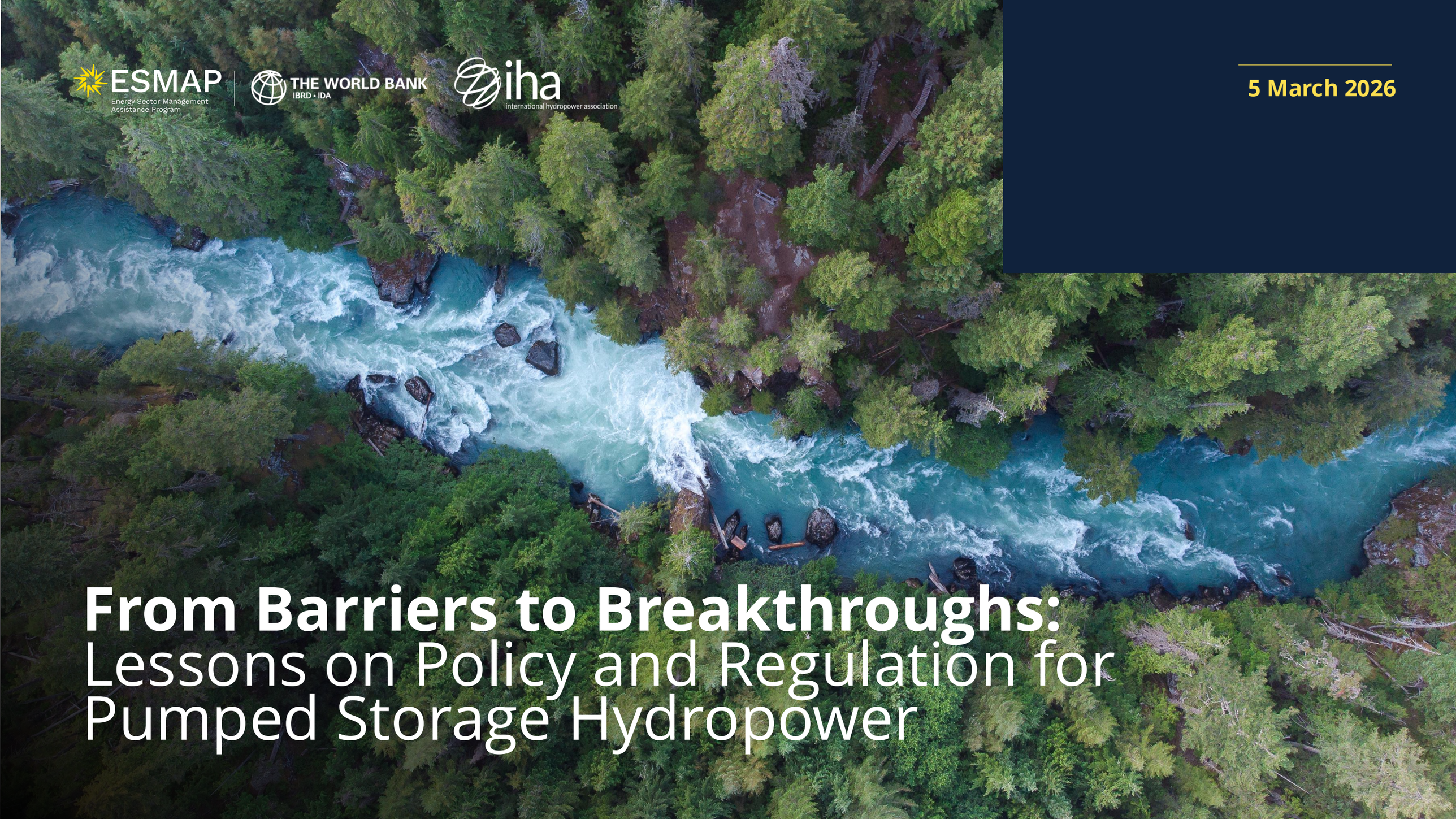


ESMAP
Energy Sector Management Assistance Program

THE WORLD BANK
IBRD • IDA

iha
international hydropower association

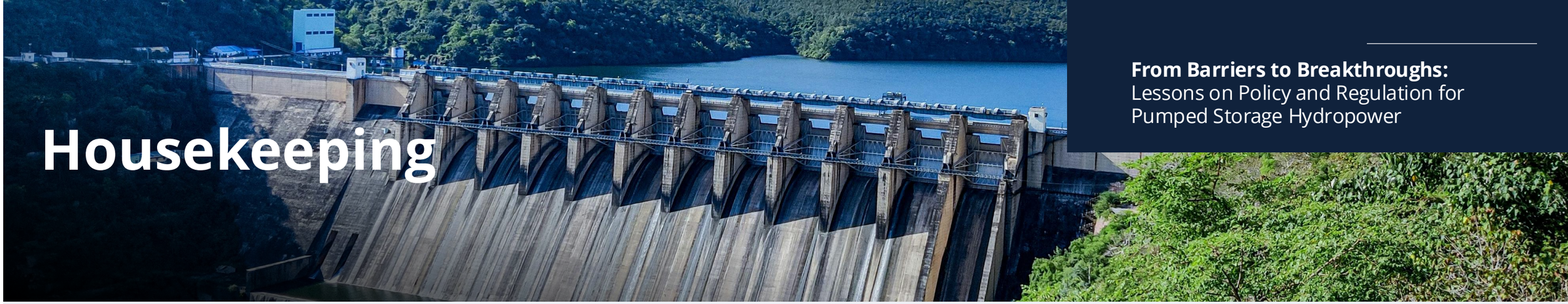
5 March 2026

From Barriers to Breakthroughs: Lessons on Policy and Regulation for Pumped Storage Hydropower

Agenda

- **Welcome and overview**
  - Demetrios Papathanasiou, Global Director - Energy, World Bank Group
- **Presentation from World Bank**
  - Bente Brunes, Senior Energy Specialist - ESMAP, World Bank Group
- **Introduction to regulatory barriers and the current policy space**
  - Matteo Bianciotto, Head of Policy, International Hydropower Association
- **Panel Discussion with Hydro Tasmania and Sarawak Energy**
  - Colin Wain, Policy Development Manager, Hydro Tasmania
  - Tony Ting Tiew Whong, Senior Manager, Sarawak Energy Berhad
- **Audience Q&A**
- **Closing remarks**
  - Jessica Kersey, Young Professional – ESMAP, World Bank Group

From Barriers to Breakthroughs:
Lessons on Policy and Regulation for Pumped Storage Hydropower



Housekeeping

- This webinar is being recorded and will be made available on our ESMAP website.
- Please post your questions in the Q&A box below. Please like questions you would like to see answered so we can prioritise these during the audience Q&A.
- Publications and useful links will be posted in the chat.

HYDROPOWER IS KEY TO RELIABLE, SUSTAINABLE ENERGY ACCESS.

Hydropower projects can be transformational…

Affordable, secure electricity supply over long time frames, supporting access efforts such as M300.

Unlocks clean power with stable and flexible supply to complement variable RE & enabling regional integration.

Broader benefits including flood and water management, job creation, exports and economic growth

Country demand for hydropower is surging.

1,300 GW of new hydropower—double today's capacity—is needed by 2050 to achieve universal access sustainably.

Investment in refurbishment of aging infrastructure is critical: **20% of global capacity will be over 55 years old by 2030.**

WE UNDERSTAND THE RISKS

Developing hydropower can have significant social and environmental implications, including community displacement, ecosystem and biodiversity impacts.

Our priority: Responsible development of hydropower.

WE ARE COMMITTED TO TACKLING THEM

- We bring long-term expertise, deep country knowledge that addresses the big picture.
- We follow stringent social and environmental framework
- We require extensive consultations with local communities throughout the project's cycle.

WE FOCUS ON REMOVING BARRIERS

POLICY & SECTOR SUPPORT

- Support strengthening planning, regulatory, and institutional capacity for sustainable hydropower development
- Support least-cost energy sector planning and power system development
- Assist with market, demand, and pre-feasibility studies
- Support preparation of national and regional plans for water & energy management
- Capacity building for E&S activities, benefit sharing arrangements

PROJECT-LEVEL SUPPORT

- Support project-specific preparation studies, including technical assistance with E&S assessments
- Support development and implementation of strategies to socio economic maximize benefits
- Guide early-stage consultations
- Due diligence assessments

Support is tailored to the country request

WE FOCUS ON REMOVING BARRIERS

Hydropower projects in the WBG portfolio face four main categories of risk:

(i) **governance risks**, such as permitting delays, security concerns, and slow government responsiveness;

(ii) **environmental and social risks**, including land acquisition, resettlement, and impacts on biodiversity and cultural heritage;

(iii) **technical risks**, including unforeseen geological conditions, cost overruns, and construction issues; and

(iv) **financial risks**, such as payment defaults by electricity buyers, resource variability, market fluctuations, and currency risks.

"Energy Sector Management Assistance Program. 2024. Leveraging Private Sector Solutions in Large Hydropower Projects. © World Bank.

WE FOCUS ON REMOVING BARRIERS

Barrier to development	Broader sectoral actions by LMICs	Upstream actions by LMICs	Project specific actions by LMICs
Lack of a regulatory framework or its enforcement	Establishing and implementing a transparent methodology for licensing, and for setting the revenue requirements of power sector companies	Designing licensing and contractual arrangements for hydropower projects	Designing project-specific contracts in the absence of procurement procedures and model contracts in a country

WE FOCUS ON REMOVING BARRIERS

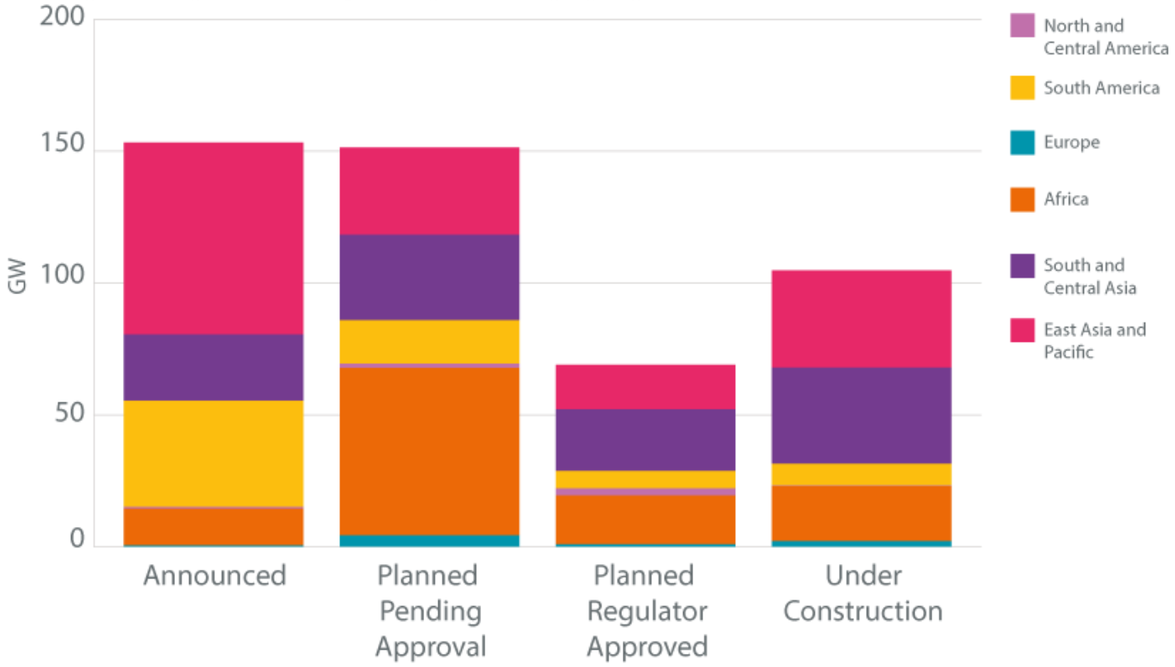
Barrier to development	Broader sectoral actions by LMICs	Upstream actions by LMICs	Project specific actions by LMICs
Difficulty in valuing the risk and return profiles of multipurpose hydropower projects, pumped storage projects, or projects involving new technologies for the country	Assess economic benefits and costs are adequately captured in the least-cost planning and feasibility studies, facilitating coordination between government agencies on use of natural resources	Optimizing hydropower planning to ensure that economic benefits are fully captured (e.g., creation of upstream storage to enhance the operation of cascade stations)	Selectively financing hydropower projects that may attract private sector participation at the appropriate stage in their lifetime or that may become a benchmark, such as the first in a region or the first use of a new technology

Matteo Bianciotto

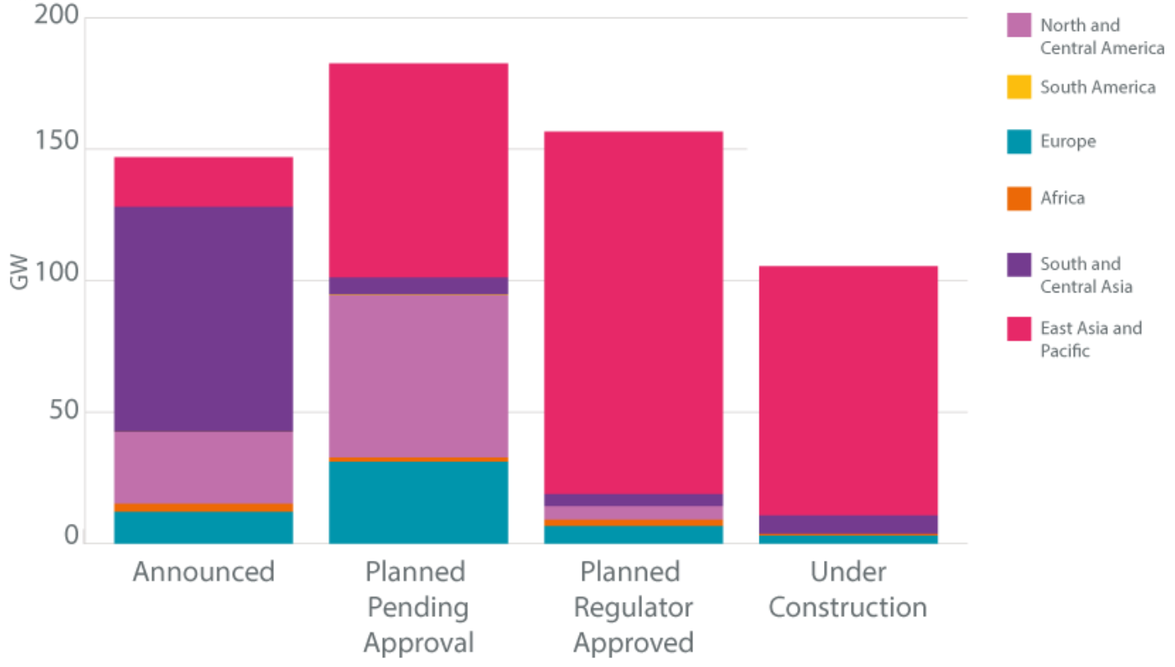
Head of Policy, International Hydropower Association

Two technologies: lessons from the pipeline

Conventional (RoR and Reservoir Hydropower) capacity pipeline



Pumped storage hydropower capacity pipeline



hydropower.org/outlook

Key Regulatory Barriers

Planning and modelling

- Many markets lack long-term modelling or targets for long duration storage needs.

Licensing and permitting

- Large infrastructure projects such as new PSH developments are subject to long and complex permitting processes.

Financial Considerations

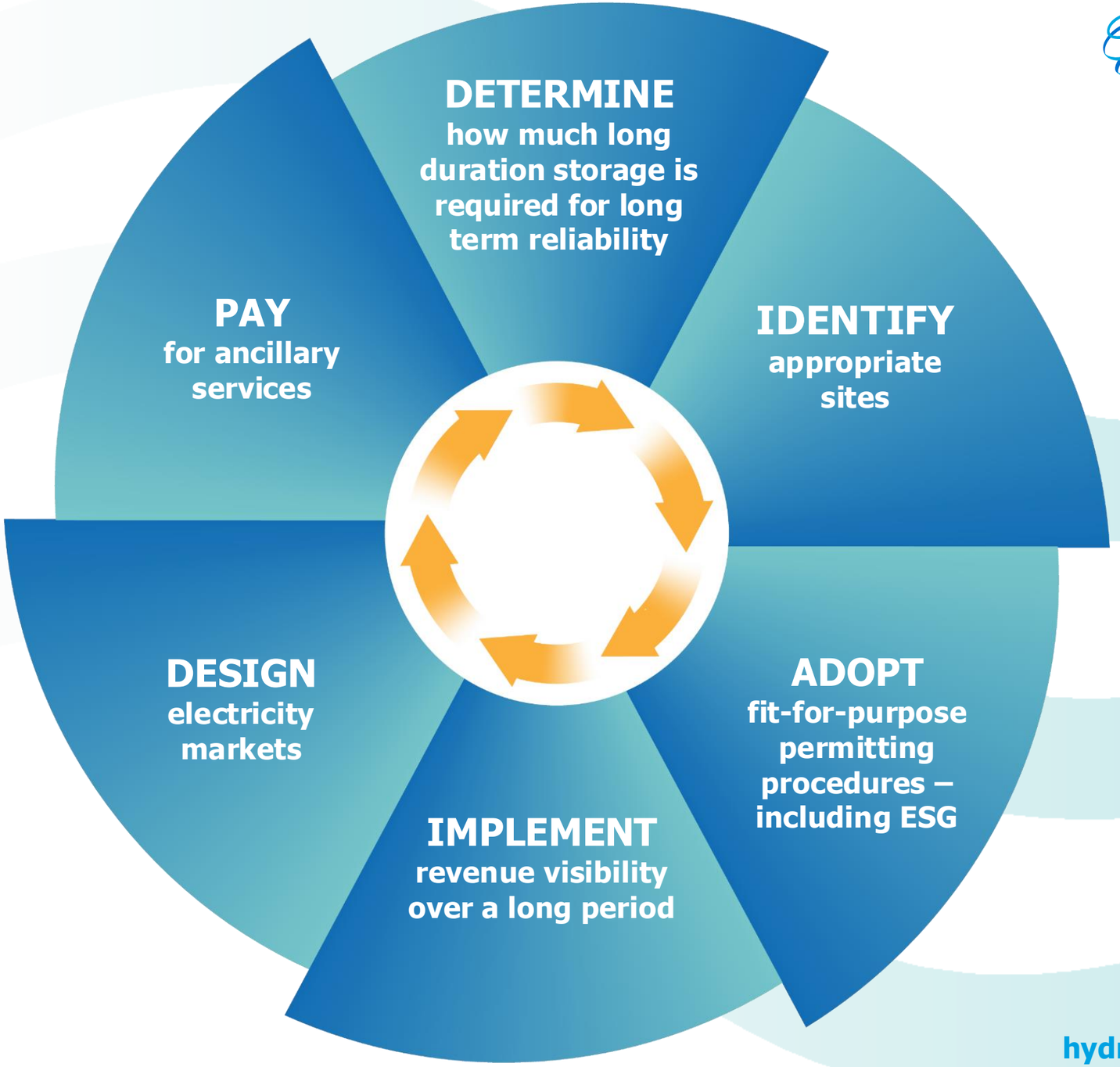
- Long-term electricity and ancillary services prices are difficult to forecast and subject to wider government policies.
- In many markets not all services provided by PSH are remunerated.
- In vertically integrated markets, there is a need to develop specific fees to remunerate PSH operations

Storage Classification

- In several countries, PSH plants are classified both as a generation asset and as a final consumer, requiring them to pay grid access fees twice.

Actions Governments can take to support PSH:

Read more here



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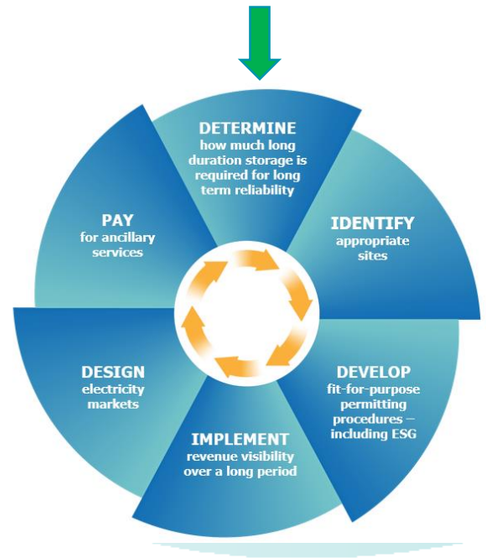
1 - Determine How Much Long-Duration Electricity Storage is Required for Long-Term System Reliability



Rationale:
Developers, investors and suppliers need confidence that local authorities will support the development of these infrastructures. Strong commitment from governments sends signals capable of attracting private companies, contributing to creating stronger project bankability and reducing political risk.

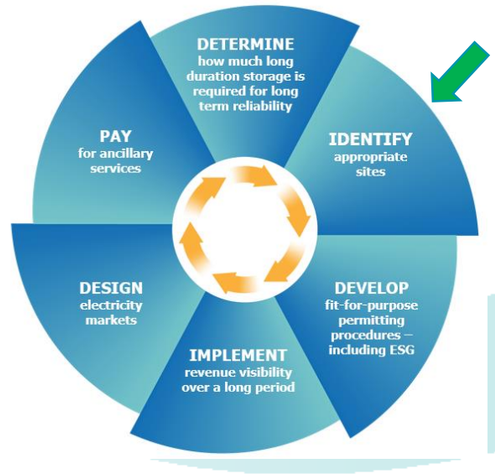
High-Level Policy Solutions:

- Carry out models and plans for electricity storage flexibility.
- Consider both short- and long-term electricity storage needs.
- Set national targets for electricity storage included in legislation and/or strategy documents highlighting the expected contribution of pumped storage.

Read more here

hydropower.org

2 – Support the Identification of Appropriate Sites For Pumped Storage Developments



Rationale:
Governments can accelerate the development of a solid local pumped storage pipeline by supporting pre-feasibility studies, conducting mapping exercises and preselecting the most economically viable, technically advantageous and sustainable sites. Holistic site planning and integration into transmission system development plants, can enhance the system benefits and optimise investment.

High-Level Policy Solutions:

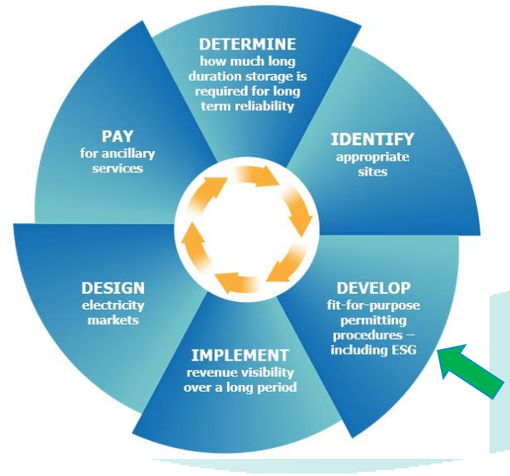
- Integrate pumped storage development into the broader energy system planning.

- Consider establishing development funds.

Read more here

hydropower.org

3 – Develop a Fit-For-Purpose Permitting Procedures, Including ESG



Rationale:
Pumped storage projects often may take several years to realise, from conception to operation. Inefficient and non transparent permitting processes can further expand development and defer payback time. This can increase system costs and discourage developers and investors.

High-Level Policy Solutions:

- Create an efficient permitting process for pumped storage development with clear timelines which ensure environmental and sustainability good practices.

- Make sure that administrative bodies have sufficient and expert resources to efficiently evaluate pumped storage projects.

Read more here

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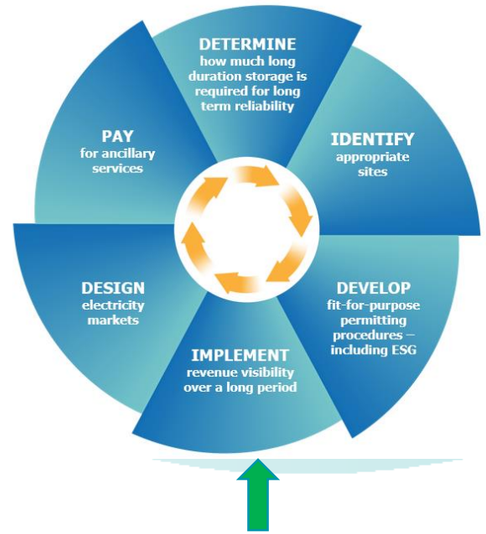
4 – Implement mechanisms that provide the necessary revenue visibility over an adequate period



Rationale:
The bulk of investment in pumped storage project is during the construction phase. The combination of high CAPEX and long payback time makes developers and finance-providers particularly exposed to long-term revenue risk. Revenue mechanisms increase the project's bankability and reduce the cost of the capital employed.

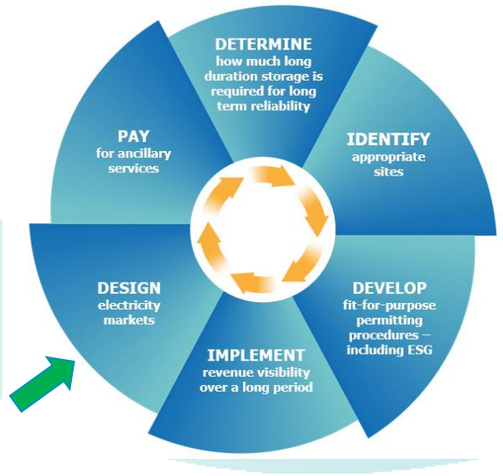
High-Level Policy Solutions:

- In regulated electricity markets, introduce dedicated fees applicable to pumped storage operations, or in liberalised markets, implement revenue stabilisation mechanisms such as cap & floor or capacity markets.
- Design these instruments taking the long payback period into consideration.
- Introduce tax incentives to reduce projects' credit risk.

Read more here

hydropower.org

5 – Recognise the Holistic Role of Pumped Storage and Reward All Energy, Water and Societal Services Provided



Rationale:
Pumped storage plants provides a combination of energy (ex: grid reliability and curtailment protection), water (flood protection, drought mitigation) and societal (irrigation, human water consumption) services which needs to be considered by policy makers and regulators when planning, financing and comparing projects or technologies.

High-Level Policy Solutions:

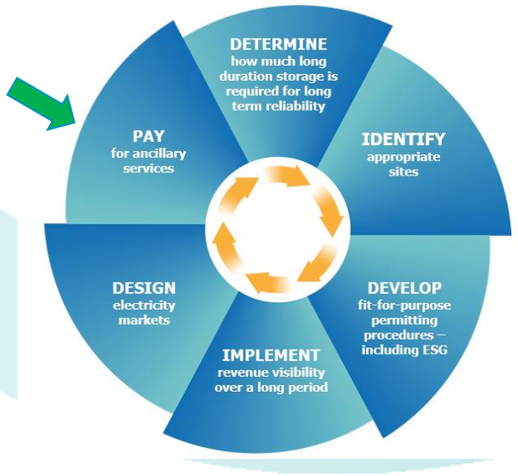
- introduce parameters that holistically value the benefits provided by pumped storage to the energy system and to society in any evaluation process .
- Compare technologies on the value generated to society on an adequately long horizon (multiple decades), capable of capturing the long-life span of pumped storage.
- Implement legal framework that properly classifies energy storage assets, considering their role in the power system and business model, avoiding double taxations or fees.

Read more here

hydropower.org

6 – Procure and Remunerate Ancillary Services

Rationale:
Pumped storage not only provides energy shifting and curtailment reduction, but is also one of the most efficient technologies to procure several critical ancillary services (inertia, frequency & voltage control, blackstart capabilities). Without clear provision or effective remuneration mechanisms, projects may be delivered with lower capabilities.



High-Level Policy Solutions:

- Procure and remunerate all these ancillary services separately from energy storage services.
- Make sure that the tariff or the price captured remunerates these effectively and over a sufficient period.
- Assess the power system demand for these services in advance, through effective long-term planning.

Read more here

Panel Discussion

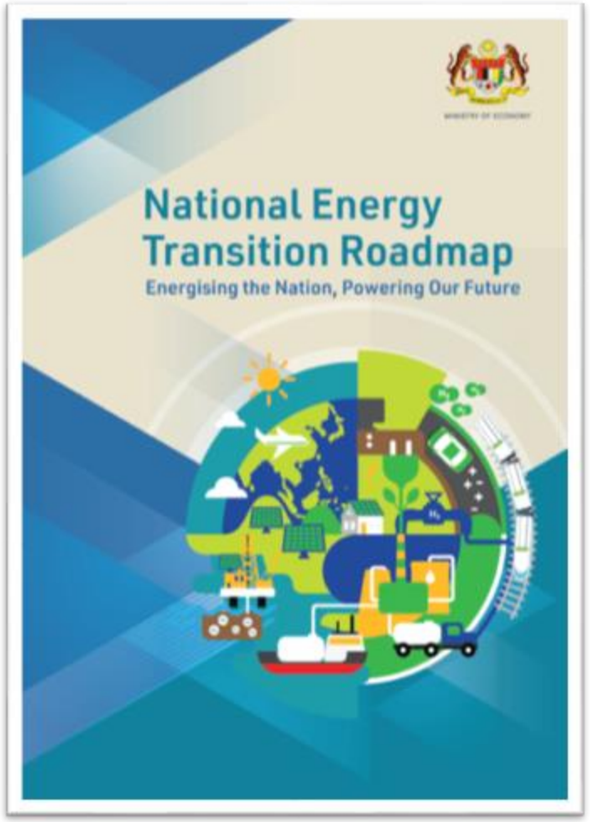
Colin Wain

Policy Development Manager,
Hydro Tasmania

Tony Ting Tiew Whong

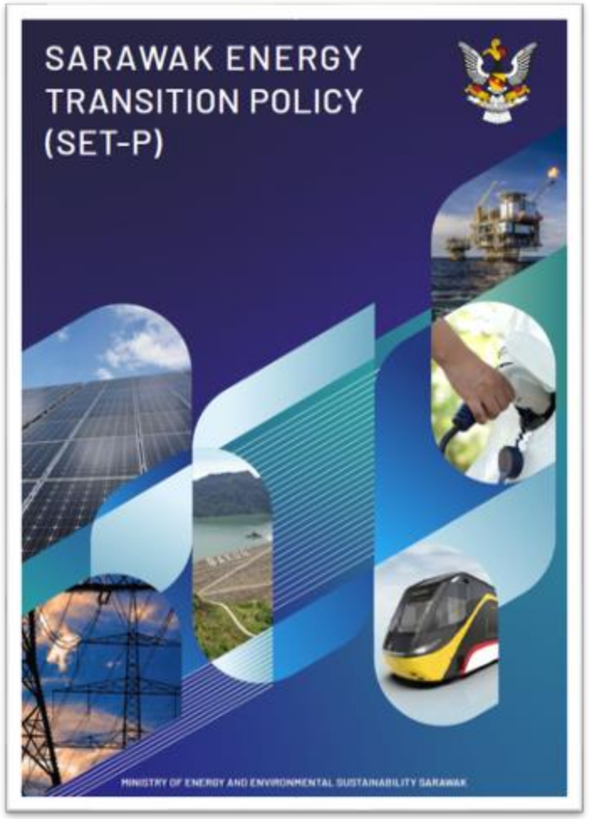
Senior Manager,
Sarawak Energy Berhad

Policy in Malaysia and Sarawak



- Steering Malaysia's shift from traditional fossil fuel-based economy to high-value green economy
- Targeting Net Zero emission by 2050

- Renewable energy as key enabler for Sarawak
- Developed State by 2030.
- 60% renewable energy capacity mix.



- Secure, equitable and low-carbon future
- Energy sector as central economic pillar
- Total generation capacity of 10GW by 2030 and 15GW by 2035, ≥60% RE

Advancing the Borneo Grid for an Interconnected ASEAN

West Kalimantan Interconnection

- Exporting 100-200MW since 2016

Sabah Interconnection

- Supplying up to 50MW since end of 2025

Semenanjung & Singapore Interconnections

- 1,000MW each from around mid 2030s

Hydro Tasmania

Australia's largest water manager and generator of renewable energy

We manage over 13,500GL/annum of water. That's the equivalent of over 27 times Sydney Harbour (approximately one every fortnight).

- 30 hydropower stations
- 2 hybrid power stations
- 1 gas-fired power station
- 54 major dams
- 52 lakes
- Around 400kms of tunnels,
- canals, flumes, pipelines and penstocks.

At any point in time, typically a third of all Hydro Tasmania's energy in storage is in Lake Gordon/ Pedder, a third is in yingina/Great Lake and a third is in all other storages combined.

Hydropower Schemes

- Mersey-Forth Scheme
- King-Yolande Scheme
- Pieman Scheme
- Yingina/Great Lake Scheme
- Gordon/Pedder Scheme
- Derwent Scheme

- Bass Strait Island hybrid power stations
- Gas-fired power station

Cethana pumped hydro – site selection

One of the most cost effective and lowest risk options for deep storage in the NEM.

- Extensive analysis produced 14 initial options (2018), narrowed to 3 candidate locations (2019), with Cethana being the preferred site (2020).

Favourable head to storage connection distance ratio, increasing efficiency and lowering constructability risk

Lower storage is an existing Hydro Tasmania storage, reducing civil costs

Low community and environmental impacts, reducing deliverability risks

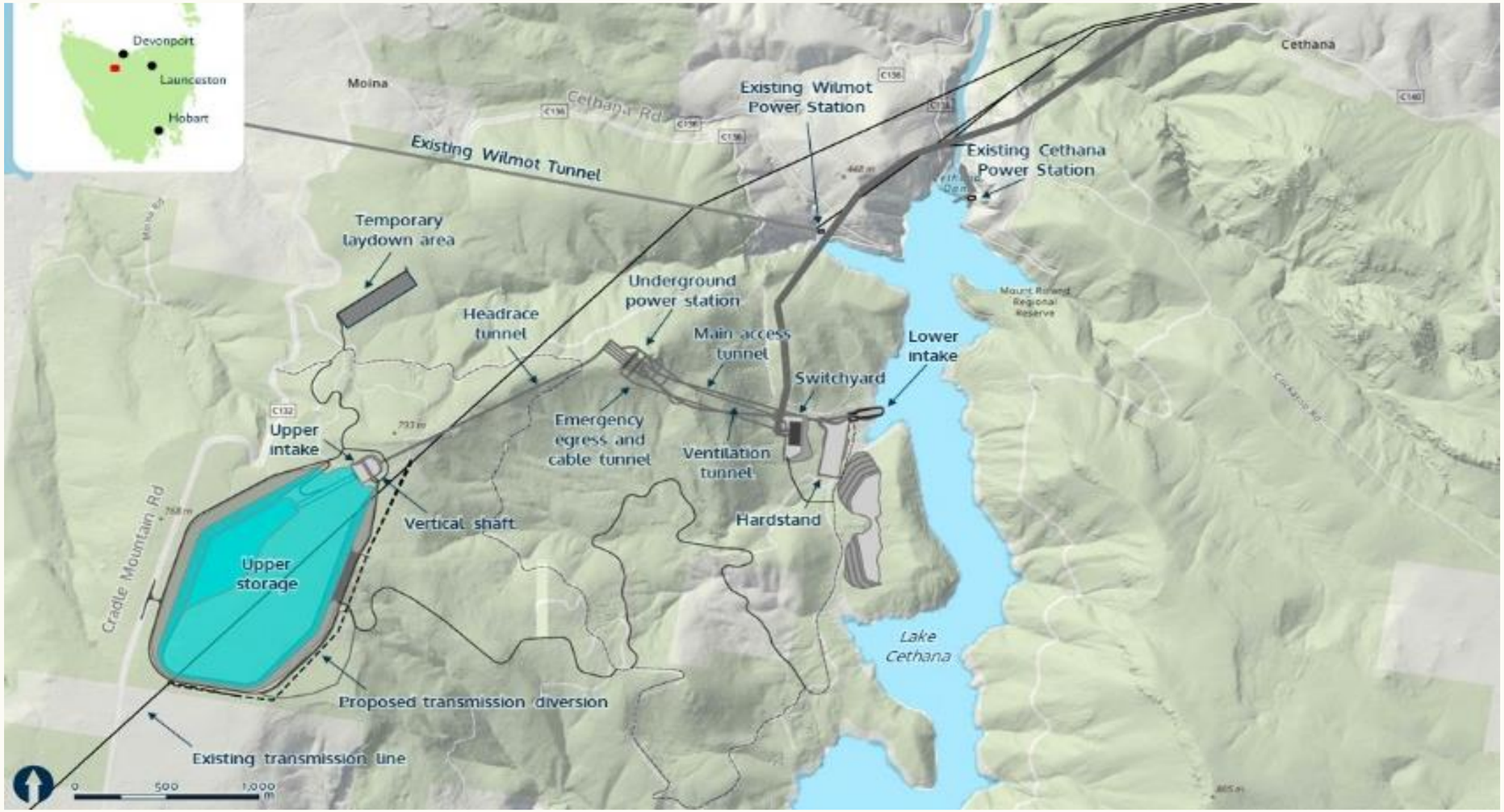
Proximity to existing transmission infrastructure reduces redevelopment costs and visual impact

750 MW of flexible renewable dispatchable capacity

20 hr storage duration

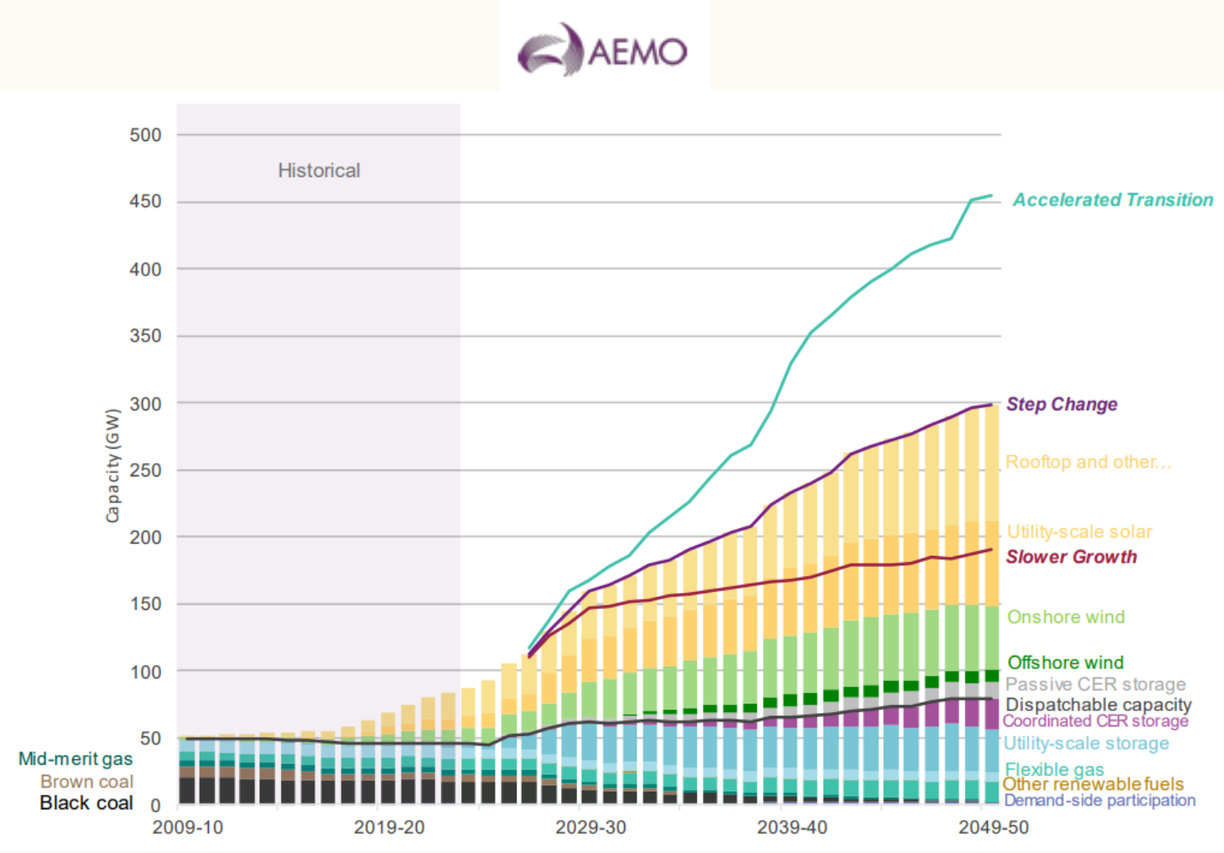
15,000 MWh of storage to firm variable renewable energy

Cethana PSH will play a key role in firming renewable energy in the NEM



Australia must invest in long-duration storage to manage the energy transition

- Australian coal generation is closing (was 80% of generation in 2000).
- Grid-scale wind and solar are forecast to increase to 120 GW by 2050, up from 23 GW today.
- National Electricity Market demand to nearly double by 2050 (electrification, EVs, data centres, H_2).
- NEM moving from (short) summer peak events to prolonged winter peaking and energy deficits.
- **Forecasts call for 13 GW of long-duration (>12hr) storage by 2050, including ~6 GW of new pumped storage hydropower** *(source: AEMO's draft 2026 ISP)*.



Does Australia's current market design incentivise Pumped Storage Hydropower (PSH)?

- 3 PSH operational - built decades ago by government(s).
- Snowy2.0 (2.2 GW, 160 hours) under construction, commissioned and built by the Australian Government.
- Many PSH proposed and in development but reaching financial close is the challenge.
- Hydro Tasmania is developing the Cethana PSH (750MW, 20 hours) having narrowed down from 14 initial locations.

- Australia's NEM is "energy only", there is no capacity market.
- Volatile pricing from minus $1000/MWh to around $20,000/MWh in 5 minute intervals.
  - *Seen to incentivise capacity but is this enough for PSH?*
  - *After 8hrs high prices are capped……what incentive is there to build storage beyond that duration?*

Figure 31 – The tenor gap

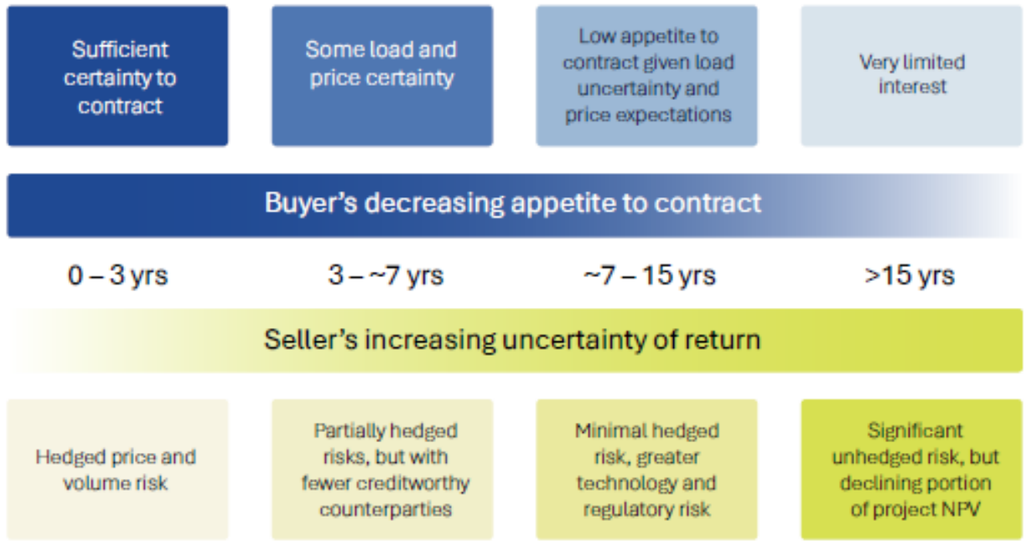
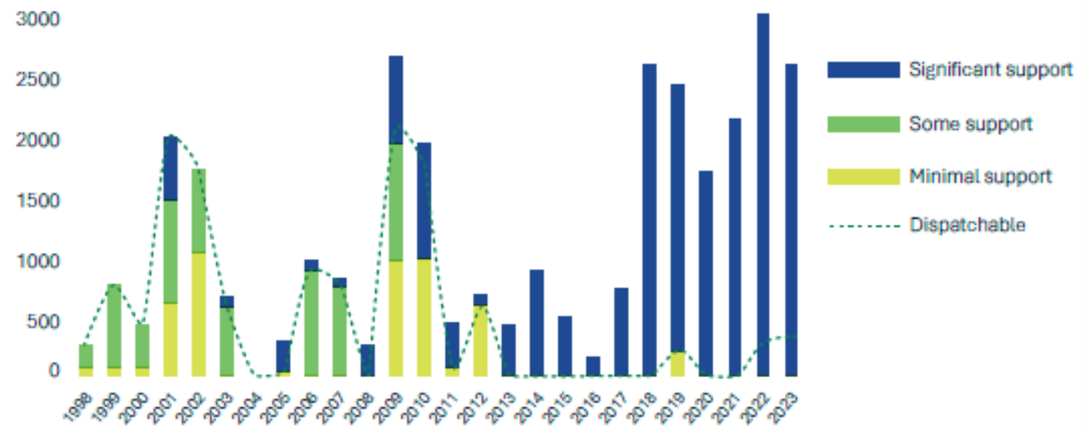


Figure 20 – Generation build by non-market support, 1998 to 2023

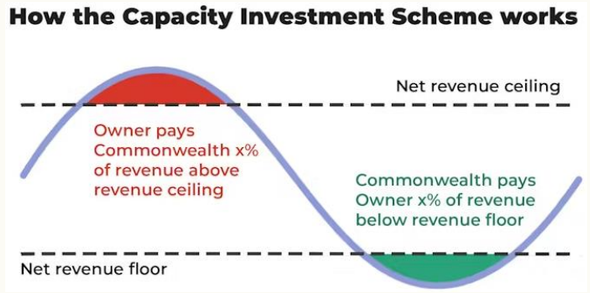


Source: *NEM Review 2025*

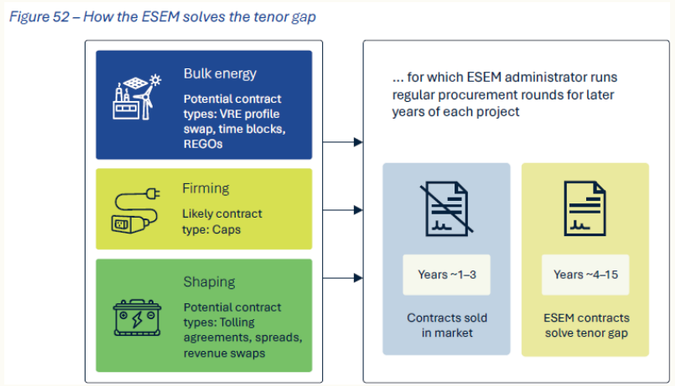
Current Australian policies……

Australian Government
Australian Renewable Energy Agency
ARENA

cefc



- ARENA – aims to improve competitiveness and supply of renewables, particularly early-stage deployment. Could do more around supporting PSH get to Final Investment Decision.
- Clean Energy Finance Corporation provides low interest capital for renewable energy and clean technology……*but is financing the barrier for PSH?*
- Capacity Investment Scheme (CIS), government underwriting of new deployment. To date, has favoured batteries and quick deploy technologies.

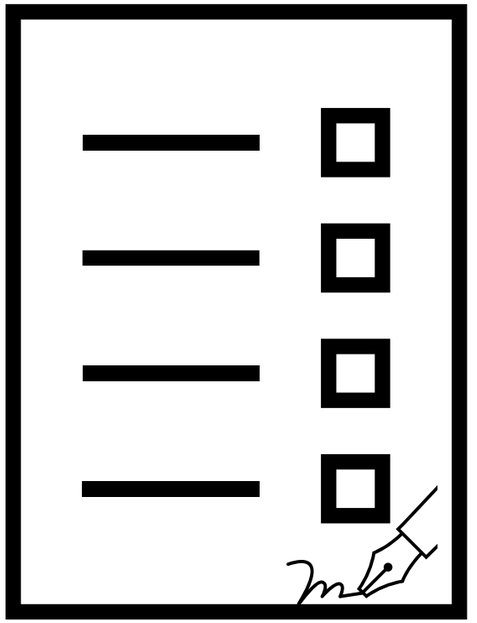


- Energy Services Entry Mechanism (ESEM) in development to replace CIS (above). Seeks to offer long-term contracting for new developments at future market prices……*but how will it value long-duration storage (>8hrs) like PSH?*

Challenges in Policy

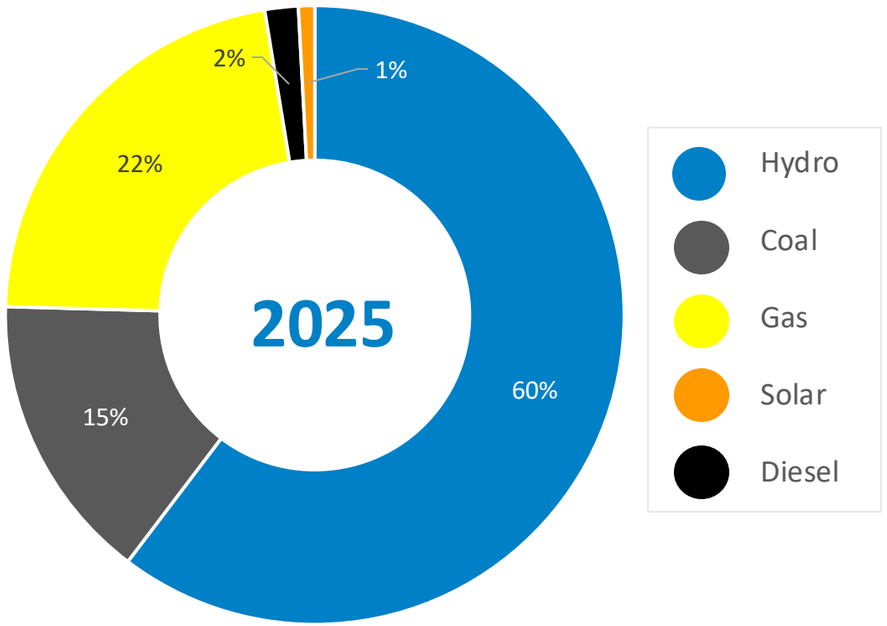
Market mechanism and policy framework to monetises and compensates PSH Operators:

- Energy Storage Tariff
- Carbon tax framework
- RE Exchange Hub and Cross-Border RE trading framework within ASEAN

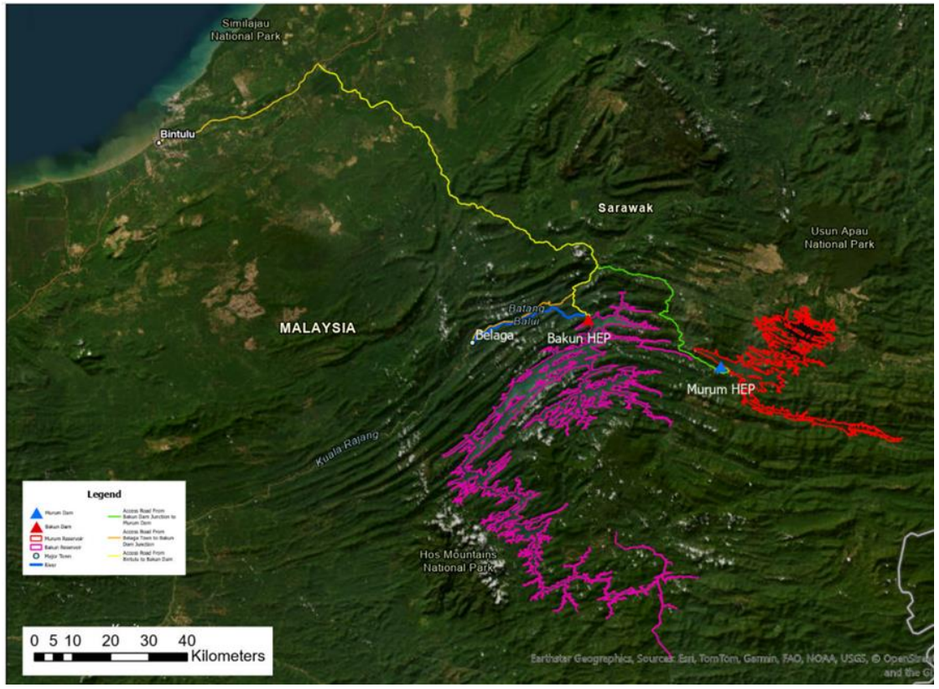


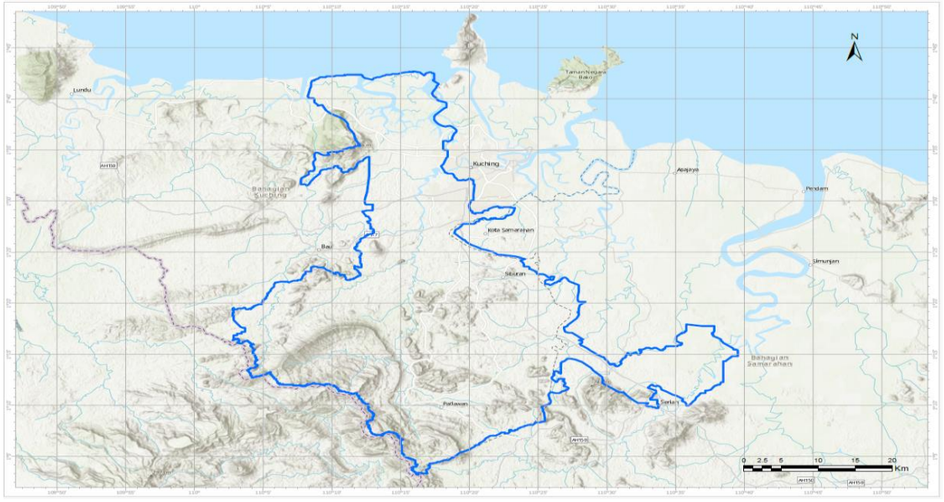
Sarawak's Energy Transition Strategy

Current Total of 5,898MW Generation Capacity



Predominantly hydropower with indigenous thermal resources for energy security





Integration of Pumped Storage Hydropower Through Large-Scale Solar in Our Long-Term Strategy

- Feasibility studies conducted at:
  - Murum reservoir
  - Bakun reservoir
  - Padawan region

Audience Q&A

Jessica Kersey

Young Professional – ESMAP, World Bank Group

Save the date
20 May 2026

Our next webinar will focus on jobs in hydropower

From Barriers to Breakthroughs:
Lessons on Policy and Regulation for
Pumped Storage Hydropower