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SEMANA DE BARRAGENS 2025
DAMSWEEK 2025
24 A 29 DE AGOSTO DE 2025 - PORTO ALEGRE - RS - BRASIL BARRASHOPPINGSUL

III WORKSHOP
ABRAGE CBDB

USINAS DE ARMAZENAMENTO HIDRAULICO: PANORAMA GLOBAL, PERSPECTIVAS E RECOMENDAÇÕES PARA O SEU DESENVOLVIMENTO

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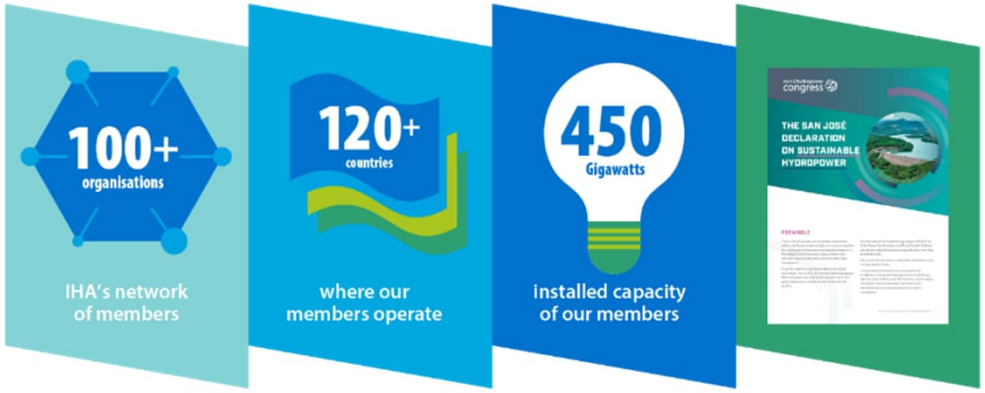
MEMBRO DO CONSELHO DO IHA
DIRETOR DE NEGÓCIOS DA WORLEY

O que é o IHA?

A Associação Internacional de Hidroeletricidade (IHA) é uma associação sem fins lucrativos. Somos a voz global da hidrelétrica sustentável. Nossos membros estão comprometidos com o desenvolvimento e a operação responsáveis e sustentáveis de hidrelétricas.



Missão

A missão da IHA é promover as hidrelétricas sustentáveis. Os objetivos mais amplos da IHA são:

Ser a voz global da hidrelétrica sustentável.

Aumentar o investimento em hidrelétrica sustentável por meio do engajamento com formuladores de políticas globais, tomadores de decisões financeiras e o público.

Posicionar a hidrelétrica sustentável como uma solução limpa, verde, moderna e acessível para as mudanças climáticas e a segurança energética.

Esses objetivos refletem os compromissos da Declaração de San José sobre Hidrelétrica Sustentável, adotada em setembro de 2021.

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Incorporando Sustentabilidade

Declaração de San José:

A hidrelétrica sustentável é uma solução limpa, verde, moderna e acessível para as mudanças climáticas. Daqui para frente, a única hidrelétrica aceitável é a sustentável.

Padrão de Sustentabilidade de Hidrelétrica

- Todos os projetos podem ser certificados de forma independente.
- Os projetos devem mitigar os impactos ao meio ambiente e às comunidades.

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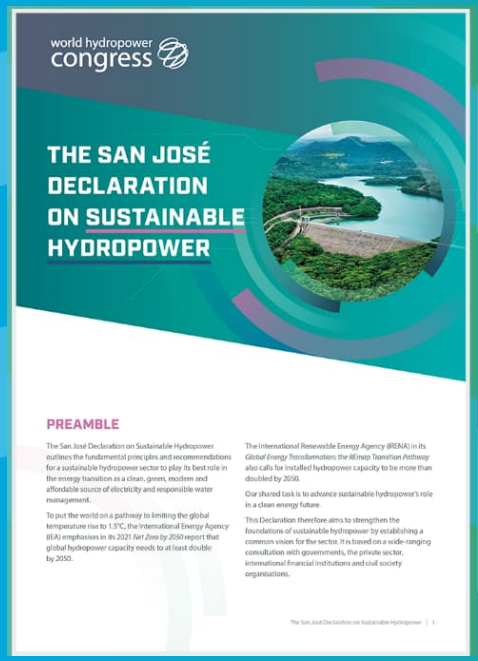
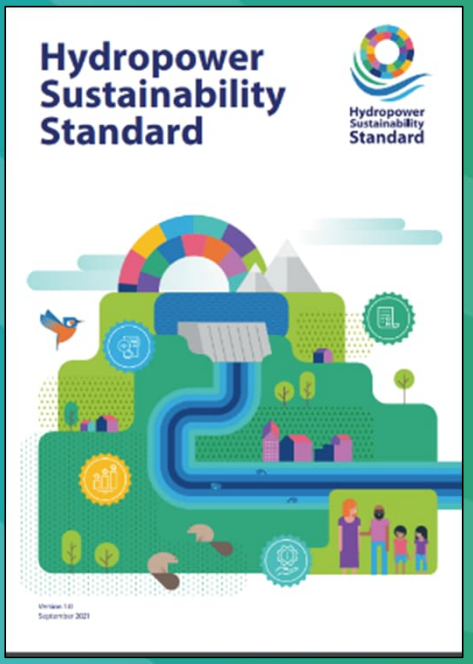




BENEFICIOS PARA TODOS

DESENVOLVEDORES & OPERADORES

- Reputação aprimorada
- Desempenho aprimorado
- Acesso a financiamento
- Mitigação de riscos

INSTITUIÇÕES FINANCEIRAS

- Redução de risco de Investimento
- Sustentabilidade a longo prazo
- Reconhecimento e influência no mercado

GOVERNOS & REGULADORES

- Conformidade regulatória
- Progresso demonstrável
- Desenvolvimento sustentável

SOCIEDADE CIVIL & NGOS

- Apoio à promoção
- Responsabilização
- Impacto positivo

PESQUISA & ACADEMIA

- Dados e insights
- Estudos de caso
- Compartilhamento de conhecimento

COMUNIDADES

- Bem-estar e atuação
- Proteções ambientais
- Desenvolvimento de infraestrutura
- Oportunidades de emprego

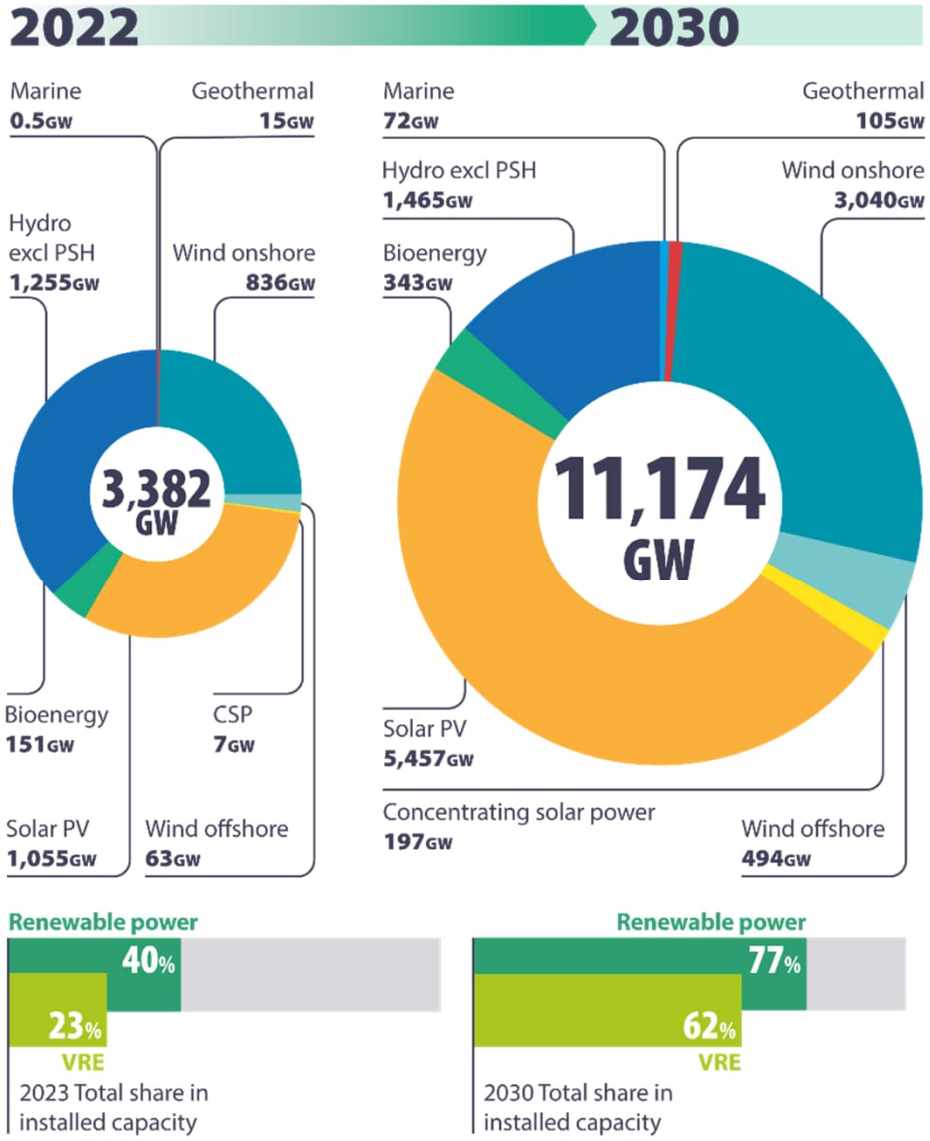
ERV impulsionam a necessidade por UHR

Líderes mundiais na COP28 em Dubai se comprometeram a "triplicar" a capacidade mundial de geração de energia renovável de 3,4 TW em 2022 para 11,2 TW em 2030.

Isso exigirá um aumento massivo das energias renováveis variáveis, especialmente eólica e solar.

Para atingir essa meta, será necessário aumentar o armazenamento, incluindo o de longa duração.

O armazenamento hidráulico é a única tecnologia madura de armazenamento de longa duração que pode fornecer a flexibilidade e a resiliência necessárias em escala para suportar esse crescimento.



Necessidade por armazenamento
Como as UHRs podem satisfazer isso?

- Equilibra os sistemas energéticos com parcelas crescentes de energias renováveis por meio da complementaridade
- Fornece serviços de curto prazo (por exemplo, frequência, inércia) e flexibilidade de longa duração
- Atua como uma "bateria de água" para armazenamento de energia de várias horas a vários dias
- Reduz a necessidade de reserva de combustível fóssil durante períodos de baixa energia eólica/solar
- Aumenta a resiliência do sistema contra a variabilidade e a incerteza causadas pelo clima

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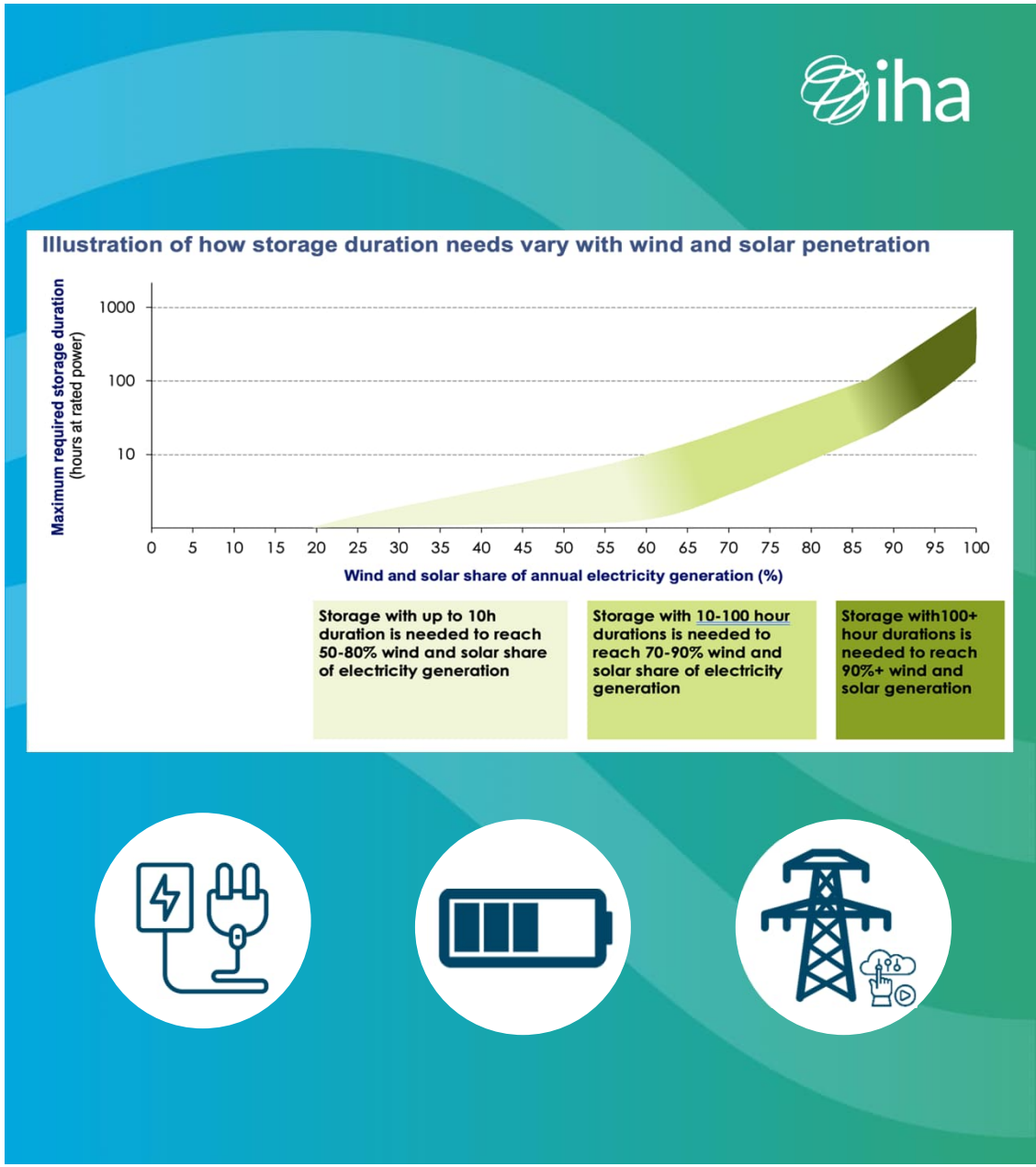

Benefícios das UHRs ao Sístema de Transmissão

Pode reduzir significativamente o “curtailment” das renováveis

O desenvolvimento do armazenamento hidráulico tem prazos longos, mas continua sendo uma tecnologia de armazenamento em larga escala e longa duração, comprovada e comercialmente viável.

- Pode armazenar o excesso de produção renovável e descarregá-lo quando necessário.
- Fornecimento de serviços ancilares essenciais necessários para integrar uma alta penetração de geração renovável, ao mesmo tempo em que aumenta a inércia do sistema.
- Redução das emissões do sistema, deslocando a operação de usinas de combustíveis fósseis de pico.
- Suporte à gestão de congestionamento da rede.

Um estudo realizado pelo Imperial College London no Reino Unido constatou que:

Apenas 4,5 GW de novas armazenamento hidráulico de longa duração (90 GWh) poderiam economizar até £ 690 milhões anualmente em custos do sistema energético até 2050.

Cerca de 75% dessas economias advêm da não realização de investimentos em transmissão e tecnologias de geração mais caras, necessárias para atingir as metas de zero emissão líquida e segurança energética do Reino Unido.

Tendência de Crescimento das UHRs

•Aceleração rápida: A capacidade global de UHRs atingiu 8 GW em 2024, acima da média de 2 a 4 GW/ano dos últimos 20 anos.

•Forte pipeline: Mais de 105 GW de UHRs atualmente em construção em todo o mundo.

•Aumento a curto prazo: Estima-se que 90 GW de nova capacidade possam ser adicionados até 2030, um aumento de quase 50% em relação aos 189 GW atuais.

•Total projetado: A capacidade global de UHRs deve atingir ~280 GW até 2030.

•Taxa de construção em rápido crescimento: Construção futura de ~18 GW/ano, 5 a 10 vezes mais rápida do que as tendências históricas.

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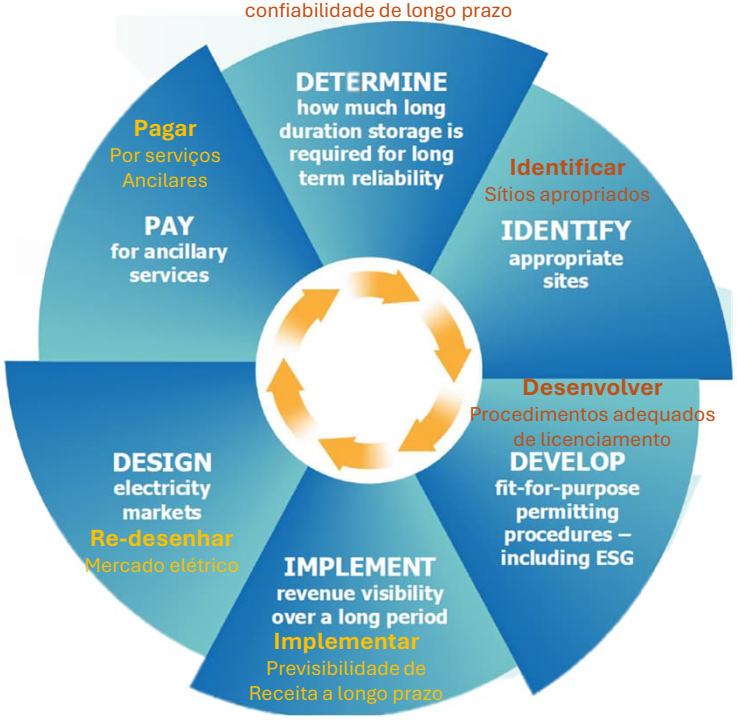
O Mundo está se movendo...

O Brasil não pode ficar para traz

Determinar
Quanto armazenamento de longa duração é necessário para confiabilidade de longo prazo



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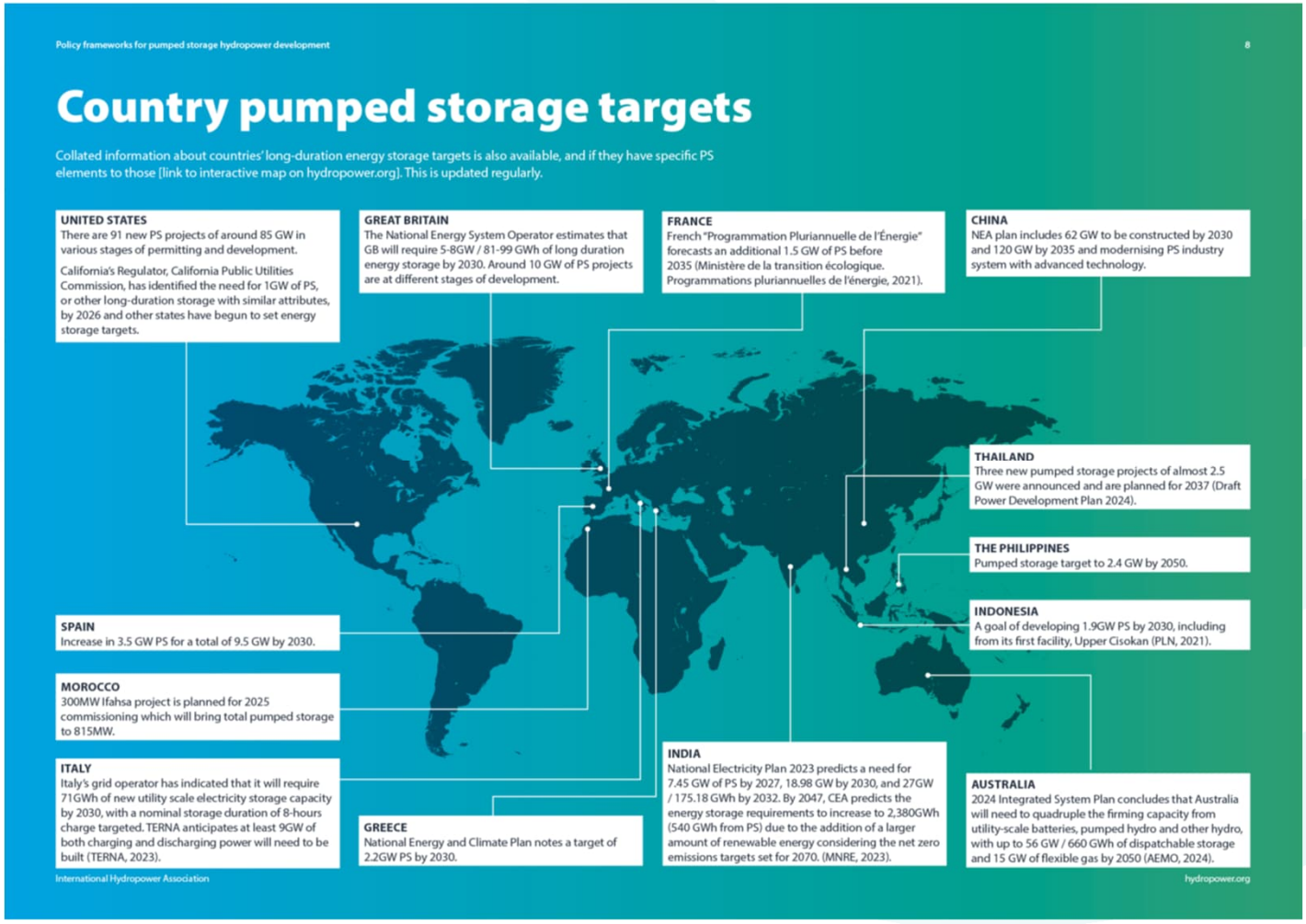
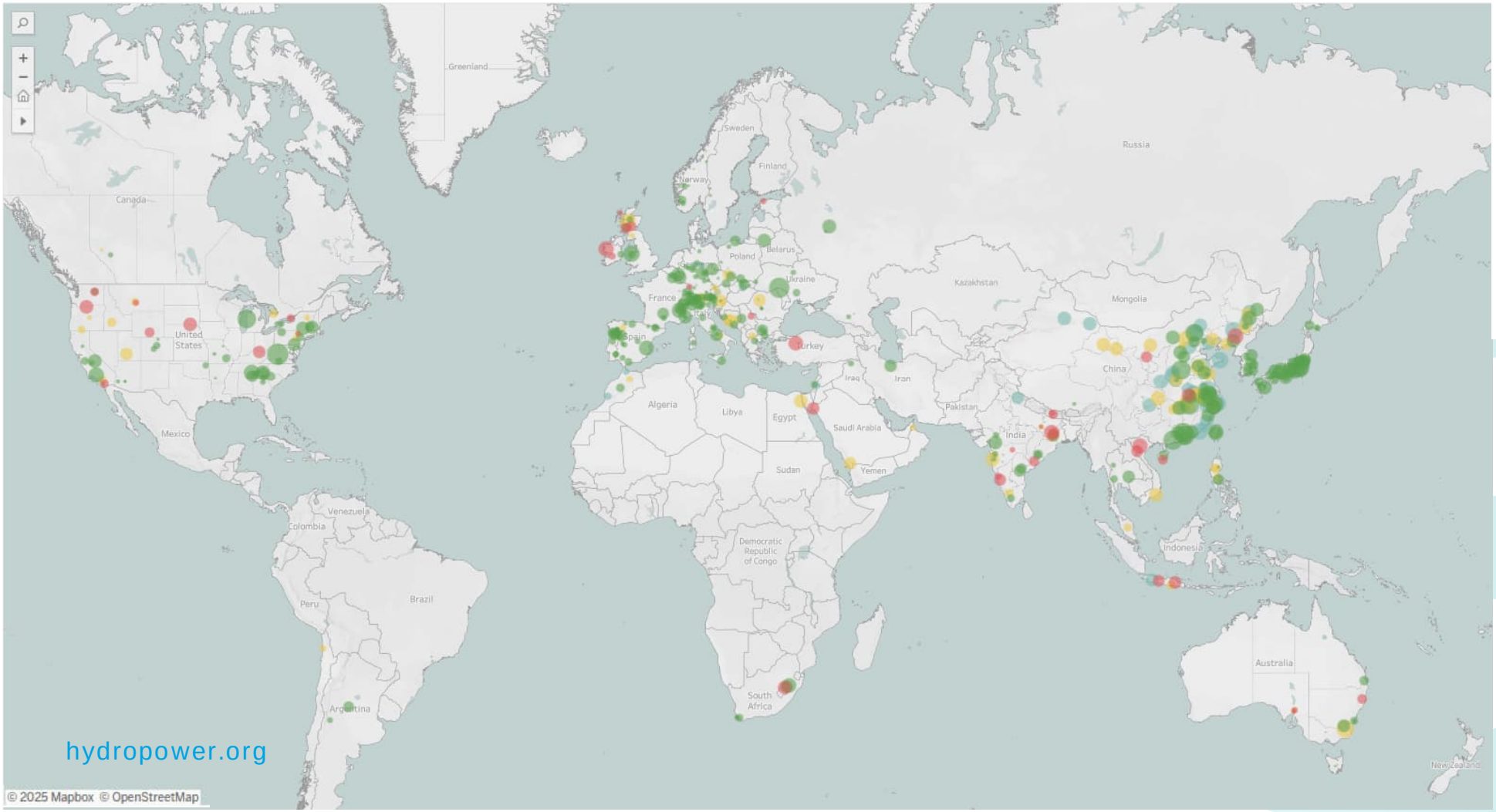
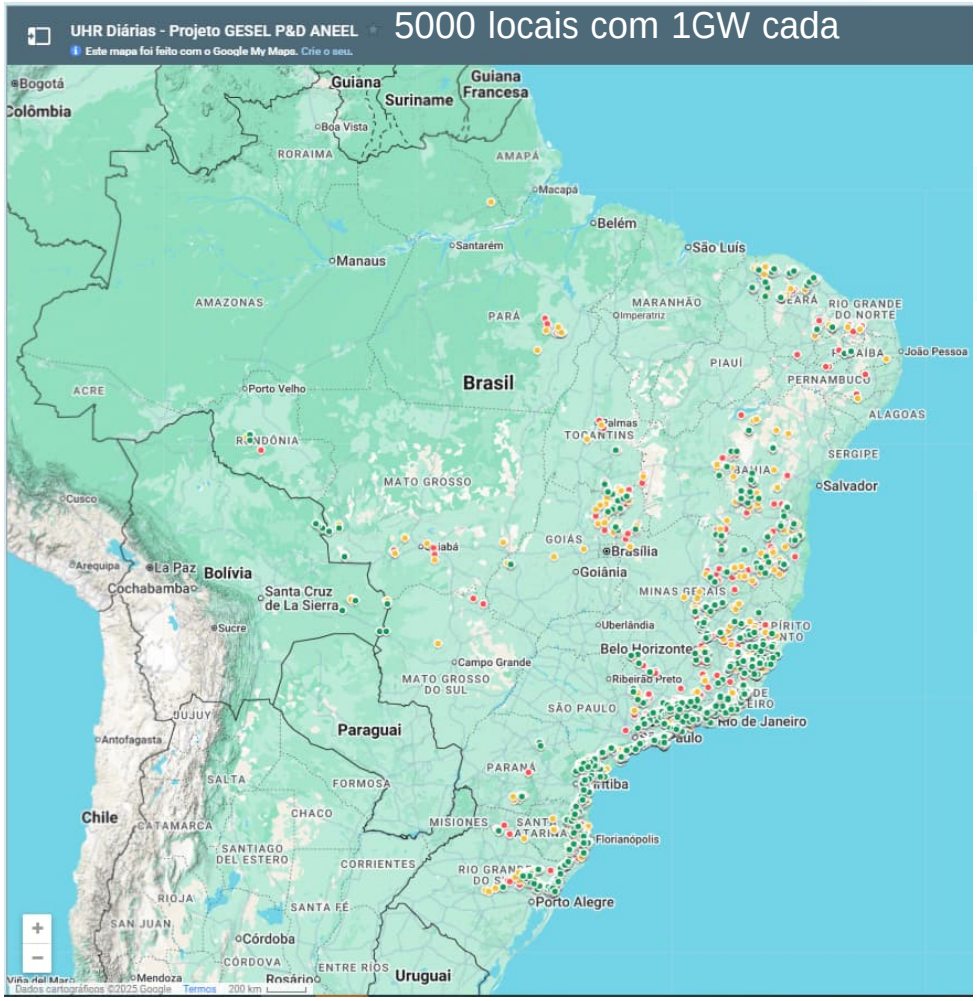


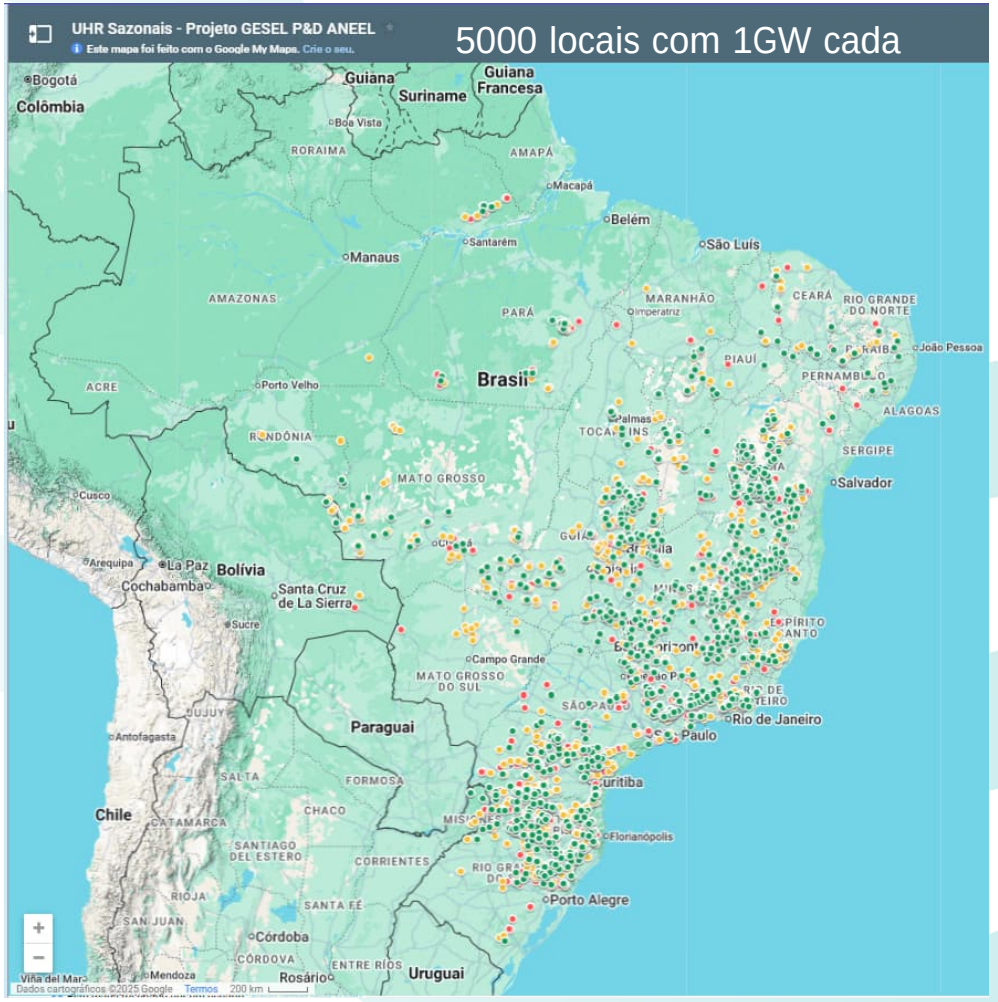
Armazenamento hidráulico pelo mundo

Hydropower Pumped Storage - Capacity
(Update: 27 June 2022)



GESEL: Mapeamento de UHRs no Brasil





https://www.projetouhr.com.br/index.php

Como avançar?

IHA desenvolveu duas publicações:

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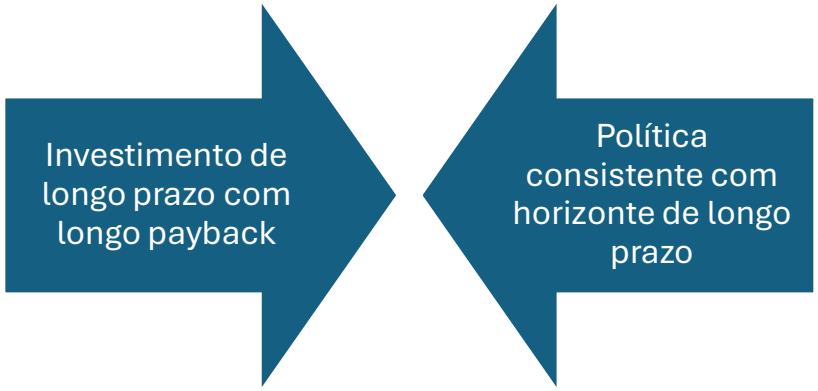
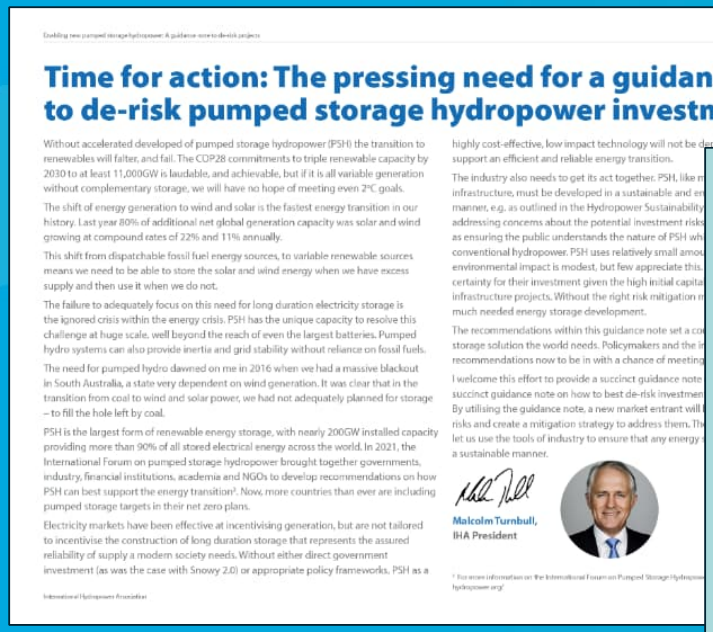
Desenvolvido pelo Setor privado – Possibilitado pelo setor público



1. Avaliar as necessidades de armazenamento, considerando as metas de ERV
2. Reconhecer que o mercado não será capaz de entregar sozinho
3. Priorizar medidas políticas para viabilizar investimentos
    1. Mecanismos financeiros
    2. Intervenções políticas públicas
    3. Racionalização do licenciamento, etc.

De-Risk PSH Guidance Note

- Introduction to PSH
- Risks critical to consider for PSH
- Path of a PSH project
- Thematic risks and recommendations



Time for action: The pressing need for a guidance note to de-risk pumped storage hydropower investments

Without accelerated developed of pumped storage hydropower (PSH) the transition to renewables will falter, and fail. The COP28 commitments to triple renewable capacity by 2030 to at least 11,000GW is laudable, and achievable, but if it is all variable generation without complementary storage, we will have no hope of meeting even 2°C goals.

The shift of energy generation to wind and solar is the fastest energy transition in our history. Last year 80% of additional net global generation capacity was solar and wind growing at compound rates of 22% and 11% annually.

This shift from dispatchable fossil fuel energy sources, to variable renewable sources means we need to be able to store the solar and wind energy when we have excess supply and then use it when we do not.

The failure to adequately focus on this need for long duration electricity storage is the ignored crisis within the energy crisis. PSH has the unique capacity to resolve this challenge at huge scale, well beyond the reach of even the largest batteries. Pumped hydro systems can also provide inertia and grid stability without reliance on fossil fuels.

The need for pumped hydro dawned on me in 2016 when we had a massive blackout in South Australia, a state very dependent on wind generation. It was clear that in the transition from coal to wind and solar power, we had not adequately planned for storage – to fill the hole left by coal.

PSH is the largest form of renewable energy storage, with nearly 200GW installed capacity providing more than 90% of all stored electrical energy across the world. In 2021, the International Forum on pumped storage hydropower brought together governments, industry, financial institutions, academia and NGOs to develop recommendations on how PSH can best support the energy transition*. Now, more countries than ever are including pumped storage targets in their net zero plans.

Electricity markets have been effective at incentivising generation, but are not tailored to incentivise the construction of long duration storage that represents the assured reliability of supply a modern society needs. Without either direct government investment (as was the case with Snowy 2.0) or appropriate policy frameworks, PSH as a highly cost-effective, low impact technology will not be deployed at the scale needed to support an efficient and reliable energy transition.

The industry also needs to get its act together. PSH, like n infrastructure, must be developed in a sustainable and e manner, e.g. as outlined in the Hydropower Sustainability addressing concerns about the potential investment risks as ensuring the public understands the nature of PSH wh conventional hydropower. PSH uses relatively small amou environmental impact is modest, but few appreciate this. certainty for their investment given the high initial capita infrastructure projects. Without the right risk mitigation much needed energy storage development.

The recommendations within this guidance note set a co storage solution the world needs. Policymakers and the in recommendations now to be in with a chance of meeting

I welcome this effort to provide a succinct guidance note succinct guidance note on how to best de-risk investmen By utilising the guidance note, a new market entrant will risks and create a mitigation strategy to address them. Th let us use the tools of industry to ensure that any energy a sustainable manner.

Malcolm Turnbull,
IHA President

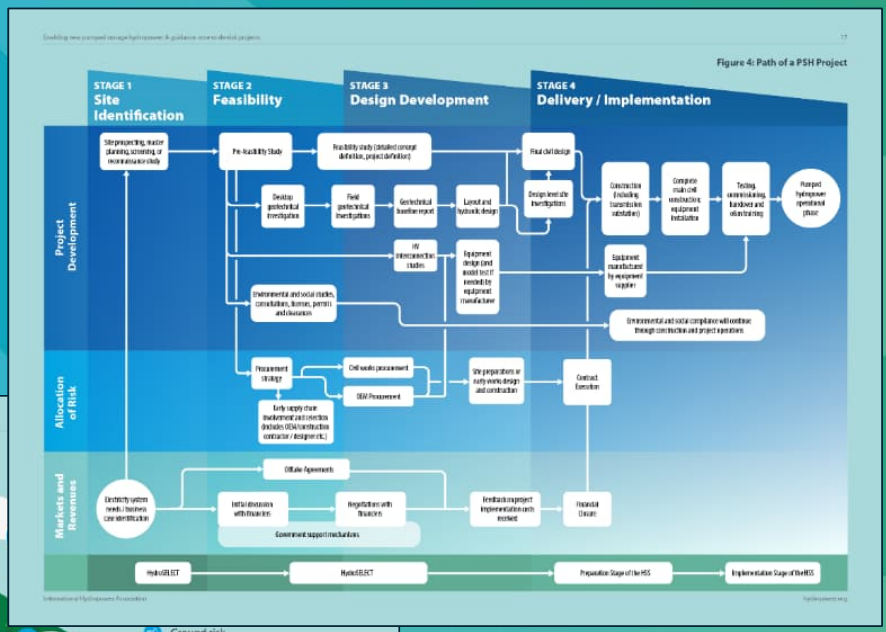


Figure 4: Path of a PSH Project

STAGE 1 Site Identification
STAGE 2 Feasibility
STAGE 3 Design Development
STAGE 4 Delivery / Implementation

Project Development
Allocation of Risk
Markets and Revenues

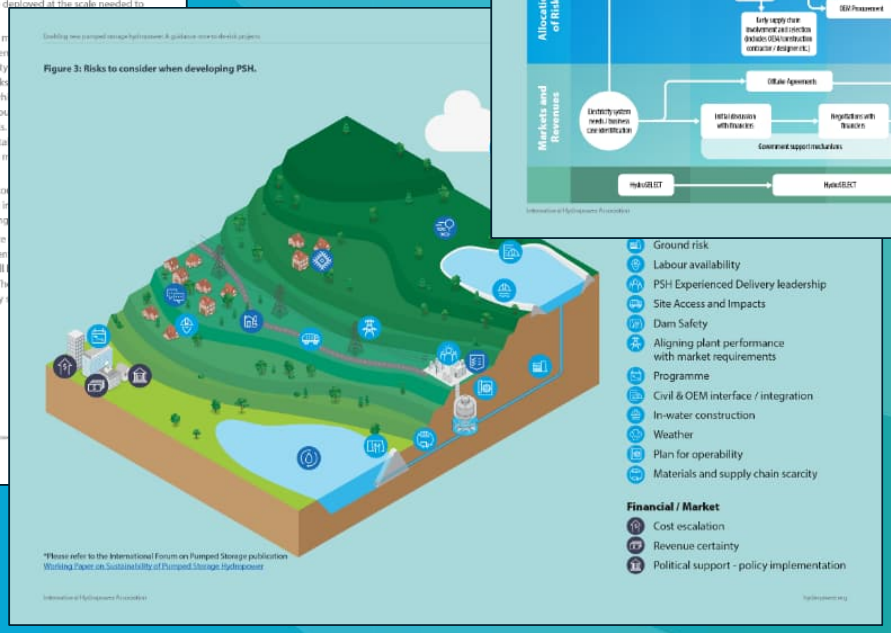


Figure 3: Risks to consider when developing PSH.

*Please refer to the International Forum on Pumped Storage publication Working Paper on Sustainability of Pumped Storage Hydropower

- Ground risk
- Labour availability
- PSH Experienced Delivery leadership
- Site Access and Impacts
- Dam Safety
- Aligning plant performance with market requirements
- Programme
- Civil & OEM interface / integration
- In-water construction
- Weather
- Plan for operability
- Materials and supply chain scarcity

Financial / Market

- Cost escalation
- Revenue certainty
- Political support - policy implementation

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Policy guidance

Recommendations for policy makers

RECOMMENDATION 1

Assess how much long duration storage and system flexibility is needed in the long-term

Pumped storage (PS) takes a long time to develop, build and pay back. At the same time, energy systems are rapidly transforming to accommodate changes in demand and supply, particularly growth in wind and solar power, making it essential to plan for future reliable energy systems which have sufficient long duration energy storage. If developers have confidence in the need for PS projects and the quantity of long duration energy storage required, then they can put the right amount of development money in upfront, de-risking projects and bringing them in on time and on budget. To deliver this win-win, Governments should seek expertise on how to assess, plan for, and build reliability, flexibility and security into energy systems.

RECOMMENDATION 2

Identify appropriate sites for pumped storage plants

Policymakers can accelerate development of pumped storage in their countries by filtering the many potential sites and highlighting those with the best economic, social and environmental outcomes. The efficiency of the energy system can be greatly enhanced by integrating the development of pumped storage with the extension of grid infrastructure, and with wind or solar energy. Holistic site planning will therefore bring significant system benefits.

Please see Australia National University atlas of potential sites.

RECOMMENDATION 3

Implement fit-for-purpose permitting procedures

A predictable and time-bound permitting process will speed up approval and reduce costs, ultimately benefitting consumers. Streamlining processes so that developers are dealing with only one agency and ensuring all branches of government are adequately resourced to respond quickly will result in timely decisions. Aligning environmental and social permitting with international standards, such as the Hydropower Sustainability Standard, ensures that the regulations, financial approvals, and company systems all align with recognised international good practice.

RECOMMENDATION 4

Apply mechanisms that deliver the necessary revenue visibility over a long period

The bulk of investment in PS projects is in the construction phase, which must be paid back over a long period. Combined with high capital costs and long build schedules, this makes these projects especially vulnerable to long-term revenue risk. If the project's income is uncertain (e.g. due to unknowns such as electricity markets or policies), then the return demanded by lenders and investors will be higher. Consequently, it is difficult for the market alone to deliver these projects. Projects need a mechanism that provides revenue certainty, which will attract greater investment.

RECOMMENDATION 5

Design electricity markets so energy storage assets are rewarded

It is important that energy storage providers receive appropriate remuneration for all the services that they provide to the system. In liberalised economies, this includes the arbitrage income that is available from being able to buy power cheaply when there is a surplus of variable renewables and sell it for a higher price when there is a deficit.

RECOMMENDATION 6

Procure and pay for ancillary services separately

PS can naturally provide lots of essential services for a reliable energy system – instantaneous physical inertia services (including frequency control services), fast start-up and shutdown and black start capabilities. Many of these services are not paid for in their respective electricity markets but grids will need them to support deployment of variable renewable energy technologies. Without clear payments for these services, projects may be built that are less capable of delivering them, or projects that are capable might not be as well maintained. The system operator should contract with them on a long-term basis.

Policy guidance

Barriers to PSH development:

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 development are subject to long 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 some markets existing PSH plant margins are being squeezed by carbon-intensive gas.

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.

Global Alliance
For Pumped Storage

O “Global Alliance for Pumped Storage” (GAPS) é um grupo de liderança intergovernamental dedicado a promover, ampliar e otimizar a PSH em todo o mundo.
O GAPS tem como objetivos:

- Conscientizar e aumentar a compreensão sobre o papel fundamental das UHRs.
- Compartilhar as melhores políticas e práticas para o desenvolvimento de PSH.
- Oferecer oportunidades de networking.
- Discutir e oferecer recomendações de políticas e financiamento.
- Desenvolver um chamado à ação para PSH .

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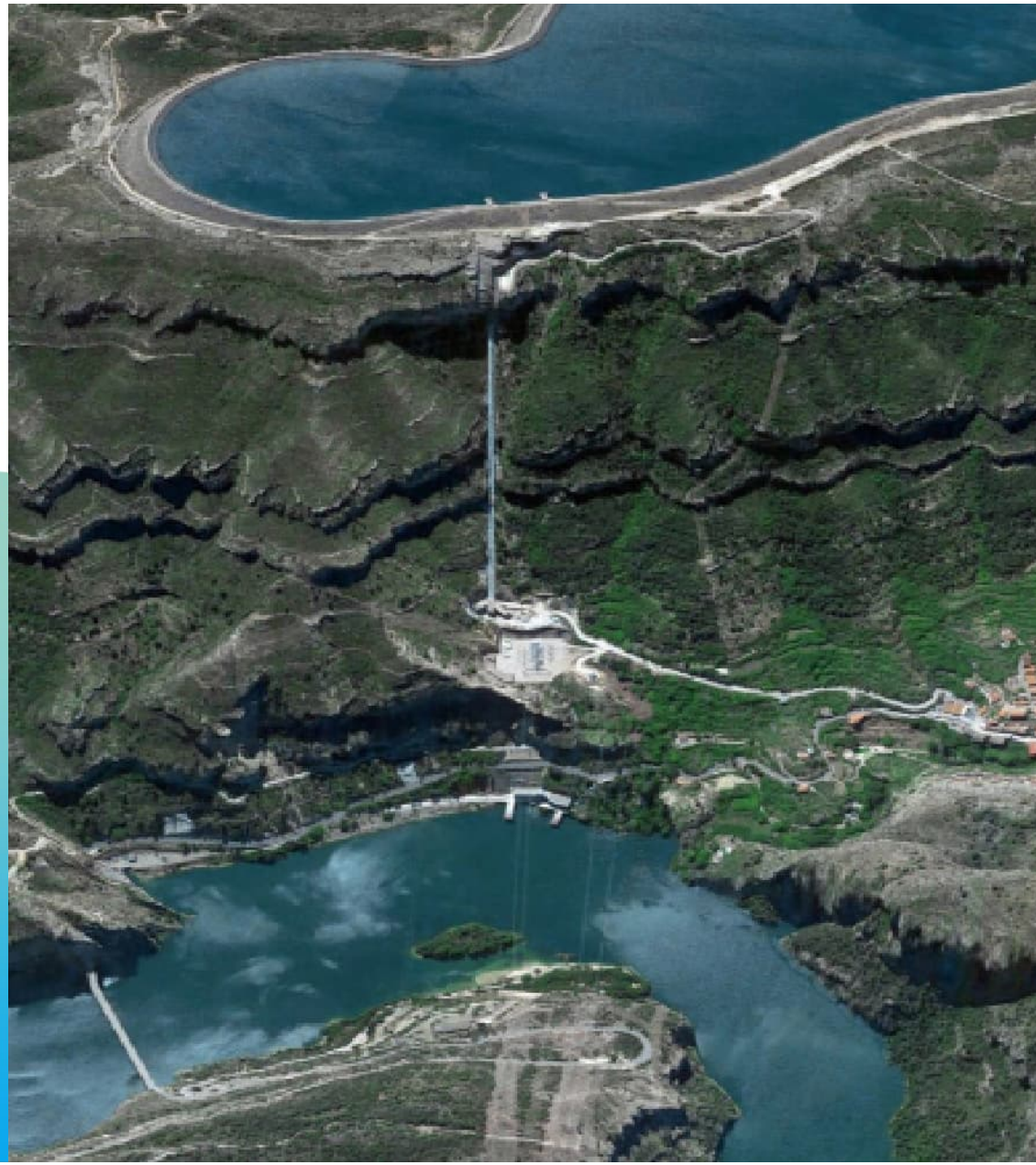
International Forum Pumped Storage Hydropower

9 a 10 de Setembro 2025 | UNESCO House, Paris



O Fórum reunirá especialistas e líderes mundiais para discutir o papel crítico da UHR na futura matriz energética e apresentar recomendações para permitir sua adoção.

Agende sua Participação

Para mais informações sobre o Fórum Internacional, escaneie o código QR ou acesse https://www.pumpedstorageforum.com/

Obrigado

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