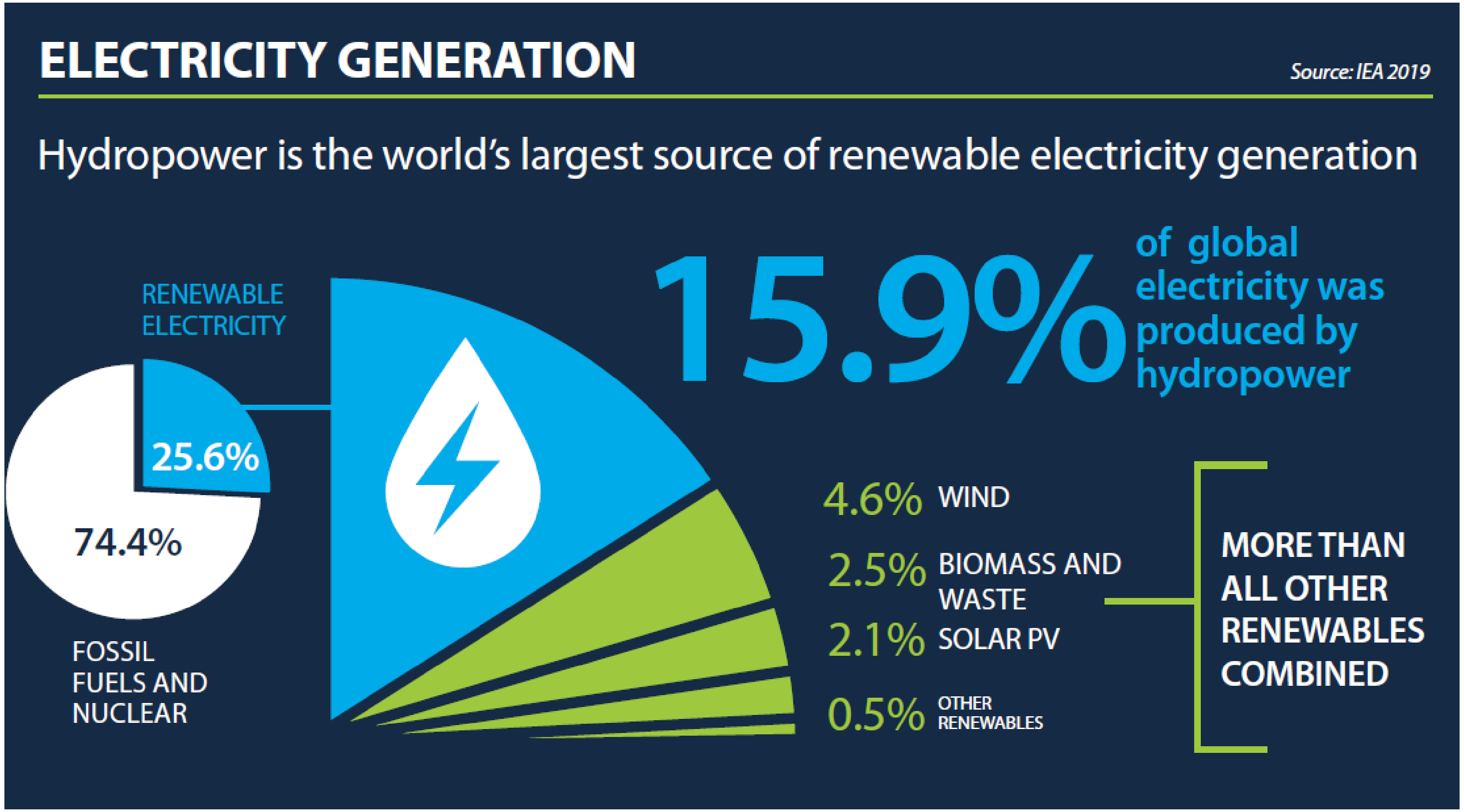
IEA Hydro kick-off workshop: Hydropower services and Climate Change

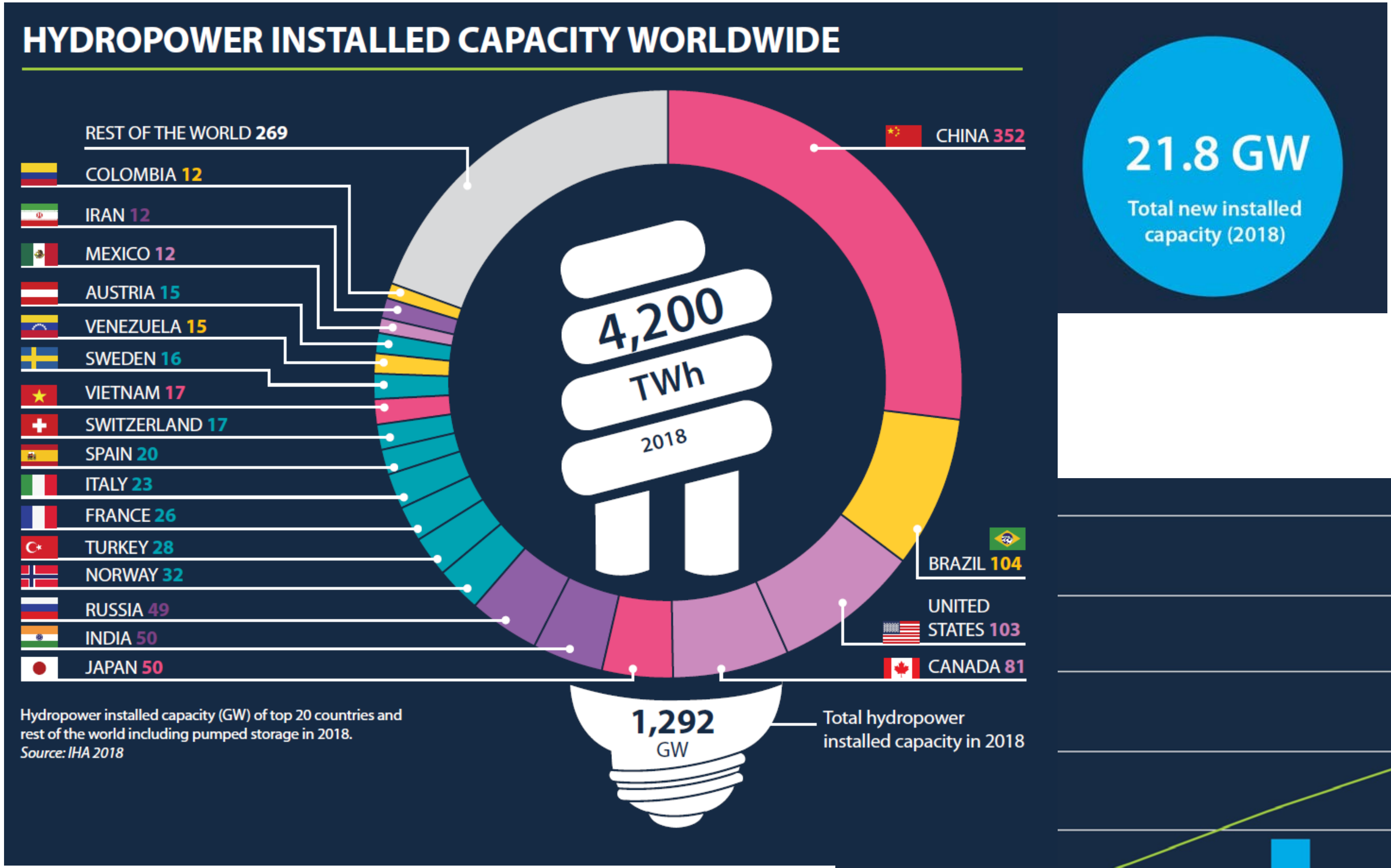
iha
international hydropower association

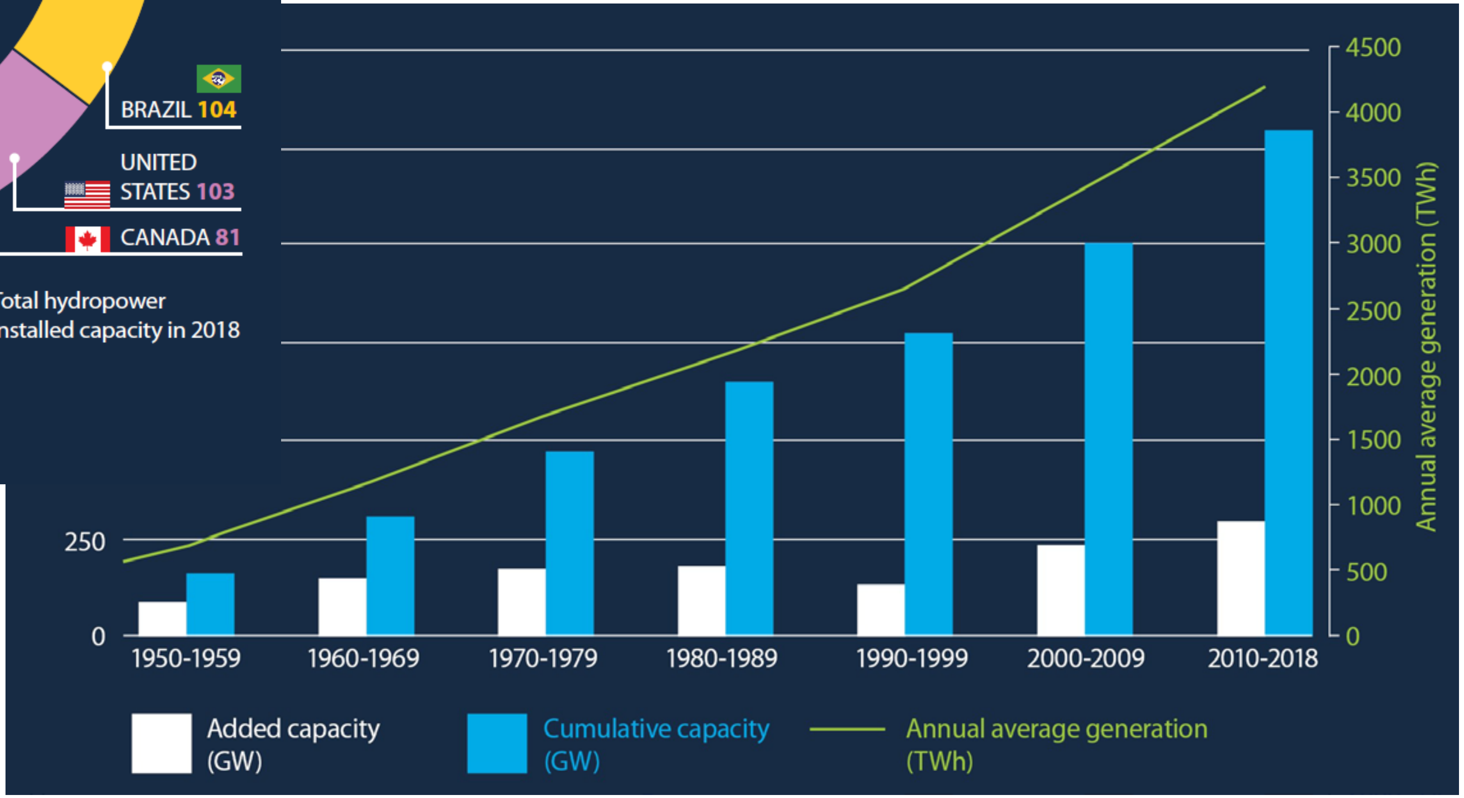
4 December 2019

Hydropower in the world



www.hydropower.org/status2019





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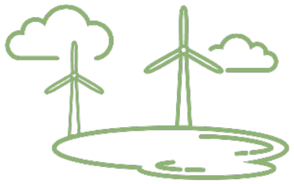
Hydropower A&R services

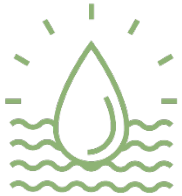
Operational flexibility and efficiency

- Fast start-up and shut-down
- Highly efficient and adjustable output
- Support power system reliability



Storage and back-up

- Rapid availability, can be used as a back-up
- Option to absorb surplus or storage energy



Multiple freshwater services

- Water supply, irrigation, navigation, tourism
- Flood control and drought mitigation

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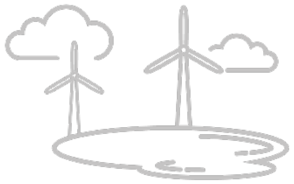

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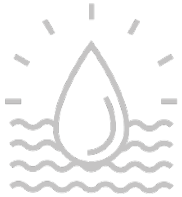

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XFLEX HYDRO

FOUR-YEAR TIMELINE

1 INNOVATION

Optimal collection of heterogeneous data to allow a precise estimate of plant KPIs, and refinement of flexibility services needs.

- Flexibility matrix
- SPPS

2 DEMONSTRATION

Validation and demonstration of XFLEX HYDRO results across six complementary and challenging HPP real-world scenarios.

- Demonstration scenarios

- Z'Mutt
- Frades 2
- Grand Maison
- Alqueva
- Vogelgrün
- Alto Lindoso
- Caniçada

3 DEPLOYMENT

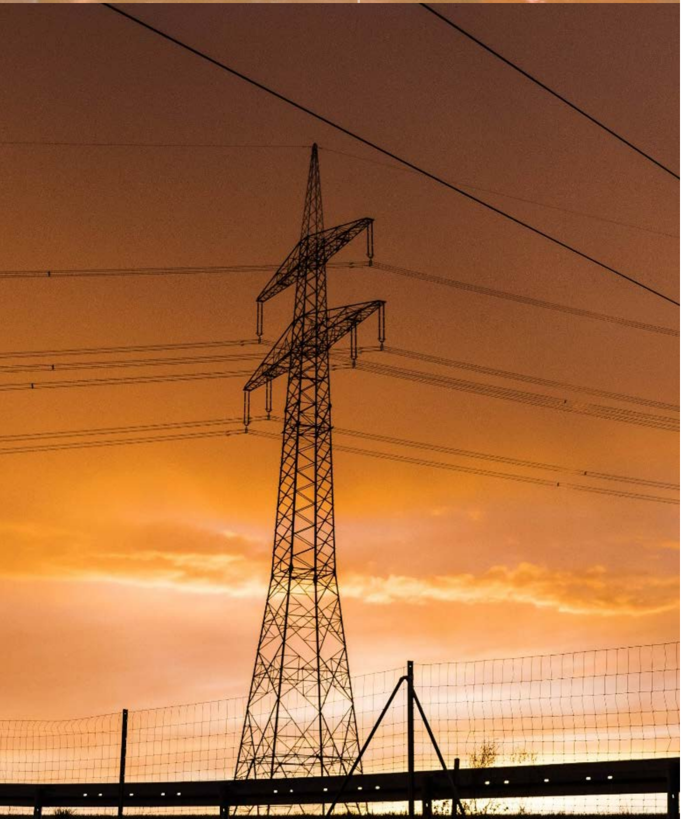
Building methodology and tools to bring the project activities to their markets, maximising and optimising XFLEX HYDRO solutions potential.

- Roadmap & White paper
- Market uptake
- Dissemination cross-cut

2019

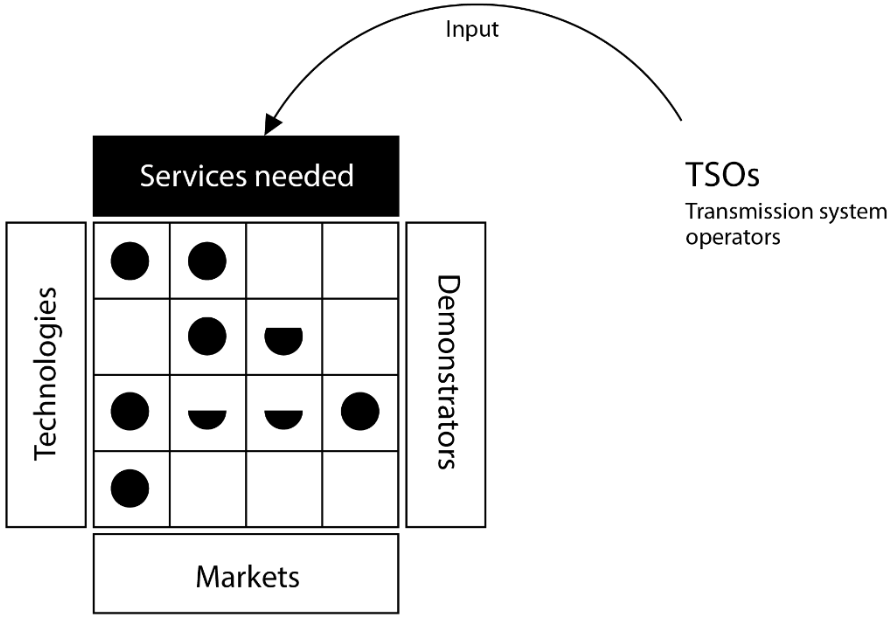
2023

Kvilldal power station © Statkraft

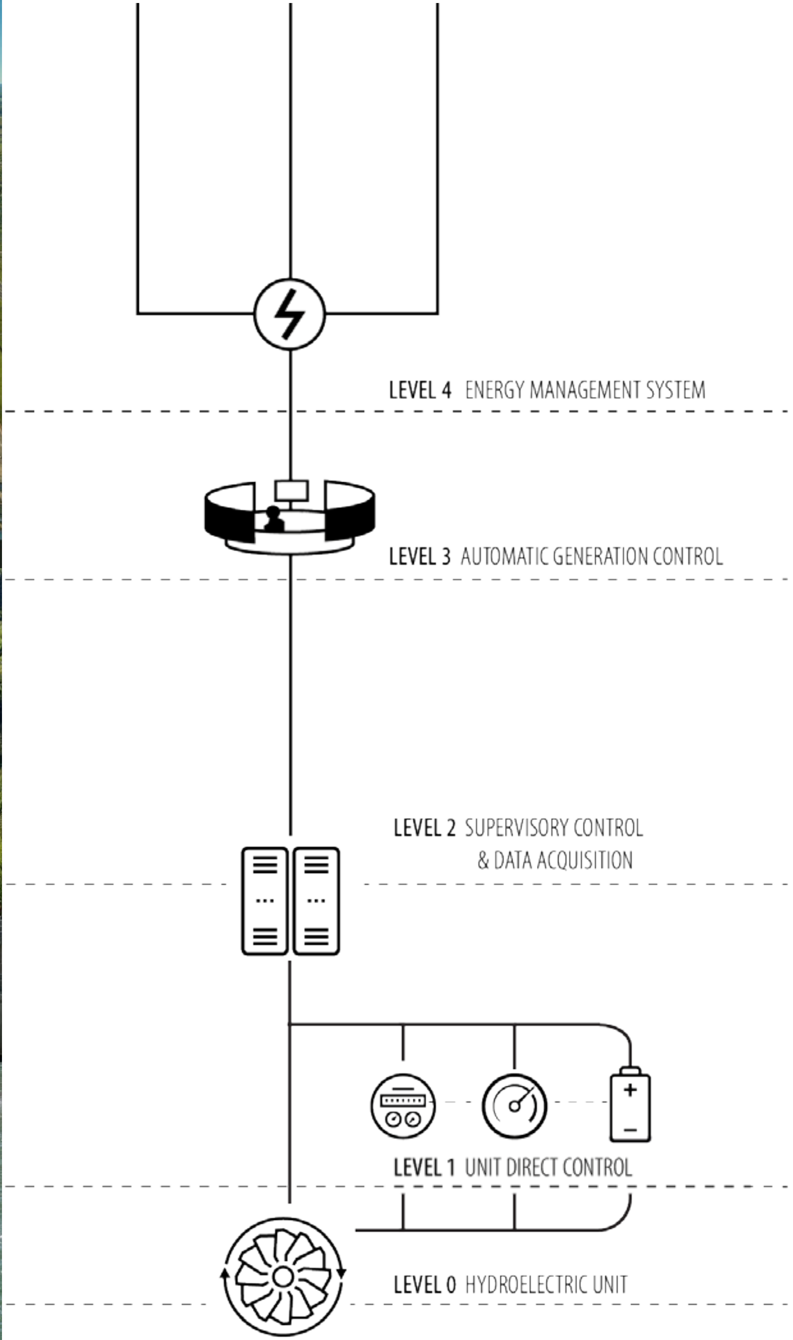


ACTIVITY 1

CREATING
A FLEXIBILITY MATRIX



The hydropower flexibility matrix will play a key role in providing a mapping of hydro technology supporting flexibility services and how they enable hydropower to take part in new power markets. It will combine information about the latest flexibility products, flexibility markets and innovative hydroelectric technology solutions that enhance the ability of HPPs to respond to EPS flexibility needs.



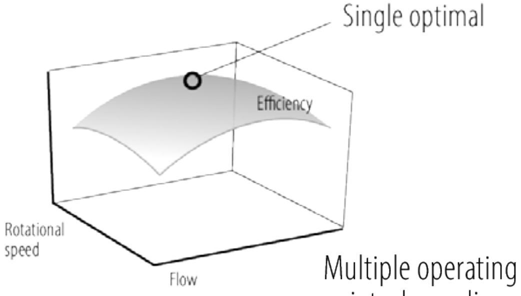
ACTIVITY 2

SMART POWER PLANT SUPERVISOR

Brings the turbine dynamics and conditions knowledge into advanced control unit operation and predictive maintenance

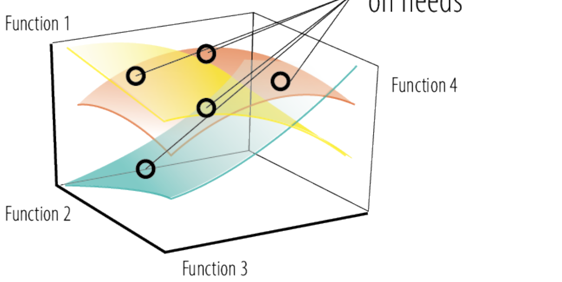
BEFORE

Limited range of operation based on functions that exclude grid needs

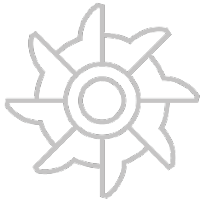


AFTER

Flexible range of operation based on a multidimensional analysis including energy grid needs



Hydropower A&R services



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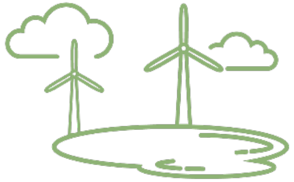

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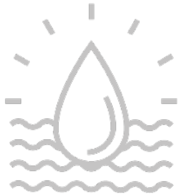

Multiple freshwater services

- Water supply, irrigation, navigation, tourism
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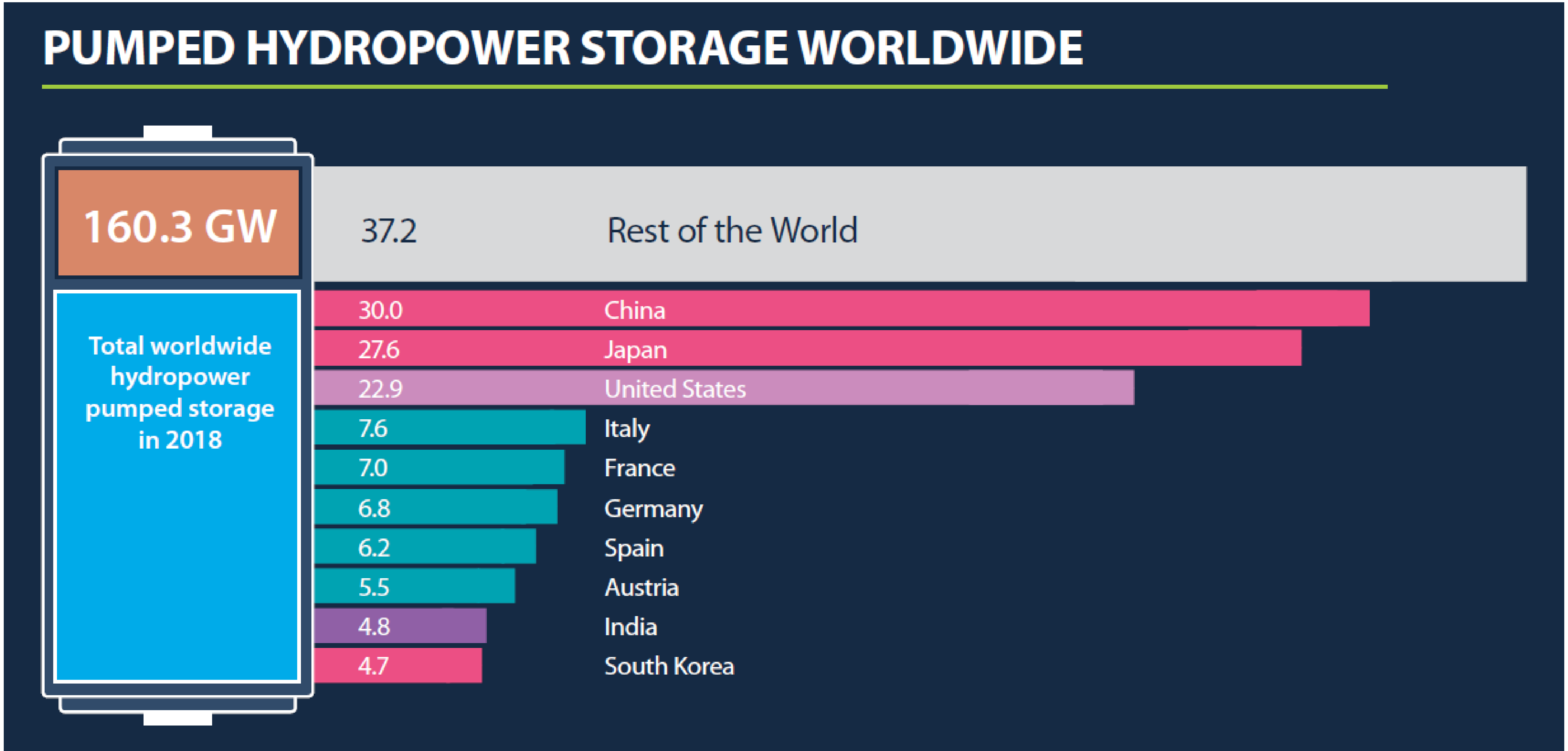
The world's water battery:



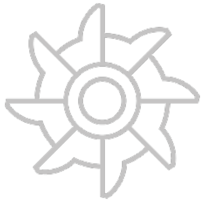
Pumped hydropower storage capacity (GW) of top 10 countries and rest of the world in 2018.
Source: IHA 2018.

Pumped hydropower storage (PHS), the world's 'water battery' accounts for over 94 per cent of installed global energy storage capacity

- Supports power grid stability, reducing overall system costs and sector emissions.
- Allow for faster and wider operating ranges, providing additional flexibility at all timescales, enabling higher penetrations of VRE at lower system costs.
- Driven by the increasing penetration of wind and solar, reduced dispatchable generation and the need for greater grid flexibility

With these adaptation services an **additional 78 GW** of PHS capacity is expected to be commissioned **by 2030**.

Hydropower A&R services



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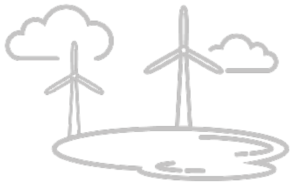

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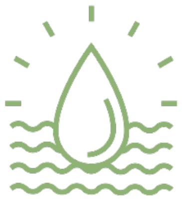

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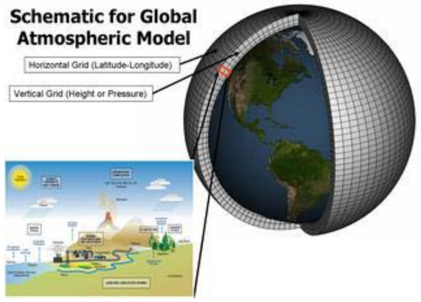
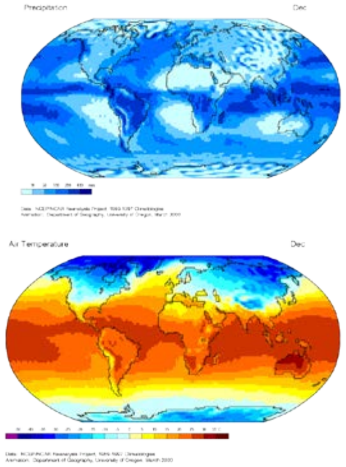
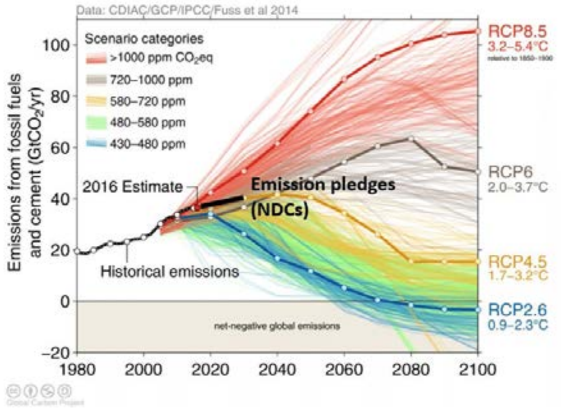
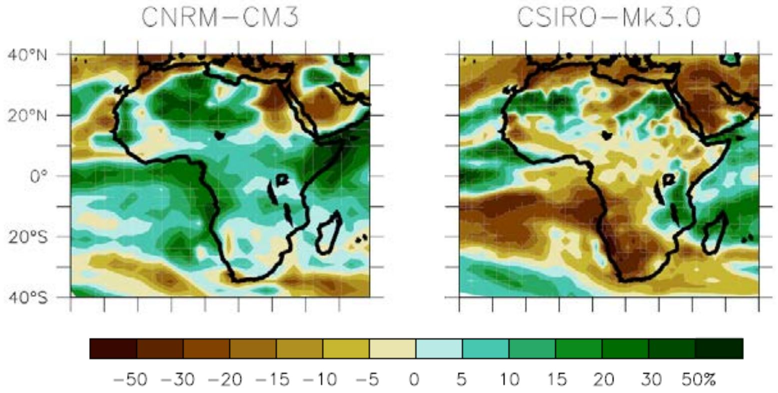
Addressing uncertainty

Gap between General Circulation Models & local vulnerabilities

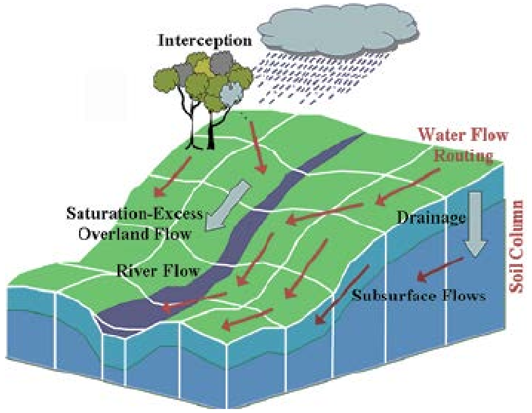








Source: S. Hallegatte



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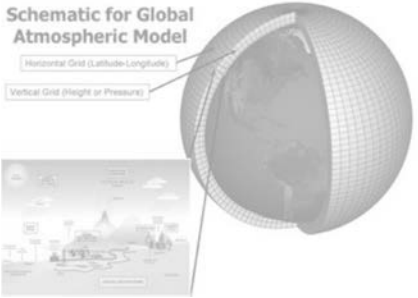

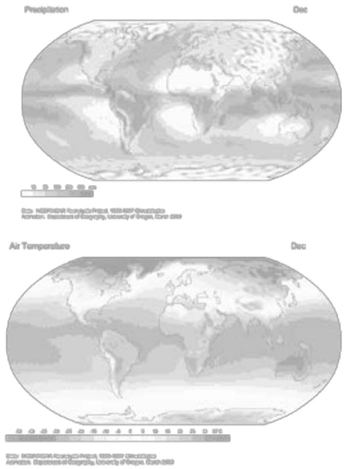

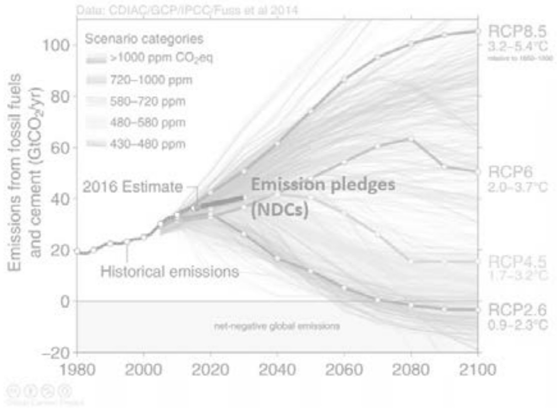

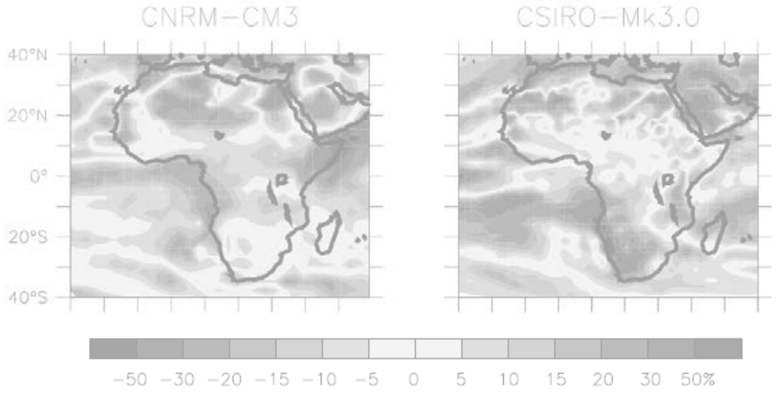

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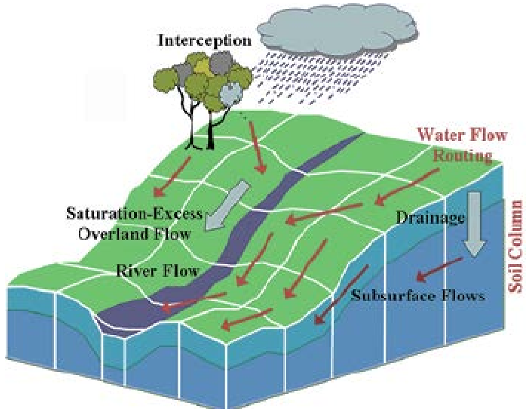
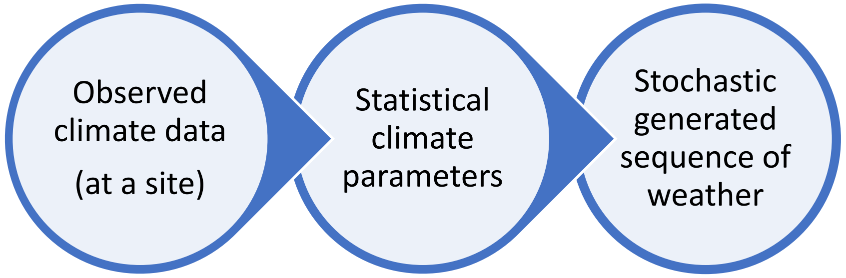




Background

Barriers to reducing climate-related risks

- **Recognition** that current and future **climate differs from past climate**
- Not informed of **potential risks to business** operations on different time scales
- Not clear **understanding how** climate change could undermine investments
- **Not ownership** of relevant climate and weather **data** to integrate into the design and operation of infrastructure
- **Perception of high costs** for resilience measures

Hydropower Sector Climate Resilience Guide

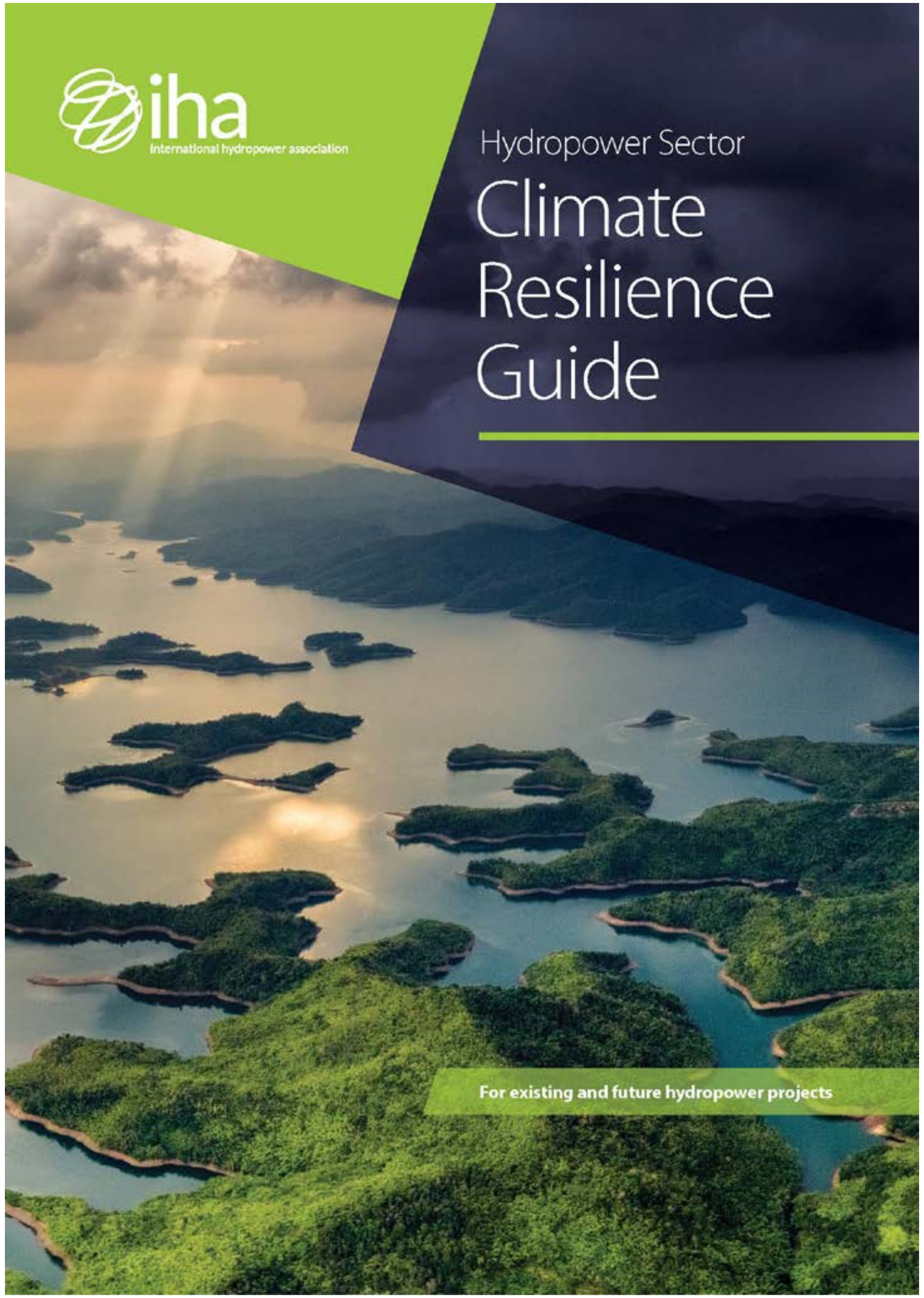
world hydropower congress

With technical and financial support from:

European Bank for Reconstruction and Development

WORLD BANK GROUP

Korea Green Growth Trust Fund



Providing guidance to **build** new and existing **resilient projects**

International Hydropower Association, 2019. ***Hydropower Sector Climate Resilience Guide*. London, United Kingdom.**

www.hydropower.org/climateresilienceguide

Delivering international guidance

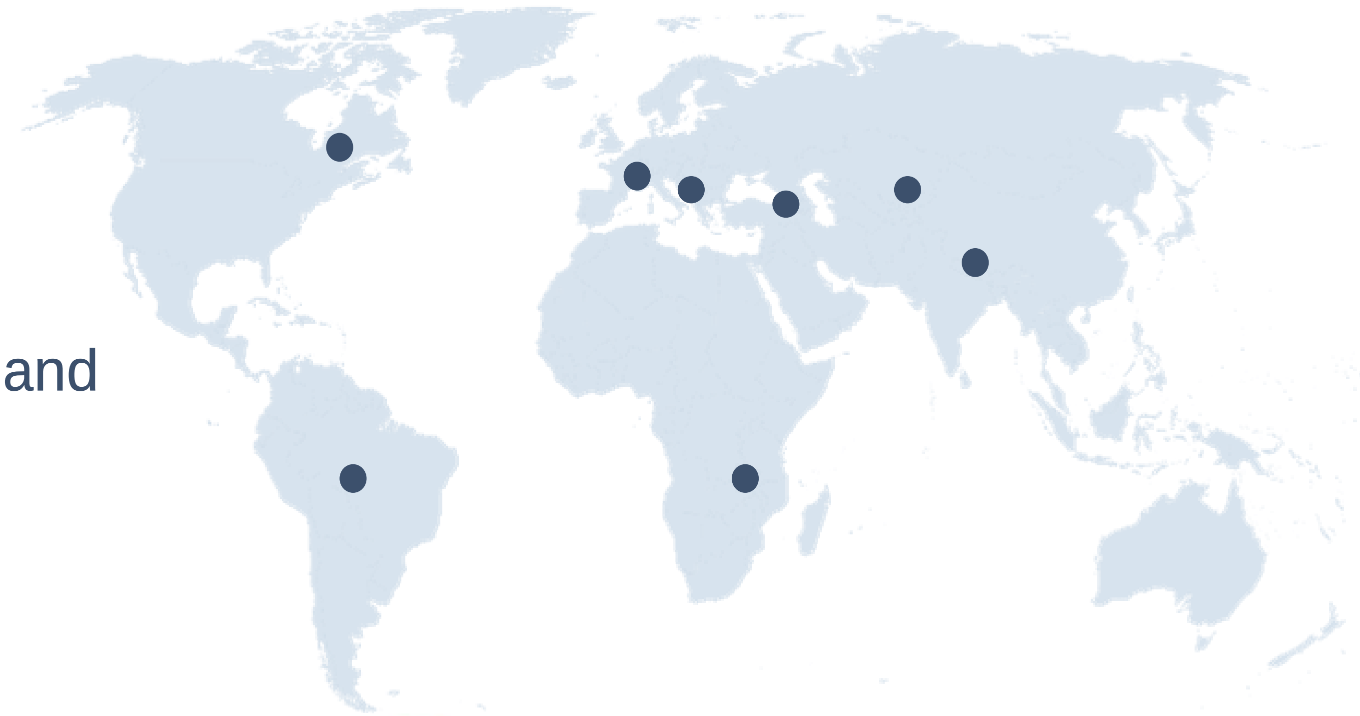
For **identifying** climate risks and opportunities

For **assessing** the impacts of climate change on hydropower projects.

For **managing** risks by selecting appropriate measures and operational procedures that **build climate resilience** across a range of scenarios.

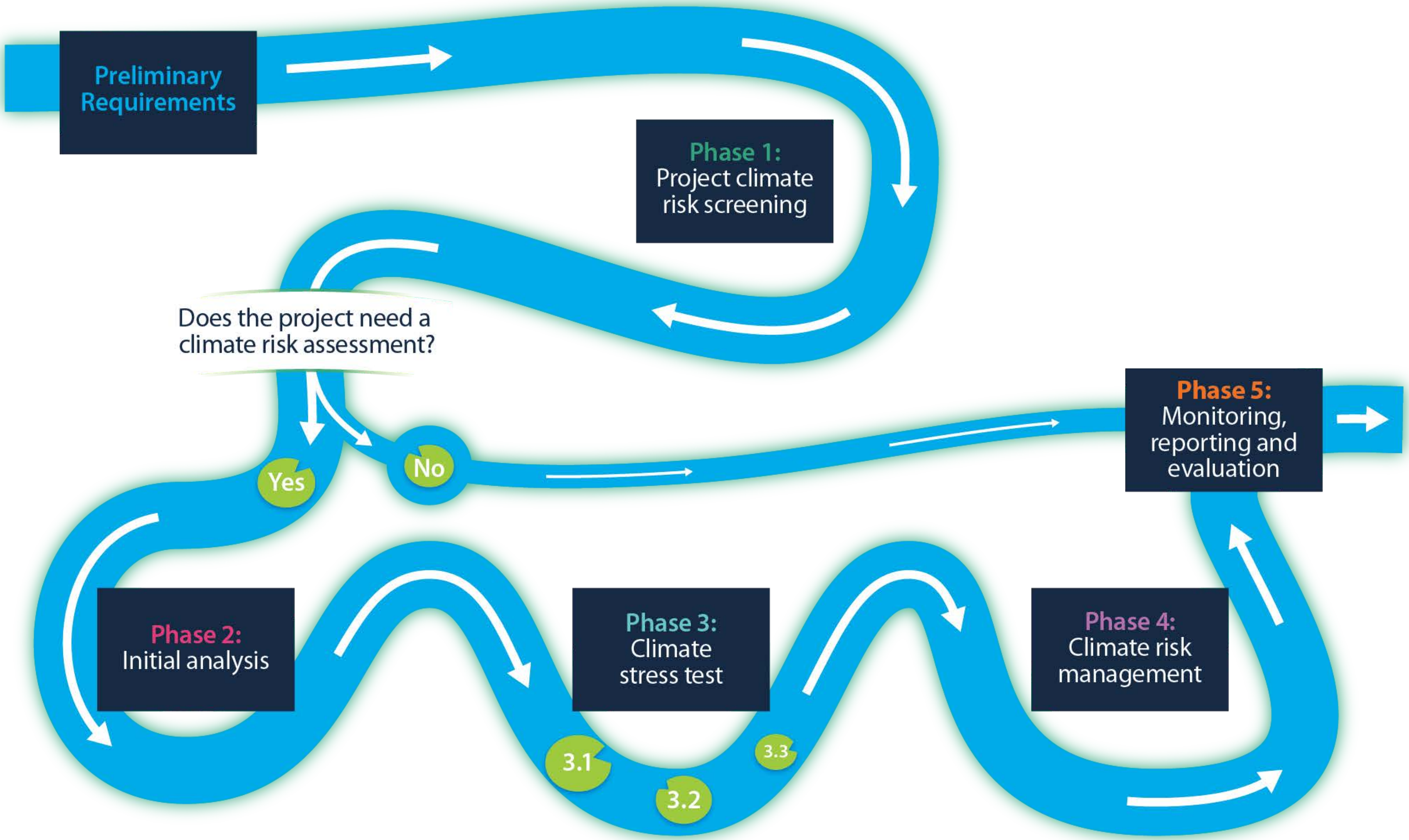
Applicability

- Any **type** and **scale** of project
- For **existing** and **future** projects
- Relevant to any **geography**
- Compatible with all **data** availability and quality
- Adaptable to **single** and **cascade** projects
- Aligned to the project’s **functions**



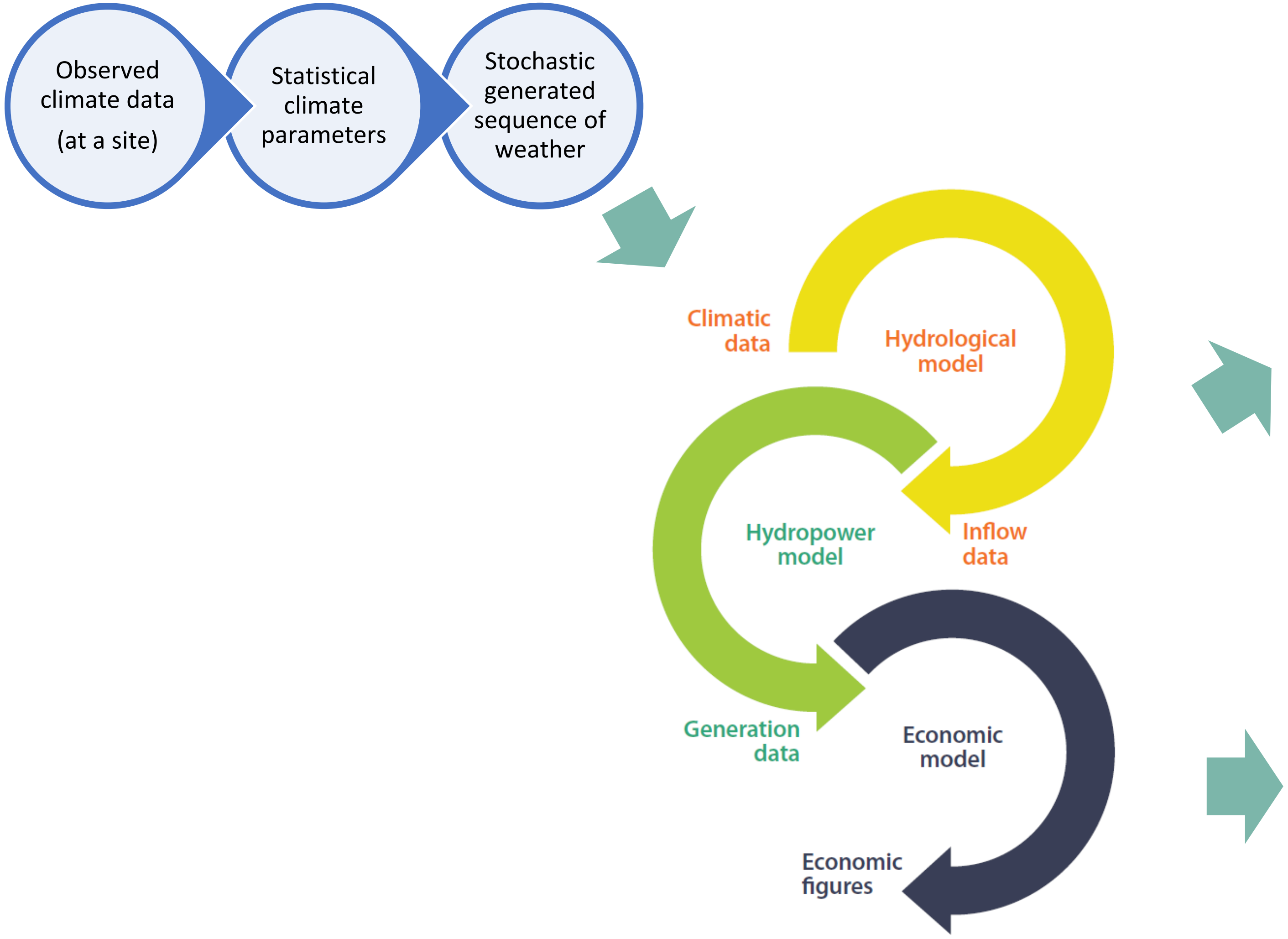
Pilot projects that applied the beta version of the guide. Its feedback was crucial for the refinement of *Hydropower Sector Climate Resilience Guide*.

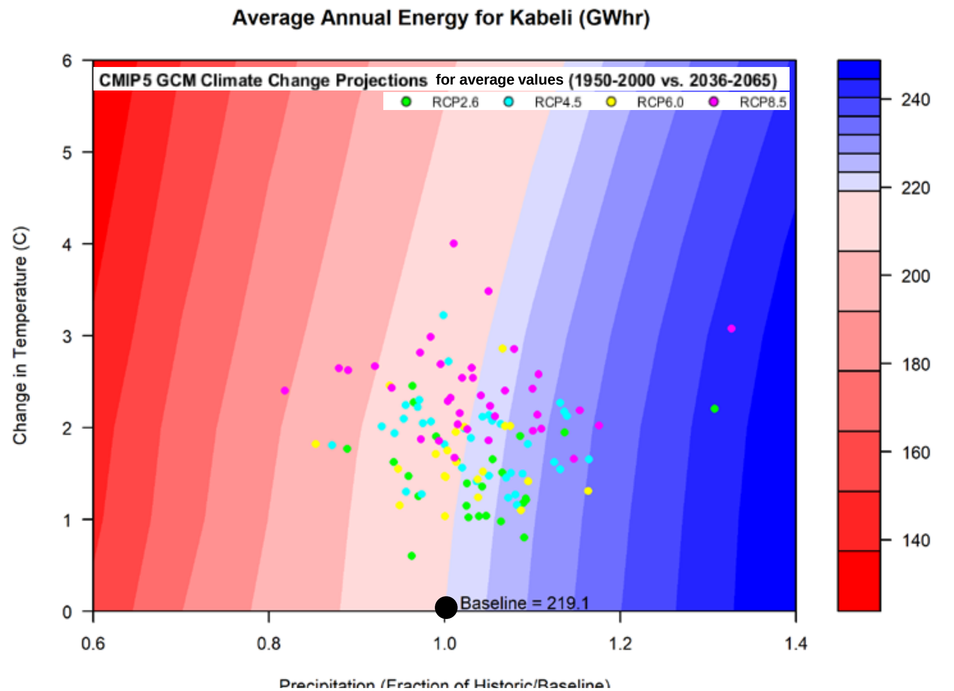
Phases

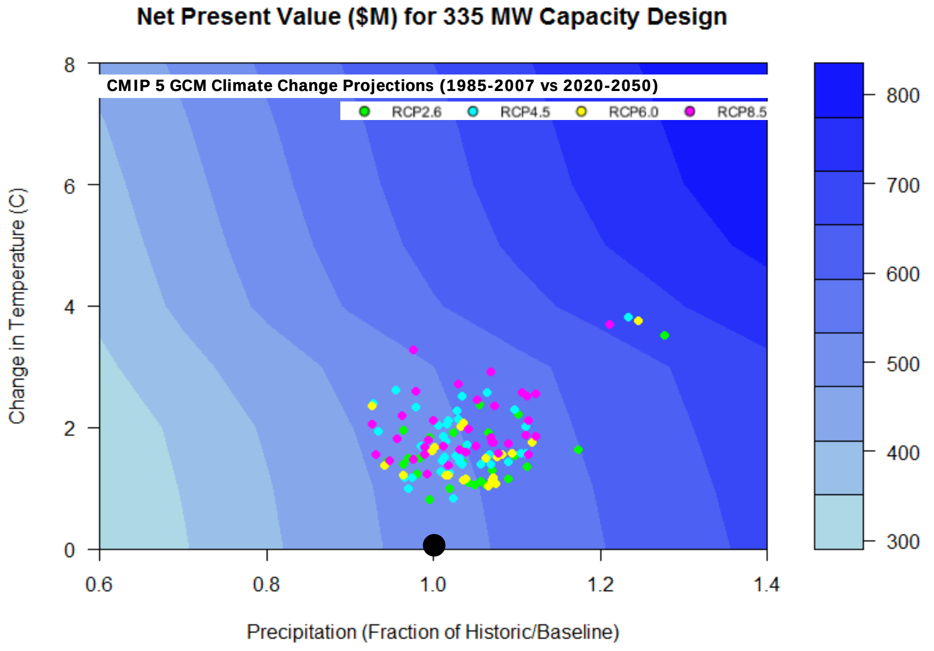


Preliminary Requirements
Phase 1:
Project climate risk screening
Does the project need a climate risk assessment?
Yes
No
Phase 2:
Initial analysis
Phase 3:
Climate stress test
3.1
3.2
3.3
Phase 4:
Climate risk management
Phase 5:
Monitoring, reporting and evaluation

Stress testing







Resilience measures

Structural measures

- Enhanced flood defences for powerhouse
- Installation of variable speed turbines or turbines with higher efficiency for a wide range of discharges
- Increased energy dissipation from spillway
- Pumped-storage power plant.
- Etc.

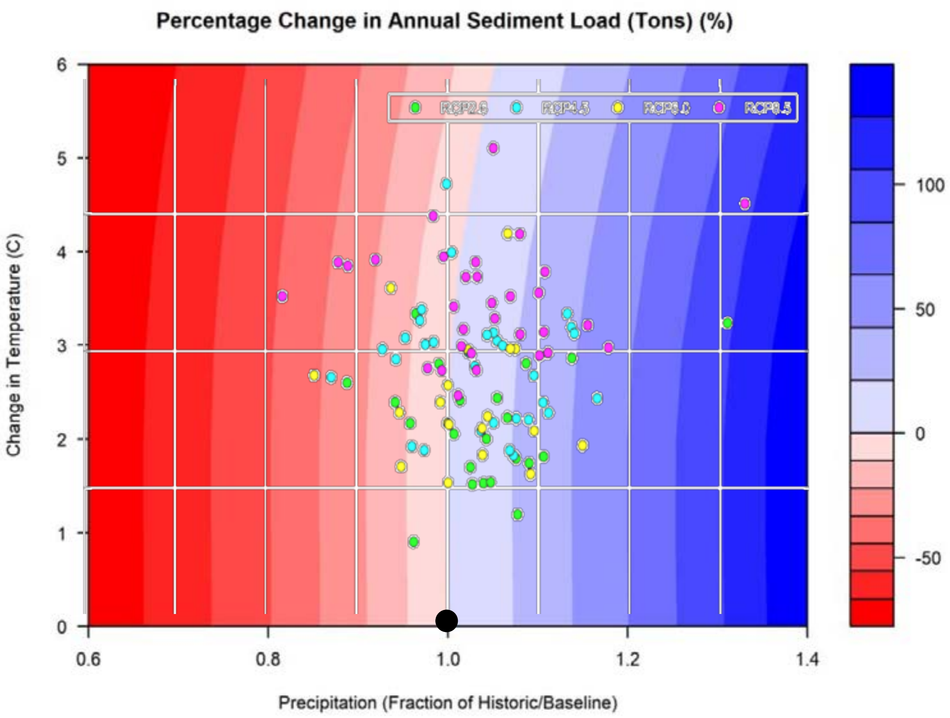
Functional measures

- Revision optimal minimum operating level
- More efficient sediment management strategies
- Reassessment of type of scheme (base load vs peaking and run-of-river vs storage)
- Etc.

Consider adaptability

Cost effective and economically acceptable.

Example - risk



Economic impact of:

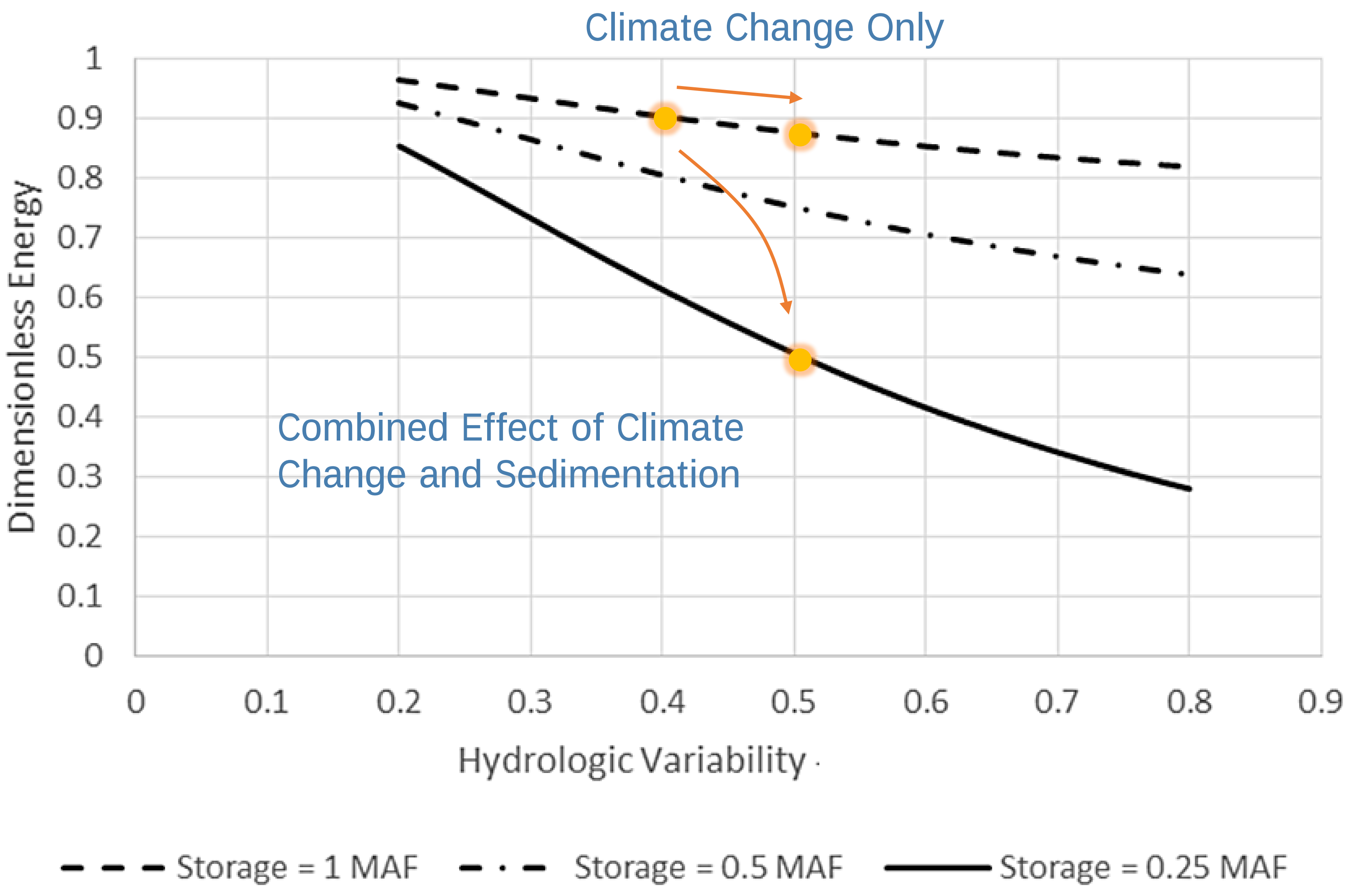
a) shutdown of the power plant during excessive sediment load

b) emergency & maintenance cost due to turbine abrasion

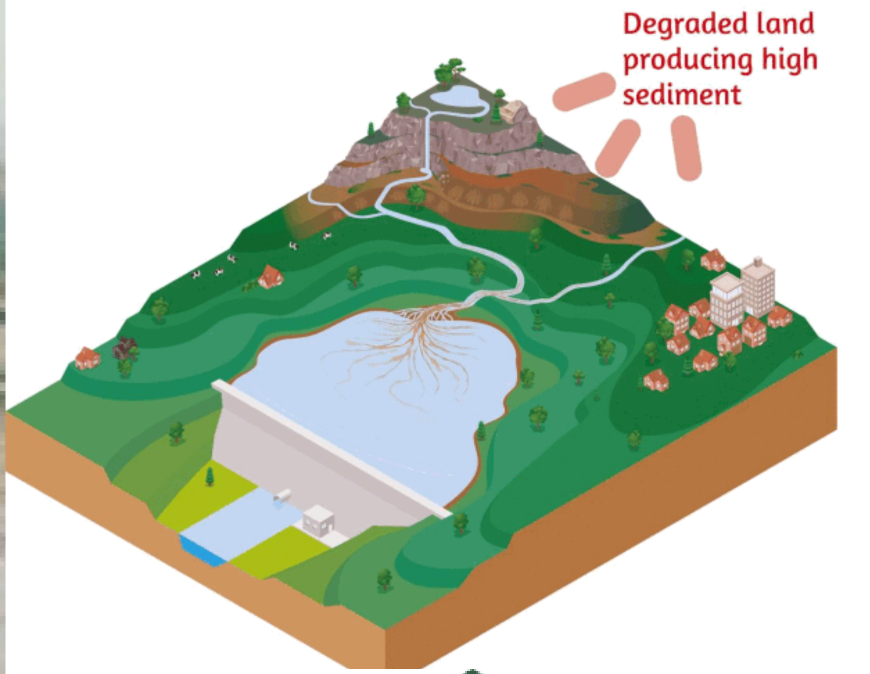
<u>Structural measures</u>: new intake design, retrofit to incorporate bottom outlets, or construct a bypass tunnel

<u>Functional measures</u>: improve sed. management (upstream mgt, sluicing)

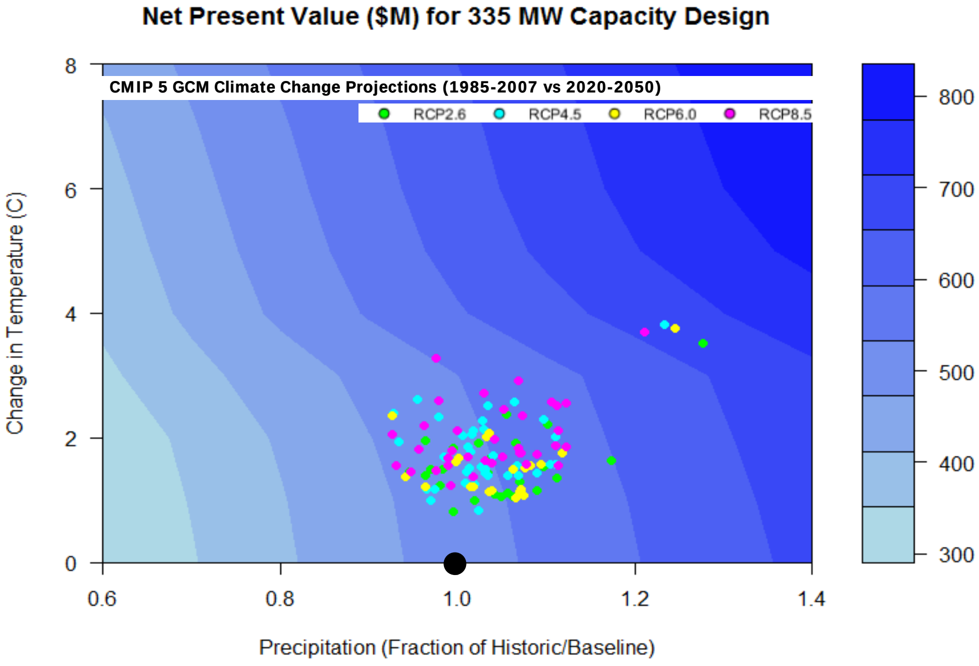
Storage and sediment



Reliability = 99%


Degraded land
producing high
sediment

Example - opportunity



a) Ability to satisfy the performance while benefiting from the increased inflow.

a) Minimise the maximum regret

a) Agreed tolerable loss.

Structural measure: increased installed capacity of turbines or expansion

Functional measure: plan for additional capacity when needed

Sustainability tools

The Hydropower Sustainability Tools define **international good and best practice** in sustainable hydropower development and are used to assess the sustainability of projects.

www.hydrosustainability.org

Unlocking finance

Proposed screening criteria

- It has a low carbon footprint, i.e.
  - **Power density > 5W/m^2**; or
  - **Emissions < 100g $CO2_e$/ kWh** (demonstrated via the G-RES tool)

www.g-res.hydropower.org

☞ **Deal breaker!**

- It is resilient to climate change and does not undermine others' resilience
  - Demonstrated via an assessment with the **ESG Gap Analysis Tool**, identifying significant gaps (if any) and establishing action plans to address these gaps.
  - A scoring methodology has been developed to determine when overall performance is sufficient
    - *A maximum of 10 significant gaps are allowed in total across all 12 sections under the Tool*;*
    - *A maximum of 2 significant gaps are allowed in any one section under the Tool*;*
    - *Where gaps are identified, the majority of significant gaps must be closed within 12 months. Any remaining significant gaps must be closed within 24 months.*

Thank you for your attention

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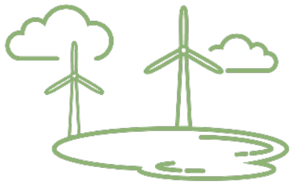

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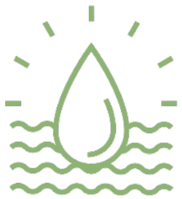

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