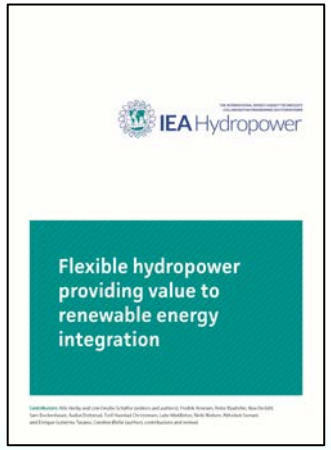
ANNEX IX -Valuing Hydropower Services

Welcome to all participants. Workshop will start 14.00 CET



Please mute yourself when not speaking. Let's try to keep webcams on!
Please use the chat 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

CET	Thursday 24th September 2020	Chaired/presented by
14:00	Welcome and brief presentation of meeting participants	Atle Harby, SINTEF
14:10	Summary of workshop 27th May on Flood Control and Drought management	Jorge Damazio, CEPEL & Atle Harby, SINTEF
14:20	Progress of work within joint Annex IX-XII Task: Flood control and drought management: Report of case studies, potential White Paper	Jorge Damazio,& Atle Harby
14:40	Hydro 2020 conference contribution	Atle Harby
14:50	Information from IEA Hydro, IEA and others	Niels Nielsen and Atle Harby
15:00	Break	
15:10	Summary of workshop 3rd June on Valuing Hydropower Flexibility in Evolving Electricity Markets	Audun Botterud, Argonne & Atle Harby
15:20	Progress of work within Flexibility services provided by hydropower. General overview	Atle Harby
15:30	Progress and first results for white Paper on Valuing Hydropower Flexibility in Evolving Electricity Markets	Audun Botterud
15:45	Further plans	Atle Harby
15:55	Any other business	
16:00	**End of meeting**	

Summary of workshop: Flood control and drought management

Time	Wednesday 27rth May 2020	Presented by
14:00	Opening and Review of Dec 2019 Joint Workshop Conclusions	Jorge Damazio, CEPEL Atle Harby, SINTEF
14:15	Brief update on Annex XII activities	Jorge Damazio, CEPEL
14:25	Brief update on Annex IX activities	Atle Harby, SINTEF
14:35	Columbia River Case study	Nathalie Voisin, PNNL
14:50	Flood forecasting and reservoir operation in the East-Telemark hydropower system	Ånund Killingtveit, NTNU
15:05	Hydropower Services Case Study: Drought Mitigation in Tasmania	Carolyn Maxwell, Hydro Tasmania
15:20	Break	
15:30	Paraíba do Sul River case study	Jorge Damazio, CEPEL
15:40	Simple estimation of potential flood control contribution from hydropower. Case studies from Norway	Bendik Hansen, SINTEF
15:50	Case study report: Reviewing contributions and edition of report	Operating agents
16:00	Potential White Paper content	Operating agents
16:15	Discussion about Special Session at HYDRO 2020	Operating agents
16:25	Any other business	All
16:30	**End of meeting**	

Jorge Damazio, CEPEL & Operating Agent for Annex XII

Flood Control & Drought Management Services

A joint workshop was held online on 27 May 2020. 35 participants from Australia, Austria, Brazil, Canada, France, Iceland, India, Iceland, Norway, Switzerland, Turkey, UK, USA, the EU and The World Bank took part in the meeting.

- Opening & Update on Annex XII activities - Jorge Damazio, CEPEL
- Update on Annex IX and further work - Atle Harby, SINTEF
- Columbia River Case study - Nathalie Voisin, PNNL, USA
- Flood forecasting and reservoir operation in the East-Telemark hydropower system - Ånund Killingtveit, NTNU. Norway
- Hydropower Services Case Study: Drought Mitigation in Tasmania - Carolyn Maxwell, Hydro Tasmania
- Paraíba do Sul River case study - Jorge Damazio, CEPEL, Brazil
- Simple estimation of potential flood control contribution from hydropower. Case studies from Norway - Bendik Hansen, SINTEF, Norway
- Dibang Multipurpose Storage Project for Flood Moderation & Hydropower - Arun Kumar, IIT, Roorkee, India
- Agenda, Particpants and Q&A

Main conclusions of the WebinarMeeting 20-05-2020

The ideas of a White Paper "Hydropower providing flood control and drought management" was presented. The content could be:

- Intro about flood control, drought management and hydropower
- Theory and examples (as boxes) on how hydropower contributes to flood control and drought management
- Future needs for services like flood control and drought management
- The value of services like flood control and drought management (discussion)

Participants were encouraged to contribute to the White Paper.

Participants were also encouraged to present a paper on the topic of flood control and drought management from hydropower to the Hydro 2020 conference in Strasbourg 26-28 October

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

Report of Case Studies

- Contributions received:
  - USA – Columbia River Basin Study
  - Australia – Tasmania Case Study
  - Germany - Roßhaupten with Forggensee reservoir
  - Germany – Schluchtseewerke
  - Turkey - Southeastern Anatolia Project (Gap)
  - Japan - Nukabira Hydropower Plants flood control management services
  - Brazil – Paraiba do Sul River Basin
  - Switzerland - Rheinkraftwerk Schaffhausen
  - Norway - pending

Flood control *Drought management* *Both*

Review process:

- Members of Annex IX and XII
- Comparable case studies

Edition process:

- Make a summary
- Implications for further work
- Done by Operating Agents

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

Potential White Paper:

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

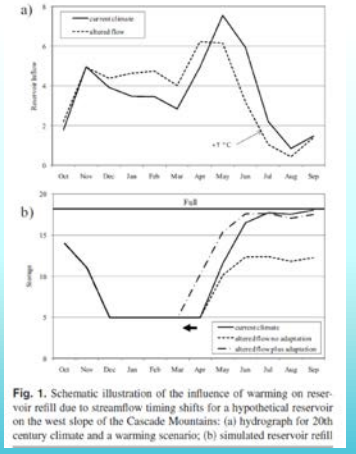


Fig. 1. Schematic illustration of the influence of warming on reservoir refill due to streamflow timing shifts for a hypothetical reservoir on the west slope of the Cascade Mountains: (a) hydrograph for 20th century climate and a warming scenario; (b) simulated reservoir refill

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

Wednesday
28th October
Last session

Hydro 2020 online Conference

- Operation and the value of hydropower providing flood control and drought management. *Jorge Damazio, CEPEL, Atle Harby, SINTEF*
- Case study from the USA: The Columbia River. *Nathalie Voisin, PNNL*
- Case study from Brazil: Flood control and drought management services provided by hydropower plants in the Paraiba do Sul river basin, Brazil. *Paulo Diniz (ONS), Fernanda Costa (UERJ), Jorge Damazio (CEPEL)*
- Hydropower plant Roßhaupten with Forggensee reservoir serving flood control and drought management to encounter climate change. *Cornelia Häckl, Uniper*
- Flood forecasting and reservoir operation in the East-Telemark hydropower system. *Ånund Killingtveit, NTNU*
- Dibang multi-purpose project for flood protection. *Arun Kumar, IIT Roorkee*
- Update on IEA Hydro's White Paper #2 on "Valuing Hydropower Flexibility in Evolving Electricity Markets" *Audun Botterud, ANL*

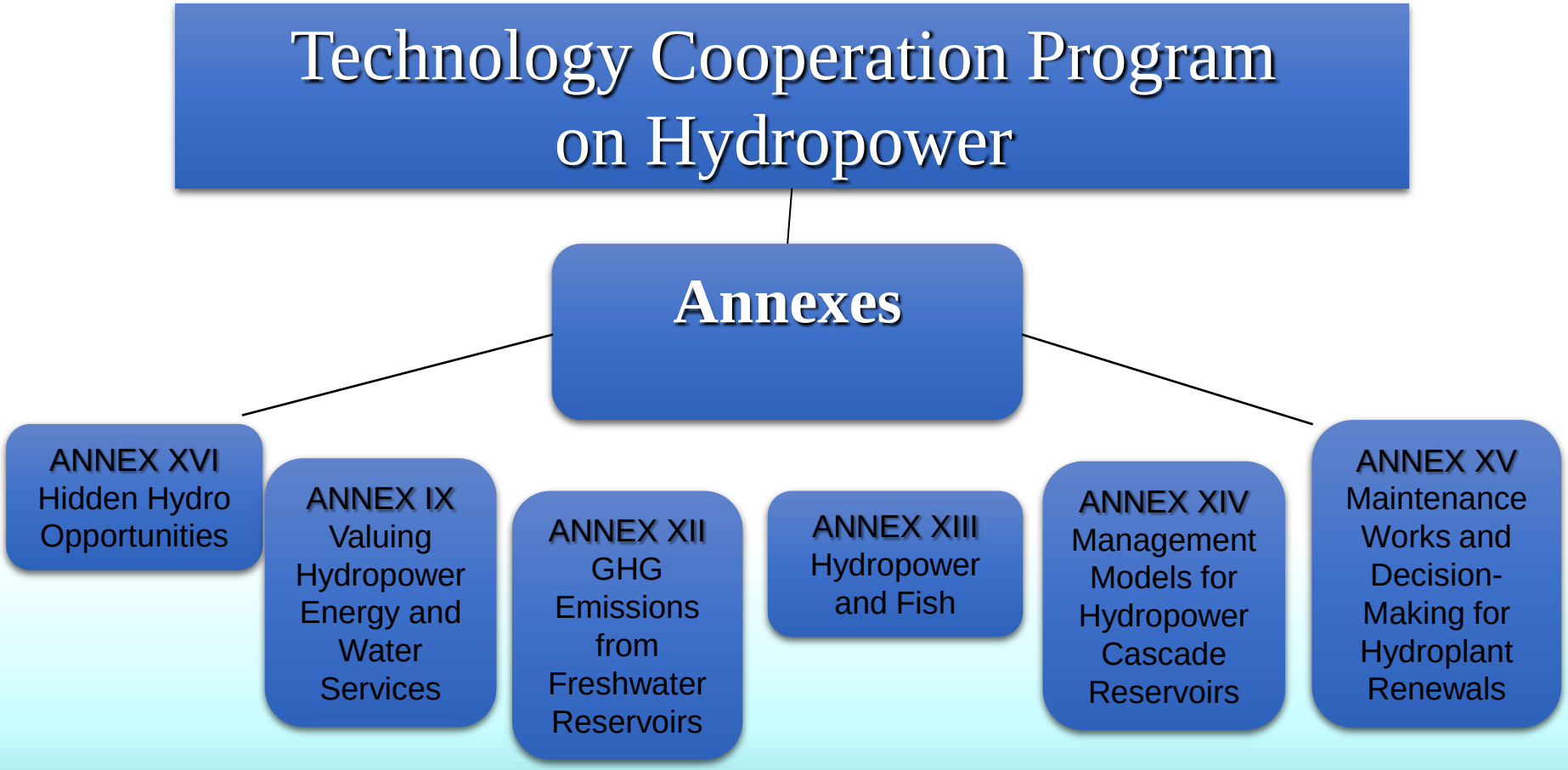
Talks will be shorter than normal and pre-recorded. Online Q&A sessions

Members of IEA Hydro TCP

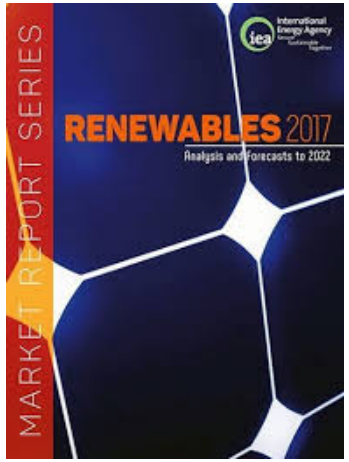
- Australia – Hydro Tasmania
- Brazil – Ministry of Mines and Energy, CEPEL
- China – China Yangtze Power Co/ICSHP
- European Union – European Commission
- Finland – Funding Agency for Technology & Innovation/Kemijoki Oy
- Japan – New Energy Foundation (NEF)
- Norway – Norwegian Water Resources & Energy Directorate (NVE)
- Switzerland – Swiss Federal Office of Energy
- USA – US Department of Energy, Oak Ridge National Laboratory

- Sarawak Energy participates as a sponsor.

Structure of program



IEA Renewables Market Report 2020



Our discussions will inform our next renewables market report this year, which will focus on hydropower – the largest source of renewable electricity generation.

Workshop 10th February
IEA main office, Paris

Fatih Birol
@IEABirol

Last year, I said the @IEA would be the "voice of hydropower", an essential renewable technology that sometimes doesn't get the attention it deserves. This week we gathered more than 90 top stakeholders at the @IEA to discuss opportunities and challenges of hydropower.

IEA Hydropower
THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

iea

HydroCen

IEA Renewables Market Report 2020

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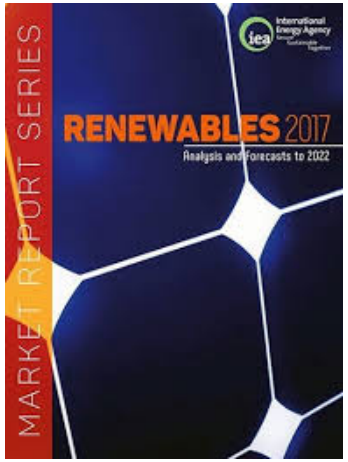

….an essential renewable technology that sometimes doesn't get the attention it deserves

IEA Hydropower
THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

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HydroCen

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

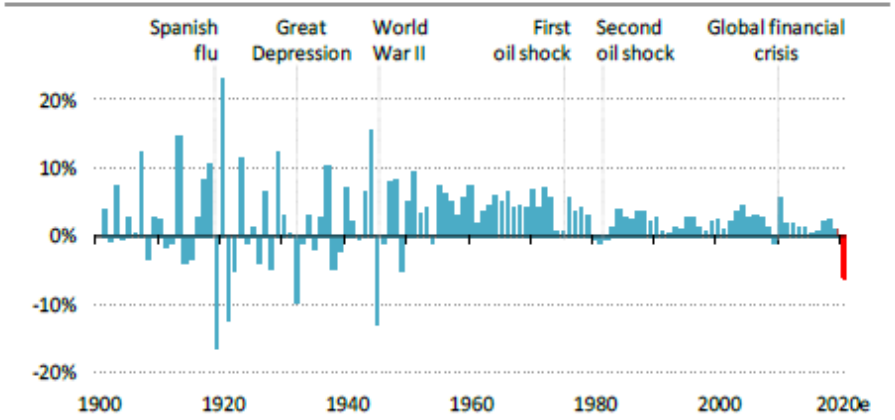
IEA World Energy Outlook Special Report

Sustainable Recovery

- *A Sustainable Recovery Plan*
- *The Covid-19 pandemic has created a historic crisis for economies and energy markets*
- *The plan provides a significant boost to jobs and growth…*
- *… and helps put the world on a trajectory in line with international climate goals*
- *Governments have a once-in-a-lifetime opportunity to shape a better energy future*

Hydropower and nuclear power….. They help reduce fossil fuel imports, improve electricity security by adding to power system flexibility, and improve the affordability of electricity to consumers. Many facilities are ageing and face financial challenges because of lower revenues as a result of the crisis…. Modernising and upgrading existing hydropower facilities… would avoid a steep decline in low-carbon electricity generation; new construction would further boost low-carbon generation, and could also be considered where appropriate

Figure 1.2 ▹ Change in global primary energy demand, 1900 to 2020e



Total primary energy demand is set to drop by 6% in 2020, the largest relative decline in 70 years and the biggest ever decline in absolute terms.

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

IEA working with hydropower

- February 10, 2020 - Hydropower workshop at IEA looking at drivers and challenges to Greenfield development, Existing asset management; and System Flexibility
- May 2020 - IEA hydropower forecasts on hydropower generation in the Global Energy Review and capacity to 2021 in the Renewable Market update
- June 2020 – launch of IEA's report: Climate Impacts on African Hydropower which assess climate risks to hydropower in Africa and gives policy recommendations to increase resilience
- June 3 2020 - IEA Hydropower Annex IX TCP workshop on Valuing Hydropower Flexibility in Evolving Electricity Market mapping remuneration schemes for flexibility products in different markets
- June 12, 2020 – IEA-IHA Discussion - IEA Executive Director discusses with industry CEOs on need for sustainable recovery in webinar organized by IHA underlining multiple benefits of hydropower
- June 18 2020 - IEA Sustainable Recovery plan identifies important role of hydropower in economic stimulus packages; will inform IEA Clean Energy Transitions Summit on 9 July with the participation of Sophie Brochu, CEO of Hydro-Quebec
- 4Q 2020 (tbc) Renewables 2020 Market Report forecast update including hydropower
- H1 2021 - *New planned date for Hydropower Focus; will outline Hydropower today; Business Case for Hydropower; Five-year deployment trends; System Flexibility

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

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- June 3 2… Electricity Market r…
- June 12, 2… sustainable recovery i…
- June 18 20… ydropower in economic stimulus packages; w… July with the participation of Sophie Brochu, CEO of Hydro-Qu…
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H1 2021 - *New planned date for Hydropower Focus; will outline Hydropower today; Business Case for Hydropower; Five-year deployment trends; System Flexibility

Collaboration projects

- **International Forum on Pumped Storage Hydropower**

  To be launched in November 2020

- **XFLEX HYDRO – Hydropower Extending Power System Flexibility (EU Horizon 2020)**

  www.xflexhydro.net

- **Hydropower Europe (EU Horizon 2020)**

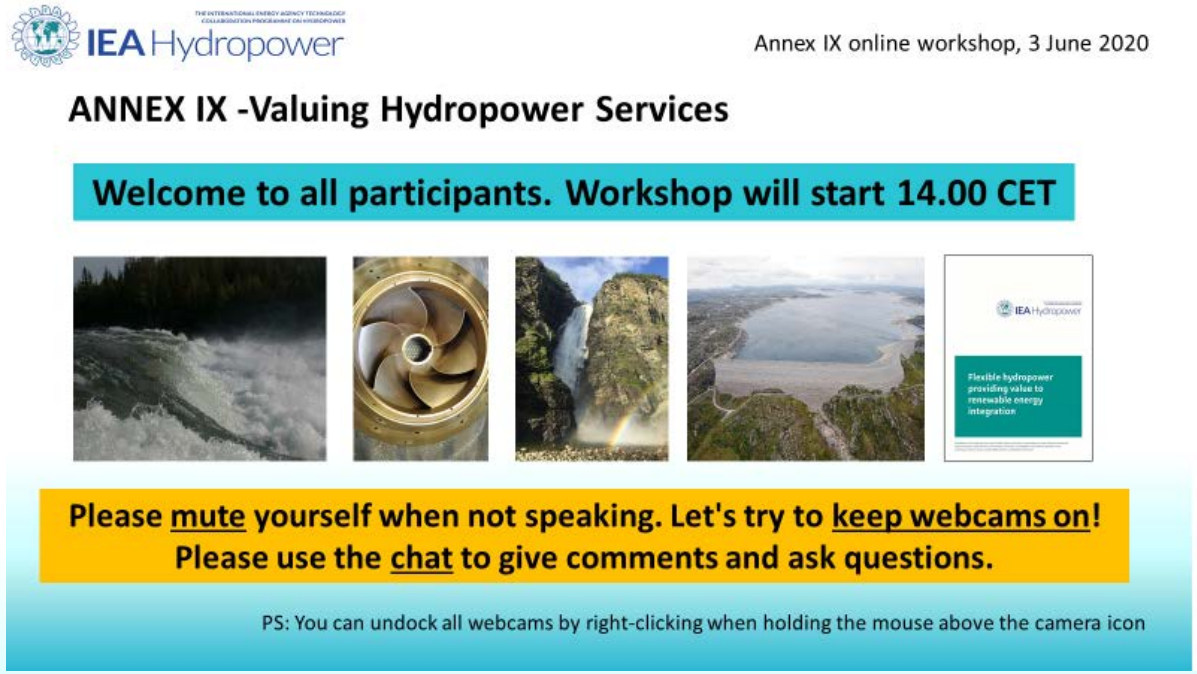
  www.hydropower-europe.eu

THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

Coffee break
We resume
15.10 CET

Summary of workshop: Valuing Hydropower Flexibility in Evolving Electricity Markets



Time	Wednesday 3rd June 2020	Presented by
14:00	Opening and welcome	Atle Harby, SINTEF
14:10	Brief overview of the idea of White Paper II "Valuing Hydropower Flexibility in Evolving Electricity Markets"	Audun Botterud, Argonne
14:20	Grid and Flexibility Services: An Overview of the Swiss scenario	Elena Vagnoni, EPFL
14:30	Flexibility Services: An overview of the Australian NEM	Donald Vaughan, ENTURA
14:40	Flexibility Services in the Power Grid: Indian case	SS Barpanda, POSOCO
14:50	Potential for flexibility revenues on different time horizons in the spot market	Fredrik Arnesen, NVE
15:00	Q&A and discussions	
15:15	Break	
15:25	Flexibility Services in the Power Grid: Brazil case	Albert de Melo, CEPEL
15:35	Flexibility Services in the Power Grid: Quebec case	Guillaume Tarel, Hydro Quebec
15:45	Flexibility Services in the Power Grid: California case	Abishek Somani, PNNL
15:55	Q&A and discussions	
16:15	Content and contributions to White Paper II	Audun Botterud, Argonne
16:25	Any other business	
16:30	**End of meeting**	

Atle Harby, SINTEF & Operating Agent for Annex IX

from Audun Botterud

FLEXIBILITY QUESTIONNAIRE

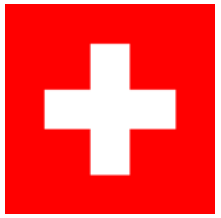
- Questions across timescales
  - Please provide a brief overview of relevant grid flexibility services and products
  - How are these flexibility services currently procured?
  - Are these services compensated?
  - Does hydropower currently provide these services to the power grid?
  - How much is normally procured of this service? Use the last year(s) average or similar
  - List important current and future developments related to these flexibility services
- Responses from 12 countries received so far
  - A wide variety of flexibility mechanisms
  - Hydro provides flexibility services across the timescales

from Elena Vagnoni

Different Timescales of Power System Flexibility

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)
Defined products or mechanisms	**Limited**	**Yes**	**Yes**		**Yes**	
Compensation	**Partly**	**Partly**	**Yes**		**Yes**	
Hydro contribution	**Yes**	**Yes**	**Yes**		**Yes**	

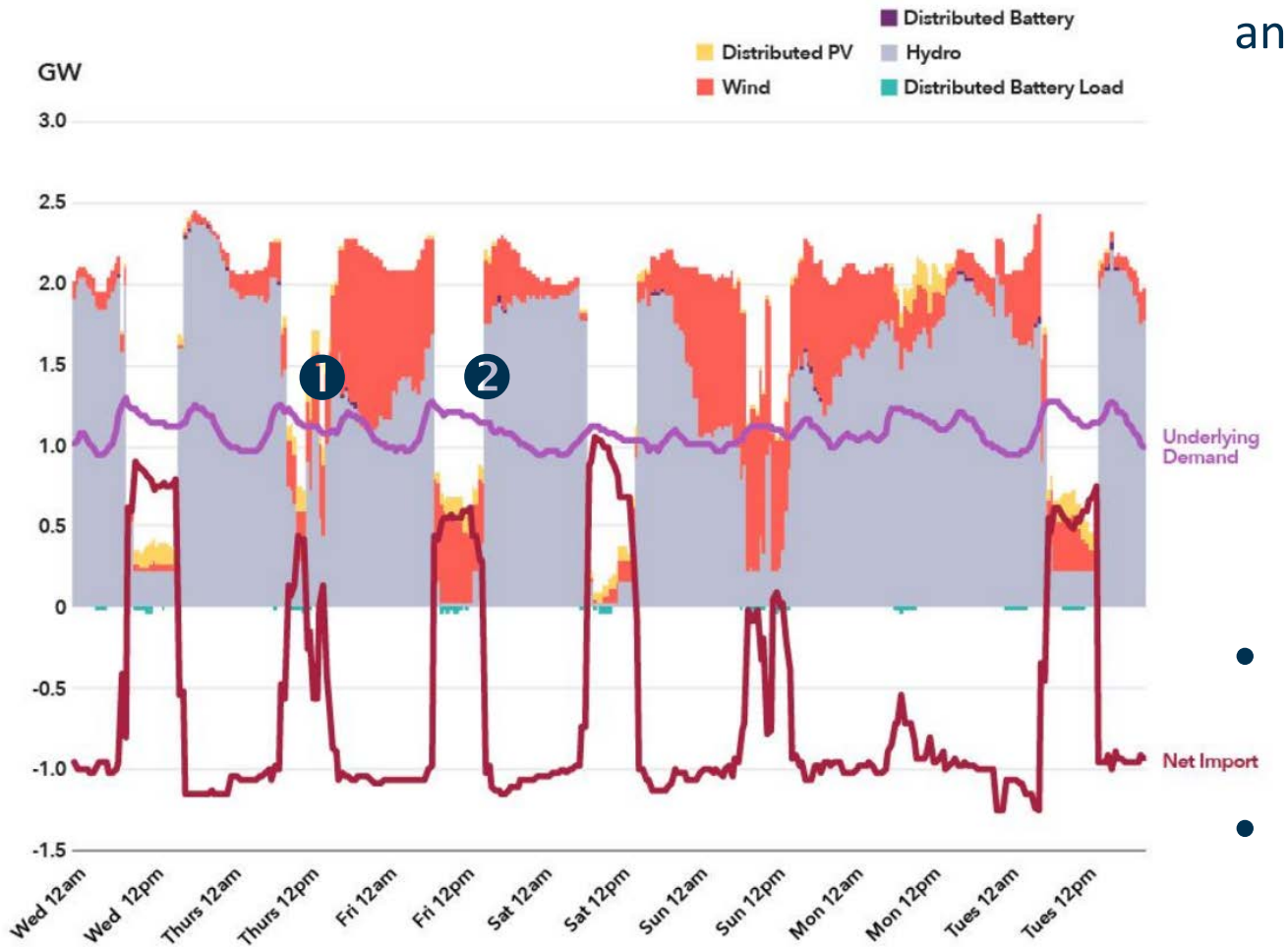
Status in Switzerland:



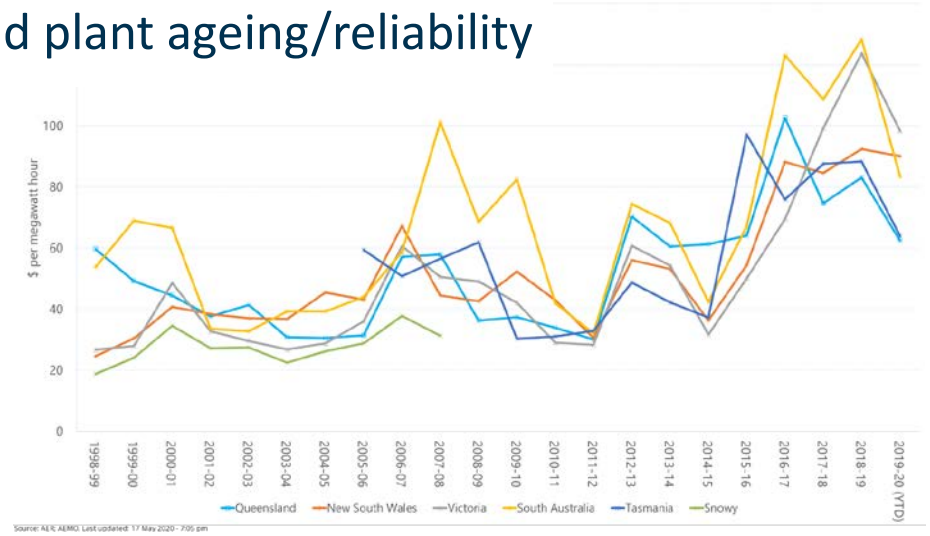
from Donald Vaughan, Luke Middleton & Alex Beckitt

Firming

Figure 18 Resources used in Tasmania, same low wind week in June 2040, GW



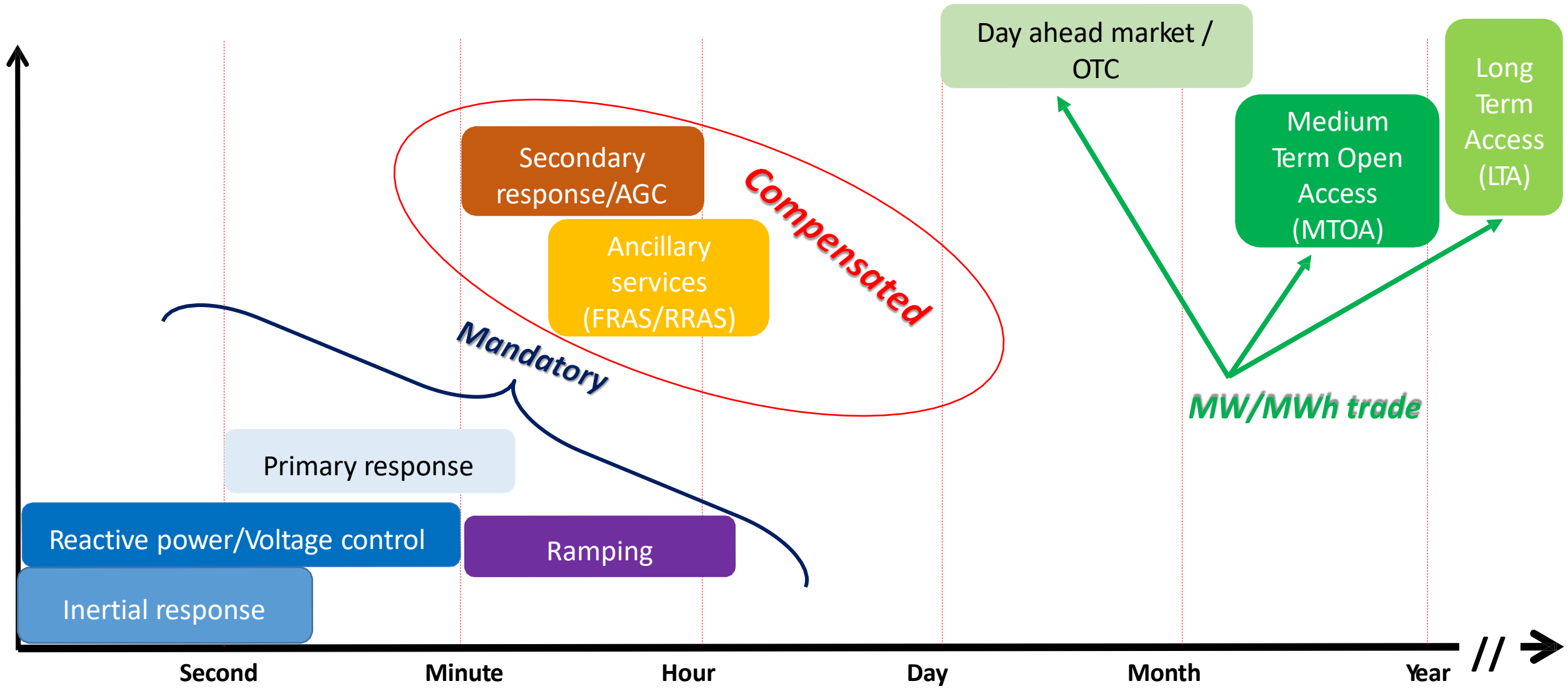
Prices trending up due to coal retirements, drought and plant ageing/reliability



- Hydro can smooth out VRE – compare ❶ and ❷
- No market mechanism other than price at the moment

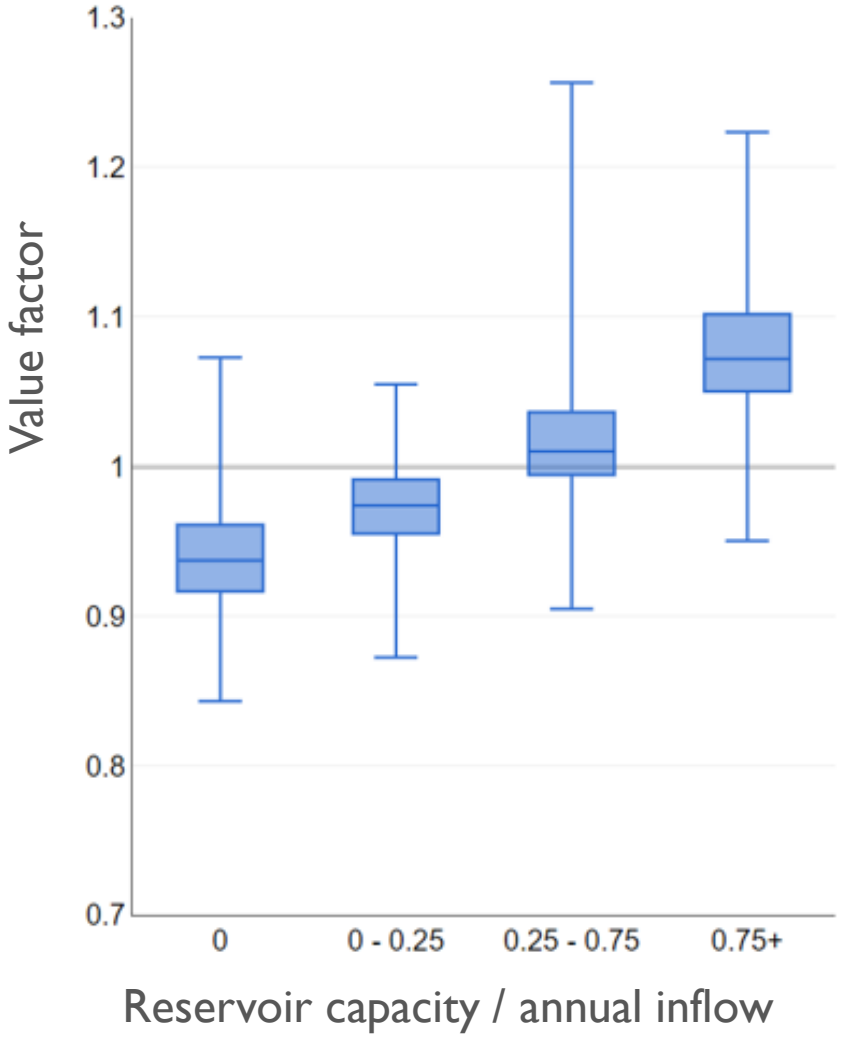
Flexibility

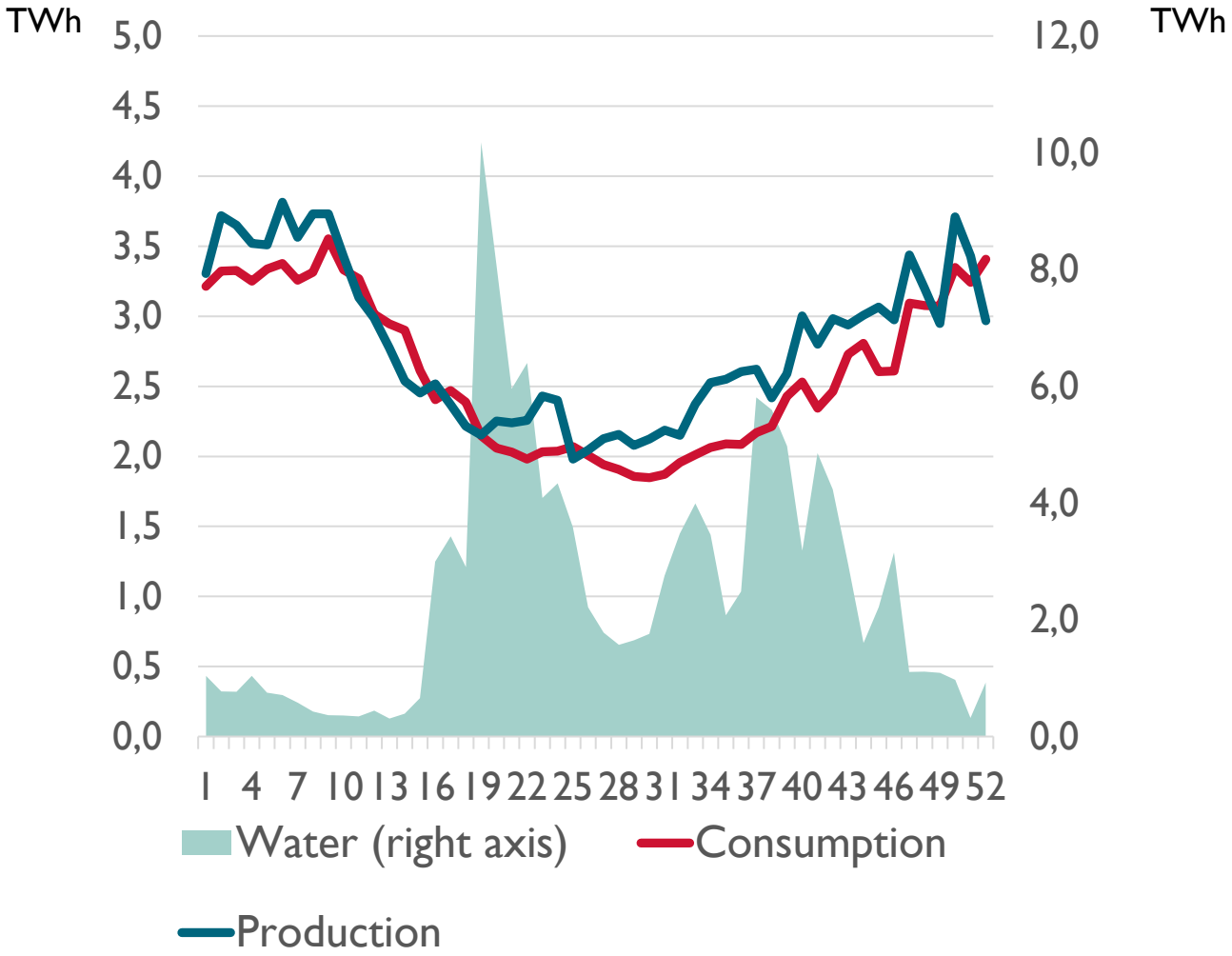
from S.S. Barpanda



from Fredrik Arnesen

Plants that can store a high share of the annual inflow tends to achieve higher value factor





Concluding Remarks

from Albert Melo & Cesar Zani

Type of Ancillary Service	Need of Sign CPSA	Types of Compensated Costs				By HPP ?
		Fixed Costs	Variable Costs		Price Bids	
			O&M	*Active Losses*		
Reactive power support / voltage control	No	-	-	-		Yes
Reactive power support - Synchronous Compensator	Yes	x	x	x		Yes
Special Protection Systems (SPS)	Yes	x	x	-		Yes
Primary Frequency Control	No	-	-	-		Yes
Secondary Frequency Control / AGC	Yes	x	x	-		Yes
Black-Start capability	Yes	x	x	-		Yes
Complementary dispatch to maintain the SR/AGC	Yes	-	-	-	x	No
Demand Response - pilot program	Yes	-	-	-	x	No

Hydropower

- provides most of the ancillary services
- is remunerated for the costs incurred instead of the opportunity costs

A Bill on the commercial model of the electric sector is under analysis in the Brazilian Congress

Two key issues regarding Ancillary Services:

- separation between capacity and energy in two products with different prices (currently they are commercialized as a single product)
- introduction of a price bidding procedure in the short-term market (currently, spot prices are calculated based on stochastic optimization models developed by CEPEL)

If approved, room will be opened for the definition of new products for the provision of ancillary services

from Guillaume Tarel

What are the "services necessary and generally considered" ?

Agreement on additional services (as part of the heritage contract); 2005

Short-term			Medium term	Long-term	
Sub-seconds to seconds	**Seconds to minutes**	**Minutes to hours**	**Hours to days**	**Days to months**	**Months to years**
250 MW of spinning reserve +reactive power + voltage control	Frequency responsive services (called RFP in Québec) between 500 MW and 1500 MW - 1500 MW of 30-minutes reserve, including 1000 MW of 10-minutes reserve	Provision for load forecasting errors up to 500 MW for the next 6 hours	Provision for load forecasting errors up to 1500 MW (day-ahad)	HQP has to provide 178,86 TWh (including losses) of energy to HQD. Large reservoirs belonging to HQP allow to store spring and automn inflows for the next winter, and to hedge against dry years.	

from Abishek Somani

Different Timescales of Power System Flexibility

Flexibility type	Short-term			Medium term	Long-term	
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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, (energy over very long durations)
Availability in California ISO (CAISO)						
Defined products or mechanisms	**Limited**	**Partly**	**Yes**		**Yes**	
Compensation	**Partly**	**Partly**	**Yes**		**Yes**	
Hydro contribution	**Yes**	**Yes**	**Yes**		**Yes**	

Flexibility services provided by hydropower - progress

- Analyse the costs of HydroBalancing.
  Identify competitors and alternate services
- Vocabulary list
- Factsheets:
  - Hydrobalancing
  - Misconceptions
  - Integration of VRE
- Test case on valuation of PHS in Japan based on methodology from DoE

Other activities:
Meetings, workshops and collaboration with IEA
Involvement of scientists outside IEA Hydro

VALUING HYDROPOWER FLEXIBILITY IN EVOLVING ELECTRICITY MARKETS

AUDUN BOTTERUD

Energy Systems Division, Argonne National Laboratory (abotterud@anl.gov)

U.S. DEPARTMENT OF ENERGY Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

IEA Hydro Annex IX Meeting, Sept 24 2020

ANNEX IX WHITE PAPER 2 - OUTLINE

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

- Introduction (ref. Annex IX white paper series)
- Brief description of fundamental system flexibility needs
- Survey of Flexibility Services in Current Systems
  - Flexibility products, procurement mechanisms, hydropower role, market size, prices
  - Different time scales (sub seconds to years, EIA definition)
  - Inputs from 15 (!) countries/regions
- International case studies of flexibility services and hydropower
  - Different perspectives from 7 countries/regions
- Perspectives on future electricity markets: important trends/developments
- Conclusion: Different solutions, good practices, evolving trends, hydro implications
- Appendix: Brief list of most important terminology

TIMESCALES OF POWER SYSTEM FLEXIBILITY

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SOURCE: IEA HYDROPOWER ANNEX IX // WHITE PAPER NO 1 - OCTOBER 2019

SURVEY SUMMARY (SUBSECOND-SECONDS)

		USA - CAISO	Norway	Switzerland	Canada - HQ	Brazil	Austria	Czech Republic	Germany	India	Australia	Japan	Turkey	Finland	Colombia
Relevant grid flexibility services and products		1) Inertia 2) Reactive Power and Voltage Control	FFR	1) Inertia; 2) Mandatory active and Semi-active Voltage Support	1) Spinning Reserve 2) Reactive Power and Voltage Control	1) Reactive Power and Voltage Control 2) Special Protection Systems	1) Inertia 2) Reactive Power and Voltage Control 3) FCR	N/A - FCR applicable (see column on the right)	Inertia ("kinetic energy of rotating masses")	1) Inertia 2) Reactive Power and Voltage Control	1) Fault level 2) Inertia/fast frequency response	1. Inertia 2. Reactive Power / Voltage Control	Ancillery Services (Reactive Power Control- No Market Product)	Fast Frequency Reserve (FFR)	1) Inertia 2) Reactive Power and Voltage Control
Procurement mechanism	**Market Based**	No	Yes - FFR	No	No	No	No		No	No	No			Yes - national hourly market based on inertia forecast	No
	Bilateral Contracts			Yes - Inertia	Yes - Spinning reserve, Reactive Power, Voltage Control	Yes - Reactive Power, Voltage Control, Special Protection Systems	Yes - Inertia, Reactive Power, Voltage Control, FCR			No	Yes - Fault level No - Inertia/FFR	Bilateral contact(TSO and provider) - Inertia, reactive power/voltage control			No
	Interconnection Agreement			Yes - Reactive Power	No	Yes				Yes - Inertia, Reactive Power, Voltage Control					No
Compensated service?		Yes - Reactive Power No - Inertia	Yes - FFR	Yes - Reactive Power No -Inertia	Yes	Yes - Reactive Power No - Voltage Control	Yes - FCR No - Inertia	No	No	No	Yes - Fault level No - Inertia/FFR	Yes - Reactive power/voltage control No - Inertia		Yes - FFR	Indirectly compensation through DA market
Does hydro provide these services to the power grid?		Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes.	Yes.	Yes
Market size	**Quantity**		~130 MW (May - September)	Reactive Power - 13.5 TVArh			+/- 70 MW	NA	NA	NA	unknown	Included in Offering Program		up to 60MW	Security constraints (2019): 12.7 TWh-yr (Total required security constraints - both In-merit and off-merit)
	Price/Size	~$4 M (2018)		Reactive Power - 3CHF/MVAr (2019)		1b) R$ 162M (US$ 40.7 M) in 2019		NA							Constraints Annual Cost (2019): US$270.8 M in 2019 (Paid by end users)

INTERNATIONAL CASE STUDIES

- Switzerland: International coordination of flexibility services
- Australia: The impending need for deep storage but no path to get there (yet)
- Norway: : Large-scale hydropower for balancing wind and solar power in Northern Europe
- Brazil: Maintaining long-term resource adequacy through public auctions, the role of hydropower
- Canada/Hydro Québec: Flexibility requirements and services
- US/CAISO: Flexibility requirements and new market initiatives
- Japan: VRE integration and the role of pumped storage hydropower in Japan

NEXT STEPS

- Survey refinements
- Case study refinements
- Add introduction, conclusion etc.
- Finalize by mid/late Oct.
- Outreach
  - Hydro 2020
    - Online conference, https://www.hydropower-dams.com/hydro-2020/
    - Session Oct 28, 3.30-5.00PM CET
  - Energy Systems Integration Group (ESIG) Fall Technical Workshop
    - Online, free registration, https://www.esig.energy/event/esig-fall-tech/
    - Session Nov. 10, 2-3pm EST

WHITE PAPER 2 – KEY CONTRIBUTORS

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THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

Further work

- White Paper: "Valuing Hydropower Flexibility in Evolving Electricity Markets". First step is to collect information on current markets and remuneration in different countries/regions – and today's workshop
- Showcasing examples of how hydropower provides value to the society in providing flood control and drought management. Next step is to analyse these services in a changing climate – potential White Paper or journal paper
- Workshops and meetings – also open to join from "non-members"
- Working with IEA on Renewable Energy Market Report
- IEA Hydropower Roadmap
- Dissemination of results