainability and strategic planning

Focus session:
Integrated planning

Co-convenor

The Nature Conservancy

Planning energy at the system scale is critical if the world is to create sustainable and secure energy systems that remain relevant in the wake of climate change. Though energy projections are difficult to predict, trends indicate a mainstreaming of solar and wind, with increasingly specialised hydropower and its ability to stabilise a variable renewable energy system and provide low-carbon storage services.

On top of renewables becoming more competitive, climate change is foreseen to make hydrological conditions less predictable for much of the world, which poses risks for energy systems that rely in hydro dominant energy systems. Through case studies, the session highlighted how system-scale planning through integrated energy systems can create better outcomes for people, nature and industry. Speakers explored the role of hydropower in creating a sustainable energy future and sparked discussion around leveraging integrated renewable energy systems to meet sustainable development and climate goals.

Key discussion points

Hydropower continues to have an essential role in the evolution of renewables and in meeting the world's increasing energy demands. Mark Lambrides and Jeff Opperman, of TNC and WWF respectively, provided an overview for the need of hydropower's future to evolve in order to forge solutions to meet the world's growing water and energy needs.

This will require a systems approach for sustainable energy systems that optimises a diverse set of power generation technologies while preserving the conservation areas, and developing from a cascade perspective to optimise power generation.

Hydropower can play an important role in meeting the low cost and low carbon grids to the future. Technological innovations have introduced smart grids, distributed systems and advanced battery storage options that allow for the delivery of electricity in different innovative ways. These technologies need to be coupled with a systematic outline and market rules to allow for the translation of these strategies for a sustainable energy future.

Roland Roesch presented the IRENA project navigator, a platform targeted at developing countries to create and develop bankable renewable energy projects while minimising the environmental and social impact of renewable energy projects. Rafael Kelman, of PSR Consultancy, presented the case of Brazil and its evolution of renewable energy development, including the expected increase in solar for the next 10 to 15 years and the current analysis for cost effective options to develop pumped storage to integrate with solar and wind. Gabon's government presented their collaboration with TNC and PSR towards an integrated strategy for the energy development in the country.

Kate Lazarus, of IFC, presented the perspective on the organisation's and the private sector's role in delivering on systems planning, highlighting the importance of engagement between the financing sector and the civil society to facilitate timely implementation of projects. Too often, the focus goes on the Environmental and Social Impact Assessment (ESIA) stage, and it is very difficult to make significant changes at the feasibility stage once the project has been selected. An example provided was Myanmar's strategic plan to better optimise power generation and minimise the cumulative environmental and social impacts.

> *"In Brazil, we have complementarities because of the size of the country with different hydrological regimes, along with different wind regimes and they all play together as a portfolio. So it is really a case for integrated planning. You can't just go and invest in the resource just by looking at that resource, you have to look at the entire picture and it's going to be difficult."*
>
> – Rafael Kelman, PSR Consultancy

Luiz Gabriel TODT DE AZEVEDO, Division Chief, IDB Invest

Focus session on Integrated Planning

Speakers:

Luiz Gabriel Todt de Azevedo
Division Chief - Environmental, Social and Corporate Governance, IDB Invest

Mark Lambrides
Energy and Infrastructure Director, TNC

Jeff Opperman
Global Lead Freshwater Scientist, WWF

Kate Lazarus
Senior Operations Officer, IFC

Rana Adib
Executive Secretary, REN21

Rafael Kelman
Executive Director, PSR Consultancy

Roland Roesch
Deputy Director Innovation and Technology Centre, IRENA

Aristide Ngari
Director General, Ministry of Water and Energy, Gabon

Panelists discussed the importance of a visualisation platform in helping stakeholders to discuss the alternatives involved in hydropower planning by comparing attributes, such as production, economic return, river fragmentation, etc.

Rana Adib pointed out the importance of including the policy and energy regulatory framework to implement this vision, as well as the need to include other values that hydropower can offer (drinking water, irrigation, etc.) to be consider in this holistic view.

Outcomes and priorities

There was a strong consensus to develop low cost and low carbon renewable energy systems with minimal impact.

Panellists decided real functioning grids, which meet economic costs, should be installed to meet fluctuating demand and politically competitive power systems.

The solutions should be mostly related to renewable energy. One of hydropower's multiple benefits is supporting other forms of energy, and where possible, there should be collaboration. It should also be ensured that options which have minimal impact be chosen.

Further information

Opperman, J. et al, 2019. Connected & Flowing: renewable future for rivers, climate and people. WWF and The Nature Conservancy, Washington, DC

The Nature Conservancy

Advancing a renewable energy revolution for the benefit of people and nature.

Climate change isn't a distant threat - it is happening now. And the power needed to fuel the world's economic development and improve standards of living will increase demands on lands and waters around the world, and impact communities who depend on them. The good news: we've run the numbers and know we can accelerate a sustainable renewable energy future. With over 65 years of experience, The Nature Conservancy is focused on finding innovative solutions that tackle the urgency of this challenge. We're working with governments, corporations, financiers and other partners to create an energy future that is affordable, reliable and sustainable.

Join us in realizing this vision.
Contact us at energy@tnc.org.

The Nature Conservancy

nature.org

Focus session:
River basin development

Co-convenor

IUCN

Successful river basin management requires a holistic approach which encourages cooperation among a diverse group of stakeholders in the utilisation of natural resources.

Integrated management of reservoirs and multiple use of water, institutional and regulatory agreements, as well as cooperation between neighbouring countries, comprise different trade-off methodologies to manage a hydropower project at a system level. The session focused around discussions on understanding river connectivity and the cumulative impact in river basins around hydropower development and that of other infrastructure. Given the multiple values around water, the session looked at balancing trade-offs across various stakeholder priorities and understanding water development interactions with social and environmental needs. As such, the water and energy nexus was seen as a crucial intersection for systems scale planning at basin scale level.

Key discussion points

Governance is moving from consultation to participation and is increasingly involving more stakeholders. Julien Harou, of Manchester University, presented a case study for trade-off analysis that was done for water resources in east England. The process involved decision input from about 30 institutions whose decision parameters were interactively plotted alongside each other to identify feasible options to optimise assets across the various sectors in the region over five years. Socio-political sensitivity is essential for larger scale systems and multi-sectoral planning to ensure there are shared benefits.

Hellen Nabwala, of the Nile Basin Discourse, spoke of the participation of women and youth in decision making within the Nile Basin and the lack of awareness within the communities of the benefits of the hydropower projects.

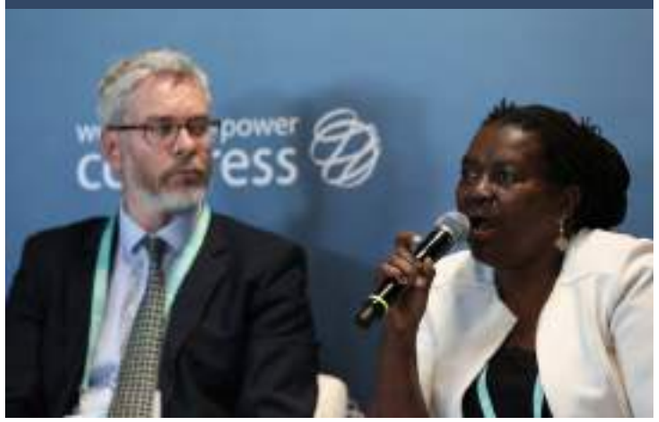
Chen Yunhua, of the Yalong River Basin Hydropower Development, spoke about how basin-wide planning for hydropower development required accountability in order to maintain social and ecological sustainability.

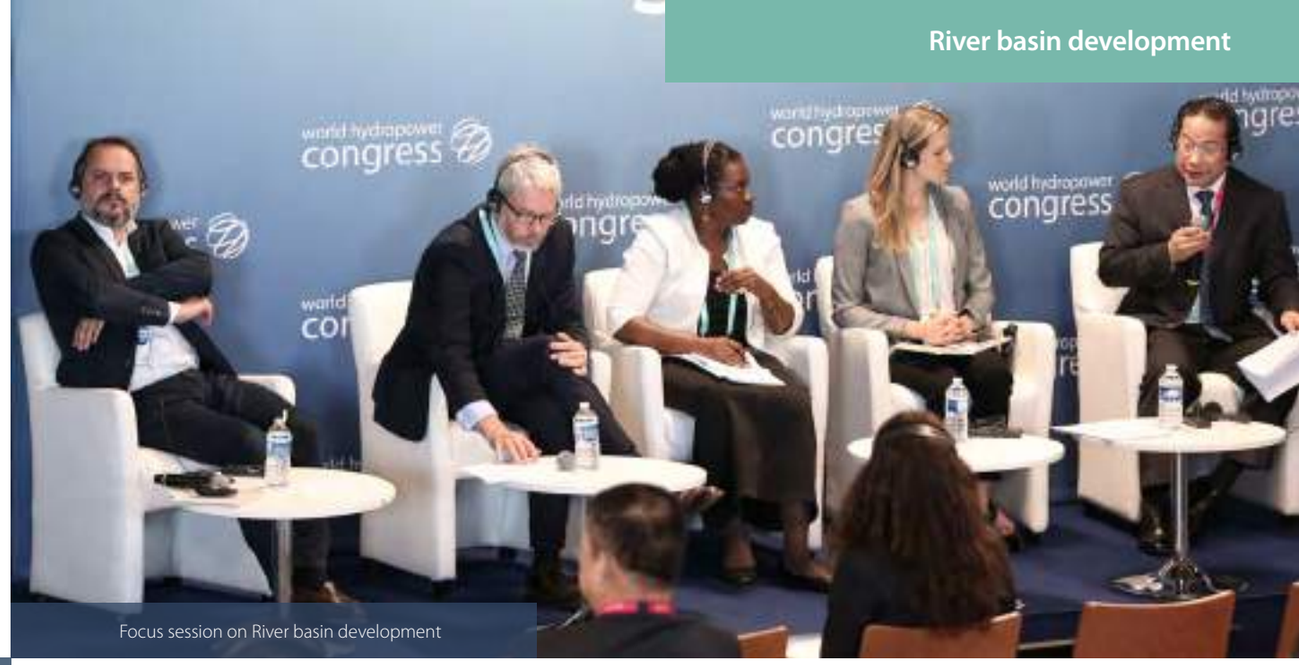
Planning for dam filling is often under-looked and yet the filling phase presents very acute potential conflict between upstream and downstream interests. Filling of Gibe III dam in Ethiopia caused Lake Turkana on the downstream to shrink, and this generated conflict among the 12 different tribes who were affected. The large extent of the impact was due to the untimely filling of the dam which was done at the beginning of a drought. Professor Andrea Castelletti, of Politecnico di Milano, explained how climate models have now made it possible to do short-term and long-term forecasts to optimally plan for dam filling and generate minimal conflict across the different water uses.

The session presented itself as a bridge between research and policy makers and a platform for various stakeholders in which multiple approaches were discussed to better practice in hydropower development.

Chen Yunhua, General Manager and Director, Yalong River Basin Hydropower Development

Julien Harou, Chair in Water Engineering, Manchester University
Hellen Nabwala Natu, Regional Manager, Nile Basin Discourse





Focus session on River basin development

Speakers:

James Dalton
Director Global Water Programme, International Union for Conservation of Nature (IUCN)

Andrea Castelletti
Professor of Natural Resources Management, Politecnico di Milano

Julien Harou
Chair in Water Engineering, Manchester University

Chen Yunhua
General Manager and Director, Yalong River Basin Hydropower Development

Hellen Nabwala Natu
Regional Manager, Nile Basin Discourse

Amy Newsock
Deputy Director, Power for Nature, The Nature Conservancy

Outcomes and priorities

Communities and local level engagement is moving beyond consultation to empowerment and creating an enabling environment for meaningful participation.

Better informed decision making leads to better planning, reduced costs, lower negative impact and reduced conflicts, which can have a long term impact on hydropower development.

Coordination between agencies is a key part of the planning process. The example by Yalong River Basin Hydropower Development showed how a single institution can drive development in a sustainable and integrated manner.

It needs to be understood that coordination is needed among sediment, water quality, flows and electricity generation. We are not just responsible for electricity generation, but for all range of natural resource assets and impact.

"Better informed decision making leads to better planning, leads to reduced costs, lower negative impacts and reduces conflicts which can have long term impacts on hydropower development."

– Julien Harou, Manchester University

Further information

Hydropower professionals can join Hydropower Pro, IHA's online member community. Please contact Cristina Diez at cds@hydropower.org for more information.

Focus session:
Project ownership and financing

Co-convenor

UNIVERSITY OF CAMBRIDGE
INSTITUTE FOR SUSTAINABILITY LEADERSHIP

Governments around the world are continuing to seek greater private sector involvement in hydropower development. This is particularly the case in developing countries where public funds are scarce with many competing priorities.

There is a need to utilise the technical expertise of the private sector. However, it remains difficult to attract private investment in developing countries as hydropower's risk profile is poorly understood by many banks, who have only limited experience of similar investments. The circle of lack of experience, poor understanding of risk and reluctance to invest is difficult to break.

This session discussed challenges in managing the various risks faced by the financial community when deciding whether to invest in hydropower. In addition, panellists explored what mitigation tools are available to help ensure that all stakeholders, including governments, development finance institutions, lenders and developers, accept a fair allocation of risk.

Key discussion points

The key theme of this session was identifying the risks associated with hydropower development from a financier's perspective and exploring the mitigation options available, with a particular focus on how greater levels of private sector investment can be leveraged in developing countries.

The session commenced with a presentation by Judith Plummer Braeckman, of CISL, who categorised risks in four broad segments: government risks, environmental and social risks, technical risks and financial risks. All of these risks can disincentivise private finance. Although financial risks are always of the greatest concern, other risks such as a government's inability to make a decision can be just as challenging to overcome. Some risks are more reputational than credit related, but ultimately any risk can cause delay and thus lead to financial difficulty.

Dr Plummer Braeckman then set out the corresponding mitigation measures for each risk and broader assurances for each risk sector such as government guarantees, government commitments, quality contracting and a functional legal and regulatory framework. The presentation kick-started a discussion amongst panellists about how hydropower is perceived by the financial community and policy makers.

Colin Clark, of Brookfield Renewable, agreed that financiers are most concerned with market and government risks, such as whether the jurisdiction has a stable legal framework to protect foreign investors and a stable revenue regime. Financers also tend to favour projects with the prospect of scaling up development.

Panellists discussed the important role that hydropower plays in providing multiple essential services, including energy storage, ancillary services to balance variable renewables, water storage, as well as climate change adaptation services in drought and flood mitigation. This was followed by Claire Shakya, of IIED, exploring some of the barriers currently preventing the sector from accessing climate finance, including the inconsistencies in how various criteria are being applied as well as a lack of awareness of the multiple benefits delivered by hydropower, especially in arid areas.

Drawing from his involvement in the 420 MW Nachtigal project in Cameroon, IFC's Julien Thureau illustrated the challenges from a both lender's and investor's perspective. Although the site conditions were exceptionally good, the project suffered from three major challenges: Firstly, the host country suffered from limited fiscal capacity and therefore significant private investment was required, which the IFC helped leverage from other development finance institutions and commercial banks to minimise the burden on the country's public finances.

> *"Not all kWhs are created equal and there are times when a hydropower kWh can offer more value than any other renewable energy source."*
>
> – Judith Plummer Braeckman

The second challenge was investor's perception of risk. To reduce the project's risk profile, IFC transformed its role from simply a lender to a developer and engaged at a very early stage in feasibility studies, while political risk insurance and loan guarantees were provided by the World Bank Group.

The final challenge was the financial sustainability of the power sector itself and its ability to adequately remunerate such a large project. The Nachtigal project is expected to sell at a levelised tariff of €0.065/kWh, which is lower than the current average price of electricity in Cameroon.

Nachtigal project (Credit: EDF)

Speakers:

Judith Plummer Braeckman
Senior Research Associate, University of Cambridge Institute for Sustainability Leadership (CISL)

Colin Clark
Chief Technical Officer, Brookfield Renewable

Torger Lien
Chief Executive Officer, SN Power

Clare Shakya
Director of Climate Change, International Institute for Environment and Development (IIED)

Julien Thureau
Head of Infrastructure Investments, Sub-Saharan Africa, International Finance Corporation (IFC)

Outcomes and priorities

The risks of hydropower development, particularly in developing countries are frequently discussed but often misunderstood. As shown by the Nachtigal project, mitigation measures are available and major challenges can be overcome.

Two success factors for lenders and developers were identified by Brookfield Renewable, which are ensuring there are multiple revenue streams (with options to contract output to industrial, wholesale and resale markets, instead of relying on a single off-taker over the project lifetime) and long-term ownership of assets. Dr Plummer Braeckman added that refinancing may be one way to get financiers more comfortable with investing in hydropower.

There is an ongoing need to raise awareness about the value and the role of hydropower in grids that are increasingly penetrated by variable renewables, which IHA should help address working with policy makers. In addition, IHA should continue its work in making the case for hydropower's deeper involvement in both the green bond market and having greater access to sources of climate finance.

Further information

Hydropower professionals can join the Markets and Finance Knowledge Network on Hydropower Pro, IHA's online member community. The network focuses on building and sharing knowledge on key trends and developments in hydropower financing.

IHA has recently conducted an ownership study to investigate the role of public and private sector investment in hydropower development around the world. Please contact Nicholas Troja for further information.

sarawak energy

Sustainable Energy for Sarawak and Beyond

'Sustainable Energy for Sarawak and Beyond' captures our ambition to provide renewable, reliable and affordable power for the growth and prosperity of Sarawak and region.

Hydropower development has enabled Sarawak to enjoy the lowest average unsubsidised tariff in the country and amongst the lowest in ASEAN.

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108MW, Batang Ai Hydroelectric Plant
Creating value and sustainability 30 years and beyond

944MW, Murum Hydroelectric Plant
Catalyst for Sarawak Corridor of Renewable Energy, SCORE

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2400MW, Bakun Hydroelectric Plant
Largest hydroelectric plant in Malaysia

Focus session:
Small-scale power systems

Co-convenor

UNIDO

To address environmental challenges, energy security, and to pursue inclusive and sustainable development, leaders are strategising ways to transition economies towards renewable energies. Access to affordable and reliable energy and water services provided by sustainable hydropower can bring economic, social and environmental dividends.

Hydropower is a mature technology, which is designed, operated and maintained. Despite having low electricity generation prices, hydropower potential in most developing countries remains untapped. Small-scale power systems involving hydropower remain site specific since each development has to be designed for the specific characteristics of the chosen site. However, small-scale hydropower systems can provide significant multi-dimensional benefits to underserved areas.

This session outlined the opportunities and challenges facing small-scale deployment around the world. It explored how to remove barriers and to highlight benefits of small-scale hydropower systems, especially to small, and perhaps under-developed grids.

Key discussion points

Small-scale systems refer to a wide range of system sizes and can vary from powering a single family house to powering a mini-grid or even grid connected network. They play a significant role in connecting rural communities. Small-scale hydropower systems bring a number of local and regional advantages. As a low-carbon source of renewable power, with proper integrated system planning, small-scale hydropower projects can minimise their associated environmental impacts. While large-scale projects often require international expertise and financing, small-scale projects enable institutional and individual capacity building. As this knowledge and competency is transferred, especially within the least-developed countries, this can further reduce project development costs.

International financing of small-scale projects is often not within the remit of large financing institutions, as they lack the institutional skills or tools to implement such projects. The case-study of the public-private-partnership (PPP) in Tajikistan is an example of where the private sector has been able to enter into a market with significant barriers to entry. Through this PPP, both sovereign and non-sovereign financing was utilised, and Pamir Energy was able to act as a facilitator between development partners, such as the Aga Khan Foundation and local governments to rehabilitate and develop the generation, transmission and distribution sectors. This resulted in Tajikistan's energy access rising from 13 per cent in 2002 to 96 per cent in 2017, and also led to the export of surplus power to Afghanistan.

As developers and companies developing small scale hydropower are increasingly from the private sector, small-scale hydropower and its components need to directly compete with wind and solar projects on a number of parameters, most importantly cost and lead times. While small-scale hydropower remains cost-competitive, it is under threat due to the rapidly reducing costs for wind and solar. Coupled with lead times that are on average twice as long as wind deployment, this represents a barrier to small-scale hydropower deployment. The panel agreed that standardisation in components and civil works can greatly reduce costs and lead times. Where previously small hydropower projects were developed analogously to large hydropower projects, the panel stressed the need to treat small-scale projects differently, allowing for more modular and optimal designs focused around decreasing commissioning times.

> *"They might be called small-scale, but for the people we serve, their impact is beyond big – it is quite literally transformational."*
>
> – Daler Jumaev, Pamir Energy

Focus session on Small-scale power systems

Speakers:

Rana Pratap Singh
Industrial Development Officer, UNIDO

Daler Jumaev
Managing Director, Pamir Energy

Arun Kumar
Professor, Department of Hydropower and Renewable Energy, IIT Roorkee

Nicolas Serrie
Hydro Product Management Leader, GE Renewable Energy and President of GE Hydro France

Sohail Hasnie
Principal Energy Specialist, Asian Development Bank

Outcomes and priorities

Small-scale power systems have the potential to play a critical role in energy security. The private sector, in this context, can play an important role as an agent for collaboration, partnership and change, if managed correctly. Small-scale hydropower development will likely fall into the hands of the private sector, and therefore needs to compete with other alternative sources, such as wind and solar. The development process of small-scale hydropower requires a fundamental transformation of how projects are planned and designed, and how components are sourced and procured. Standardisation and modular components have the potential to significantly reduce costs. Finally, local capacity building towards domestic institutions is also key to developing successful projects.

Further information

Hydropower professionals can join Hydropower Pro, IHA's online member community. The network provides opportunities to share information on the many benefits created by hydropower.

Focus session:
Benefits of hydropower

Co-convenor

ECA

Single and multipurpose hydropower facilities can deliver multiple power and non-power benefits.

Over and above electricity generation, the power related benefits include flexible generation and flexible storage, as well as a reduction in the dependence on fossil fuel. Moreover, they can provide local macroeconomic revenues, benefits related to employment, education and recreation, and constitute new possibilities for trade, transport and tourism. Furthermore, affected communities can benefit also from flood mitigation, water supply, pollution control and irrigation.

Hydropower projects have been designed to suit particular needs and specific conditions and are classified by project type, values and benefits of hydropower. Setting out more realistic indicators to quantify the above mentioned power and non-power benefits will help to meet the power needs in developing countries and emerging economies together with the development of the UN Sustainable Development Goals

Key discussion points

The session started with an overview of good practices in hydropower project work and the benefits that can be expected after 10 years into a project. Nam Theun Power Company's Olivier Didry said the NT2 hydropower project in Laos was an example of good practice. Ten years after its commissioning, the local community has moved from very poor to one of the most dynamic ones in Laos. Thanks to the project, people now have access to transport, water and electricity. What the company learnt in the process is that flexibility, timing and cooperation are the key instruments towards success. Being in the post construction phase of the project, the role of the company is now shifting towards a more project related entity and is currently developing new goals in terms of diversifying revenue sources for their 2035 vision.

In terms of successful hydro practices and planning, Frederic Hofmann from EDF, stated the importance of being flexible and adaptive to change when conducting a project. He said that in order to maximise success, one should never try to write the end of the story in advance. Forecasting the need of a community 10 years on can be difficult since technology, transportation systems and fish populations are constantly changing. Therefore, Hofmann suggested adaptive management when writing a concession agreement. Community leaders, often women, should be identified since they know best what the community needs and can provide useful insights. It was further discussed that after putting the community at the forefront, it is always crucial to support the integration of a bottom up approach from the very beginning of the project and keep all the stakeholders around the table.

CGGC's Guo Guangwen said even though there is no doubt that the benefits of hydropower are many, it is a challenge to quantify and evaluate them. In order to form a set of scientifically and systematically appraised methods recognised by the public, it is necessary to conduct detailed research, which reflects upon benefits of hydropower stations. Moreover, it is important to raise public awareness and formulate policies to promote hydropower development. Pascal Radue, of GE Renewable Energy, underlined the importance having an open and honest dialogue about the benefits. With respect to climate change, what may be perceived as a benefit for example in Laos, wouldn't necessarily have positive consequences in France.

Speakers:

Anthony Monganeli Mehlwana
Economic Affairs Officer, UNECA

Frederic Hofmann
Development Director, EDF

Oliver Didry, CEO of Nam Theun Power Company

Guo Guangwen
Chief Engineer, China Gezhouba Group Corporation (CGGC)

Pascal Radue
President & Chief Executive Officer Hydro Solutions, GE Renewable Energy

Outcomes and priorities

The panellists agreed that it is important to know how to measure hydropower benefits efficiently. It is only possible to compare its positive effects and make informed decisions, if they can be quantified or monetised.

Objective assessment of the benefits can only be achieved, if they can be presented in a commercially sensitive way, available for public interpretation. Hence, there is a need for the international community to develop a tool allowing the quantification and assessment of hydropower benefits.

Climate resilience, local adaptation and concession agreements should be considered and serve as a baseline for the development of the device. EDF's Nachtigal project and its successful monitoring system could serve as a benchmark for such a tool.

> *"Let's use the data, let's use the methodology, let's be proud of hydro and then have an honest dialogue as a group about it."*
>
> – Pascal Radue, GE Renewable Energy

Further information

Hydropower professionals can join the Hydropower Benefits Knowledge Network on Hydropower Pro, IHA's online member community. The network provides opportunities to share information on the many benefits created by hydropower.

Focus session:
Indigenous peoples

Hydropower provides an important contribution to clean energy systems, but its development can affect the communities that live around it, and in several countries, those communities include indigenous peoples.

The need to safeguard the rights of indigenous peoples is internationally recognised. So is the need to provide clean energy to the world's population. There is an increasing demand, by various stakeholders, for Free Prior Informed Consent (FPIC) to have been obtained for aspects of hydropower development that affect indigenous peoples. The session explored the practice of FPIC by examining examples of where it had, and had not, been achieved. Speakers included representatives of indigenous peoples, FPIC negotiators, and hydropower developers.

Key discussion points

Gregory Guldin, of Cross-Cultural Consulting, and Phurpa Tamang, of the Tamang People of Nepal, began with a presentation of their experience negotiating FPIC for the UT-1 project, a 216 MW run-of-river project on the Upper Trishuli river, in Nepal. They achieved FPIC according to International Finance Corporation (IFC) performance standard, PS7. The triggers for FPIC had been economic displacement, physical displacement and impacts on the Tamang Peoples territory. At the beginning of the process, trust had to be built between the involved parties via good-faith negotiations between three partners: the developer; the indigenous people; and Nepal Federation of Indigenous Nationalities (NEFIN). IFC had facilitated the interpretation between the affected community and the project developer.

Community representatives were selected. The partner's capacity to understand the concept of an Indigenous Peoples Plan (IPP) and the FPIC planning process was assessed and a capacity programme agreed and implemented. There were multiple consultations to introduce the project, FPIC and IPP process. The IPP was drafted, reviewed and revised.
At all times the community's spiritual association's, religion, and culture were respected.

EW Sustainable Hydropower Consulting's Eduward Wojczynski recounted his experience with FPIC. Although an expensive and time-consuming process, Mr Wojczynski said it had been worthwhile. According to Stephen Sparks of Statkraft, from a developer's perspective, implementing a hydropower project was challenging because the process of consultation and negotiation could be open-ended.

Kimberly Lyon of the World Bank acknowledged there was no universally recognised definition of FPIC. The IFC's standard, PS7, required consent to the design, implementation arrangement, risks and impacts of the project; it did not give the right to veto the project.

Soledad Mills, of Equitable Origins, said FPIC should not be imposed from outside, but defined from within. She also recommended initiating contact through the hierarchy of indigenous organisations, starting at the national level. Director of the Danish Institute for Human Rights, Birgitte Feiring, said that FPIC is not only required for hydropower, but other renewables. To achieve SDG7, whilst ensuring that human rights were upheld, a broader governance approach to FPIC may be needed.

Engie's Gil Maranhão agreed that when there was trust between all parties, FPIC was a realistic goal. In Brazil it was not a straightforward process to enter into dialogue with indigenous people, as federal laws prevented them from directly approaching the affected community. Instead, such negotiations could only be done via the federal agency FUNAI.

Focus session on Indigenous Peoples

Speakers

David Harrison
Water resources consultant

Gregory Guldin
Principle, Cross Cultural Consulting

Phurpha Tamang
Economic Affairs Officer, UNECA

Eduard Wojczynski
Representative of Tamang People of Nepal

Gil Maranhão
Head of Strategy, Communications & CSR, Engie

Birgitte Feiring
Director, Danish Institute for Human Rights (DIHR)

Stephen Sparks
Head of Environmental & Social Governance, Statkraft

Kimberly Lyon
Water Resources Specialist (consultant), World Bank

Soledad Mills
CEO, Equitable Origins

Chief Arnaldo Kab á
Representative of Munduruku People of Amazon, Brazil

Alessandra Korap
Representative of Munduruku People of the Amazon, Brazil

Candido Waro
Representative of the Munduruku People of the Amazon, Brazil

Outcomes and priorities

The overall message was that it was important to include the affected community involved at every stage of the process. This could include having them collaborate on plans for FPIC, for example through a consent process document, which defined how consent could be recognised. Gender issues were found to be best tackled by the local community. It is also important be aware of social divisions, such as class, caste and ethnicity.

> *"The Indigenous Peoples Major Group want to have inclusion and dialogue around sustainable development."*
>
> - Brigitte Feiring, DIHR

Delegates proposed companies should acknowledge and deal with past grievances and disputes and not ignore them. It was found beneficial to employ an indigenous person as a representative facilitating discussions, as discussions then could be interpreted through local culture.

If the FPIC process was tied to the IPP, to set up a co-governance of social benefits plan, that would mean the indigenous people would have an ongoing investment in the project. Delegates agree FPIC can provide a risk reduction in project development.

Focus session: **Hydropower and World Heritage Sites**

Co-convenor

United Nations Educational, Scientific and Cultural Organization – World Heritage Convention

Healthy protected areas provide basic goods and services, as well as access to food, fibre, shelter and security, and clean water. They can offer valuable options for society to mitigate climate change through ecosystem benefits such as water and climate regulation.

Some protected areas are given an international protected status through the World Heritage Convention. Through their World Heritage Listing, the global community has recognised a shared international responsibility to protect these sites and manage them. Although hydropower projects can offer clean energy and promote sustainable development of the communities they serve, they also inevitably alter the existing conditions of the river basins they operate in. This session addressed the question of how to ensure hydropower projects are planned and do not negatively impact protected areas, particularly World Heritage sites, while meeting water and energy needs.

Key discussion points

Panellists debated whether existing hydropower good practice guidelines need to be strengthened to ensure impact on protected areas can be avoided or otherwise mitigated.

Francesca Antonelli, of WWF, highlighted that Protected Areas are a crucial stronghold of biodiversity, and hydropower developments can impact them negatively. She said that the hydropower sector needs to recognise that more stringent mechanisms are needed to preserve Protected Areas.

Eugene Simonov, of Rivers without Boundaries, raised concerns over biodiversity offsets, observing that most freshwater biodiversity impact is felt downstream. He stated that offsetting cannot be the solution for World Heritage sites where ecosystems are unique and irreplaceable.

In his presentation, IUCN's James Dalton showed examples of good practice – including commitments and guidance – from the mining sector and financial institutions. He highlighted the need for collaboration between organisations, and the importance of engaging in conversation, learning from best practices and applying the new knowledge to advance better hydropower.

IHA's João Costa presented the Hydropower Sustainability Tools and explained how they provide a framework to independently evaluate projects in and around World Heritage sites. He added that the Tools can be used to reveal any positive and negative impacts in World Heritage sites, thus allowing stakeholders to make informed decisions based on adequate knowledge and thorough evidence.

Emmanuel de Merode, of Virunga National Park, presented a case study of his park. He highlighted the complexity of managing a World Heritage Site – a designation that can even bring counterintuitive negative impacts, both social and environmental. Mr de Merode then explained how hydropower development close to the national park provided clean energy and leveraged economic growth in Virunga – with transforming environmental and social benefits.

Finally, Danielle Crisa, of CTG, demonstrated the organisation's commitment to best international corporate governance standards and practices, biodiversity, cultural heritage and their respect for international agreements, such as World Heritage sites and RAMSAR sites. A case study Ms Crisa mentioned was CTG's decision to not pursue the development of the Stiegler's Gorge project, due to its potential negative impact on the biodiversity of a World Heritage site.

> *"Protected areas are the stronghold of biodiversity."*
>
> – Francesca Antonelli, WWF

Focus session on Hydropower and World Heritage Sites

Moderator:

Guy Debonnet
Chief of Unit, Nature, Sustainable Tourism and Outreach, World Heritage Centre, UNESCO

Speakers:

Francesca Antonelli
Rivers and Infrastructure Coordinator, WWF

James Dalton
Director, Global Water Programme, IUCN

João Costa
Senior Sustainability Specialist, IHA

Emmanuel de Merode
Park Director, Virunga National Park

Danielle Crisa
Consultant, International Affairs Department, China Three Gorges (CTG)

Eugene Simonov
Coordinator and Conservation Science Expert, Rivers without Boundaries

Outcomes and priorities

The general consensus was there is a need to increase awareness of potential risks and synergies between hydropower projects and World Heritage sites. To achieve this, the sector could engage in collaborative efforts to look for guidance, identify solutions and learn from case studies inside and outside the sector.

Richard Taylor, CEO at IHA, made a commitment for IHA to work closely with the UNESCO WHC, WWF, IUCN, civil society, business, governments and investors to achieve a common understanding of good practice for hydropower projects affecting protected areas.

> *"Every hydropower project is an ambassador for the whole sector. There is no hiding place for bad practice or projects that are deemed to be a loss to society or the planet."*
>
> – Richard Taylor, IHA

Further information

The Hydropower Sustainability Guidelines provide valuable insight into sustainable hydropower development. The guidelines can be downloaded here: www.hydrosustainability.org

Your guide to hydropower

The Hydropower Status Report is an authoritative guide to key trends in hydropower development, featuring policy insights and latest global capacity and generation data.

To download:
www.hydropower.org/statusreport

Focus session:
Capacity building on sustainable hydropower

Co-convenor

Focus session on Capacity Building on Sustainable Hydropower

Capacity building on sustainable hydropower aims to build or strengthen local resources to improve understanding and ownership of hydropower good practice. Effective capacity building programmes look to increase the development impact and sustainability of hydropower in developing countries by strengthening normative and institutional capacity within local regulators, developers and project owners.

Capacity is typically defined as the ability to solve problems, make informed choices, define priorities and plan future. The objective of capacity building programmes in hydropower should focus on developing in-country resources, physical and intangible, to guide sustainable hydropower performance and ensure the long-term viability of project benefits.

The objective of the session was to share knowledge and lessons learned of how capacity building programmes in hydropower can effectively result in strengthened local institutional capacity and ensure the long-term viability of project benefits.

Key discussion points

Panellists shared their aims for capacity building and training programmes through presentations.

Francois Edwards, of CEH, defined environmental flows and provided insight into relevant capacity building projects on the topic. He spoke about the EuroFlow international training network – a capacity building programme funded by the European Union's Horizon 2020 research and innovation programme. The programme provides 15 fully-funded PhD scholarships to train future leaders in the science, business and policy of environmental flows. By applying a multi-disciplinary approach, Mr Edwards highlighted how the scientific community and key stakeholders (policy makers, regulators, food, water, energy, environmental sectors and the public) can benefit from the research conducted as part of the programme and further its impact and dissemination potential.

IHA's João Costa presented the different types of capacity building training offered by the IHA. He explained how the suite of Hydropower Sustainability Tools, i.e. the Hydropower Sustainability Assessment Protocol, the Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool and the Hydropower Sustainability Good International Industry Practice Guidelines, can be used to strengthen in-country resources and develop institutional capacity. IHA's capacity building programmes focus on providing training on the use of the tools adapted to the local context. These can be in the form of introduction courses, topic specific workshops, online courses and accreditation trainings.

> *"Training is about teaching people to perform efficiently and safely in their job roles and to have the necessary knowledge and skills to competently do their job tasks."*
>
> – Didier Farez, Voith

Didier Farez from Voith and Line Amlud Hagen from ICH presented case studies of successful capacity building and training programmes.

Mr Farez discussed the work Voith has completed in Africa through the HydroSchool. He explained how Voith offers three different types of training - public courses, dedicated training and training programmes. Through the HydroSchool, Voith applies the Systematic Approach to Training (SAT) – an internationally recognised methodology in the energy sector for the analysis, design, development, implementation and evaluation of training – to help its customers and partner countries better utilise their own hydropower capacity and potential.

Similarly, Ms Hagen presented ICH's programme of work in Latin America, Africa and Asia, and Norway. ICH's aim is to promote sustainable development of renewable energy resources. She explained how ICH uses monitoring scheme to secure accountability and build a global network of skilled practitioners and future leaders. She also said the number of participants does not necessarily reflect the impact of ICH. The impact comes rather from training the right individuals that will drive change within their organisations. ICH studies revealed that in most cases women were the key individuals making impact.

Outcomes and priorities

As hydropower is a local resource, local expertise must be developed through adapted training and capacity building programmes to utilise the resource. Capacity building is about helping local consultants, practitioners, governments and relevant public sector staff better manage hydropower on their own and ensure the long-term viability of hydropower projects.

Panellists highlighted the need for capacity building programmes to be adapted to the local context. Panellists also agreed that strengthening in-country resources through effective capacity building programmes can lead to improved institutional capacity to help drive sustainable development in target countries.

The sector has to continue training local actors in sustainable hydropower development. Indeed, as Mr Farez stated, training is about teaching people to perform efficiently and safely in their job role, and to have the necessary knowledge and skills to competently do their job tasks. Appropriate skilled human capital and clean energy provisions are essential to inclusive economic growth and well-being for every country.

Further information

The HGIIP Guidelines published by IHA provide valuable insight into sustainable hydropower development and act as the foundation of IHA's capacity building programmes. The Guidelines can be downloaded here: http://www.hydrosustainability.org/Hydropower-Sustainability-Guidelines.aspx

Moderator:

João Costa
Senior Sustainability Specialist, IHA

Speakers:

Didier Farez
Marketing Director French Speaking Africa, Voith

Francois Edwards
Lead River Ecologist, Centre for Ecology and Hydrology (CEH), UK

Line Amlud Hagen
International Centre for Hydropower (ICH)

Focus session:
Sustainability assessment

Co-convenor

Norad

With the completion of the Hydropower Sustainability Guidelines on Good International Industry Practice (HGIIP), the sector now has a suite of sustainability tools to harmonise the understanding of sustainability in a hydropower context.

Performance against the guidelines can be measured through two complementary tools. The Hydropower Sustainability Assessment Protocol (HSAP) measures performance above and below the defined good practice. The Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool (HESG) can be used to check for gaps against good practice on relevant topics, and includes a gap management plan to improve processes and outcomes.

The session explored the best ways of using the guidelines and assessment tools to guide and measure performance with optimum level of efficiency. It also explained how the tools can be used to improve institutional capacity and enhance the development impact of hydropower projects worldwide.

Key discussion points

The session introduced the new Hydropower Sustainability Tools to delegates by exploring four different perspectives around the implementation of the Tools, represented by the session panellists. The Tools promote and guide sustainable hydropower projects, while also providing a systematic methodology to measure the performance of a hydropower project across twenty-six environmental, social, technical and economic topics. They provide a common language to allow governments, civil society, financial institutions and the hydropower sector to discuss and evaluate sustainability issues. The panellists and their different perspectives represented some of the different voices of that common language.

Independent consultant Doug Smith offered the perspective of an accredited assessor – the person responsible for carrying out assessments. He explained how the different Tools can be used independently and jointly to enhance the sustainability performance of hydropower projects. Mr Smith provided valuable insight into how the Tools can complement one another at each stage of the project life cycle. He also highlighted how the Tools can be used to reduce risks and attract financers, such as the World Bank, and other international financial institutions.

Kimberly Lyon from the World Bank and Geir Hermansen from Norad agreed with Mr Smith stating that developers can successfully attract foreign investment and reduce risk by applying the Tools on their new and existing hydropower projects. Ms Lyon added that the Tools align well with the World Bank standards from their Environmental and Social Framework and provide added value. This is because the Tools are hydropower-specific, while the WB standards are generic.

Both Mr Hermansen and Ms Lyon presented case studies of projects or development programs they financed in which the Tool were applied. Ms Lyon highlighted the lessons learned from the application of the HSAP in Vietnam and in the Zambezi River Basin while Geir presented the success stories and best emerging practices from the use of the Tools in Myanmar.

The application of the Tools by the World Bank and Norad demonstrated how the Tools can be integrated in development interventions and can support capacity building programmes to improve hydropower planning and development.

> *"The value of embedding sustainability in business is key in developing a strong sustainability profile and enhancing corporate strategy, project planning and management and guidance on international best practices."*
>
> – Irwan Aman, Sarawak Energy

Focus session on Sustainability Assessment

Speakers:

Alain Kilajian
Senior Hydropower Analyst, IHA

Irwan Aman
Senior Sustainability Manager, Sarawak Energy

Geir Hermansen
Senior Advisor, Norwegian Agency for Development Cooperation

Kimberly Lyon
Water Resources Specialist (Consultant), World Bank

Doug Smith
Environment and Social Expert, independent consultant and accredited assessor

Irwan Aman, from Sarawak Energy, then explained how the Tools can also be integrated in internal processes. Sarawak Energy has used the Tools to guide their sustainability program and enhance the performance of their hydropower assets. Mr Aman detailed how Sarawak uses the HSAP for internal assessments. The assessments are then reviewed by independent accredited assessors.

Outcomes and priorities

The session revealed how the Hydropower Sustainability Tools can be used not only to drive internal capacity, but also enhance the impact of development interventions and contribute to wider sustainable hydropower development. The session looked at specific case studies of their application, in Africa and southeast Asia, demonstrating how they can be used to encourage the sustainability of projects. It also enabled participants to have a better understand of how the Tools can be applied, and complement each other, at each stage of a project's life cycle. Finally, the session contributed to wider sustainable development goals, such as Sustainable Development Goal (SDG) 7 'Affordable and Clean Energy', SDG 6 'Clean Water and Sanitation' and SDG 13 'Climate Action', and helped draw a clearer path towards achieving our global carbon emission reduction targets.

Further information

The 'Application of the Hydropower Sustainability Assessment Protocol in the Zambezi River Basin' report published by the World Bank provides valuable insight into understanding the added value of the Hydropower Sustainability can bring to development interventions. It can be downloaded here: http://documents.worldbank.org/curated/en/653781547149896277/Application-of-the-Hydropower-Sustainability-Assessment-Protocol-in-the-Zambezi-River-Basin

The HGIIP Guidelines published by IHA provide valuable insight into sustainable hydropower development. The Guidelines can be downloaded here: http://www.hydrosustainability.org/Hydropower-Sustainability-Guidelines.aspx

Climate change and resilience

Focus session:
Hydropower's carbon footprint

Co-convenor

Vincent Chanudet, Environmental Engineer, EDF

The emissions of greenhouse gases (GHG), especially carbon dioxide and methane, from reservoirs have been the source of extensive debate, especially with respect to the climate mitigation potential of hydropower projects.

While reservoirs are known to most as sources of GHG to the atmosphere, only rarely acting as carbon sinks, the debate has stemmed from the underlying uncertainties associated with quantifying the new fluxes to the atmosphere. As such emissions are highly variable in both time and space, establishing accounting methodologies that can correctly identify what constitutes new emissions or sinks from what would be naturally occurring is key in assessing GHG footprint.

For this reason, IHA and the UNESCO Chair in Global Environmental Change developed the G-res Tool, which was released in 2017 after a multi-year, multi-stakeholder research effort. The G-res Tool employs a conceptual framework that reflects a net emissions approach, which takes into account pre-impoundment conditions and emissions translated from other human activities.

Key discussion points

Mitigating climate change is a key issue for sustainable development and it is imperative for stakeholders to quantify it in terms of GHG footprints. The GHG status of freshwater reservoirs – or any change in the GHG emissions in a river basin resulting from the creation of such a reservoir, thus concerns the hydropower industry.

Hydropower's carbon footprint has received a lot of media attention lately, which has led to misconceptions. While a lot of discussion has focused on the hydropower technology as a whole, hydropower projects are unique in that they are always custom-designed and site-specific projects, each with their own characteristics, risks and impact.

The GHG emissions profile of a reservoir is just one criterion in a suite of economic, social and environmental factors that needs to be holistically assessed on a system scale. Hydropower reservoirs sit in additionally complex systems, as they encompass both the energy and water sectors, providing essential services to both over very long time-scales compared to their alternatives.

Panellists stressed the need to assess each reservoir on a case-by-case basis. Hydropower operators, EDF and Hydro Quebec, both employed the G-res Tool to assess their hydropower fleets, partly in order to give existing and potential customers confidence on their footprint. Hydro Quebec's Boreal system of 28 large reservoirs feeding over 60 hydropower stations demonstrated lower emissions than previous studies that omitted the net-emissions concept used in the G-res Tool. EDF, which has a much larger hydropower fleet consisting of smaller reservoirs, many with high power densities (and very high heads) exhibited emissions intensities considerably lower than earlier.

The panel also outlined some of the design and operational factors that can lead to additional GHG emissions and how these could be mitigated.

Finally, the panel discussed the Intergovernmental Panel on Climate Change (IPCC)'s recently adopted 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, which included new guidance on assessing and accounting for emissions from reservoirs. The IPCC decided to include these emissions, which were previously only in the appendix, into the main guidance. It included an optional approach to provide an indicative estimate of the anthropogenic component of total emissions, which built upon the net-emissions concept developed during the creation of the G-res tool. This may garner attention towards GHG emissions from reservoirs as well as the G-res Tool.

"Reservoirs are not intrinsically good or bad. Their value has to be decided by weighing the balance of their benefits and their consequences, environmental and social. The same principle applies to the small vs large hydro debate. From a GHG perspective, their emission does not favour one size of hydro over the other"

Yves PRAIRIE, Professor and UNESCO Chair in Global Environmental Change, Université du Québec à Montréal (UQAM)

Speakers:

Mathis Rogner
Senior Hydropower Analyst, IHA

Yves Prairie
Professor and UNESCO Chair in Global Environmental Change, Unversité du Québec à Montréal

Christian Turpin
Environmental Performance Advisor, Hydro Québec

Jessica Fong
Senior Biologist, Sarwak Energy

Vincent Chanudet
Environmental Engineer, EDF

Atle Harby
Senior Research Scientist, SINTEF Energy Research

Outcomes and priorities

The IPCC announced it had adopted a methodology that will compel countries to report GHG emissions from flooded lands, including reservoirs.

Panellists unanimously agreed reservoirs are not intrinsically good or bad. Their value has to be decided by weighing the balance of their benefits and their consequences, environmental and social.

The same principle applies to the small versus large hydropower plant debate. From a GHG perspective, their emissions do not favour one size of hydropower plant over another. Panellists concluded there are ways to reduce the GHG footprint of a reservoir, both at the design phase but also in their operation.

Further information

Learn more about the G-res Tool by visiting the G-res Tool website: www.grestool.org, or sign-up to the G-res Tool newsletter: http://eepurl.com/gsCDwL.

You can find out more about hydropower's carbon footprint and follow more about by joining the Climate Change Knowledge Network on Hydropower Pro, IHA's online member community.

Download and read more about IPCC's 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

Other papers and references mentioned during the session:

Prairie et al., (2017): Greenhouse gas emissions from freshwater reservoirs: what does the atmosphere see? Ecosystems, 21 (5) 1058-1071.

Focus session:
Climate resilience

Co-convenor

European Bank
for Reconstruction and Development

Governments, lending institutions, and asset owners are increasingly seeking assurances that hydropower projects – greenfield developments or rehabilitations – are climate resilient. This is partly driven by international agreements such as the Paris Agreement, and increasing awareness about the materiality of physical climate risks to investments.

The session focused on new international guidance, the Hydropower Sector Climate Resilience Guide intended to support investors, owners and developers to make informed decisions about how to plan, build, upgrade and operate hydropower systems in the face of increasingly variable climatic and hydrological conditions.

Launched at this session, the guide introduces an innovative methodology for assessing climate risks and identifying corresponding climate resilience measures. The panellists discussed how asset owners and developers can demonstrate that their project is climate resilient and what it means for investments.

Key discussion points

After years of stakeholder consultations and testing, IHA officially presented the Hydropower Sector Climate Resilience Guide, with the assistance of the European Bank for Reconstruction and Development (EBRD) and the World Bank Group (WBG) and its Korea Green Growth Trust Fund (KGGTF), which provided technical and financial support for its development.

The guide provides a practical framework for assessing the projected impacts of climate change on hydropower systems. This includes guidance for selecting appropriate measures and operational procedures that build climate resilience, and for the development of a climate risk management plan.

It is intended for hydropower projects of all types, scales and geographies, and suitable for upgrade and greenfield projects. The six-phase methodology looks at climate risk screening, data analysis, climate stress testing, climate risk management, and monitoring, evaluation and reporting.

Furthermore, panellists discussed the importance of the Hydropower Sector Climate Resilience Guide for asset owners and developers in demonstrating that a project is climate resilient and what that means for ensuring investments.

Divas Basnyat, of NDRI, emphasised the benefit of the change in paradigm to approach climate risk assessments that the Guide proposes. However, as an advisor to the government, he pointed out the need to build capacity and sensitisation of decision makers on bottom-up decision scaling approach. It is also necessary to develop new financial mechanisms to help justify investing now in resilience measures to ensure future viability of hydropower projects.

Malawi is one of the least electrified countries globally with 11 per cent of electricity access level and with 98 per cent of the generation coming from a cascade of run-of-river hydropower projects in the Shire river outflowing from Lake Malawi. Being so vulnerable to the hydrological variability and effect of climate change in Lake Malawi, the greenfield 258 MW Mpatamanga project is carrying out a climate risk assessment following the framework of the Hydropower Sector Climate Resilience Guide to evaluate the viability of the project. Yet, the risk analyses and recommendations should be rooted in an understanding of the broader river basin to help Malawi improve the resilience of the entire energy system.

Operators leading on climate risk management shared their practice. Hörður Arnarson, of Landsvirkjun, described how climate change and the uncertainty of future climate affects their risk management portfolio and the obstacles to investing in climate resilience measures.

> *"Greater investment in hydropower is needed as part of the transition towards low-carbon and climate-resilient energy systems"*
>
> – Craig Davies, Head of Climate Resilience Investments at the EBRD.

Speakers:

Craig Davies
Head of Climate Resilience Investments, EBRD

Pravin Karki
Global Lead of Hydropower & Dams, WBG

María Ubierna
Hydropower Specialist, IHA

Panel discussion:

Denis Aelbrecht
Chairman Technical Committee on Climate Change, ICOLD

Hörður Arnarson
Chief Executive Officer, Landsvirkjun

Divas Basnyat
Senior Water Resources Specialist, Nepal Development Research Institute (NDRI)

Frédéric Vigeant
Air Quality Specialist, Hydro Quebec

Theresa Mkandawire
Dean of Engineering, University of Malawi

Outcomes and priorities

The Hydropower Sector Climate Resilience Guide sets a milestone for international guidance to the sector to build resilient projects. The guide represents good practice in climate change risks assessments with its new bottom-up approach.

The Guide provides a systematic, phased approach to identifying, exploring and addressing risks of a hydropower project without being overly prescriptive. Looking ahead for the next steps, further guidance should cover system level assessments to understand the broader context and assess how hydropower projects can also help develop climate resilient water and energy systems.

As a recommendation, climate change should be part of any existing or future hydropower risk management plan, as other factors of risk.

Further information

The Hydropower Sector Climate Resilience Guide published with the technical and financial support of EBRD and the World Bank provides a practical framework for assessing climate risk and build resilience of hydropower projects. It can be downloaded here: http://hydropower.org/climateresilienceguide

Hydropower professionals can join the Climate Change Knowledge Network on Hydropower Pro, IHA's online member community.

Focus session:
Green bonds for hydropower

Co-convenor

Climate Bonds

New sector-specific criteria have been announced for green bond issuers and investors to open up the burgeoning market to sustainable and socially responsible hydropower projects.

Green bonds are examples of the emerging instruments for green finance and investment in the energy sector that can be used for hydropower. They are fixed income loans specifically created to finance and refinance projects and assets that help address environmental and climatic risks and shift investment to a low carbon, sustainable economy. In 2018, over USD 167 billion of labelled green bonds were issued, with expectations of it reaching USD 250 billion this year.

This session focused on the development of the proposed eligibility criteria whilst also assessing what role the green bond market will have in the future of hydropower financing. Furthermore, with the market acting as a bridge towards many of the UN's Sustainable Development Goals (SDG), panellists explored how the criteria helps better align the hydropower sector with SDG 6, 7 and 13 and the Paris Agreement.

Key discussion points

Investor demand for green bonds is strong and increasing but there are also growing concerns about the credibility of green labelling, including for hydropower.

Following more than two years of discussions with industry, academia, governments and international NGOs, Anna Creed announced that the Climate Bonds Initiative is due to launch a consultation in the coming months on their proposed green bond eligibility criteria for hydropower. These criteria are seen as key to fully unlocking the market to the hydropower sector, which has to date been held back by a lack of clarity over appropriate standards.

Panellists discussed how the proposed criteria will boost confidence within the finance community to invest in green bonds linked to hydropower development, noting there is a significant demand from both issuers and investors. Developed to provide a robust, transparent and easy-to-use screening tool, the criteria will ensure that eligible hydropower projects and assets are in line with the goals of the Paris Agreement and achieve international good practice across a number of wider environmental and social issues.

Drawing on his years of experience as an environmental expert, Jorge Hartmann outlined how the recently developed Hydropower Sustainability ESG Gap Analysis Tool (HESG Tool) will be used as part of the CBI's proposed criteria to ensure compliance and also spread good practice across the sector.

The importance of sustainable hydropower to the clean energy transition and achieving the Sustainable Development Goals means it should be an integral part of the growing green bond market according to panellists. Hydropower can not only provide low carbon generation but also support the scaling up of variable renewable energy sources. It can also have multi-purpose benefits, such as water storage and flood control.

Carine de Boissezon and He Shan, from EDF and China Three Gorges respectively, explained the motivations behind their company's deep involvement in the green bond market. While to date there have been no obvious financial benefits, green bonds have diversified and widened their investor base coupled with long-dated tenors which better match the length of their investments. In addition, green bonds help to increase their resilience to market volatility and demonstrate their long-term commitment in sustainability.

"Green bonds help investors allocate capital to sustainable projects which contribute to the clean energy transition. If we want to reach the below two degrees objective, hydropower will be critical thanks to its unique storage value and flexibility."

– Carine de Boissezon, EDF

Outcomes and priorities

It was recognised that there is significant investor demand and potential for using green bonds to finance hydropower's role in clean energy transition, yet the lack of appropriate standards has been a major obstacle to date. The release of the CBI's proposed sector criteria for hydropower in 2019 will be an important milestone for the sector to aid the further development of sustainable hydropower.

Focus session on Green Bonds for Hydropower

Moderator:

Paul O'Connor
Executive Director, Green bonds, J.P. Morgan (moderator)

Speakers:

Carine de Boissezon
Chief Financial Officer, International Division, EDF

Anna Creed
Head of Standards, Climate Bonds Initiative

Joerg Hartmann
Independent Consultant

HE Shan
General Manager, Three Gorges Finance HK Limited

Further information

The CBI's hydropower criteria consultation was launched in June. For the latest information please check www.climatebonds.net.

Hydropower professionals can join the Markets and Finance Knowledge Network on Hydropower Pro, IHA's online member community. The Finance and Investment Knowledge Network focuses on building and sharing knowledge on key trends and developments in hydropower financing. Please contact Nicholas Troja at nicholas.troja@hydropower.org for more information.

Focus session:
Sediment management

Co-convenor

Hydropower has a prominent role in achieving the Paris Agreement. Reservoir and run-of-river hydropower projects provide low carbon energy production, stability and reliability to the electricity grid, and water services.

Alteration in the sediment budget in the catchment sedimentation undermines the capacity of hydropower projects to deliver water and energy services in addition to the upstream adverse effects of delta formation and downstream scour.

Sediment management contributes to maintaining storage capacity, reducing operating risks, and minimising river connectivity impacts. Implementing effective sediment management strategies is essential to extend the life of a project, to ensure a reliable and sustainable source of water and energy, and to maintain the river connectivity.

This session addressed the following questions: Why is sediment management important to hydropower projects for delivering sustainable water, energy and other multipurpose services? What are the policy needs, regulatory challenges, financial incentives and initiatives to promote sustainable sediment management?

Key discussion points

In the context of climate change, natural disasters and extreme weather events are more likely to happen, increasing the sediment yield and thus affecting the sediment transport in river basins. UNESCO IHP ISI encouraged international cooperation for policy development and collection and sharing of erosion and sediment data.

Hydropower asset owners discussed the challenges in the business which can be categorised as: (1) abrasion of hydro-mechanical equipment; and (2) loss of reservoir storage. Siri Stokseth, from Statkraft, addressed both categories from a financial perspective. The decision-making process draws on optimisation of O&M costs and required investments of the infrastructure that fits into Net Present Value models (e.g. risk of intake clogging, downtime, reservoir flexibility, etc.). Luiz Maldonado highlighted Itaipu Binational's investment in environmental programmes and soil conservation practice to reduce loss of storage and thus sustain operations in the long-term. He also emphasised the importance of sediment monitoring, particularly at extreme event, without which, operations could not be optimised.

With a wider perspective of sediment issues, Manfred Spreafico, of UNESCO IHP, pointed out that reservoir sedimentation is an integral part of water resources management in the river basin. Sediment management of a river basin should cover erosion, sediment transport and deposition upstream and downstream of the reservoir, including economic, environmental and social issues. In addition, long-term planning should also include the uncertainties of climate change and take a no-regret approach.

For the reconciliation of short-term and long-term objectives, there has to be a balance between operators and national perspectives. Policy that focuses on sustainable development and creation of intergenerational equity would encourage a sustainable design of hydropower facilities and hydropower operations. Stable and predictable regulatory framework and business environment are key towards long-term national sustainable development.

> *"There has to be a balance between operators and national objectives so that we can achieve the sustainable development that we seek."*
>
> – George Annandale, independent consultant

Focus session on sediment management

Moderator:

Anil Mishra
Programme Specialist, UNESCO IHP ISI

Speakers:

Siri Stokseth
R&D Manager and Dam Safety Coordinator, Statkraft

Luiz Henrique Maldonado
Hydrometry Specialist, Itaipu Binational

Manfred Spreafico
Chair of the advisory group, UNESCO IHP ISI

George Annandale
Independent consultant

Outcomes and priorities

The panellists agreed reconciliation of hydropower operators' perspectives and long-term objectives is of paramount importance if a policy framework is generated that creates the environment for long-term river basin sustainable development.

UNESCO IHP ISI and IHA will continue to work with other international organisation to promote cooperation in sediment management, advancing knowledge for policy development and sharing knowledge in international good practice in sediment management at both project level and river basin level.

Further information

Hydropower professionals can join the Freshwater Management Knowledge Network on Hydropower Pro, IHA's online member community. The network focuses on exchanging experiences and best practices on operations and maintenance, including hydropower safety and modernisation programmes. Members can join the Sediment Management Knowledge Hub.

Focus session: **Hydropower safety**

Safety continues to be the number one priority for hydropower utilities globally.

Providers need to ensure that all staff on site are properly trained and must prevent accidents related to design, construction, operation and maintenance of hydropower facilities. Advancements to hydropower safety measures are essential to ensure that hydropower remains a leading source of renewable energy into the future, by continuously improving dam safety practices, with consideration of plausible future climate scenarios. This will also require operators and maintenance staff to build the necessary skills to adapt to more extreme operating conditions, while maintaining a high level of cyber-security.

The session discussed some of the challenges the hydropower sector is facing in terms of ensuring the overall safety of the world's hydropower assets and highlighted advancements being made by leading organisations, who are continuously improving their overall safety programs.

Key discussion points

ICOLD representatives, Michel de Vivo and Michel Lino, conveyed the primary goals of the organisation, which included setting standards and guidelines to ensure that dams are built and operated safely, efficiently and economically, and are environmentally sustainable and socially equitable.

Mr. Lino said that despite decades of improvement in reducing the rate of dam failures on a global scale, the past two decades have seen a decline in progress, evidenced by numerous incidents over the past year. This sends a strong message to the hydropower sector that more work needs to be done to ensure that dam owners and operators are better prepared to safely operate the global fleet of ageing infrastructure and plan new projects resilient to a more extreme climate.

Dam safety specialist Alessandro Palmieri outlined the World Bank's tool for risk-informed dam safety assessment, designed to avoid or minimise risks and impacts, particularly in developing countries. He said the 'worst enemy of dam safety is complacency,' as often after dams have been operating safely for some time, operators can become complacent, allowing the level of surveillance and monitoring to become less stringent.

Ahmed Chraibi, also a dam safety specialist, described the circumstances that led to the disastrous failure of the Xe Namnoy saddle dam in Laos. While investigation of the incident continues, he said the tragedy revealed that

Co-convenor

assessment of potential consequences of failure should be undertaken for all dams, regardless of height. He also added that geological risk appraisal should be part of requirements at the design and construction stages and an emergency action plan should be prepared, covering all structures under all modes of failure. An independent experts' group was recommended for any dam structure representing a serious downstream risk. Industry representatives, Karima Mussi, of Itaipu in Brazil, and Farah Tipol, of Sarawak Energy in Malaysia, further spoke about the need for early stage implementation and training around dam safety principles.

> *"The worst enemy of dam safety is complacency."*
> – Alessandro Palmieri, independent expert

Outcomes and priorities

The session succeeded at informing the international hydropower community about the importance of safety and the need to continuously improve and enhance overall safety practices.

Recent incidents have placed a priority on re-examining dam safety under a broad range of climate extremes and operating conditions, as well as a more in-depth assessment of geological risk. Traditional safety programmes need to consider cyber threats under the spectrum of plant security. Hydropower safety should not exclusively focus on dam safety, but also other threats, such as downstream impacts of a sudden release of spill during normal operations, such as in the Shushenskaya hydroelectric dam in Russia.

ICOLD was urged to gather reliable information on each dam failure incident and create a public incident and dam failure database, which will go public.

Further information

Hydropower professionals can join the Asset Management Knowledge Network on Hydropower Pro, IHA's online member community. The network focuses on exchanging experiences and best practices on operations and maintenance, including hydropower safety and modernisation programmes.

Speakers:

Michel de Vivo
Secretary-General, ICOLD

Michel Lino
Vice-President (Europe)
ICOLD

Alessandro Palmieri
Independent Consultant

Karimi Mussi
Civil Engineer
itaipu binacional

Farah Hanan Tipol
Senior Engineer
Sarawak Energy

Ahmed Chraibi
Independent Consultant

China Society for Hydropower Engineering

China Society for Hydropower Engineering(CSHE) is a nonprofit social organization. It was established in 1980 with 196 organizations as its members and 32 Technical Committees offering strong technical support for CSHE.

We focus on hydropower industry and policy research for government decision making. We make Chinese power industry's voice heard by connecting China with the world. We set up platform for both Chinese and foreign companies for communication and place Awards to undergraduates, young engineers and professionals who make outstanding contribution to the industry and Hydropower Technology Award to encourage innovation.

www.hydropower.org.cn

CSHE

Connecting China with The World

Regional focus sessions

Overview

Hydropower remains the world's largest source of renewable electricity generation, providing clean, affordable and reliable power in more than 150 countries, across every continent. In doing so, hydropower makes an important contribution to achieving both the Sustainability Development Goals and aims set out in the Paris Agreement.

Regional monitoring reveals where capacity is being added and provides a window into the status of hydropower. A series of regional focus sessions presented the latest trends and developments shaping the region at both the government and industry level. The regional sessions provided an overview of where capacity has been added, project developments and policy updates, and short deep dives into developments occurring in key countries.

Europe

Session summary

The European Union as well as Switzerland, Norway and Turkey have brought forward climate and energy policies over recent years aimed at securing sustainable clean energy systems. Hydropower in Europe has a rich history in the development of its energy system and looks to continue playing a significant role. To help address barriers in hydropower development, a consortium has launched an EU funded initiative called Hydropower Europe. The initiative involves consultation with the broad network of hydropower stakeholders to develop a research agenda and strategic innovation roadmap for the sector.

The European Commission's energy policy framework aims towards an energy union strategy, led by the Clean Energy for All Europeans programme. The EU has a renewable energy target of 32 per cent in its energy mix by 2030.

Moreover, the Integrated Strategic Energy Technology plan draws up a framework for moving towards sustainable energy sources. A comprehensive roadmap is needed for the sustainable use of existing hydropower and the development of the untapped hydropower potential under environmental and socio-economic constraints.

Hydropower Europe will hold technical fora and transparent public debates through a forum that gathers all relevant stakeholders in the sector. The consultation process will be held through the Hydropower Europe consultation platform, integrating feedback from online consultation, workshops and expert working groups.

Africa

Session summary

Hydropower will play a key role towards achieving Africa's 2040 Agenda for energy transformation, with 89 per cent of the continent's hydropower potential still untapped.

The session highlighted flagship projects, including the development of the 43 GW Grand Inga Project in the Congo basin. A major challenge discussed was the lack of necessary capacity for operations and maintenance amidst growing hydropower capacity.

In a region with high hydrological variability, hydropower can play a major role in achieving water security through the multiple uses associated with dams. An example is Cameroon's Lom Pangar dam that couples power generation with regulation of river flows, thereby boosting hydropower generation along the Senaga River. Moreover, the flexibility of hydropower coupled with the expected increase of solar (floating PVs) and wind energy will be key to ensure the security and reliability of the electricity supply in the region.

Participants noted the private sector could play a huge role in accelerating hydropower capacity in Africa. The GetFit programme in Uganda was mentioned as a successful project by the private sector, which provided incentives for small-scale private sector investments, which added up to 150 MW of installed capacity. In Nigeria, power sector reform has led to the private sector playing an important part in power generation and distribution. This has facilitated necessary funding to upgrade and revitalise the operation of hydropower plants from 50 per cent capacity to full operating capacity.

North America

Session summary

The Canadian and US-based national organisations' representatives provided perspectives on the status of hydropower development and existing assets in their respective countries.

Anne-Raphaelle Audoin, president, Waterpower Canada, pointed out that hydropower supplies over 60 per cent of Canada's electricity supply. Currently, Canada has the cleanest electricity grid in the G20 with 82 per cent of total electricity generation being from non-emitting resources.

There are four major hydropower projects under construction in Canada across four provinces: BC Hydro's 1,100 MW Site C project on the Peace river, the 824 MW Muskrat Falls project on the Lower Churchill River in Labrador, the 695 MW Keeyask project on the Nelson River in Manitoba and Hydro-Québec's La Romaine 4 hydropower project at 245 MW. By 2020, another 2800 MW of clean renewable hydropower will be in service in Canada.

In the US, Linda Church-Ciocci, president, National Hydropower Association, said hydropower comprised 7 per cent of the nation's electricity generation and around 40 per cent of its renewable energy supply. At 102 GW, the US still retains the second largest fleet of hydropower assets globally, with over 22 GW of pumped hydropower storage comprising 95 per cent of the energy storage in the country.

South & Central Asia

Session summary

South and Central Asia is one of the fastest growing regions in hydropower with vast potential. Introducing the panel, Demetrios Papathanasiou, Practice Manager at the World Bank explained that a quarter of the global population lives in South Asia, while energy capacity is currently well below the world average. To meet rising needs, significant growth in energy is expected over the coming decades.

The Government of India, represented by Aniruddha Kumar, Joint Secretary of Power, presented new measures being implemented, including the declaration of all hydropower projects as renewable power, as of March 2019. Cross-border guidelines also allow Nepal, Bhutan and Bangladesh to access India's power market, boosting prospects for new hydro.

Giorgi Chikovani, CEO of Georgian Energy Development Fund (GEDF) then discussed Georgia's energy strategy, including investment in renewables, market development, and regional trading. There are almost 2,000 MW new hydropower and 1,200 MW wind projects at construction or feasibility stage, including projects in GEDF's portfolio supporting private sector uptake.

Representing a private developer, Kamran Kamal, CEO of Laraib Energy presented Pakistan's recent growth, which had 2,487 MW hydropower capacity, added in 2018 alone. While this is public owned, local and foreign investors are also playing a role, with additions such as the first 84 MW hydropower IPP in 2013, 147 MW Patrind in 2017, and a pipeline of developments looking ahead.

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Latin America

Session summary

Latin America ranked second in regions worldwide for hydropower capacity increase in 2018.

Led by Brazil, the region accounts for approximately 15 per cent of the world's installed capacity and generation. Ambitious governments such as Ecuador, Peru and Bolivia aim to decarbonise the energy matrix and foster hydropower development. The session presented trends and developments shaping the region, including an overview of energy transition and planning.

Medardo Cadena, Director of Energy Integration, Accessibility and Security, at the Latin America Energy Organisaiton (OLADE), said prospects for future hydroelectric projects in the region looked bright, with potential for development at almost 70 per cent.

OLADE estimates by 2040, there will be a significant increase in installed capacity of all renewable energy resources. However, hydropower development has social and environmental challenges related to the need of larger transmission lines and more storage to face the uncertainty of seasonal hydrological variability and the influence of climatic phenomena.

Based on OLADE studies and projections, Mr Medardo pointed out the need to propose energy policies and plans for more ambitious targets for substitution of fossil fuels and penetration of renewable energy sources and energy efficiency in the region. He concluded that the region needs to increase its efforts in energy efficiency and responsibility in the use of its greatest resource: water.

East Asia & Pacific

Session summary

East Asia and the Pacific remains the leader in hydropower development led by China and accounting for nearly 40 per cent of the world's installed capacity and annual generation. Rapid economic growth has helped propel hydropower development across the region.

Zheng Sheng'an, President, China Renewable Energy Engineering Institute, said China was increasingly committed towards sustainable hydropower with improved resettlement standards and benefit sharing framework. He also noted that pumped storage in the country is expected to continue growing in order to help address the issue of renewable energy curtailment.

Meanwhile, Indonesia's abundant hydropower resources are fraught by challenges in land permission and acquisitions, as well as project financing, due to high borrowing costs and off-taker risks, said Josaphat Rizal Primana, Director, Ministry of National Development Planning, Indonesia. The government has formulated several policies to mitigate these risks and attract the private sector.

Elsewhere, Papua New Guinea is facing a double jeopardy of a low electrification rate and high electricity tariffs, due to years of underinvestment in power sector, high energy losses, low reliability and a dispersed population. However, Bruce Corbet, Executive General Manager, PNG Power, explained they are planning to rectify the situation through several measures including smart metering, legalising "informal" connections and new distributed hydropower baseload plants.

In Australia, Snowy Hydro's 'Snowy 2.0' project was given the green light and is expected to be completed by 2025. Hydro Tasmania's 'Battery of the Nation' initiative has also identified 2,500 MW of high potential pumped storage sites.

Study Tour

A group of delegates participated in a tour of Voith's hydropower facilities in Germany and Luxembourg between 17-18 May.

The tour was organised by Congress supporting partner Voith and started at their headquarters in Germany, where visitors got the opportunity to see Voith's research and development as well as training centre, and on-site small hydropower plant equipped with Voith's StreamDiver.

Participants were then taken to the Gaildorf wind-pumped storage hybrid power plant, the first of its kind worldwide. Combining wind mills with a pumped storage plant ensures that energy generated is immediately and reliably stored when it cannot be directly fed into the power grid.

Delegates at study tour held by Voith

The second day of the tour took participants to Luxembourg, where they visited the Vianden pumped storage power plant, which supplies electricity directly into the German transmission grid. It is used as a flexible electricity storage system to regulate the grid as part of the transition process to renewable energies.

"It was a great opportunity to show the diverse group of delegates our premises in Heidenheim and also to visit two examples of where our state-of-the-art technology is applied," said Dr Jürgen Schuol, Head of Sustainability, Voith Hydro.

Supporting partner

VOITH

Workshop:
Francophone workshop on sustainability and good practices

Co-convenor

ORGANISATION INTERNATIONALE DE la francophonie

INSTITUT DE LA FRANCOPHONIE POUR LE DÉVELOPPEMENT DURABLE IFDD

This initiative, supported by the Institut de la Francophonie pour le développement durable, was the first workshop tailored for the francophone hydropower community designed to introduce the new Hydropower Sustainability Tools.

The Hydropower Sustainability Tools comprise: an expanded version of the Hydropower Sustainability Assessment Protocol (HSAP) to include climate change mitigation and resilience, a new Hydropower Environmental, Social and Governance Gap Analysis (HESG) Tool – aligned with the safeguards policies of the International Financial Institutions – to identify gaps against good practice in environmental, social and governance topics – and the Hydropower Good International Industry Practice (HGIIP) Guidelines.

The workshop also showcased examples of good practice in sustainable hydropower in francophone countries, including projects and programmes from EDF, The Nature Conservancy Gabon, Hydro-Québec and ENERGIES 2050.

Finally, this workshop explored how the Hydropower Sustainability Tools can help enhance the impact and sustainability of development projects in francophone countries worldwide, with a focus on Africa.

Key discussion points

Alain Kilajian, of IHA, and Trycia Van Den Berg, of IFDD, introduced the workshop programme and provided a brief introduction on key sustainability and sustainable development concepts towards promoting a low carbon future. The workshop covered several energy-related topics and highlighted the important role of hydropower in reaching global development goals.

The workshop was divided into three sessions. The first session focussed on the role and application of sustainable development practices in francophone countries. The second consisted of an interactive session led by IHA's Sustainability Specialist, Alain Kilajian, and experienced Accredited Assessor, Margaret Trias, on the suite of Hydropower Sustainability Tools and how they can be used to define and measure sustainable hydropower performance. Finally, the third session looked at case studies of good practices in hydropower development, both on the individual project level and in basin-wide approaches.

Outcomes

Over 30 participants from francophone countries in North America, Europe and Africa benefited from the workshop. The session enabled participants to have a better understanding of the suite of Hydropower Sustainability Tools and their applicability worldwide, especially for francophone Africa. Participants also discussed challenges, emerging best practices and lessons learned from implementing their sustainable development agendas.

> *"Training is about teaching people to perform efficiently and safely in their job roles and to have the necessary knowledge and skills to competently do their job tasks."*
>
> – Didier Farez, Voith Hydro

In addition, the workshop illustrated how the new Hydropower Sustainability Tools aligned with relevant IFI standards and how these tools can contribute to wider sustainable hydropower development.

In terms of its contribution to sustainable development, the workshop covered many of the SDG's, but the main ones addressed were SDG 7 'Affordable and Clean Energy', SDG 6 'Clean Water and Sanitation', and SDG 13 'Climate Action'.

The Hydropower Sustainability Tools can indeed help developers, practitioners, consultants and other relevant

Further information

For training opportunities on the Hydropower Sustainability Tools, please visit the website at http://www.hydrosustainability.org.

Speakers:

Jean-Pierre Ndoutoum
Director, IFDD

Guillaume de Laboulaye
Programme Manager, Energies2050

Christian Turpin
Environmental Performance Advisor, Hydro-Québec

Alain Kilajian
Sustainability Specialist, IHA

Margaret Trias
Accredited Assessor, Independent Consultant

Elvis Makady
Sustainable Hydropower & Renewable Energy Coordinator, TNC Gabon

Olivier Salignat,
Head of Environment and Social, EDF

Workshop:
Sediment management

Co-convenor

Federal Ministry Republic of Austria Finance

Sedimentation, or sediment related issues, undermine the capacity of hydropower projects towards delivering water and energy services.

Sediment management contributes towards maintenance of storage capacity, reduction of operating risks, and minimisation of river connectivity impact. Managing sediment is essential to extend the life of a project, to ensure a reliable and sustainable source of water and energy, and to maintain river connectivity. This workshop focussed on understanding the impact of sedimentation and techniques to mitigate it through sediment management strategies to achieve sustainable operations.

Programme

The workshop started with an introduction of reservoir sedimentation, effects of climate change, and sustainable development to emphasise the importance of sediment management as a proxy for reliability of hydropower generation in the long-term.

Case studies illustrated sedimentation as a worldwide sustainability issue and showed innovative approaches and management alternatives for sustainable sediment management.

Responding to the need of preliminary screening analysis of viable sediment management alternatives, the World Bank's Nikolaos Efthymiou presented the Reservoir Conservation Model RESCON 2 Beta, a rapid assessment tool of sediment management strategies taking into consideration sustainability factors and hydrological uncertainties associated with climate change. For further detailed sediment management studies, numerical (iSed) and physical models proven capabilities were discussed with examples of case studies from Europe and Nepal.

Outcomes

The necessity of a new approach and incentives for managing sediment was stressed, with sedimentation described as a worldwide sustainable issue. Sedimentation is reducing worldwide storage capacity, losing the best reservoir sites and reducing water and energy supply reliability.

Hydropower as a renewable energy source cannot ignore its long-term role to reliably supply water and energy. Independent expert Greg Morris discussed different sediment management alternatives, from upstream sediment management to sediment routing or removal strategies, intended to sustain long-term hydropower operations, replacing the traditional life span concept.

> *"Currently, the global volume of reservoir storage is declining because more storage is lost per year due to sedimentation than the amount of new storage added."*
>
> – George Annandale, international expert

Participants also learned about other innovative approaches to sediment management, rapid assessment tools, such as the open-source RESCON 2, the capabilities of numerical models, like UNESCO chair in Integrated River Research and Engineering Helmut Habersack's iSed, and the advantages of physical scale models proven to work through multiple case studies developed at HydroLab in Nepal.

Find out more

Visit IHA's Sediment Management Knowledge Hub at www.hydropower.org/sediment-management

You can download the Reservoir Conservation Model RESCON 2 Beta at www.hydropower.org/sediment-management/resources/tool-reservoir-conservation-model-rescon-2-beta

Many other publications by the international experts that presented in the workshop are available at www.hydropower.org/sediment-management/resources

Workshop on Sediment Management

Speakers:

María Ubierna
Hydropower Specialist, International Hydropower Association

Pravin Karki
Global Lead Hydropower and Dams, World Bank Group

Helmut Habersack
UNESCO Chair in Integrated River Research and Engineering, BOKU

George Annandale
International expert

Greg Morris
International Expert

Nikolaos Efthymiou
Consultant, World Bank Group

Meg Bishwakarma
General Manager, Hydro Lab

Workshop:
Climate Resilience Guide

Co-convenors

European Bank for Reconstruction and Development

WORLD BANK GROUP

Optimising the role of hydropower infrastructure in the provision of climate adaptation services is possible by only understanding and assessing climate-related risks and opportunities.

This workshop introduced the Hydropower Sector Climate Resilience Guide, a practical guidance to better prepare for an uncertain future and ensure robust and climate resilient hydropower projects. It provided a walk-through of the steps required in carrying out a climate risk assessment and integrate climate resilience measures into hydropower operations illustrated by industry best-practice case studies.

The workshop was oriented towards hydropower practitioners, climate specialists and those responsible for management and planning decisions. It was also geared towards representatives of financial institutions dealing with climate risk assessments.

Programme

After an initial introduction by the co-conveners on the importance of international guidance that the Hydropower Sector Climate Resilience Guide provides to incorporate climate resilience into hydropower project design and operations, IHA's María Ubierna presented the framework and overview of the Guide.

Those with a more technical background could attend a breakout group for hands-on technical training focused on a deeper understanding of the climate stress test methodology included in the Guide.

Those who heard for the first time about the Guide and its bottom-up approach attended the primer covering all the phases of the Guide in more detail supported by illustrative case studies of industry best practice.

Outcomes

The workshop proved to be of high interest and reached the maximum capacity of 90 participants. The participants represented the wider hydropower industry stakeholders including utilities, operators, consultants, research institutions, governments and lenders coming from all around the world.

The participants of the more technical training were equipped with hands-on training on the core methodologies of the Hydropower Sector Climate Resilience Guide. They deepened their understanding in a practical case study using numerical modelling resources, which are ready to be used and applied with the appropriate data.

"I am thankful for having the opportunity to attend it and to contribute to the development of the Guide. This topic is very important to the Brazilian electricity sector due the majority contribution of renewable sources, in particular, hydropower. The tool will be useful in providing guidance to have resilient projects around the world."

– Thais Soares, Environment and Energy Transition Manager, ENGIE Brasil.

The participants were then given an introduction to the Guide, which examined some of the underlying questions related to climate resilient hydropower projects. They gained insight to the six-phase approach with explanations from real experiences. In particular, the lender community welcomed the Guide towards helping to ensure climate resilient investments in their portfolios.

Find out more

Download the Hydropower Sector Climate Resilience Guide at www/hydropower.org/climateresilienceguide

Hydropower professionals can join the Climate Resilience Knowledge Network on Hydropower Pro, IHA's online member community.

Workshop on Climate resilience Guide

Presenters:

Pravin Karki
Global Lead Hydropower & Dams, WBG

Craig Davies
Head of Climate Resilience Investments, EBRD

María Ubierna
Hydropower Specialist, IHA

Patrick Ray
Assistant Professor University of Cincinnati

Asphota Wasti
Environmental Engineer, University of Cincinnati

Martin Fuchs
Global Head of Hydro Consulting, Pöyry

Pierre Biedermann
Consultant, Alpage

Peter Rae
Independent Consultant

Marco Braun
Hydroclimatology Specialist, Ouranos

Workshop:
Preparing operation & maintenance strategies

Co-convenor

WORLD BANK GROUP

While global statistics on the performance of existing hydropower assets are not readily available, there are several documented cases, especially in developing countries, where hydropower has been shown to be under-performing relative to hydropower sector standards. Poor governance, insufficient financing and a lack of human resources for O&M can be significant factors that explain such cases.

As a follow-up to the O&M workshop in Addis Ababa, the World Bank, with the support of Swiss cooperation, collaborated with IHA and experienced consultants to develop a guidance note that aims at supporting decision makers and O&M practitioners in planning O&M strategies.

This workshop provided a synopsis on the content of the World Bank Guidance Note for preparing O&M Strategies, and invited the participants to identify where there may be gaps or major revisions required that could be addressed in final version.

Programme

Pierre Lorillou, of World Bank, provided background on the development of the Guidance Note for preparing O&M Strategies. World Bank, with support from SECO created the SOMAH (Sustainable O&M for Hydropower) initiative, with objectives to (i) build a community around O&M for hydropower and (ii) foster development and dissemination of good practices in the sector. Commitment to prepare proposed Guidance Note aims at contributing to these objectives.

An overview of the Guidance Note, by the expert consultants for World Bank, Babar Khan and Nigel Wills provided context for ensuing discussions, describing the 8-step process for developing O&M strategies.

Industry representatives from hydropower utilities in five different countries (China, Switzerland, Brazil, Pakistan and France) and from the equipment manufacturing sector provided insightful case studies, each sharing their unique O&M strategies for managing risk, allocating CAPEX/OPEX, optimising human resources and in some cases, developing ad-hoc strategic (and contractual) models.

Outcomes

In presentations and group discussions, it was recommended that O&M strategies should consider effective risk analysis and structure of contractual agreements and stakeholder engagement. Management should be supportive to the development and implementation of O&M strategies, which should be prepared during the feasibility stage. Doing so would not only improve performance, but also provide comfort to financiers.

> *"Environment with low O&M capacities often results in more frequent and more severe outages, which can result in costs & constraints higher than in developed countries and sometimes in threat to the sustainability of the facilities, if not the electricity system as a whole,"*
>
> – Pierre Lorillou, World Bank

It was further discussed there should be a change in the O&M Guidance note to reflect a sound O&M strategy to enhance sustainability. More guidance on management and staff training and budgeting was also recommended.

Find out more

Hydropower professionals can join the Asset Management Knowledge Network on Hydropower Pro, IHA's online member community. The network focuses on exchanging experiences and best practices on operations and maintenance, including hydropower safety and modernisation programmes.

Workshop on Preparing operation & maintenance strategies

Presenters:

Pierre Lorillou
Senior Hydropower Specialist, World Bank

Nigel Wills
Independent Consultant, World Bank

Babar Khan
Independent Consultant, World Bank

Bernard Valluy
Head Group Operations, Alpiq AG

Thiago Tomazzoli
Asset Manager, Statkraft Brazil

Kaleem Khan
Station Manager, Laraib Energy Ltd.

Roberta Galli
Hydro Service Leader, GE Renewable Energy

Luo Rencai
Deputy Director, CTG

Patrick Bellet
Hydropower O&M Expert, EDF

Mike McWilliams
Independent Consultant, World Bank

> *"With an effective O&M Strategy, the benefits are many - from improved safety, to capital planning, reliable operation and improved finances."*
>
> – Babar Khan, World Bank

Workshop:
Sustainability assessment tools

Co-convenor

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Volkswirtschaftsdepartement EVD
Staatssekretariat für Wirtschaft SECO

This workshop introduced the Hydropower Sustainability Tools and explored how they can help enhance the impact and sustainability of development intervention.

The Hydropower Sustainability Assessment Protocol (HSAP) was launched in 2010, in response to a need for a common language to describe good and best practice in hydropower development. A series of new tools under the Hydropower Sustainability Assessment Protocol were launched in 2018. These included: the Hydropower Environmental, Social and Governance Gap Analysis (HESG) Tool – aligned with the safeguards policies of the International Financial Institutions - to identify gaps against good practice in environmental, social and governance topics and the Hydropower Good International Industry Practice (HGIIP) Guidelines.

Programme

IHA's João Costa introduced the workshop programme and provided a brief introduction to the suite of Hydropower Sustainability Tools and their added value for developers, lenders, international financial institutions and other key stakeholder groups in the hydropower sector. The workshop covered important sustainability topics relevant to hydropower, such as benefit sharing and integrated planning, and highlighted the important role of the sector in reaching global development targets.

The workshop was divided into 3 sessions. The first session focused on the Hydropower Sustainability Assessment Tools in the development context, with presentations from SECO and Sarawak Energy. The second consisted of an interactive session led by Mr. Costa, on the suite of Hydropower Sustainability Tools and how they can be used to define and measure sustainable hydropower performance. Finally, the third session looked at how the tools can be used to enhance the impact and sustainability of development intervention, with presentations from Norad and the World Bank. The three sessions were followed by a panel discussion with all five speakers moderated by IHA's Alain Kilajian.

Outcomes

Over 20 participants from countries in North America, South America, Europe and Africa, including Brazil, Portugal, United States and Congo, benefited from the workshop. Organisations represented in the audience included EDP, EDF, Cepel, Cornell University, Voith and Arup. The session enabled participants to have a better understanding of the suite of Hydropower Sustainability Tools and their applicability worldwide, especially in a developing country context. Finally, participants were also able to network among each other to discuss challenges, emerging best practices and lessons learned from hydropower development in their local context.

> *"The HSAP is a comprehensive and hydropower-specific assessment tool based on the collective experiences of the sector and provides a balanced, practical perspective."*
>
> – Kimberly Lyon

In addition, the workshop illustrated how the new Hydropower Sustainability Tools aligned with relevant IFI standards and how these tools can contribute to wider sustainable hydropower development.

In terms of its contribution to sustainable development, the workshop covered many of the SDGs but most directly addressed SDG 7 'Affordable and Clean Energy', SDG 6 'Clean Water and Sanitation', and SDG 13 'Climate Action'.

The Hydropowe Sustainability Tools can indeed help developers, practitioners, consultants and other relevant hydropower stakeholder to promote best practices and advance sustainable hydropower.

Find out more

For training opportunities on the Hydropower Sustainability Tools please visit the website at www.hydrosustainability.org/.

Workshop on sustainability assessment tools

Presenters:

João Costa
Senior Sustainability Specialist, IHA

Mohamad Irwan Aman
Senior Sustainability Manager, Sarawak Energy

Kimberly Lyon
Water Resources Specialist (Consultant), World Bank

Daniel Menebhi
Programme Manager, SECO

Geir Hermansen
Senior Advisor, Norwegian Agency for Development Cooperation

Alain Kilajian
Sustainability Specialist, IHA

Workshop:
Hydropower benefit sharing

Co-convenor

IFC International Finance Corporation WORLD BANK GROUP

Hydropower development can help improve social and economic benefits for local and regional communities. Benefits for local communities may include employment, community services, infrastructure, energy, education, new markets, government revenues and economic development. It is a continuing challenge to ensure that benefit sharing responds to local expectations, builds on existing capacities, and results in sustainable and positive impact.

From existing research, it appears that many factors influence the success of benefit sharing programmes, including: thorough understanding of local context and stakeholders; examination of the business case, company values and culture; suitable engagement carried out by experienced practitioners and selection of benefit sharing programmes and implementation mechanisms that make most sense for the given context and business model.

The workshop aimed to share the current trends and lessons learned from the implementation of benefit sharing mechanisms by hydropower developers, and also share the challenges and opportunities that arise from them.

Programme

The benefit sharing workshop was co-convened by International Finance Corporation (IFC) which presented key findings and lessons learnt from ongoing projects, and also included a group-discussion to share experiences and reflect on the needs for improvement in benefit sharing practices.

The workshop was structured in two main sections. In the first one, the IFC and IHA presented the key findings from the ongoing study on benefit sharing practices in hydropower projects. Independent consultant Joerg Hartmann explained how benefit sharing practices are captured in the HSAP (Hydropower Sustainability Assessment Protocol), as well as the ESG (Environmental, Social and Governance Gap) and GIIP (Good International Industry Practice) tools. Kate Lazarus, of IFC, introduced the importance of benefit sharing towards peace building models to create and strengthen markets that are environmentally and socially sustainable.

The second section included short presentations of benefit sharing applications in different regions, projects and organisations (Nepal, Papua New Guinea, Nachtigal Hydropower Project, and Statkraft) followed by group discussions. Sophia Tamot facilitated a group discussion on how local shares can be an effective benefit sharing mechanism. Fabien Nathan, of EDF, presented the Local Economic Development Action Plan in the Nachtigal project and facilitated the discussion on how to involve the government into the benefit sharing activities. Orlando San Martin, of Statkraft, presented benefit sharing through community investment with examples from Chile and Nepal and facilitated a discussion around managing liabilities pending from earlier owners.

> *"For something to be considered benefit sharing, there has to be an incremental advancement or effort to provide a benefit to the local communities. Ideally, the benefits will outweigh the negative impacts and costs to the community, creating a positive net benefit towards the community, so that the community is better off with the project than without."*
>
> – Eduard Wojzcynski, Manitoba Hydro International

Outcomes

There were 47 participants including senior hydropower specialists, financial institutions, hydropower leads, governmental officials and civil society representatives who attended the workshop. Around 29 per cent of the participants were from Europe, 26 per cent from Africa and Asia and 19 per cent from America.

Participants discussed the importance of the needs of the local community, and the role of leadership in those communities to effectively deliver benefit sharing programmes. Most communities have a local or regional development plan. One of the first stages in the consultation with the communities is to identify the needs and express them and prioritise them in the development plan.

Workshop on Hydropower benefit sharing

Presenters:

Kate Lazarus
Senior Operations Officer, IFC

Maria Arsenova
Operations Officer, IFC

Joerg Hartmann
Independent Consultant

Eduard Wojzcynski
Project Manager, Manitoba Hydro International

Sophia Tamot
Consultant, IFC

Orlando San Martin
Senior Advisor, Environmental and Social Sustainability, Corporate Responsibility and Compliance, Statkraft

Fabien Nathan
CSR Officer, EDF

William Greene
Senior Advisor – Renewable Energy, Multiconsult

Cristina Diez Santos
Senior Hydropower Analyst, IHA

Timing is very important when dealing with legacy liabilities. The lack of trust the community may have from previous projects can be a great challenge and the sooner benefit sharing is incorporated in the project the greater the likelihood for success. Relying on existing well-known institutions was concluded as a key outcome to effectively integrate benefit sharing into existing community decision processes.

In an example of using local shares as a form of a benefiting sharing mechanism, timing was thought to be relevant. When shares are offered after commercial operation and the project is already generating electricity, the benefit for the community is clear, as the risk is minimal.

Find out more

Please visit the website of the International Hydropower Association www.hydropower.org for further information.

Closing session

The seventh World Hydropower Congress concluded on 16 May 2019.

IHA, which convened the biennial event in collaboration with 50 partner organisations, pledged to continue work on advancing sustainable hydropower and to share solutions towards achieving the Paris Agreement and Sustainable Development Goals.

IHA Chief Executive Richard Taylor said the association would continue to build and share knowledge on clean energy systems, responsibly managed freshwater, and climate change solutions. "Every hydropower project is an ambassador for the whole sector. There is no hiding place for bad practice or projects that are deemed to be a loss to society or the planet," he said.

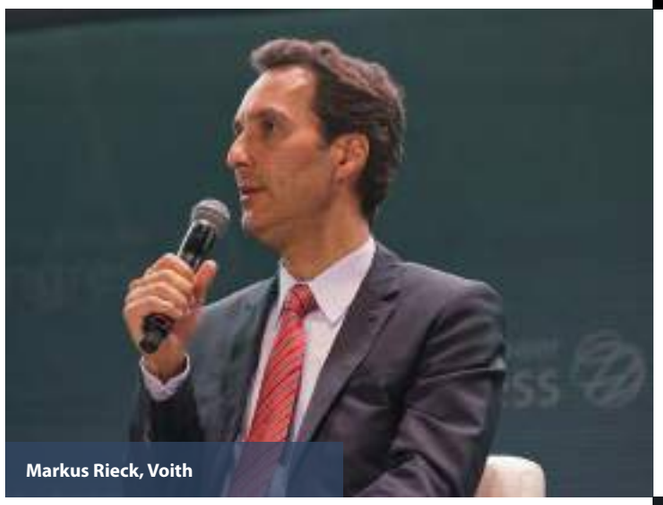
Mr Taylor announced IHA would pursue new initiatives to help the sector bring forward solutions to enhance hydropower's flexibility and deliver clean, efficient storage for integrated electricity grids, involving a mix of hydropower, solar and wind power and other renewables.

Mr Taylor also made a commitment for IHA to work closely with the UN, civil society, business, governments and investors to achieve a common understanding of good practice for hydropower projects affecting protected areas, and when working with indigenous communities.

Markus Rieck, of Voith, said while going to areas where hydropower was developing, helping local communities and companies was the goal. "Best practice sharing is exactly what we and IHA are doing in this Congress," he said.

CTG's Wang Shaofeng reiterated the need of power companies to use ESG best practice for all future projects. He said while working abroad, the main difference was of political risk and to avoid this, companies should put people first. "We are doing the projects for the country, for the people but not for any political forces. We need to put this line across," Mr Wang said.

Yves Giraud, of EDF Hydro, highlighted what he felt were the two key topics at the Congress - greenhouse gas (GHG) emissions and pumped storage. "Hydro is really the largest source of electricity after coal and gas," he said. "It accounts for 16 per cent of the power mix and only 1 per cent of gas emissions, and it is crucial all of us promote this fact to say that hydropower is a low carbon energy."


Markus Rieck, Voith

Mr Giraud further stressed the need for regulatory frameworks recognising the role of pumped storage in energy storage. "Today in most countries, storage is considered as a producer when generating and as a consumer when charged," he said. "So pumped storage has to pay charges to the grid while not considering the services that pumped storage provides to the grid that should be recognised and paid by the grid."

GE's Bill Armstrong said two-thirds of future energy supply would come from renewable energy, and thus as a business, GE integrated wind, solar and hybrid solutions and grid business together, giving them the ability to work to the needs of the customer.

Nuno Portal, of EDP Generation, said that hydropower will have a key role in the 2030 EDP vision of more than 90 per cent renewables generation and 90 per cent reduction of greenhouse gas emissions, compared to 2005 levels. "Decarbonisation is essential to EDP's future and hydropower is a mature technology, with unique flexibility capacity," he said.


Mark Lambrides, TNC

Mark Lambrides, from The Nature Conservancy, said the world faces a challenge to meet global demand for affordable electricity, while at the same time reducing carbon emissions and safeguarding the environment.

"To achieve this vision, as a reflection after Congress but not in the statement, we will focus efforts on ways which the world can move into this renewable energy 2.0 at a time when we will support the targets," he added.

Itaipu Binacional's Jose Maria Sanchez said it was important to continue working together to achieve the goals proposed in the Paris Agreement on Climate Change and the 2030 Agenda for Sustainable Development.

Moderator:

Richard Taylor
Chief Executive, IHA

Speakers:

Yves Giraud
Chief Executive, EDF Hydro

Bill Armstrong
Hydro Europe General Manager, GE Renewable Energy

Nuno Portal
Director of Sustainability, EDP

Wang Shaofeng
Deputy Chief Economist, CTG

Markus Rieck
Chief Sales Officer, Voith Hydro

Mark Lambrides
Global Director, Energy and Infrastructure, The Nature Conservancy

Jose Maria Sanchez
Paraguayan Technical Director, Itaipu Binacional

Looking forward, collaboration with the wider renewable energy industry will be key and the hydropower sector should identify synergies wherever possible

Outcomes and priorities

Participants unanimously agreed that hydropower deserves greater visibility in public awareness and the political arena. Climate change has figured prominently in public discourse over the past decade and the sector should communicate to the public and policymakers that hydropower has an essential role in clean energy transition.

A new market design is necessary to make a business case for hydropower technology and attract investment into the sector. A carbon levy was also suggested to accelerate decarbonisation in the power sector.

Looking forward, collaboration with the wider renewable energy industry will be key and the hydropower sector should identify synergies wherever possible.

China Renewable Energy Engineering Institute (CREEI) said it was willing to share China's experience in clean energy transition through IHA's platform.

There was a strong consensus that role of pumped hydro will become more significant over the longer-term, as the need for flexibility and energy storage will increase. However, as policymakers do not recognise its value, panellists said the hydropower sector should come together to promote it.

Yann Baros, from EDF, announced they would support IHA in setting up an international forum on pumped storage for further advancing policy discussion around pumped storage development.

Panellists recommended further research and development in the design and operation of floating solar hybrids to address challenges in operations and maintenance and reliability.

Participants noted every reservoir is context specific, so when planning new solar hybrid projects, developers need to adopt an approach specific to its needs to ensure it's environmentally, technically and economically viable.

The right market design also needs to be developed to support the business case for solar hybrids. The panel unanimously agreed that current market conditions render necessary investments in hydropower modernisation unfeasible.

Low carbon and flexibility services that hydropower provides need to be appropriately valued, regulations need to be adapted, and hydro generators need to be appropriately compensated to make the business model viable. Otherwise, existing hydropower assets approaching the end of their life may be at risk and miss opportunities for cost-effective upgrades.

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IHA Awards for Excellence

IHA Awards for Excellence

The IHA Awards for Excellence recognise contributions made to the hydropower sector by individuals and organisations.

The IHA Blue Planet Prize is awarded to hydropower projects which demonstrate excellence in sustainable development. It is awarded on the basis of an assessment using the Hydropower Sustainability Assessment Protocol, a tool that measures the sustainability of a hydropower project across a range of social, environmental, technical and economic aspects.

The Mosonyi Award for Excellence in Hydropower recognises individuals within IHA's membership for outstanding contributions to the sector. The award is named after Emil Mosonyi, the founding President of IHA, who made major contributions to hydropower during his long career. His determination to champion excellence in hydropower lives on through IHA's vision and mission.

The IHA Young Researcher Award recognizes emerging talent in the hydropower sector.

"We are grateful to the IHA in awarding the IHA Blue Planet Prize to the Reventazón project. This proves what 70 years of acquired expertise by the Instituto Costarricense de Electricidad can do, developing sustainable hydropower projects that comply with the best practices in the world."

- Irene Cañas Díaz, President of ICE

IHA Blue Planet Prize

The 2019 IHA Blue Planet Prize, which recognises excellence in sustainable hydropower development, was awarded to the the Instituto Costarricense de Electricidad (ICE), Costa Rica's national electricity company, which built, owns and operates Reventazón.

Reventazón is the largest hydropower project in Central America with 305.5 megawatts of installed capacity. Since it came into operation in 2016, the project has led Costa Rica to achieve a target of generating 100 per cent of its electricity from renewable energy sources.

The project achieved proven best practice for its management of communications and consultation, resettlement, public health, biodiversity and invasive species, and waste, noise and air quality, according to an assessment using the Hydropower Sustainability Assessment Protocol.

Richard Taylor, Chief Executive of the International Hydropower Association (IHA), said: "The winner of the 2019 IHA Blue Planet Prize, Reventazón, demonstrated remarkable sustainability performance across a range of performance criteria, meeting or exceeding international good practice in all 19 assessment topics. The hydropower project is a worthy recipient of the IHA Blue Planet Prize and is an example of many stakeholders working together to achieve a common goal."

The hydropower plant is located on the Reventazón river in Limón province, 50 kilometres upstream of the Caribbean Sea.

Reventazón is one of the first hydroelectric projects in Latin America to use a river offset approach, in order to develop hydropower potential while avoiding development in other free-flowing rivers. It shows how hydropower projects can make a significant contribution to biodiversity conservation at regional and basin levels.

IHA Mosonyi Award for Excellence in Hydropower

The prestigious 2019 IHA Mosonyi Award for Excellence in Hydropower was jointly awarded to three leading members of the hydropower community, at an awards ceremony at the World Hydropower Congress in Paris on 15 May.

The award went to: Karin Seelos, Statkraft Vice President (Power Generation and International Affairs); Refaat Abdel Malek, Former President of IHA and Vice Chairman of MWH Global; and Yan Zhiyong, Chairman of Power Construction Corporation of China

Karin Seelos was recognised by the judging panel for her long-standing commitment to hydropower sustainability, which has had a major impact on the profession. Her work, including on an IHA White Paper on Hydropower and Sustainable Development, helped form the foundation for sector-wide sustainability guidelines and assessment tools. This helped catalyse a revolution of policy and thinking in the sector.

On receiving her award, Ms Seelos said "I am very grateful and deeply honoured to receive this prestigious award and would like to thank the IHA Board for this recognition. I was lucky to gain experience from some of the world's leading hydropower utilities, Hydro-Québec in French Canada, and Statkraft in Norway."

Ms Seelos reflected on the "tremendous journey" that the hydropower sector has undergone in the past two decades since IHA was established. Hydropower is now considered a "key resource to achieve the United Nations Sustainable Development Goals and the Paris Agreement on climate change", she said.

"I hope the sector will continue its collaborative journey, focusing on gaining and sharing knowledge as an important part of the renewables family. Being part of the solution will be key to our success."

Refaat Abdel Malek was President of IHA between 2007 and 2013, during which time he contributed to the development of the Hydropower Sustainability Assessment Protocol. Under his leadership, IHA led outreach to civil society organisations and governmental agencies supporting development around the world. He contributed actively to the participation of Latin American and Chinese organisations in international forums and to sharing knowledge in an inclusive way.

Mr Malek said: "I am grateful to the IHA for the excellent recognition through the IHA Mosonyi Award. The highlight of my career is to be a part of the IHA effort, together with other colleagues and organisations, to achieve the Hydropower Sustainability Assessment Protocol. This is an achievement that returned the development of hydropower to the forefront of sustainable energy around the world."

Yan Zhiyong was recognised for his contribution to the development of China's hydropower industry and for his commitment to implement sustainability practices. With a philosophy of 'people oriented green development', he has organised and participated in formulating renewable energy development master plans for around 100 countries. He started as a designer in hydropower planning, then became the President of the China Renewable Energy Engineering Institute before he was Chairman of Power Construction Corporation of China.

"I am grateful for the IHA for the excellent recognition...The highlight of my career is to be a part of the IHA effort, together with other colleagues and organisations, to achieve the Hydropower Sustainability Assessment Protocol." - Refaat Abdel Malek, Former President of IHA

IHA Young Researcher Award

The 2019 IHA Young Researcher Award was jointly awarded to two rising stars from universities in Switzerland and China.

Martina Botter, a PhD student at ETH Zurich in Switzerland, and Weijia Yang, a Research Associate Professor at Wuhan University, were recognised by the International Hydropower Association (IHA) for their research studies.

Ms Botter's research provides a decision support system to test new hydropower operation strategies to adapt to a changing climate and economic context. The framework has the capability of accounting for the uncertainty which characterises the operating context, so that multiple different scenarios can be considered at the same time and robust adaptation strategies can be identified.

On receiving her award, Ms Botter said: "I am honoured to have received this prize. It means motivation to me, motivation to continue investigating in the field of climate resilience, adaptation strategies and a multi-objective approach in the decision making process of hydropower planning and management.

"I am very glad to see the relevance these topics have in this World Hydropower Congress, since they represent the main challenges for the future of hydropower."

Mr Weijia Yang, who works at Wuhan University's State Key Laboratory of Water Resources and Hydropower Engineering Science, submitted research offering an assessment framework of burden on hydropower units for short-term balancing of renewable power systems. His paper looks at the burden, performance and payment of hydropower regulation under various conditions and future scenarios, leading to potential benefits for hydropower producers and transmission system operators.

Two finalists were also recognised at the awards ceremony: Sebastián Leguizamón, a PhD student from EPF Lausanne, and Chantel Monica Niebuhr, a PhD student from the University of Pretoria.

"I am honoured to have received this prize. It means motivation to me, motivation to continue investigating in the field of climate resilience, adaptation strategies and a multi-objective approach in the decision making process of hydropower planning and management." - Martina Botter, PHD student at ETH Zurich

world hydropower congress

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