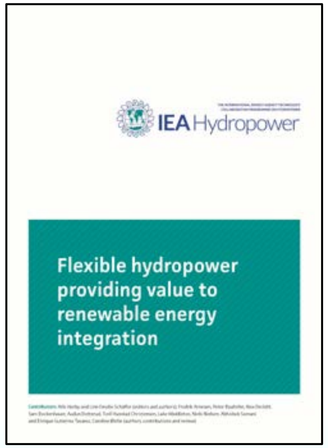
THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER
IEA Hydropower

Annex IX online meeting 14 September 2021

ANNEX IX -Valuing Hydropower Services

Welcome to all participants. Workshop will start 15.00 CET



Please <u>mute</u> yourself when not speaking. Let's try to <u>keep webcams on</u>!
Please use the <u>chat</u> to give comments and ask questions.

PS: You can undock all webcams by right-clicking when holding the mouse above the camera icon

ANNEX IX -Valuing Hydropower Services

Task 1. Energy, Grid Services and Flexibility:

The future role and value of hydropower in energy markets and electricity systems. The final outcome of this task is a Hydropower Balancing and Flexibility Roadmap

Task 2. Climate Change Services Adaptation:

The role and value of hydropower in minimising or mitigating risks associated with a changing climate

Annex IX online meeting 14 September 2021

CET	Thursday 24th September 2020	Chaired/presented by
15:00	Welcome and introduction	Atle Harby
15:10	News from IEA Hydro	Klaus Jorde & Niels Nielsen
15:25	IEA Hydropower Special Market Report	Heymi Bahar
15:40	Report and White Paper "Valuing Flexibility in Evolving Energy Markets: Current Status and Future Outlook for Hydropower"	Audun Botterud
16:00	Break	
16:10	Draft report "Hydropower providing flood control and drought management: Case studies"	Atle Harby and Jorge Damazio
16:15	Draft report " Role and Challenges of Pumped Storage Hydropower Under Mass Integration of Variable Renewable Energy"	Hiroshi Murashige
16:20	Discussion on further work	Atle Harby
16:45	Commitments to further work	Atle Harby
16:55	Any other business	
17:00	End of meeting	

Structure of program

- **Technology Cooperation Program on Hydropower**
  - **Annexes**
    - ANNEX XVI Hidden Hydro Opportunities
    - ANNEX IX Valuing Hydropower Energy and Water Services
    - ANNEX XII GHG Emissions from Freshwater Reservoirs
    - ANNEX XIII Hydropower and Fish
    - ANNEX XIV Management Models for Hydropower Cascade Reservoirs
    - ANNEX XV Maintenance Works and Decision-Making for Hydroplant Renewals

Hydro 2021 – 25-27 October, Strasbourg, France

Session on international research programs:

- IEA Hydropower Special Market Report, Heymi Bahar, Yasmina Abdelilah, Paolo Frankl
- The USA/DoE Research Program on Hydropower, Sam Bockenhauer pre-recorded
- The Norwegian HydroCen Research Program on Hydropower, Ole Gunnar Dahlhaug
- IEA Hydropower TCP Research Program, Klaus Jorde

A general session on the TCP work:

- Hidden and Untapped Hydro Opportunities (Annex XVI), Cécile Münch-Alligné, Vincent Denis
- Hydropower enabling integration of variable renewables, Audun Botterud and Atle Harby
- The benefits and value of flood control and drought management from hydropower, Jorge Damazio and Atle Harby
- Hydropower and Fish, Marcell Szabo-Meszaros

+ IEA Hydro informal meetings 28 October

Hydropower Special Market Report

Market analysis and forecasts to 2030

Heymi Bahar

14 September 2021, Hydro TCP Meeting

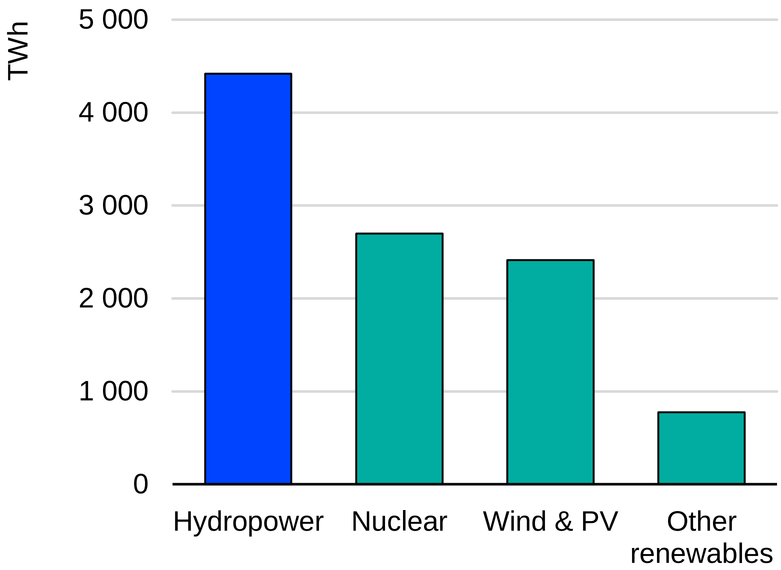
International Energy Agency

Hydropower Special Market Report 2021 – key facts

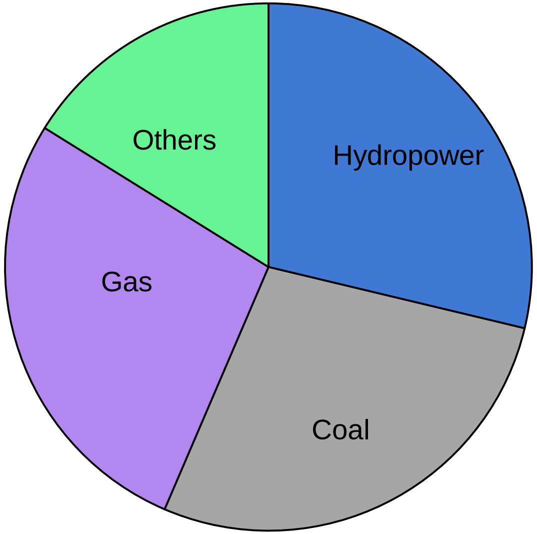
- Announcement by Dr. Birol in May 2019 – Hydropower Conference in Paris
- February 2020 – High level workshop in Paris with 120 people participation
- 10 May 2021 – Peer review with 280 experts including TCP
- 30 June 2021 – Report Launch:
  - Ministerial launch event – 1000 live views and 1000 views online
  - 12000 page visits of hydropower report page
  - 10000 downloads

Hydropower is the forgotten giant of the electricity sector

Low-carbon electricity generation

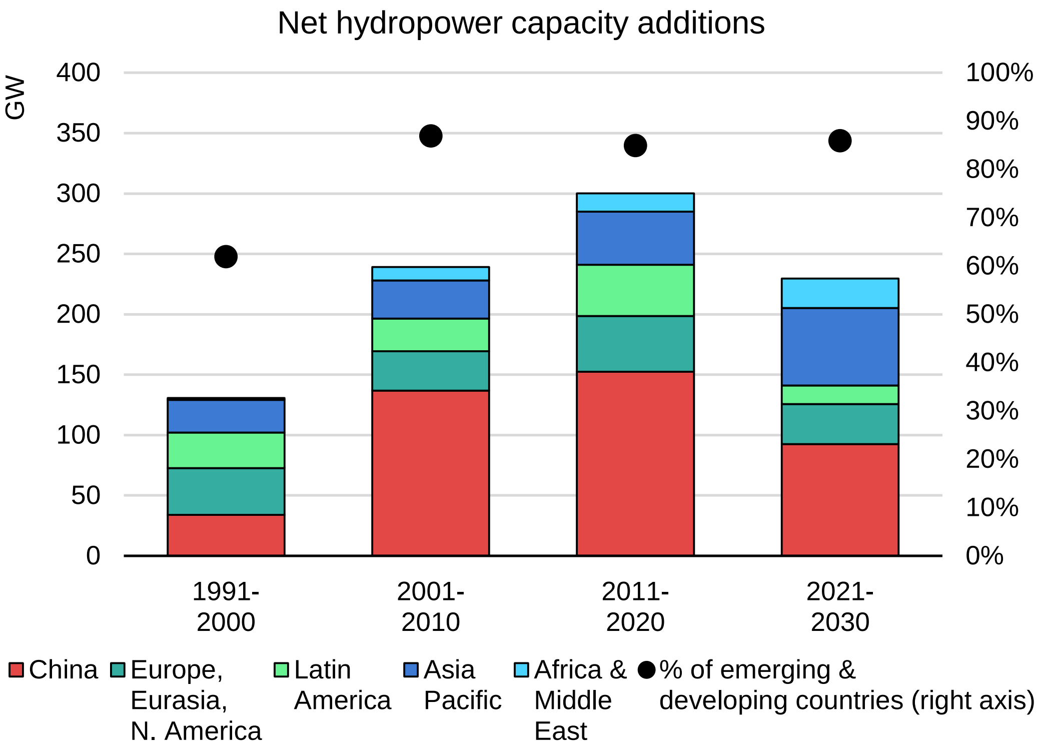


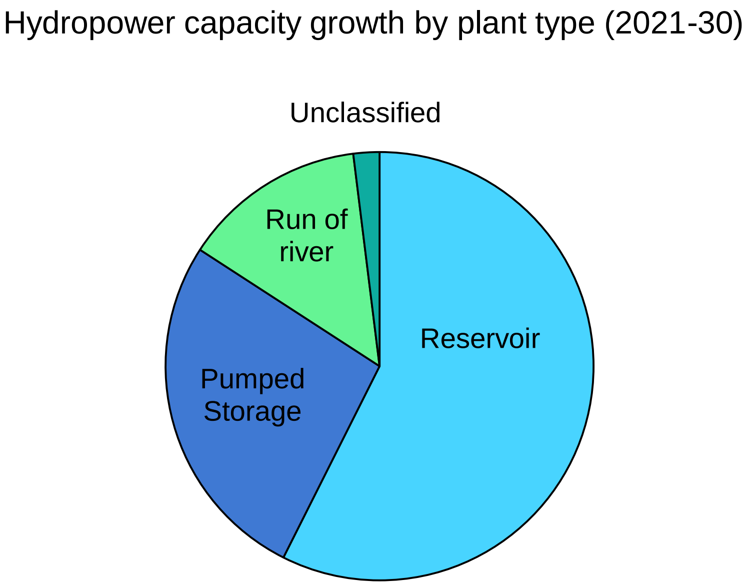
Flexible power capacity



Hydropower is the backbone of low-carbon electricity generation, providing almost half of it worldwide today, and makes a major contribution to the flexibility and security of electricity systems.

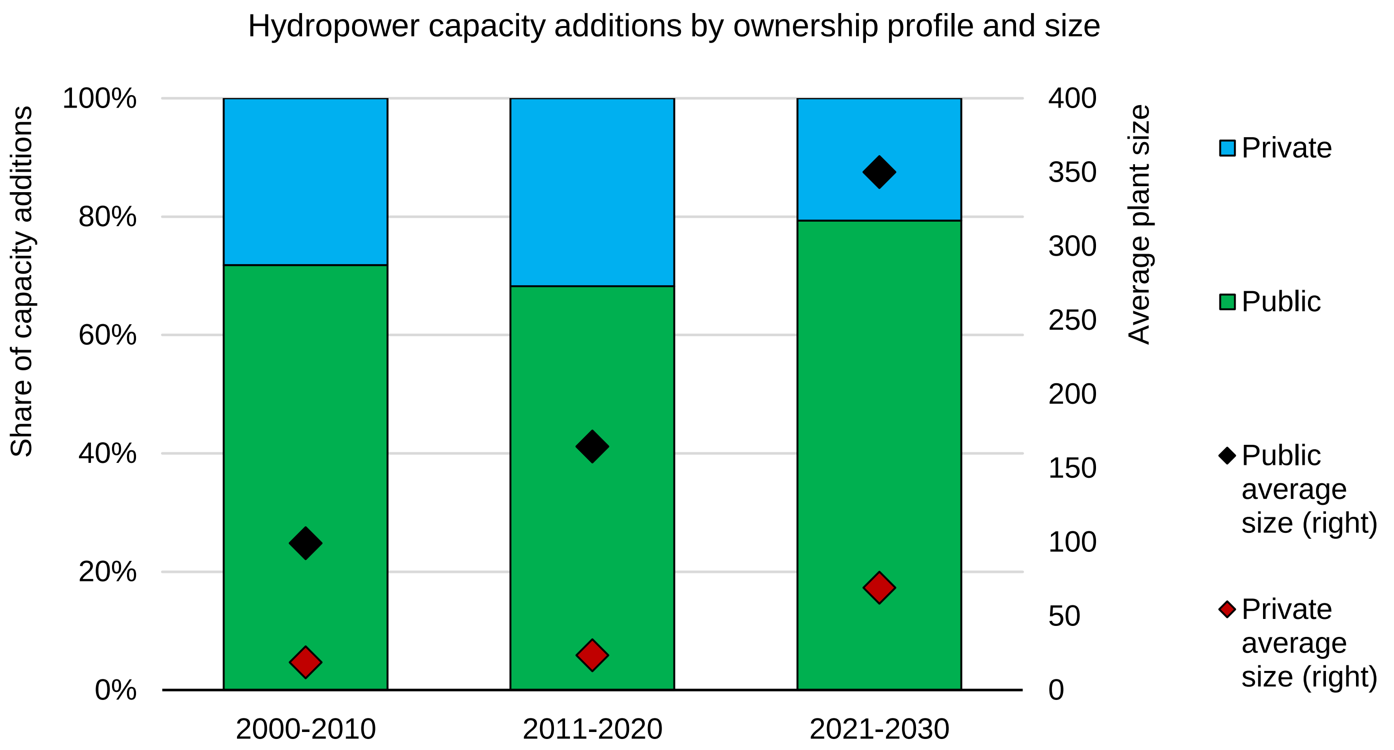
Growth in India & ASEAN partly offsets declines in China





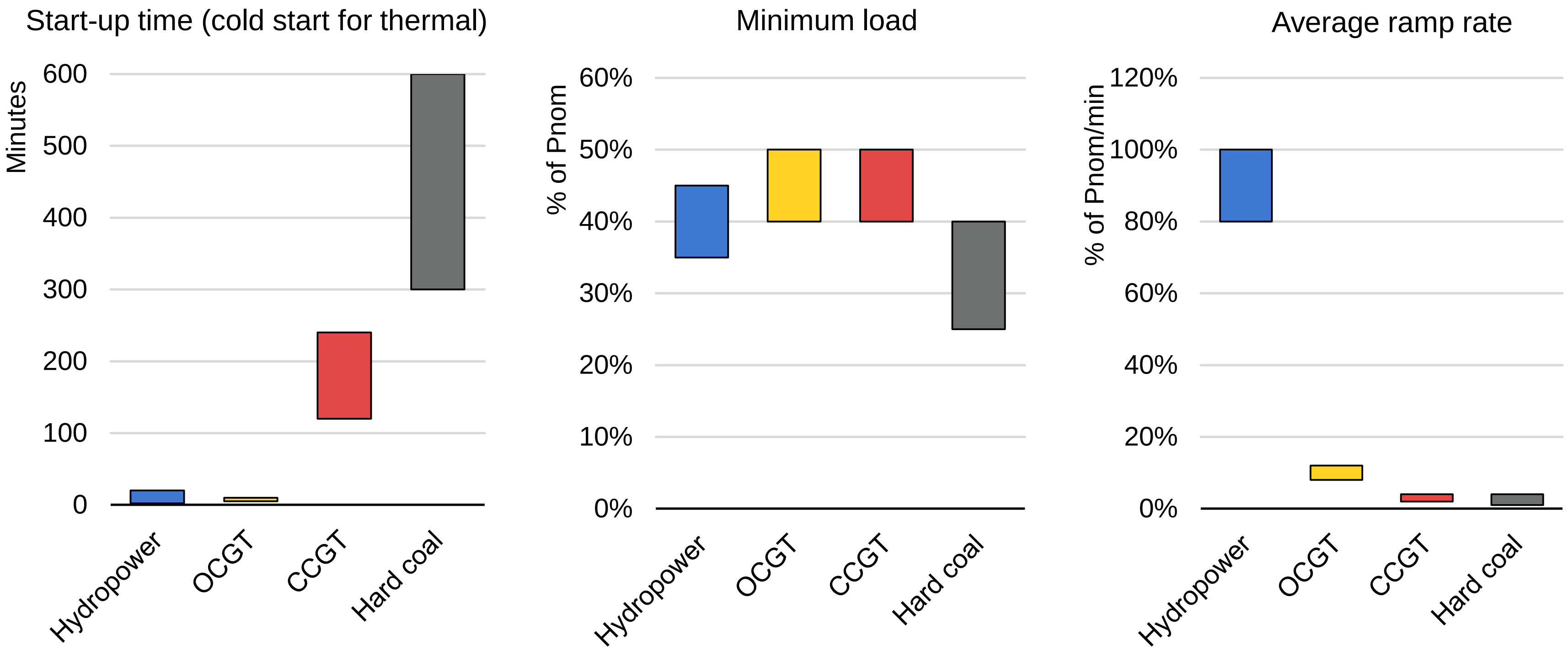
Reservoir plants lead the expansion by increasing electricity access cost-effectively, providing export opportunities and multi-purpose use of dams. The need for flexibility stimulates strong expansion of pumped hydro plants.

Public sector role in hydropower remains key



The involvement of the public sector in large plants helps mitigate investment risks associated with permitting, social acceptance and long construction times, while the private sector deploys smaller plants with low risks.

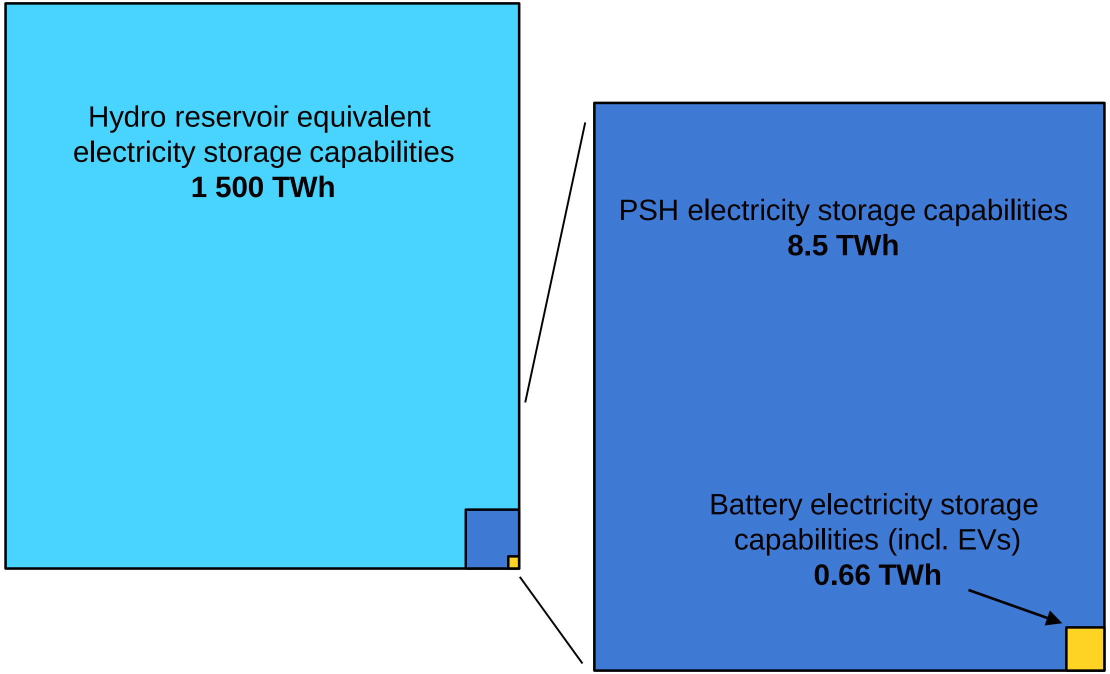
Hydropower is the most flexible low-carbon power technology



Hydropower's flexibility capabilities are unmatched by any other technology. It is the only clean technology that can supply broad range of system services from sub-seconds to months, which are crucial for secure operation of the power systems.

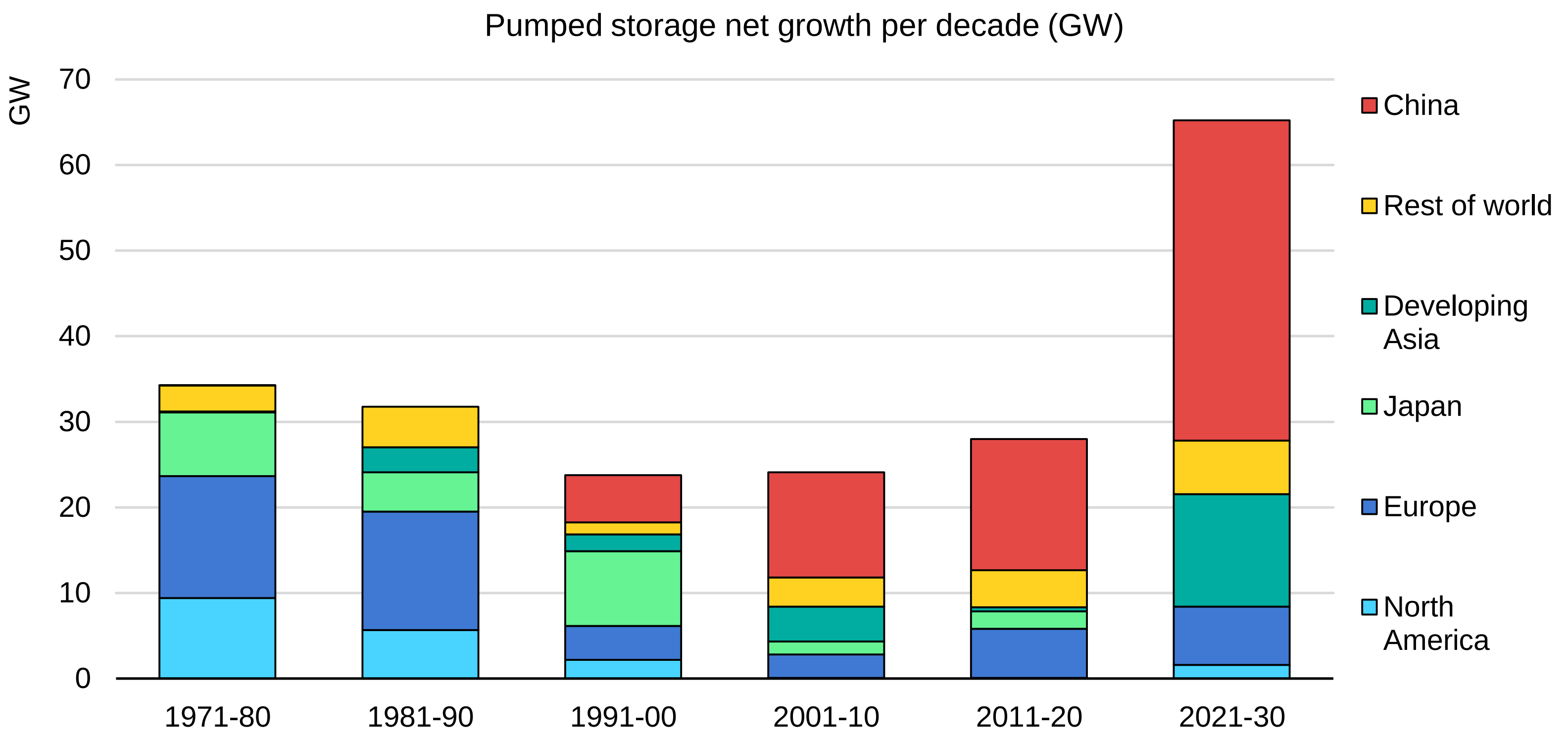
Hydropower's flexibility role is critical in integrating wind & solar PV

Storage capabilities of hydropower plants and batteries (1 full cycle)



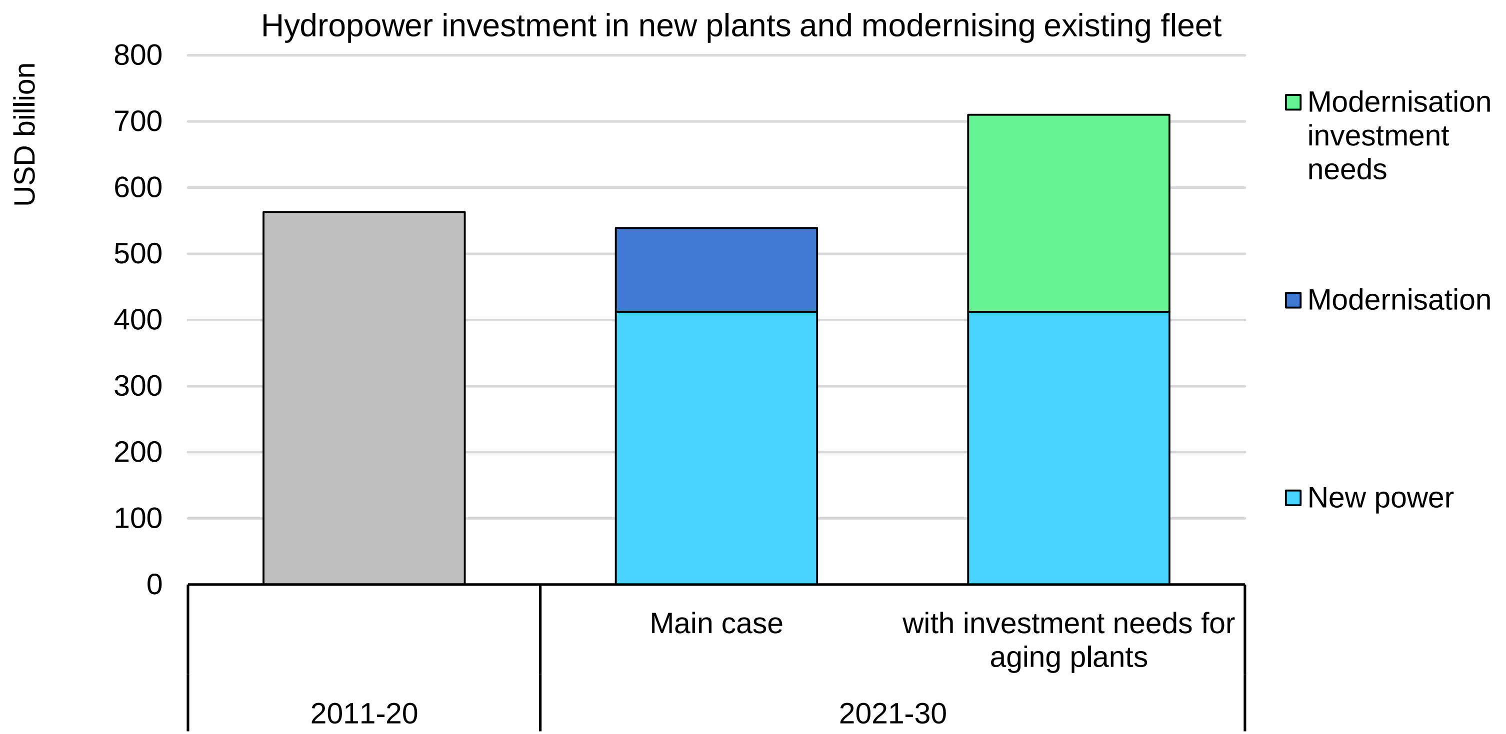
With low operational costs, existing reservoir hydropower plants are the most affordable source of flexibility today, while pumped storage and battery technologies are increasingly complementary in future power systems.

A revival of pumped storage over the next decade



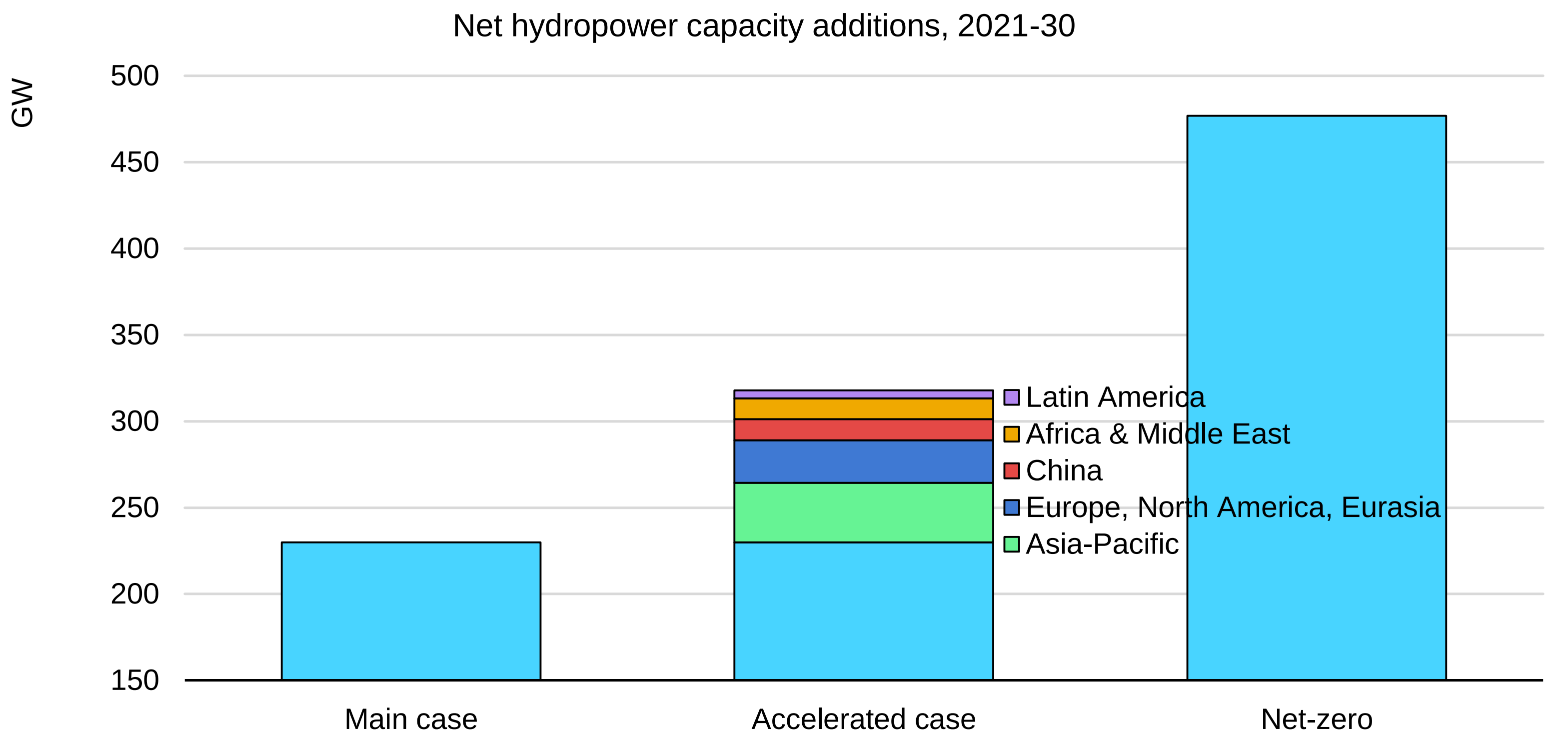
After 30 years of decline, PSH rebounds due to system flexibility needs in Europe and Developing Asia. When China’s growth is included, new PSH additions between 2021-30 will be the highest growth recorded in one decade.

More investment is needed to modernise an ageing hydropower fleet



By 2030, more than 20% of the global fleet's generating units will be over 55 years old. Modernising all ageing plants would require investment of USD 300 billion, more than double the amount in our forecast.

Faster hydro growth is possible but net zero requires higher ambition



In our accelerated case, growth is 40% higher thanks to improvements in policy & market design, such as streamlining of permitting, increasing affordable financing, and providing better visibility on revenues for projects under development.

7 policy considerations

- Move hydropower up the energy and climate policy agenda
- Enforce robust sustainability standards for all hydropower development with streamlined rules and regulations
- Recognise the critical role of hydropower for electricity security and reflect its value through remuneration mechanisms
- Maximise the flexibility capabilities of existing hydropower plants through measures to incentivise their modernisation
- Support the expansion of pumped storage hydropower
- Mobilise affordable financing for sustainable hydropower development in developing economies
- Take steps to ensure that the value of the multiple public benefits provided by hydropower plants is priced in

Report: https://www.iea.org/reports/hydropower-special-market-report

Data explorer: https://www.iea.org/articles/hydropower-data-explorer

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IEA Hydropower

IEA Hydro Annex IX meeting, Sept. 14 2021

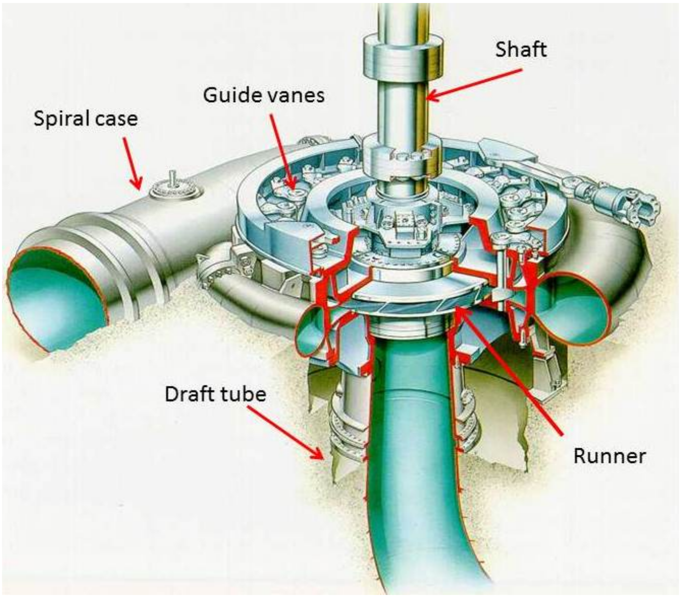
Annex IX

Valuing Flexibility in Evolving Electricity Markets: Current Status and Future Outlook for Hydropower

Editors: Audun Botterud (USA), Chris O'Reilley (USA), Abhishek Somani (USA)
Authors: Alex Beckitt (Australia), Osamu Kato (Japan), Magnus Korpås (Norway), Albert Cordeiro Geber de Melo (Brazil), Luke Middleton (Australia), Linn Emelie Schäffer (Norway), Guillaume Jean Tarel (Canada), Elena Vagnoni (Switzerland), Donald Vaughan (Australia), Cesar Zani (Brazil)
Reviewers: Hill Balliet (USA), Sam Bockenhauer (USA), Atle Harby (Norway), Niels Nielsen (IEA)
Report and white paper online: https://www.ieahydro.org/news/2021/6/annex-ix-report-published

Background

- Increasing penetration of variable renewable energy (VRE)
- Increasing need for flexibility in the power system
- Electricity markets are evolving to address these challenges
- A number of different flexibility solutions, including hydropower
- How is flexibility procured in current electricity markets?
- What is the status and outlook for hydropower as a flexible resource?



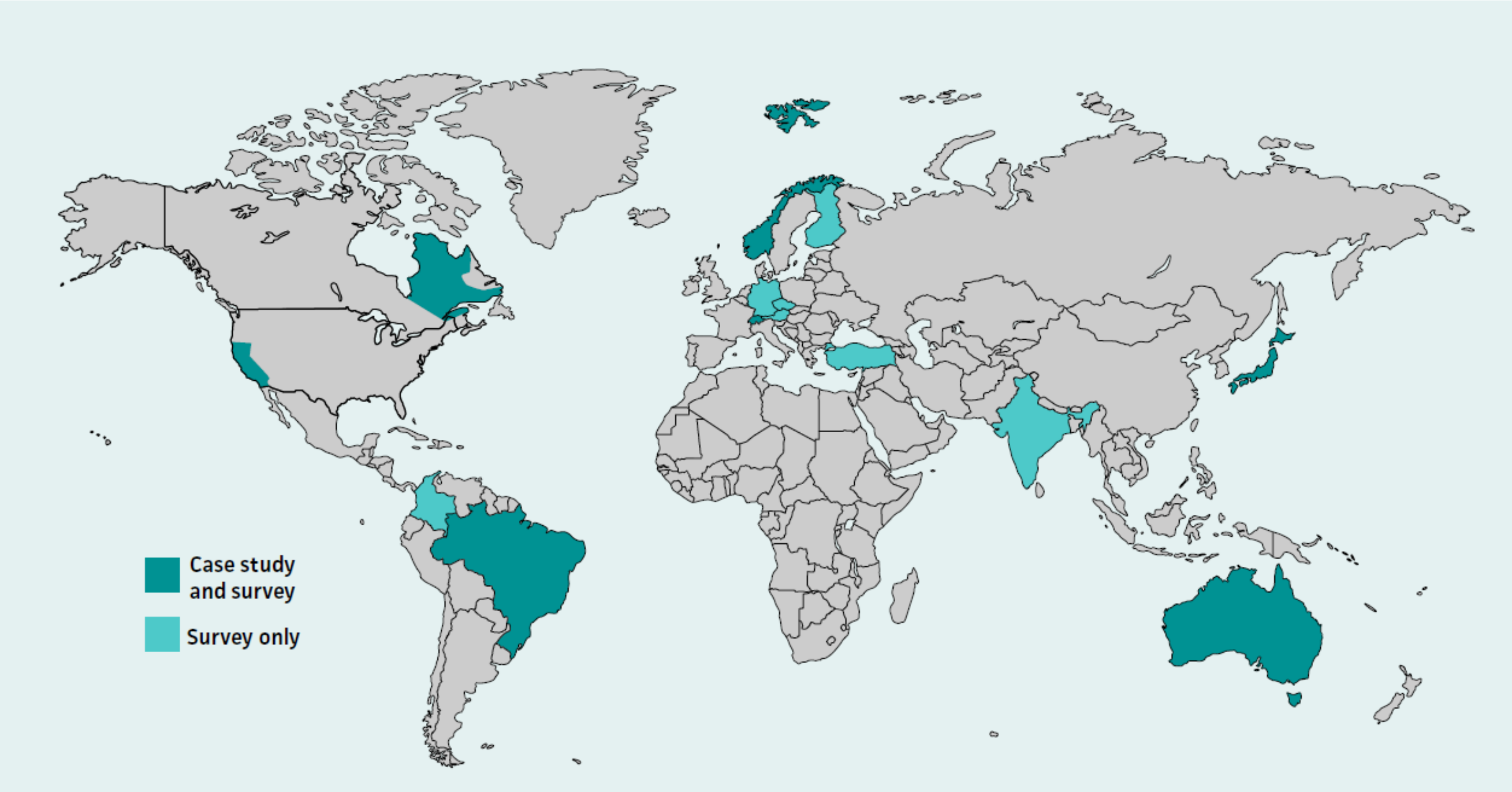
Power System Flexibility Across Different Timescales

Flexibility type	**Short-term**			**Medium term**	**Long-term**	
Time scale	**Sub-seconds to seconds**	**Seconds to minutes**	**Minutes to hours**	**Hours to days**	**Days to months**	**Months to years**
Issue	Ensure system stability	Short term frequency control	More fluctuations in the supply / demand balance	Determining operation schedule in hour- and day-ahead	Longer periods of VRE surplus or deficit	Seasonal and inter-annual availability of VRE
Relevance for system operation and planning	Dynamic stability: inertia response, voltage and frequency	Primary and secondary frequency response	Balancing real time market (power)	Day ahead and intraday balancing of supply and demand (energy)	Scheduling adequacy (energy over longer durations)	Hydro-thermal coordination, adequacy, power system planning (energy over very long durations)

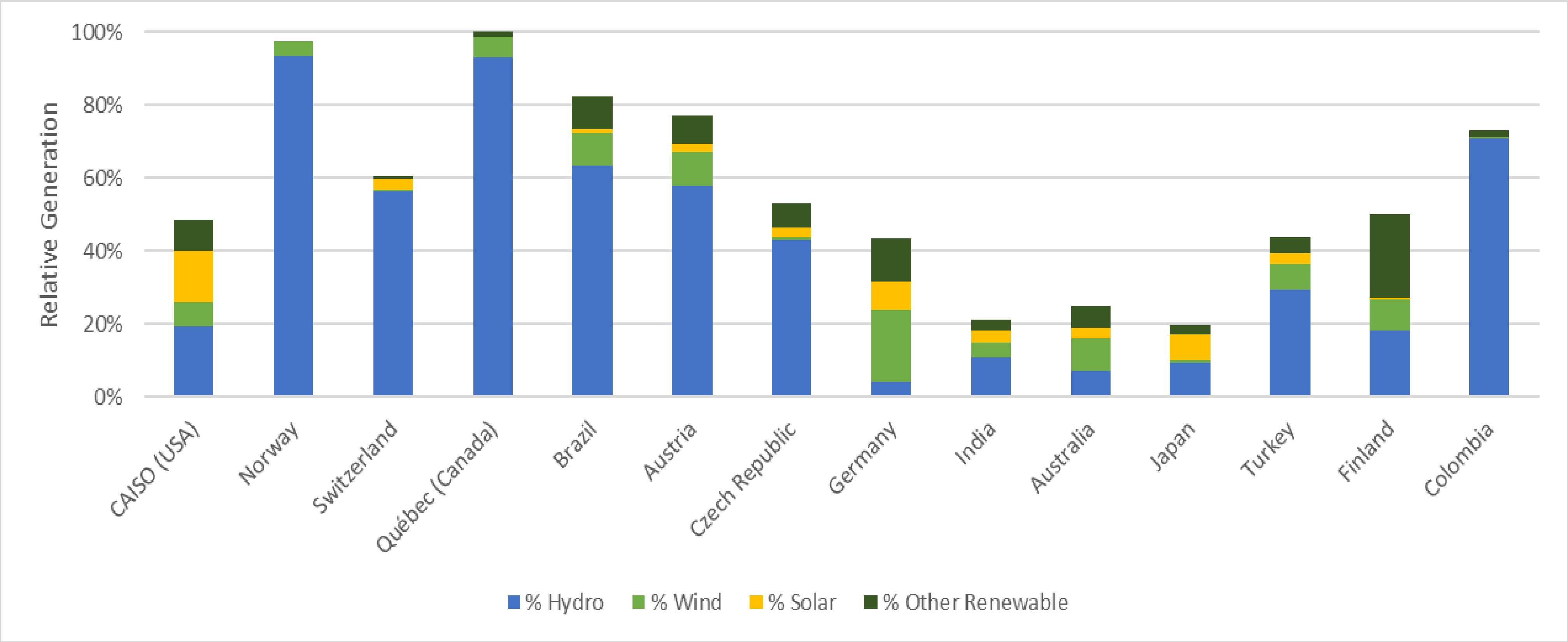
SOURCE: IEA

Survey of Electricity Markets and Flexibility

- Responses from 14 countries/regions and 5 continents
- Survey inputs
  - Flexibility products
  - Procurement mechanisms
  - Compensation
  - Hydropower contribution
  - Market size and quantity
  - Future developments
- 5 case studies



Renewable Penetration in Participating Countries/Regions



- Hydro penetration (4-96%)
- VRE penetration (0-28%)

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Survey Results – Flexibility Products

Timescale	Services	
Subsecond-seconds	1) Inertia 2) Reactive power 3) Voltage control	4) Frequency support 5) Spinning reserve 6) Special protection systems
Seconds - minutes	1) Frequency support	2) Last minute dispatch
Minutes - hours	1) Energy 2) Frequency support	3) Black start 4) Power unit dispatch
Hours - days	1) Energy 2) Ancillary services	3) Long term reserves 4) Demand response
Days-months; Months-years	1) Resource adequacy	2) Storage

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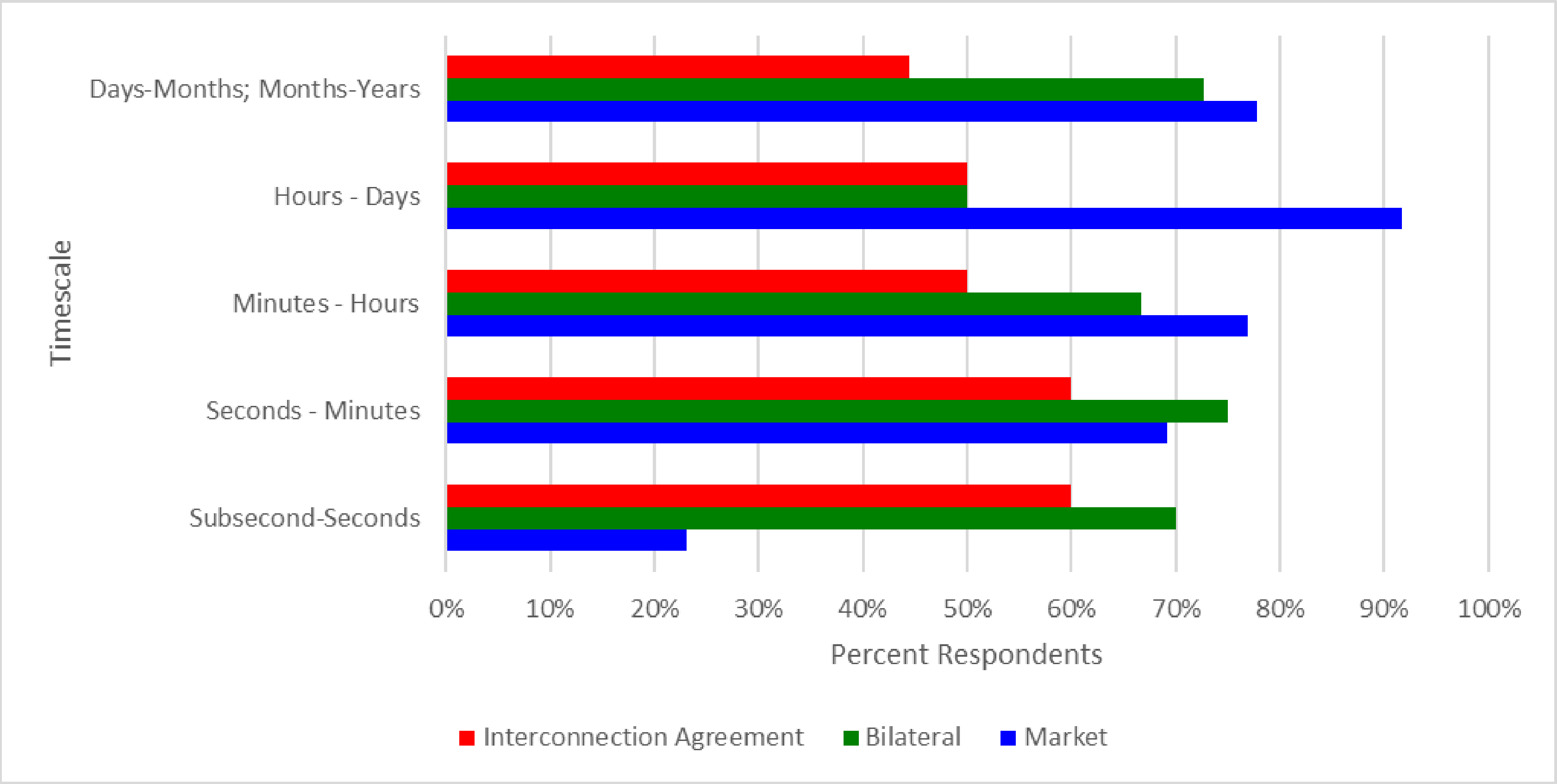
Survey Results – Procurement of Flexibility Services



Most respondents state that some (or all) services are compensated, although less at the shortest timescale

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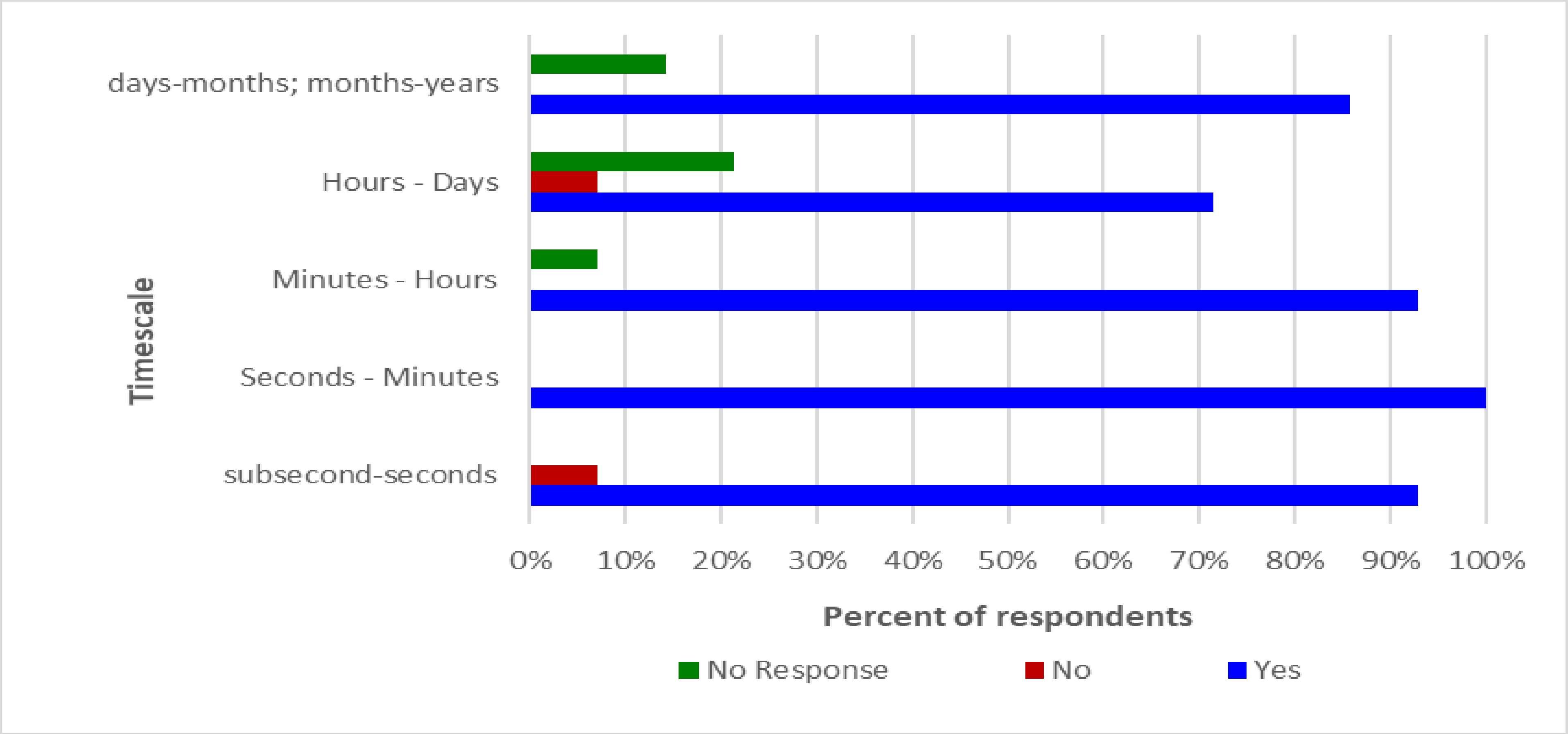
Survey Results - Does Hydropower Contribute to Flexibility Services?

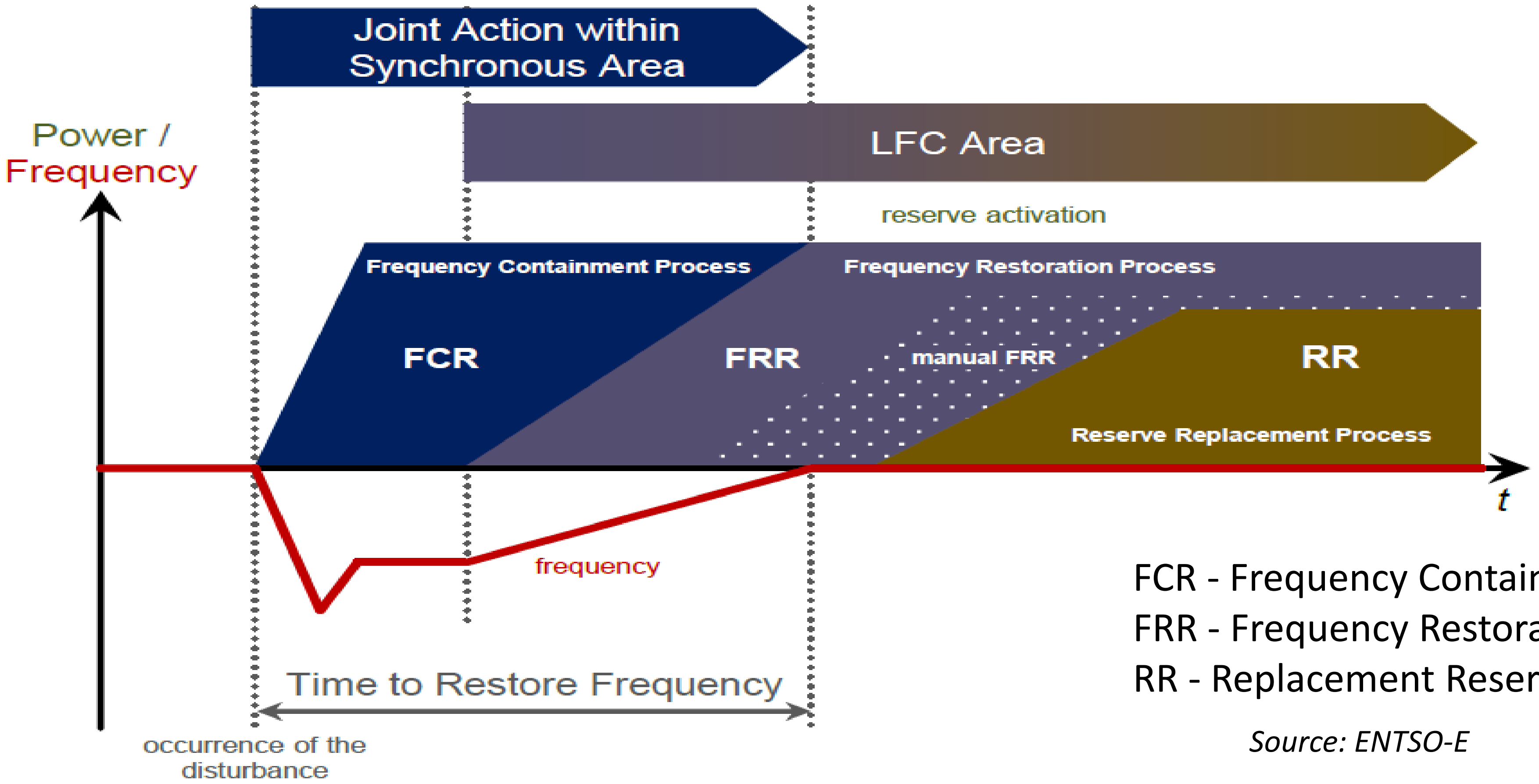


Hydropower contributes to flexibility across the timescales

International Case Studies

- Switzerland: Coordination of Flexibility Services with Continental Europe
- Norway: Large-scale Hydropower for Balancing Wind and Solar Power in Northern Europe
- Canada: Flexibility Requirements and Services in Hydro Québec
- USA: Flexibility Requirements and New Market Initiatives in California ISO
- Brazil: Maintaining Long-term Resource Adequacy through Public Auctions
- Australia: The Need for Deep Storage – an Uncertain Pathway
- Japan: VRE Integration and the Role of Pumped Storage Hydropower

Joint Definitions of Flexibility Services (Europe)

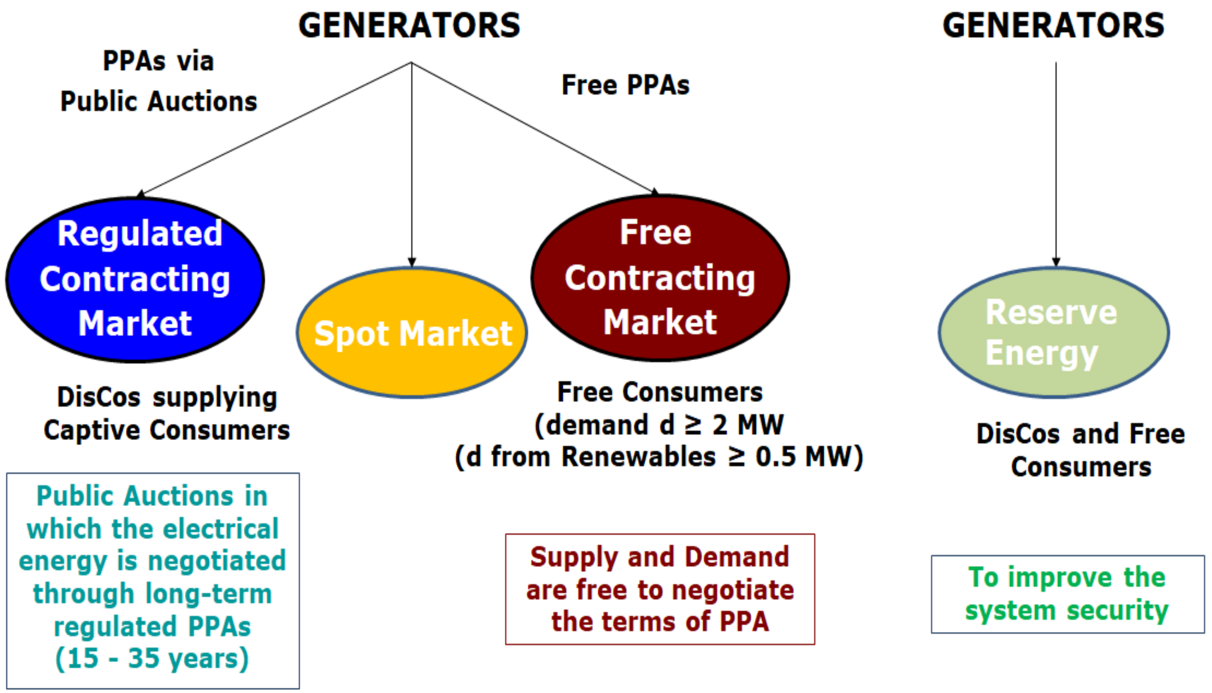


FCR - Frequency Containment Reserve
FRR - Frequency Restoration Reserve
RR - Replacement Reserve

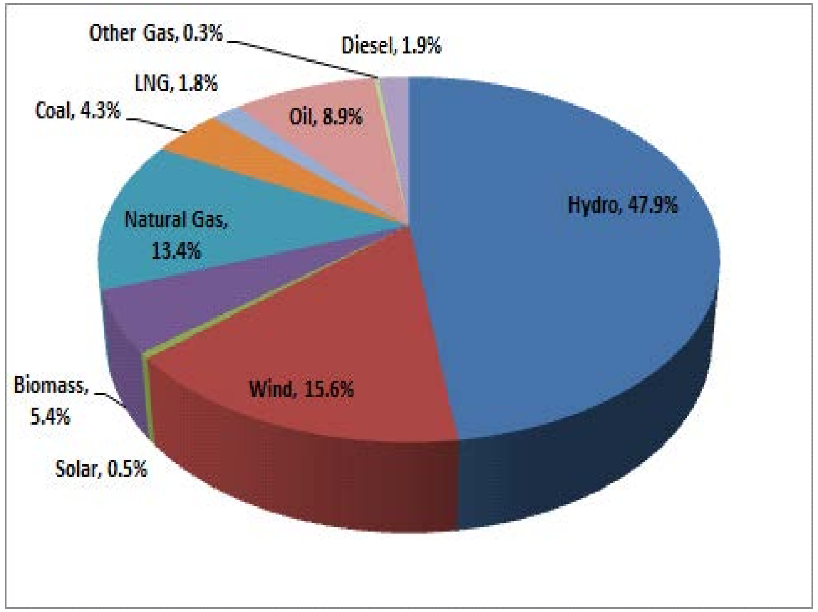
Source: ENTSO-E

Joint definitions and common trading platforms enable coordination and exchange of flexibility services across regions/countries

Public Auctions for Long-term Procurement (Brazil)



Contract environment for electricity in Brazil.



Results of public auctions in Brazil: 2008-2015. Total investment 65 GW.

Long-term contracts have enabled substantial hydropower investments

Main Observations

1. Hydropower is an important contributor to essential reliability services
2. Mechanisms for procurement and compensation of grid services vary across countries
3. Lack of market signals for long-duration storage
4. Stored energy is presently compensated through markets for reserve and energy products
5. Market rules and regulations can distort market-based arbitrage signals for storage
6. New market opportunities for flexibility services are emerging:
7. Flexibility services require increased cycling, which leads to accelerated wear and tear
8. Long-term contracts offer stability but mask the true cost and value of flexibility
9. Standardized product definitions facilitate efficient use of resources across different markets
10. Transmission capacity is a key enabling factor for hydropower

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Conclusions and Hydropower Outlook

- A wide range of solutions to address flexibility challenges in evolving power systems with higher VRE levels
- Hydropower plays an important role providing flexibility services across all timescales
- Hydropower's value to grid flexibility will increase with more VRE and as non-renewable generation is retired
  - Could also lead to more stress on hydropower plants
- Important to overcome common challenges
  - Shortest time-scale: compensation and/or price signal lacking for some services
  - Longest time-scale: investment incentives for reliability and flexibility
- Importance of international collaboration and cooperation
  - Similar challenges, different solutions
  - Lessons to be learned between countries and regions
- Report and white paper (executive summary) published in June 2021: https://www.ieahydro.org/news/2021/6/annex-ix-report-published

Directions for Future Work

- Changing hydropower operations
  - Assess what are likely to be the most important flexibility services for hydropower in future electricity markets
  - Assess impacts of climate change on precipitation, reservoir inflows, and hydropower operations (including frequency of draught and flooding events)
  - Investigate implications on machine wear and tear, required investments to upgrade and/or retrofit resources, etc.
  - Conduct a survey of changes in hydropower operations with special emphasis on a) start/stops, b) cycling, c) ramping, d) pumping/generation cycles (arbitrage patterns), e) environmental effects
  - Estimate the socio-economic value of hydropower flexibility to the grid in selected regions with high VRE shares
- Long-duration energy storage
  - Identify instances of long-duration energy storage solution solutions being provided by hydropower presently
  - Conduct a survey of ongoing initiatives to set mandates/targets and requirements for long-duration energy storage
  - Review potential remuneration mechanisms for long-duration energy storage (e.g. availability or capacity payments for flexibility services), recognizing that these assets may be idle for extended periods of time while providing critical services to the grid during other periods
- Electricity market design
  - Develop a set of more specific guidelines for the design of flexibility services and corresponding compensation mechanisms across the timescales in future electricity markets
  - Investigate price formation in a zero marginal cost world and its implication for different types of hydropower plants

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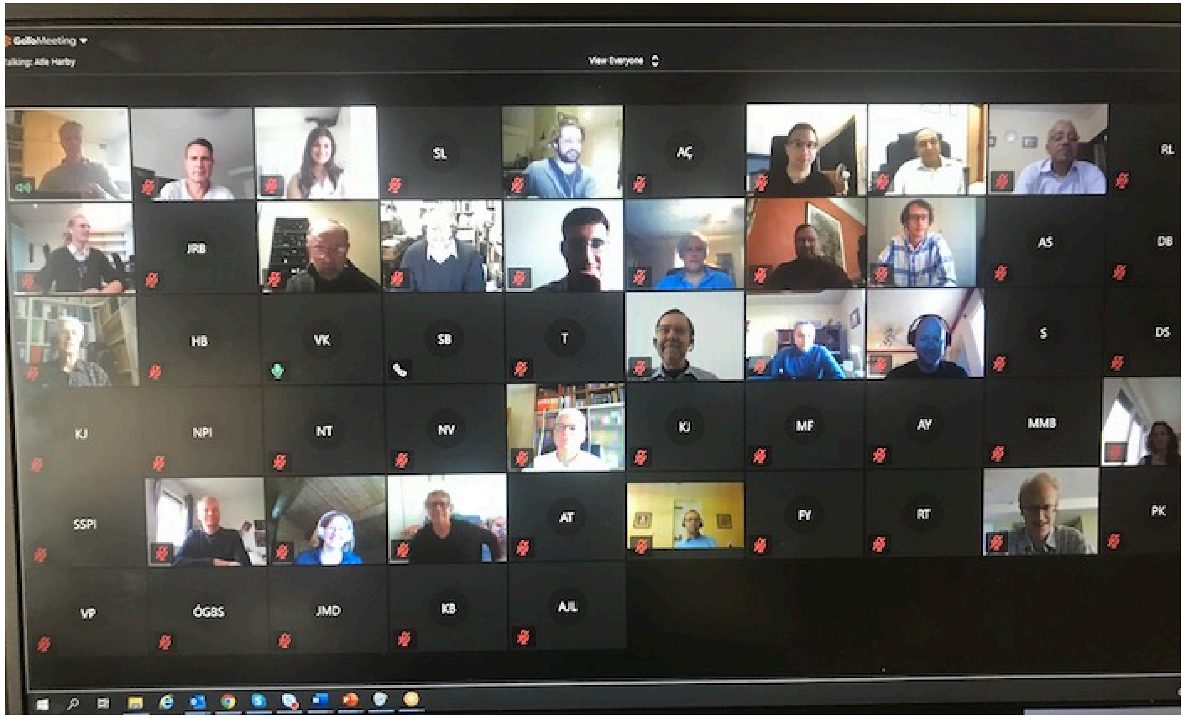
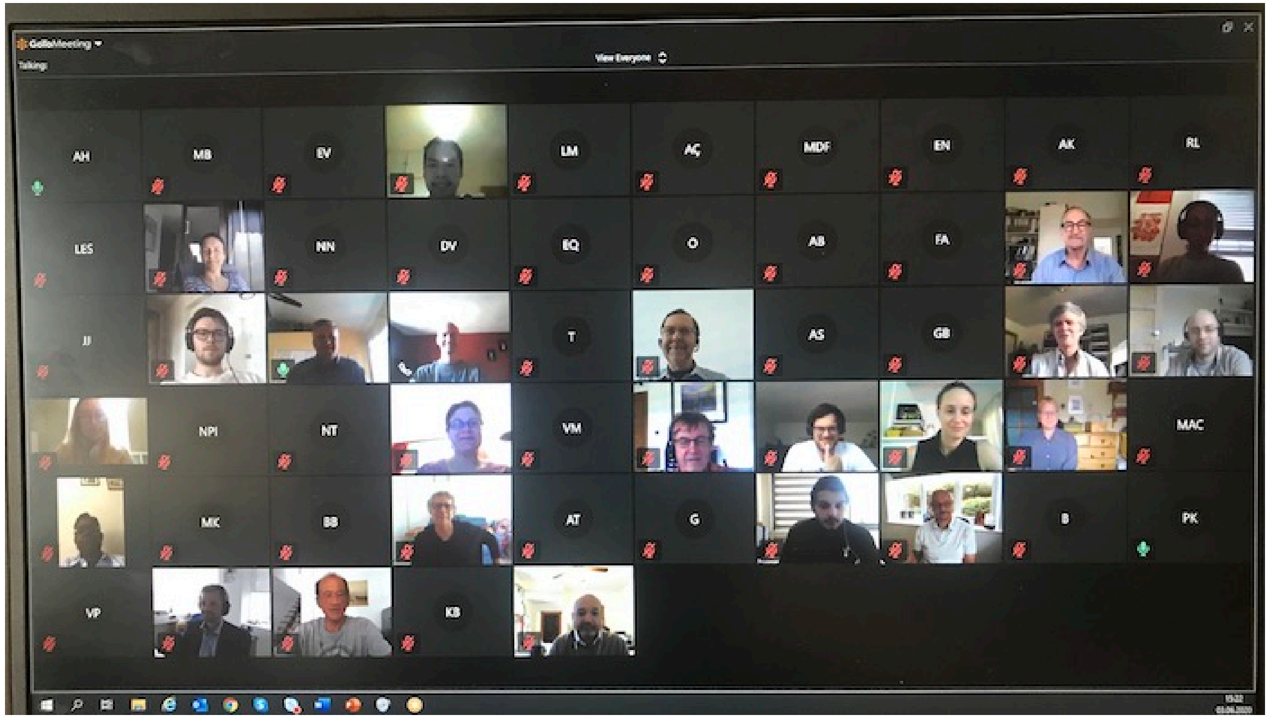
Thank You!





Annex IX: Hydropower Services Online Workshop 3 June 2020

https://www.ieahydro.org/annex-ix-hydropower-services/workshops/flexibility-in-evolving-hydropower-markets

IEA Hydro Annex IX

Coffee break
We resume
16.13 CET

Hydropower providing flood control and drought management



1. Introduction
2. Need for controlling floods and droughts + climate change
3. Reservoir operations
4. Methods for valuation
5. Value of avoiding floods
6. Value of reducing floods
7. Value of providing water when needed
8. Case Studies (examples and summary)
9. Discussion and conclusion

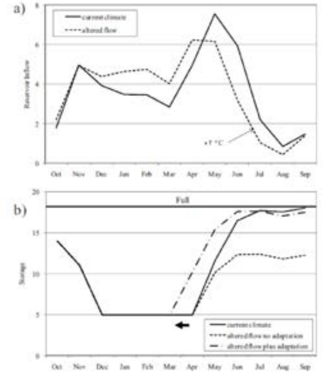
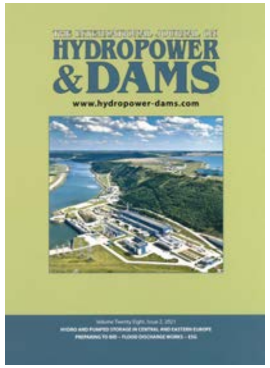


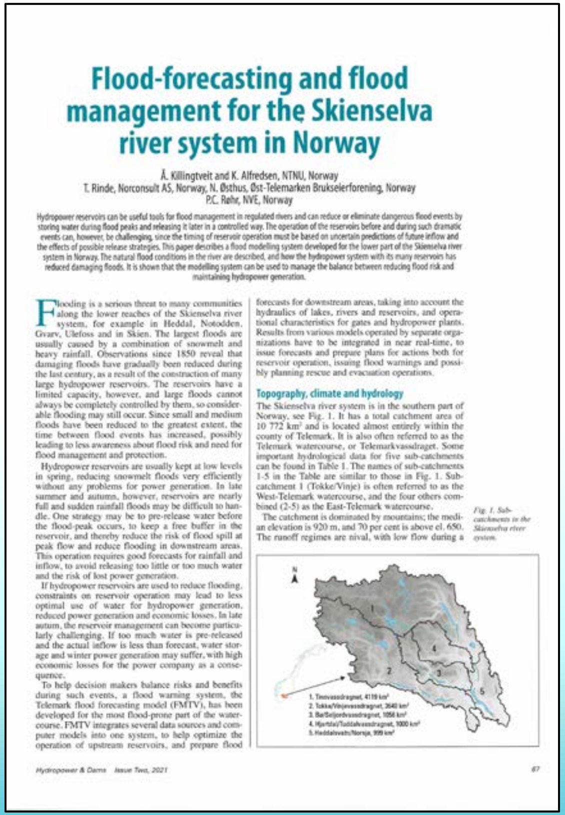
Fig. 1. Schematic illustration of the influence of warming on reservoir refill due to streamflow timing shifts for a hypothetical reservoir on the west slope of the Cascade Mountains: (a) hydrograph for 20th century climate and a warming scenario; (b) simulated reservoir refill

Report of Case Studies

- Tasmania irrigation schemes, Australia
- Inn River Basin, Austria
- Paraiba do Sul River Basin, Brazil
- Columbia River Basin, Canada and USA
- Lech River Basin, Germany
- Schluchtsee catchment, Germany
- Nukabira Hydropower Plants flood control management services
- Flood forecasting and management in Skiensvassdraget, Norway
- Schaffhausen, Switzerland
- Minerve System, Upper Rhone Valley, Switzerland
- Atatürk HEPP&Dam, Southeastern Anatolia Project (GAP), Turkey
- Dibang multipurpose Project, Lower Dibang valley, India
- Tehri Dam as flood moderator, India

Flood control *Drought management* *Both*





Flood-forecasting and flood management for the Skienselva river system in Norway

Å. Killingtveit and K. Alfredsen, NTNU, Norway
T. Rinde, Norconsult AS, Norway, N. Østhus, Øst-Telemarken Brukseierforening, Norway
P.C. Røhr, NVE, Norway

Hydropower reservoirs can be useful tools for flood management in regulated rivers and can reduce or eliminate dangerous flood events by storing water during flood peaks and releasing it later in a controlled way. The operation of the reservoirs before and during such dramatic events can, however, be challenging, since the timing of reservoir operation must be based on uncertain predictions of future inflow and the effects of possible release strategies. This paper describes a flood modelling system developed for the lower part of the Skienselva river system in Norway. The natural flood conditions in the river are described, and how the hydropower system with its many reservoirs has reduced damaging floods. It is shown that the modelling system can be used to manage the balance between reducing flood risk and maintaining hydropower generation.

Flooding is a serious threat to many communities along the lower reaches of the Skienselva river system, for example in Heddal, Notodden, Gvarv, Ulefoss and in Skien. The largest floods are usually caused by a combination of snowmelt and heavy rainfall. Observations since 1850 reveal that damaging floods have gradually been reduced during the last century, as a result of the construction of many large hydropower reservoirs. The reservoirs have a limited capacity, however, and large floods cannot always be completely controlled by them, so considerable flooding may still occur. Since small and medium floods have been reduced to the greatest extent, the time between flood events has increased, possibly leading to less awareness about flood risk and need for flood management and protection.

Hydropower reservoirs are usually kept at low levels in spring, reducing snowmelt floods very efficiently without any problems for power generation. In late summer and autumn, however, reservoirs are nearly full and sudden rainfall floods may be difficult to handle. One strategy may be to pre-release water before the flood-peak occurs, to keep a free buffer in the reservoir, and thereby reduce the risk of flood spill at peak flow and reduce flooding in downstream areas. This operation requires good forecasts for rainfall and inflow, to avoid releasing too little or too much water and the risk of lost power generation.

If hydropower reservoirs are used to reduce flooding, constraints on reservoir operation may lead to less optimal use of water for hydropower generation, reduced power generation and economic losses. In late autum, the reservoir management can become particularly challenging. If too much water is pre-released and the actual inflow is less than forecast, water storage and winter power generation may suffer, with high economic losses for the power company as a consequence.

To help decision makers balance risks and benefits during such events, a flood warning system, the Telemark flood forecasting model (FMTV), has been developed for the most flood-prone part of the watercourse. FMTV integrates several data sources and computer models into one system, to help optimize the operation of upstream reservoirs, and prepare flood forecasts for downstream areas, taking into account the hydraulics of lakes, rivers and reservoirs, and operational characteristics for gates and hydropower plants. Results from various models operated by separate organizations have to be integrated in near real-time, to issue forecasts and prepare plans for actions both for reservoir operation, issuing flood warnings and possibly planning rescue and evacuation operations.

Topography, climate and hydrology

The Skienselva river system is in the southern part of Norway, see Fig. 1. It has a total catchment area of 10 772 km² and is located almost entirely within the county of Telemark. It is also often referred to as the Telemark watercourse, or Telemarkvassdraget. Some important hydrological data for five sub-catchments can be found in Table 1. The names of sub-catchments 1-5 in the Table are similar to those in Fig. 1. Sub-catchment 1 (Tokke/Vinje) is often referred to as the West-Telemark watercourse, and the four others combined (2-5) as the East-Telemark watercourse.

The catchment is dominated by mountains; the median elevation is 920 m, and 70 per cent is above el. 650. The runoff regimes are nival, with low flow during a

Fig. 1. Sub-catchments in the Skienselva river system.

Hydropower & Dams Issue Two, 2021

Hydropower providing flood control and drought management

Summary to be updated.
Adding a Table to focus on "key subjects for future evaluation and development" for each Case Study

Reported by	Furkan Yardimici
Case study	Atatürk HEPP&Dam, Southeastern Anatolia Project (GAP)
Country	Turkey
Project responsible and partners	Elektrik Üretim A.Ş
Short description	The hydropower dam has been used to mitigate floods, protect from droughts and generate electricity
Flood control	Floods from Tigris and Euphrates Rivers decreased significantly after the construction of the dams with positive consequences on the local communities
Drought mitigation	Up to now, the dam has been used for irrigation purposes not for mitigation of extreme drought events.
Climate change	Predictions for the area show a reduction in precipitation and an increased evapotranspiration that will shift the beginning of the irrigation period from May to March
Technical details	Reservoir total volume: 48.7 billion cubic meters Installed capacity: 2 400 MW (8 x 300 MW Francis turbines) Annual generation: 8,9 TWh Dam height: 169 m Dam length: 1 819 m
Other services	Surface water supply for non-drinking purposes (irrigation)
Type	Reservoir volume

Summary table for each Case Study already included

Review, publish and disseminate

Summarize into White Paper

Role and Challenges of Pumped Storage Hydropower Under Mass Integration of Variable Renewable Energy

JEPIC

SEPTEMBER, 2021

Main Contents

- Improving Balance of Capability of PSH in Europe
  - Variable speed PSH with secondary exciter system
  - Ternary-type PSH
  - Hydraulic Short Circuit operation in ternary-type PSH
  - Hybrid operation of PSH and Battery Energy Storage System
- PSH Business in the United States
  - Form of wholesale electricity transactions and operation of PSH
  - Integration of variable renewable energy and operation of PSH
- PSH Development
- VRE Integration and the Role of PSH in Japan

Further work - Deliverables

Type	Title	Status
Communiqué	The value and contemporary role of hydropower.	Delivered Dec 2018
White Paper I	Flexible hydropower providing value to renewable energy integration	Delivered Oct 2019
Report	Hydropower services in the energy system: Relevant research projects and activities	Delivered Jan 2020
Report	Valuing Flexibility in Evolving Energy Markets: Current Status and Future Outlook for Hydropower	Delivered Jun 2021
White Paper II	Valuing Flexibility in Evolving Energy Markets: Current Status and Future Outlook for Hydropower	Delivered Jun 2021
Report	Hydropower providing flood control and drought management: Case studies	In preparation
Report	Role and Challenges of Pumped Storage Hydropower Under Mass Integration of VRE	In review
Factsheet	Definition of hydrobalancing	Planned
Factsheet	Misconceptions and false myths about hydropower	Planned
Factsheet	Hydropower and integration of VRE (Popular science and summary version of White Paper I)	Planned
White Paper III	Hydropower providing flood control and drought management – executive summary of report	Proposed for 2022
White Paper or report	Electricity market solutions for VRE integration and value and remuneration of long-duration flexibility and energy storage (collaboration with IEA Wind and other TCPs ?)	Proposed for 2022
White Paper or report	Hybrid solutions with hydropower: Hydropower – floating solar PV; Hydropower – batteries; Hydropower – wind. Collaboration with other TCPs	Proposed for 2022
Roadmap	Final roadmap on hydrobalancing and value of flexibility services from hydropower	Planned for 2022

Further work - Deliverables

Type	Title	Status
Communiqué	The value and contemporary role of hydropower.	Delivered Dec 2018
White Paper I	Flexible hydropower providing value to renewable energy integration	Delivered Oct 2019
Report	Hydropower services in the energy system: Relevant research projects and activities	Delivered Jan 2020
Report	Valuing Flexibility in Evolving Energy Markets: Current Status and Future Outlook for Hydropower	Delivered Jun 2021
White Paper II	Valuing Flexibility in Evolving Energy Markets: Current Status and Future Outlook for Hydropower	Delivered Jun 2021
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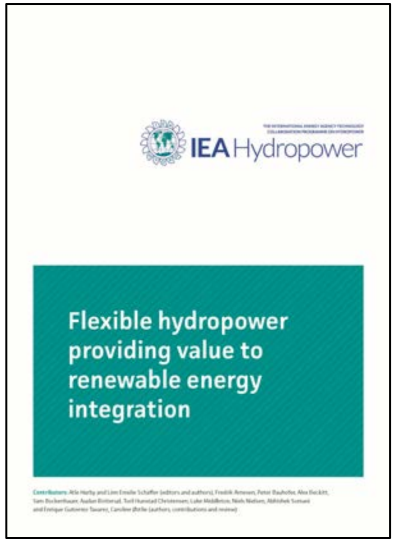
White Paper or report	Hybrid solutions with hydropower: Hydropower – floating solar PV; Hydropower – batteries; Hydropower – wind. Collaboration with other TCPs	Proposed for 2022
Roadmap	Final roadmap on hydrobalancing and value of flexibility services from hydropower	Planned for 2022

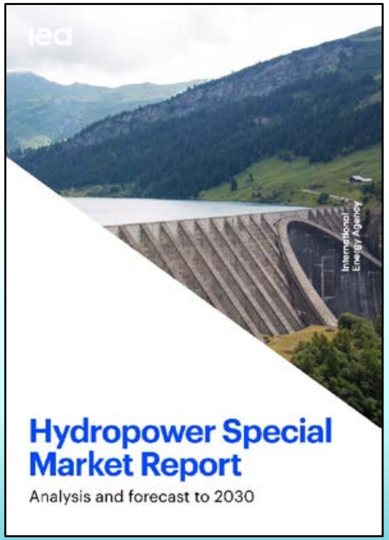
Further work - Meetings

Type	Title	Date
Workshop	Kick-off workshop in Brussels	Dec 2018
Conference	Session "Valuing Hydropower Flexibility" at Hydro 2019	Oct 2019
Meeting	Annex IX meeting at Hydro 2019 in Porto	Oct 2019
Workshop	Hydropower Services and Climate Change (with Annex XII)	Dec 2019
Workshop	IEA Hydropower Workshop, IEA headquarters, Paris	Feb 2020
Meeting	IEA Hydro Annex IX-XII Joint Task: Flood Control and Drought Management Services online meeting	May 2020
Workshop	Valuing Hydropower Flexibility in Evolving Electricity Markets	Jun 2020
Meeting	Annex IX online meeting	Sep 2020
Webinar	Inter-TCP meeting on Integrated Energy Systems	Apr 2021

Annex IX Phase 2 – main activities so far

- Gather information about ongoing and recently finalised relevant research projects. Summarizing these in a report
- Writing a White Paper about "Valuing Hydropower Flexibility", disseminating activities by distributing printed version, emailing pdf version and giving several talks
- Organising workshops and meetings about Hydropower providing Flood Control and Drought Management Services in collaboration with Annex XII
- Organising workshops and meetings about Valuing Hydropower Flexibility
- Writing a report and a White Paper about Valuing Hydropower Flexibility in Evolving Electricity Markets
- Assisting IEA in preparation of the Hydropower Special Market Report, including attending meetings, workshops, and supporting IEA with text, facts and review
- Participating and giving talks at international conferences and meetings
- Taking part in IHA Forum on Pumped Storage
- Participating in Inter-TCP meeting on Integrated Energy Systems, starting initial discussions with TCP Wind





Further work

- Annex IX online meeting Sep 2021
- Disseminate White Paper and Report "Valuing Flexibility in Evolving Energy Markets: Current Status and Future Outlook for Hydropower" Sep-Dec 2021
- Participate in Hydro 2021 conference 25-27 Oct 2021
- Finalise and publish factsheets (se deliverables plan) by Feb 2022
- Edit and publish report "Role and Challenges of Pumped Storage Hydropower Under Mass Integration of Variable Renewable Energy" by Oct 2021
- Edit and publish a report "Hydropower providing flood control and drought management: Case studies (common task with Annex XII)" by the end of 2021
- Write a White Paper as a summary of the report "Hydropower providing flood control and drought management: Case studies" together with Annex XII. By April 2022
- Write White Papers and Reports according to deliverables plan for 2022
- Discuss common work and publications with other TCP
- Discuss further collaboration with IEA

Further work - Deliverables

Type	Title	Status	Contribution
Report	Hydropower providing flood control and drought management: Case studies	In preparation	Mauro Carolli, Jean-Jaques Fry
Report	Role and Challenges of Pumped Storage Hydropower Under Mass Integration of VRE	In review	Niels Nielsen
Factsheet	Definition of hydrobalancing	Planned	Atle Harby
Factsheet	Misconceptions and false myths about hydropower	Planned	Fredrik Arnesen
Factsheet	Hydropower and integration of VRE (Popular science and summary version of White Paper I)	Planned	
White Paper III	Hydropower providing flood control and drought management – executive summary of report	Proposed for 2022	
White Paper or report	Electricity market solutions for VRE integration and value and remuneration of long-duration flexibility and energy storage (collaboration with IEA Wind and other TCPs ?)	Proposed for 2022	
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End of meeting
– thank you for your participation!