2026 **World Hydropower Outlook**

Pathways to sustainable and secure energy systems

iha
international hydropower association

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Cover photograph
Foz do Chapecó hydropower plant, Brazil.
Credit: Axia Energia

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Enguri Hydropower Plant, Georgia.
Credit: Enguri

Foreword

Malcolm Turnbull, IHA President

Energy systems around the world are entering a period of profound change. Electricity demand is rising rapidly, driven by industrial growth, electrification and the expansion of digital infrastructure. At the same time, geopolitical instability, fuel price volatility and climate impacts are exposing vulnerabilities across power systems at a moment when energy security has rarely been more important.

Against this backdrop, hydropower is entering a new phase of strategic relevance. As the world's largest source of renewable electricity, hydropower already plays a central role in supporting economic development and reducing emissions. Increasingly, however, its value lies in the broader range of services it provides to modern power systems: dependable domestic generation, long-duration electricity storage, system stability, flexibility and resilience during periods of stress.

This year's World Hydropower Outlook highlights strong momentum in pumped storage. Global installed capacity surpassed 200GW in 2025, while annual additions reached a record high. It is on track to double over the next decade and potentially triple whin 15 years. Around the world, pumped storage is moving rapidly from the margins of energy policy to the centre of system planning, reflecting its critical role in balancing variable renewables and strengthening grid reliability.

Conventional hydropower remains indispensable in many emerging and developing economies, where reliable and affordable electricity is essential to expanding energy access, supporting industrial growth and strengthening long-term energy independence. Across the world, the modernisation of existing hydropower fleets also presents a low-hanging fruit to increase flexibility, extend asset life and improve performance from infrastructure already in place.

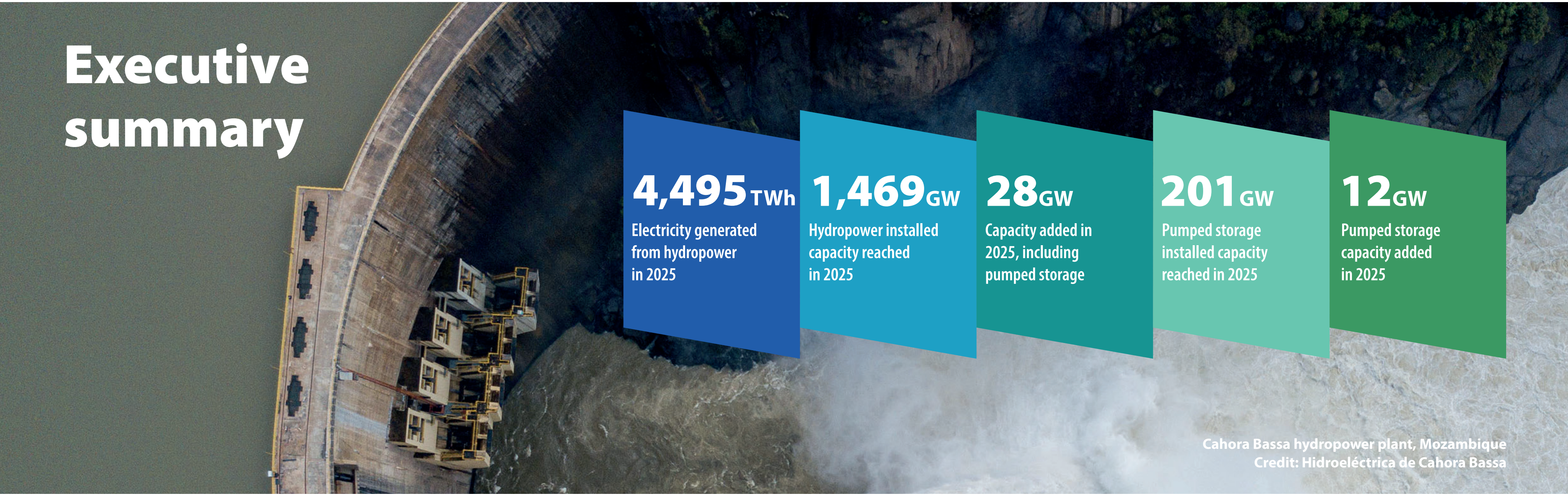
The Outlook makes clear that hydropower development is now inseparable from wider questions of sovereignty and resilience. Hydropower harnesses domestic renewable resources, reduces exposure to imported fuels and supports stable electricity systems and prices over the long term. In an increasingly electrified world, these attributes are strategically essential.

This opportunity must be realised sustainably. The only acceptable hydropower is sustainable hydropower, developed and operated in accordance with international good practice. Encouragingly, governments, developers, financial institutions and energy buyers are increasingly recognising the role of the Hydropower Sustainability Standard in strengthening transparency, improving investment quality and building public confidence.

The time to translate momentum into delivery is now. Governments must recognise hydropower and pumped storage as strategic infrastructure, backed by clear market frameworks, streamlined permitting and long-term investment certainty. With the right policy conditions, sustainable hydropower can deliver secure, resilient and renewable-powered economies for decades to come.

Malcolm Turnbull
IHA President

Executive summary



4,495TWh
Electricity generated from hydropower in 2025

1,469GW
Hydropower installed capacity reached in 2025

28GW
Capacity added in 2025, including pumped storage

201GW
Pumped storage installed capacity reached in 2025

12GW
Pumped storage capacity added in 2025

Cahora Bassa hydropower plant, Mozambique
Credit: Hidroeléctrica de Cahora Bassa

The global hydropower sector entered 2026 with strong momentum, growing strategic relevance and a clearer role. Installed hydropower capacity reached 1,469GW by the end of 2025, including 1,269GW of conventional hydropower, and pumped storage hydropower passed the 200GW milestone (201GW).

There were 28GW of new additions during the year – 16GW of conventional hydropower and close to 12GW of pumped storage. This was the highest annual deployment of pumped storage on record. Hydropower generation totalled 4,495TWh, comparable to global wind and solar generation combined, reaffirming hydropower's position as the world's largest source of renewable electricity. Increased demand appears to be a response to hydropower's unique combination of essential power system services including flexibility, reserve capacity, balancing, inertia, voltage support and black-start capability. Policymakers and power system operators are therefore increasingly recognising hydropower as a fundamental pillar of energy security and system resilience, and a necessary pillar to achieve decarbonisation. Hydropower is entering a new growth cycle. IHA data indicates a global pipeline of 1,127GW, including 621GW of pumped storage and 506GW of conventional hydropower. More than 390GW in total is already under construction, pointing to a step-change in annual deployment over the coming decade if projects continue to advance. The clearest signal comes from pumped storage: around 240GW is now under construction worldwide, making it the dominant force in the hydropower buildout.

The pipelines suggests growth will accelerate further. Global pumped storage installed capacity is on track to double over the next 10 years, thanks to a large portion of projects being under construction, and potentially triple within 15 years. Annual deployment is expected to exceed 20GW/y by 2030 and further increase thereafter if the significant targets set by several governments are enabled by a supporting regulatory framework. This year's data reflects the projection presented in the 2024 World Hydropower Outlook that annual deployment of pumped storage would surpass conventional hydropower by 2030.

At the same time, conventional hydropower remains indispensable in emerging economies and many regions of the world, where expanding access to reliable and affordable electricity still depends on dispatchable renewable generation. Deployment remains below the level envisaged in the International Renewable Energy Agency's tripling-renewables scenario, underscoring the need for faster permitting, stronger policy signals and more investable market frameworks.

Across all regions, energy security is becoming the major concern. As electricity demand rises and geopolitical tensions increase, fuel price volatility and climate risks expose weaknesses in power systems, hydropower offers an indigenous, renewable and multi-decadal source of strategic infrastructure. Conventional hydropower supports dependable domestic generation. Pumped storage enables mass integration of variable renewables. Both reduce dependence on imported fossil fuels for balancing and peak supply.

In increasingly electrified economies, this contribution is key. For policymakers focused on sovereignty as well as decarbonisation, there is increased value in hydropower's support of frequency control, voltage stability to prevent outages and blackstart capability for system restoration when needed. It also links climate mitigation with adaptation through water management, flood control and drought resilience.

New development trends are also emerging. For instance, the rapid growth of data centres is creating a new class of electricity-intensive demand with direct implications for 24/7 renewable technologies such as hydropower. According to the International Energy Agency, data centres consumed around 415 TWh in 2024, or roughly 1.5% of global electricity demand, and consumption is projected to rise to 945 TWh by 2030. This expansion is sharpening interest in firm, low-carbon electricity that can operate around the clock and support grid reliability at the same time. Hydropower is well positioned to meet that need.

In North America, long-term agreements between hydropower operators and technology companies are beginning to demonstrate new commercial models for relicensing, modernisation and co-located industrial growth. Similar dynamics are emerging in South America, where abundant hydropower resources are helping attract high-performance computing and digital infrastructure, helping the development of new sites to move demand closer to generation. If carefully planned, these partnerships can strengthen project economics, support wider network investment and align digital growth with broader electrification goals.

Sustainability is also becoming more deeply embedded in hydropower planning, financing and operations. The Hydropower Sustainability Standard (HSS) is increasingly shaping how governments, developers, lenders and energy buyers evaluate project performance across environmental, social and governance criteria. By mid-2026, 20 projects across major continents had been certified under the HSS, reflecting growing recognition that sustainability is integral to investment quality.

As electricity buyers seek stronger assurance over renewable sourcing, independently verified sustainability frameworks are becoming a practical means of improving transparency, managing risk and strengthening confidence across the value chain.

Regional developments underline both the diversity of hydropower markets and the consistency of the sector's strategic value. In Africa, major additions in Ethiopia and Tanzania showed how hydropower can transform national supply, while modernisation and interconnection remain essential to unlocking wider regional benefits. The East Asia and Pacific region continued to lead global deployment, with China dominating both conventional hydropower and pumped storage additions, while Southeast Asia advanced cross-border trade and long-duration storage planning.

In Europe, rising curtailment, negative pricing and system stress reinforced the case for pumped storage, modernisation and non-fossil long-duration flexibility in order to reduce strategic dependencies on imported fuels. Nevertheless, the required pace of expansion – particularly of pumped storage – continues to be held back by regulatory barriers and lengthy permitting procedures. In North and Central America the emphasis has been on upgrading ageing fleets, expanding Indigenous and community partnerships, and linking hydropower to data-centre demand growth. In South America, hydropower is being revalued as both an energy backbone and a flexibility resource capable of balancing higher shares of wind and solar, even as climate variability increases operational risk. In South and Central Asia, strong policy momentum, especially in India, is accelerating pumped storage and conventional hydropower development. The Government of India announced its plans to reach over 100GW installed capacity of pumped storage by 2035–36.

The central conclusion of this World Hydropower Outlook is that hydropower is entering a new phase of strategic relevance. The sector's importance lies not only in installed capacity or annual generation, but in the range of services it can provide to renewable-dominated systems: firm electricity, storage, dispatchability, inertia, flexibility, resilience, water management and long-term domestic value creation.

Realising this opportunity will require action on several fronts. Governments need to recognise hydropower and pumped storage as strategic infrastructure, value flexibility and system services more effectively, streamline permitting, support modernisation, and implement mechanisms to create stable investment conditions for both greenfield and brownfield projects. Done well, sustainable hydropower can help deliver not only more renewable electricity, but more secure, resilient and sovereign power systems.

Methodology

The data presented in this report have been continuously tracked and updated to account for new information in IHA's global hydropower database, which tracks more than 14,000 stations in over 150 countries. Data was compiled by a team of analysts using information sourced from:

- Official statistics from governments, regulation agencies, transmission network operators and asset owners
- Scientific articles and reports
- Daily news reports involving hydropower plant development, official declarations of contracts and equipment deals
- Direct consultation with operators and industry sources.

Different sources report on capacity and generation using their own methodologies. For example, some countries may not include off-grid facilities (hydropower plants not connected to the main electricity grid) in their official statistics, while others do. Where possible IHA has accounted for these differences but some inconsistencies may remain.

When generation data from primary sources were not available, estimates were prepared based on previous year figures, averaged capacity factors and regional meteorological data. For a small number of countries, capacity data sources may have been changed due to data availability and have been revised with updated information. As a result, some countries may show year-on-year differences compared to previous years' reports. These updated capacity numbers, however, do not represent new capacity added or retired in 2025.

Since the 2023 reporting cycle, historical capacity and generation data may also be revised during the annual data collection process to reflect updated information published by source organisations and improve the accuracy of year-on-year comparisons. As a result, values reported for previous years may differ from those published in earlier editions of this report.

Publicly available information on projects has been supplemented by IHA's own research.

Figures presented in this report are rounded to an appropriate level of precision for clarity and consistency. As a result, totals may not always equal the sum of their component parts, and percentage shares may not add to exactly 100%.

Jirau hydropower plant, Brazil.
Credit: Engie Brazil

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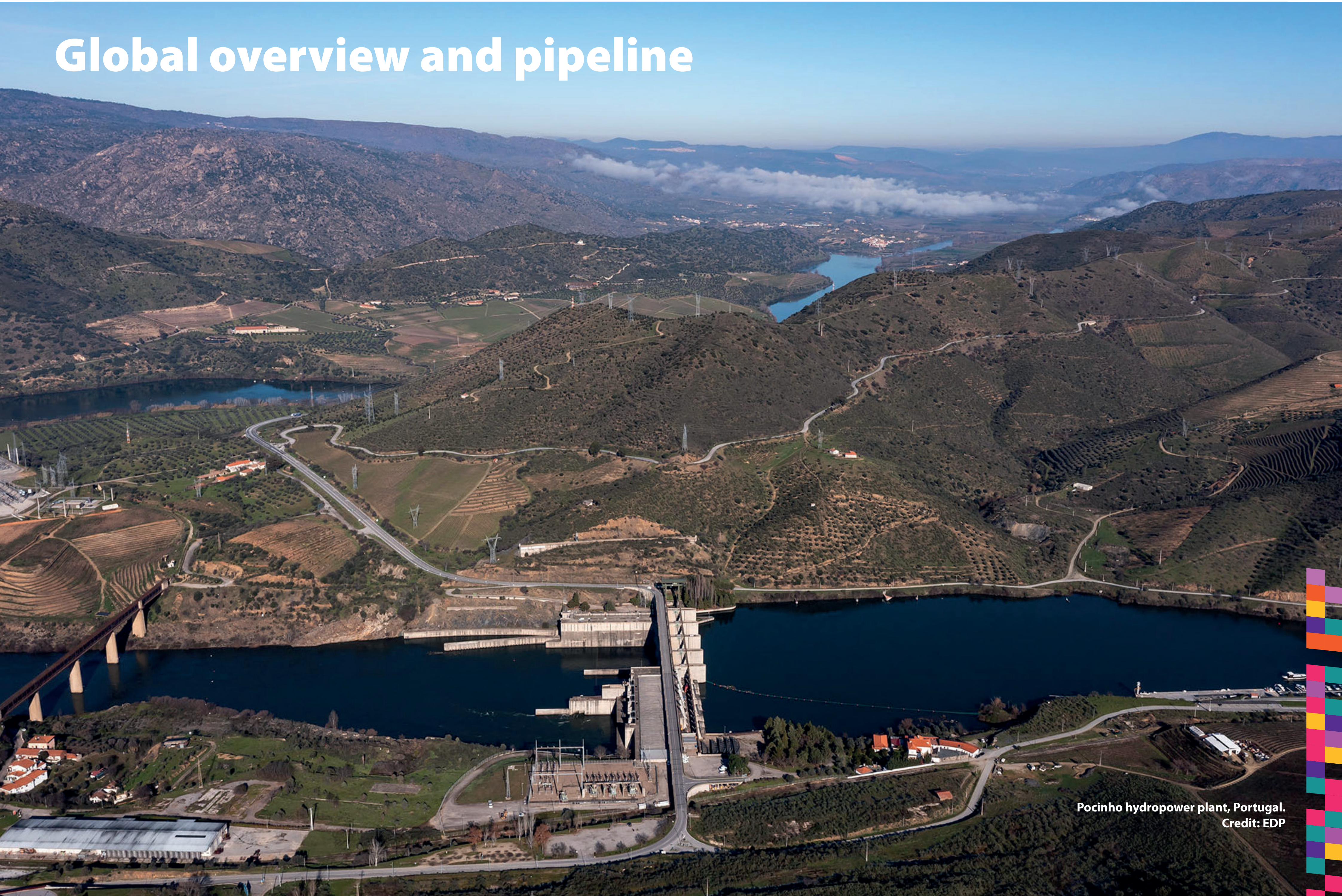
Global overview and pipeline



Pocinho hydropower plant, Portugal. Credit: EDP

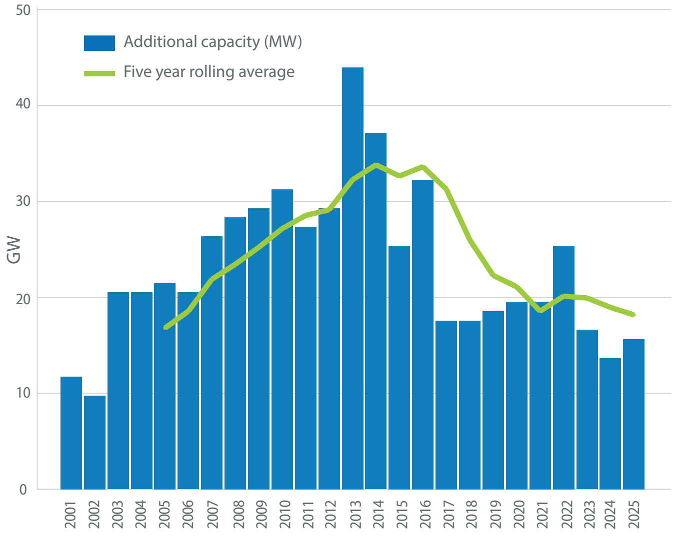
Global hydropower status in 2025

Hong Ping pumped storage plant, China
Credit: Voith Hydro

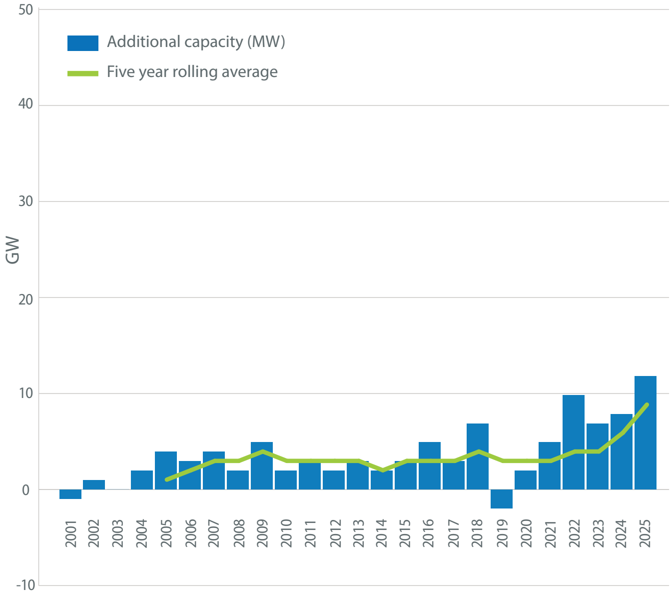
Global hydropower capacity continued to expand in 2025, reaffirming its position as the world's largest source of renewable electricity and an increasingly important provider of flexibility services to modern power systems. Total installed hydropower capacity reached over 1,469GW by the end of the year, comprising 1,269GW of conventional hydropower and 201GW of pumped storage.

A total of 28GW of new hydropower capacity was commissioned globally in 2025, including 16GW of conventional hydropower and 11.7GW of pumped storage. The year marked a record for pumped storage deployment, with annual additions reaching their highest level to date as global capacity breached the 200GW milestone.

Conventional hydropower annual additions and five-year rolling average

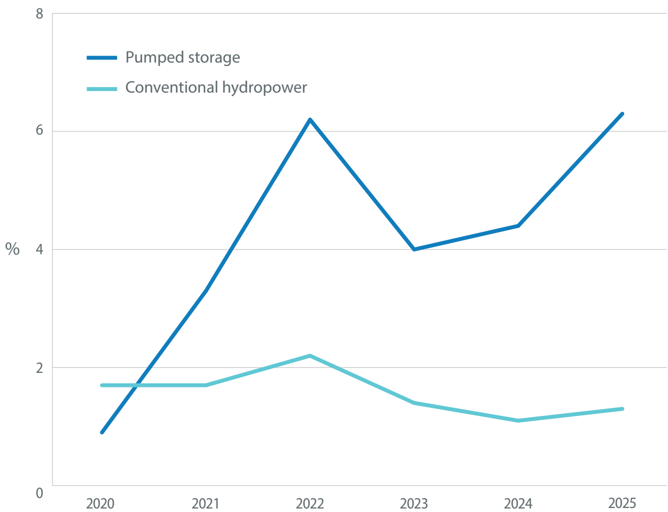


Pumped storage annual additions and five-year rolling average



Annual pumped storage additions are clearly accelerating. In 2025, they entered double digits for the first time, driven by pumped storage's crucial role in the electrification process. The 6% annual growth of pumped storage in 2025 represents a sharp increase from the historical average of circa 2% between 2010 and 2020.

On the other hand, conventional hydropower growth remains stable between 1% and 2% per year and heavily concentrated in emerging and developing economies, where the growing demand for reliable and affordable electricity can be satisfied by the vast remaining hydropower potential. Africa, South and Central Asia, and East Asia and Pacific delivered most of the new capacity in 2025.



Conventional hydropower and pumped storage % annual growth
Note: % Annual Growth calculated as Annual Additional Capacity over Annual Total Installed Capacity

On a country level, China again led the way on both conventional hydropower and pumped storage expansion with 4.7GW and 7.5GW added respectively. Significant development also occurred in Ethiopia, with the completion of the 5GW Grand Ethiopian Renaissance Dam (GERD) project. Other countries with notable additions included India (4.2GW) and Indonesia (1.1GW).

Despite these signals and the considerable remaining untapped potential, conventional hydropower development continues to progress well below the deployment rate outlined by the International Renewable Energy Agency in its tripling up scenario to achieve a successful and timely energy transition process.

Hydropower generation in 2025 totalled 4,495TWh. Despite continued capacity expansion, overall output declined compared with the previous year, reflecting variable hydrological conditions across several major producing regions. Regional performance remained uneven, with increases in East Asia and Pacific, Africa and North America offset by lower generation in Europe, South America, and South and Central Asia.

While annual generation remains a key indicator of sector performance, these trends also highlight the evolving role of hydropower within modern power systems. As variable renewable energy deployment accelerates globally, hydropower is increasingly valued and operated not only for its contribution to electricity production, but also for its ability to provide flexibility, balancing services, reserve and blackstart capability and overall system stability. In many markets, hydropower assets are progressively shifting away

Credit: Dans Energy, India

from traditional baseload operation towards more dynamic and flexible modes of dispatch, supporting the integration of growing shares of solar PV and wind generation.

Lesson from the pipeline

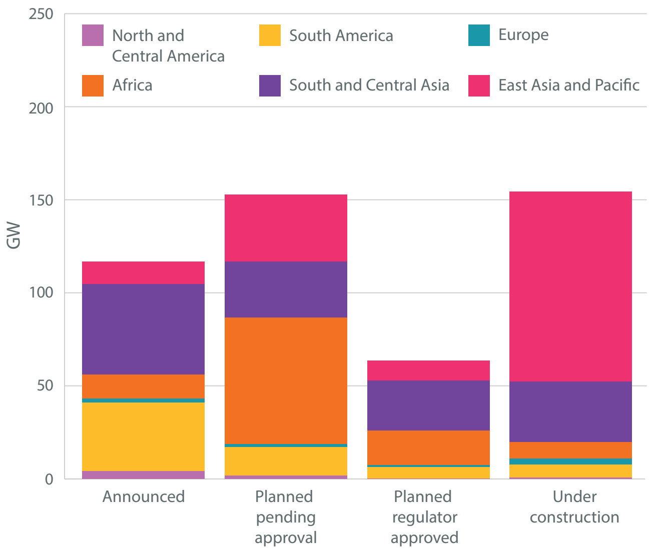
Data collected by IHA indicate that the overall hydropower pipeline is progressively growing, with a total of 1,127GW of projects identified. Noticeably, the pumped storage pipeline reached 621GW in 2025, comprising 243GW under construction, 188GW in a planning or pre-financing phase, and 190GW announced.

Today, pumped storage represents the majority of hydropower capacity under construction globally, highlighting its central role in long-duration electricity storage and system balancing. China remains the dominant market, accounting for more than 80% of capacity under construction.

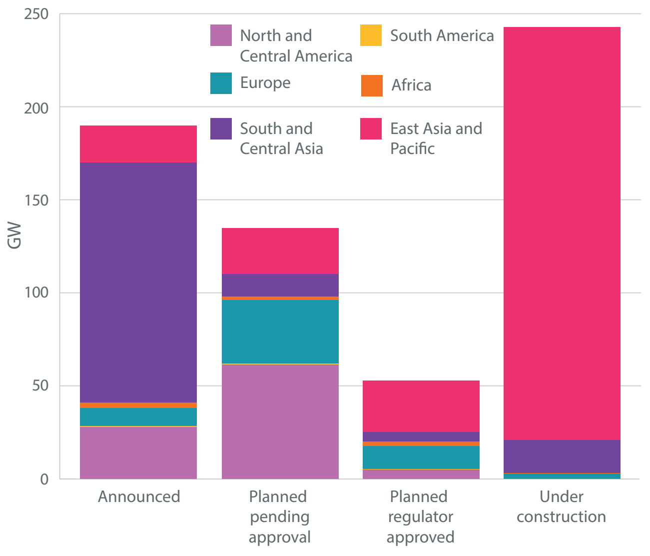
Other mature power markets, such as India, Europe, US and Australia, continue to account for most remaining pipeline activity, reflecting increasing system flexibility and long-duration electricity storage requirements combined with the urgency to reduce dependency on expensive and volatile carbon-based energy sources.

An emerging trend is the deployment of pumped storage in countries with limited or no conventional hydropower base. The United Arab Emirates commissioned a 250MW pumped storage facility, while Israel expanded its capacity with a second plant, bringing total installed pumping capacity to 644MW. Saudi Arabia has over 4GW of projects in the pipeline, with 1GW already approved by regulators.

Conventional hydropower capacity pipeline



Pumped storage capacity pipeline



This further reinforces how pumped storage is effectively a universal solution, implementable at large scale across all regions.

Interest is also beginning to grow across developing economies with rapidly accelerating renewable energy deployment. In Southeast Asia, countries such as Indonesia, Vietnam and the Philippines are exploring pumped storage to address rising flexibility and storage requirements linked to expanding solar and wind generation. Similar discussions are emerging in Brazil, where increasing renewable curtailment is strengthening the case for long-duration storage solutions.

Meanwhile, the conventional hydropower pipeline reached 506GW, of which 160GW is under construction. A further 224GW is in planning or waiting for final investment decision, and 122GW is still in the early stages of development.

The global conventional hydropower pipeline remains heavily concentrated in emerging and developing regions, with East Asia and Pacific accounting for the largest share of projects currently under construction. The vast majority of the 106GW of capacity under construction in East Asia and Pacific is located in China, followed by Indonesia with almost over 10GW. South and Central Asia also maintains a substantial pipeline across all development stages, driven by continued investment in large-scale renewable generation and electricity system expansion in India, Pakistan and Nepal.

Earlier-stage development activity is more geographically diversified. Projects in the planning


Faslefoss hydropower plant, Norway
Credit: ANDRITZ Hydro

and approval phases are distributed across Africa, South and Central Asia, East Asia and Pacific, and South America, indicating sustained long-term interest in conventional hydropower development across emerging markets. Africa in particular has a significant volume of projects in pre-construction stages and remained a key driver of new conventional hydropower additions in 2025, installing more than 4GW for a second consecutive year. This highlights the sector's potential role in supporting future electrification, industrial growth and energy security objectives across the continent.

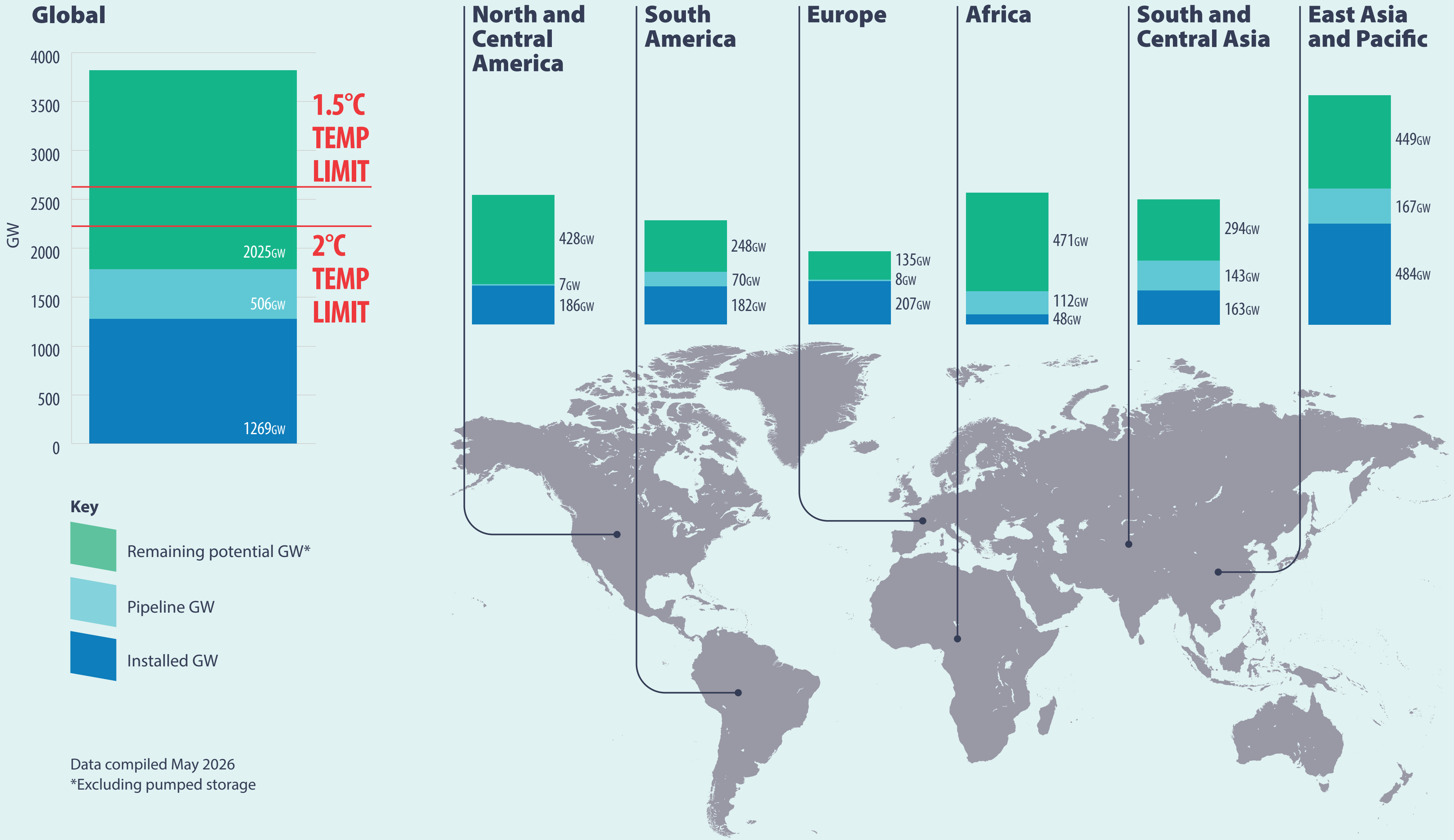
These figures highlight the significant remaining potential for conventional hydropower development and its fundamental role in supporting electricity access, grid stability and broader economic development.

The global outlook

The hydropower sector enters the coming years with a record development pipeline and growing recognition of its role in energy security, decarbonisation and system flexibility. Conventional hydropower continues to underpin electricity expansion in developing economies, while pumped storage is emerging as the dominant growth driver in more mature markets.

More than 400GW is currently under construction globally across both technologies. While it is difficult to foresee when all of these projects will be commissioned, or whether they will reflect their current form, this scale of activity points to a potential deployment rate of 30–40GW per year over the coming decade, well above recent historical levels.

Installed, pipeline and potential for conventional hydropower capacity



Data compiled May 2026
*Excluding pumped storage

Pumped storage accounts for over half of this construction activity and is on track to double over the next 10 years and potentially triple over the next 15 years. Annual additions are expected to remain in double digits, reaching more than 20GW in peak years. The East Asia and Pacific region is expected to account for most near-term development, with China retaining a leading role.

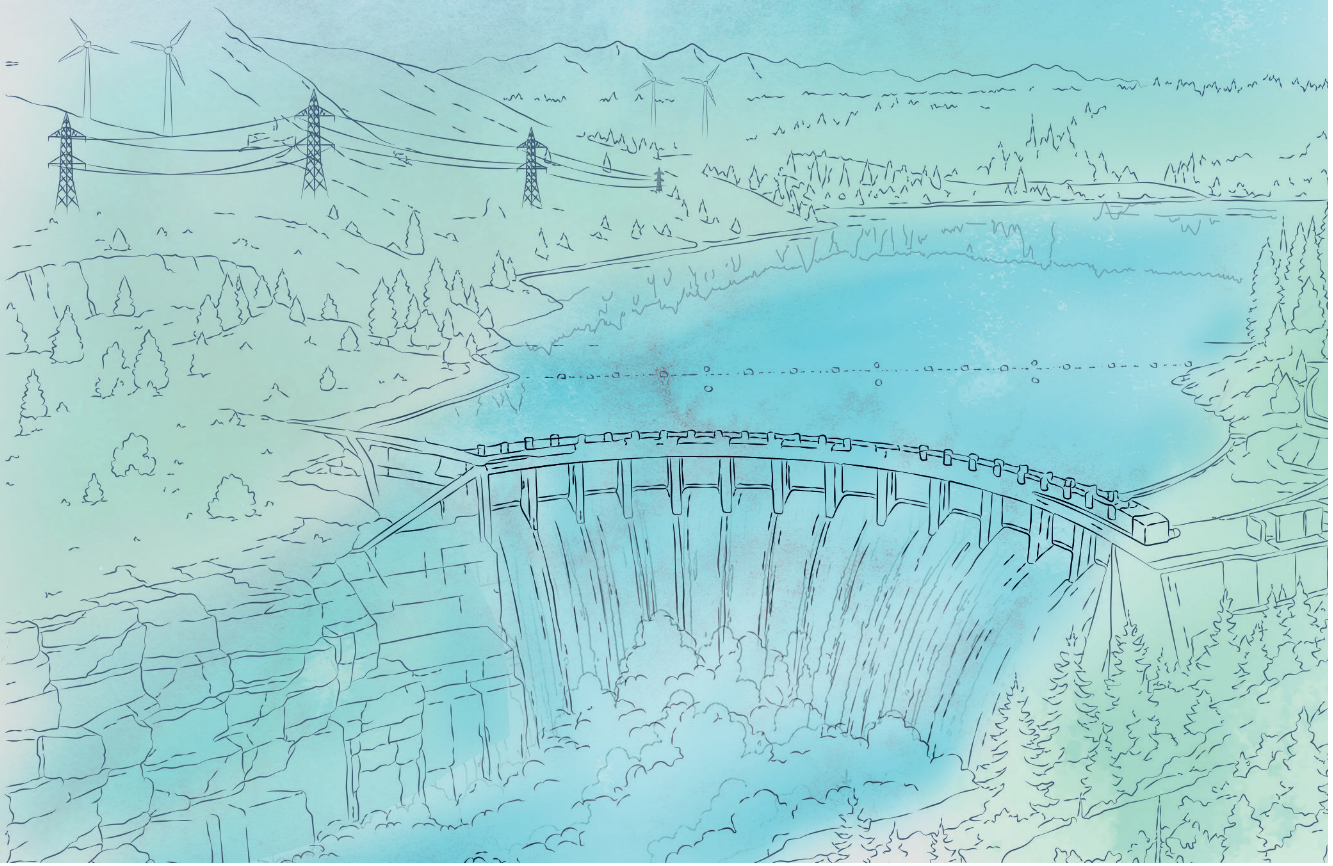
This analysis, focusing primarily on projects under construction, may potentially understate near-future pumped storage growth. Beyond China's mass-scale development, several countries hold significant portfolios of well-defined projects that could advance rapidly under supportive conditions. India is particularly notable: over 150GW of pumped storage is currently in development, and the country's recently announced target of over 100 GW operational capacity by 2035-36 could accelerate a substantial share of this pipeline towards construction and commissioning. Additionally, India has already demonstrated strong delivery capability. The 1.3GW Pinnapuram project, for instance, was completed in just 48 months.

Even if it is complex to forecast the sector's development in the longer term, the substantial volume of projects in planning and announced stages is an encouraging signal, indicating that the current expansion could evolve into a sustained multi-year investment cycle rather than a short-term peak. Realising this potential at scale will depend on improved and sustained policy support to facilitate project development and strengthen investment certainty, especially in more liberalised markets.

Taken together, these dynamics suggest that the current growth trajectory, increasingly driven by a pumped storage renaissance should further progress in the next 5–10 years and could be sustained over the medium to long term. The combination of substantial under-construction capacity and a deep early-stage pipeline provides a structural foundation for continued expansion, signalling that deployment is poised to accelerate in the years ahead.

Achieving this potential will require policymakers to play a central role in establishing clear market and political signals, streamlining permitting and approval processes, and ensuring that regulatory frameworks properly recognise hydropower's strategic contribution to reliable, flexible and low-carbon power systems.

Francis turbine runner for Rogun hydropower plant, Tajikistan
Credit: Voith Hydro



Hydropower's global impact in numbers (2025)

1,469GW
Installed hydropower capacity (conventional + pumped storage)

4,495TWh
Electricity generation

2.3 million
Direct jobs

1,127GW
Capacity in development

14%
Total electricity generation

+90%
Potential energy converted to electrical energy

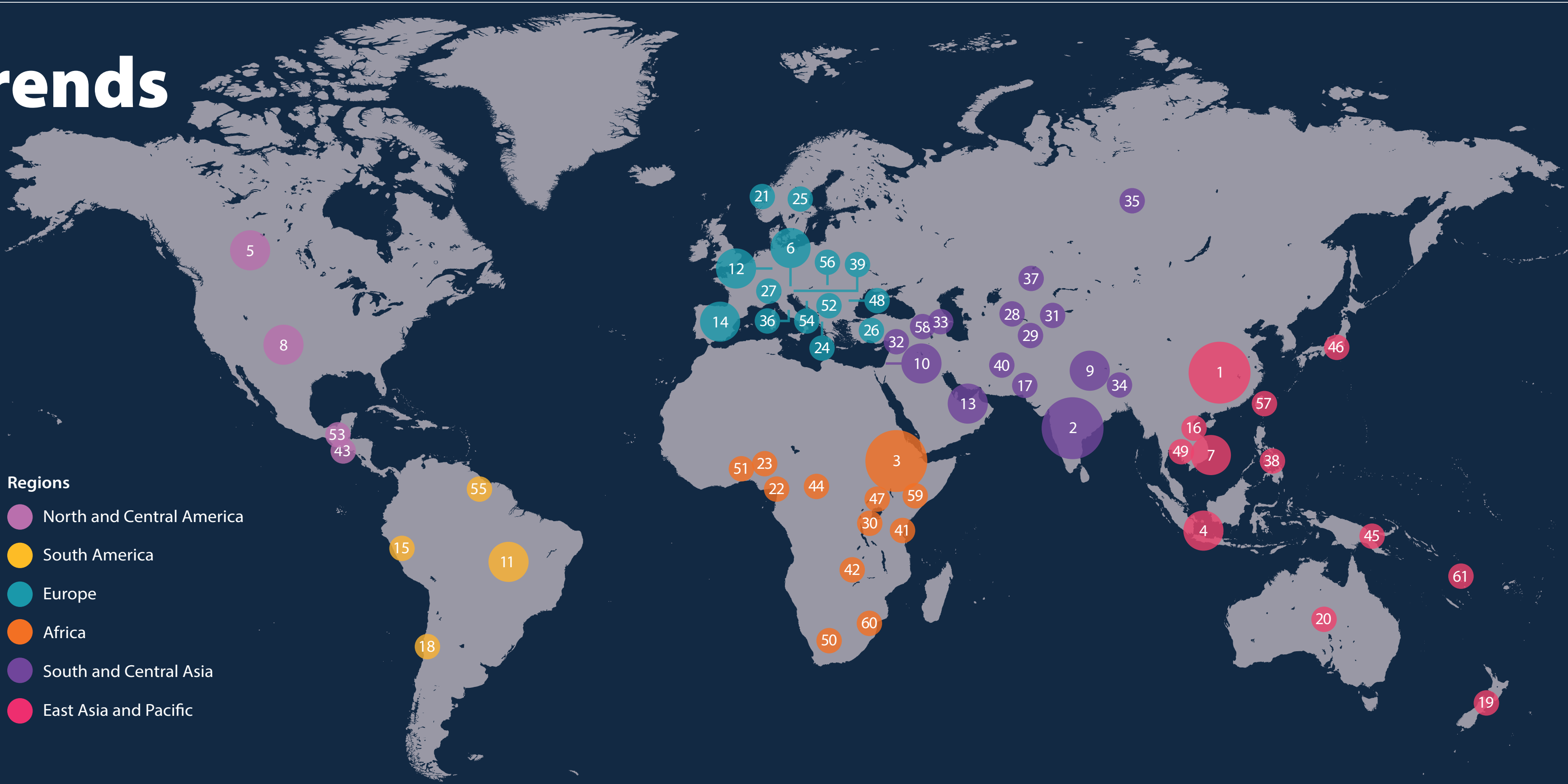
100+ years
Facility lifetime

17x
the total electricity consumption of Australia

2.2 billion
Tonnes of CO_2 avoided
as compared to gas combined cycle generation

Global trends

Where was capacity added in 2025?



Key

Capacity

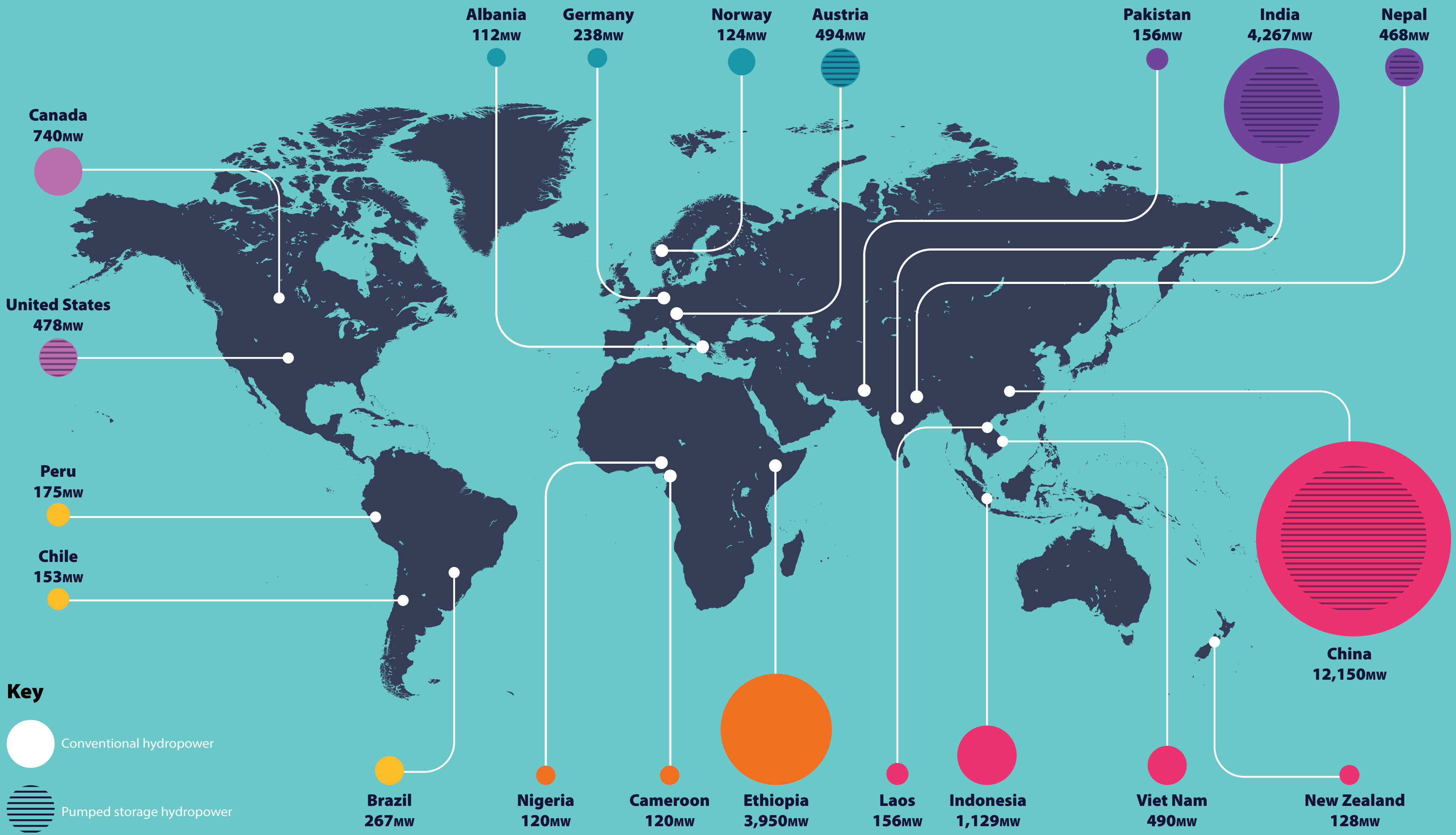
- 199MW and below
- 200MW to 1,999MW
- 2,000MW to 15,000MW

Regions

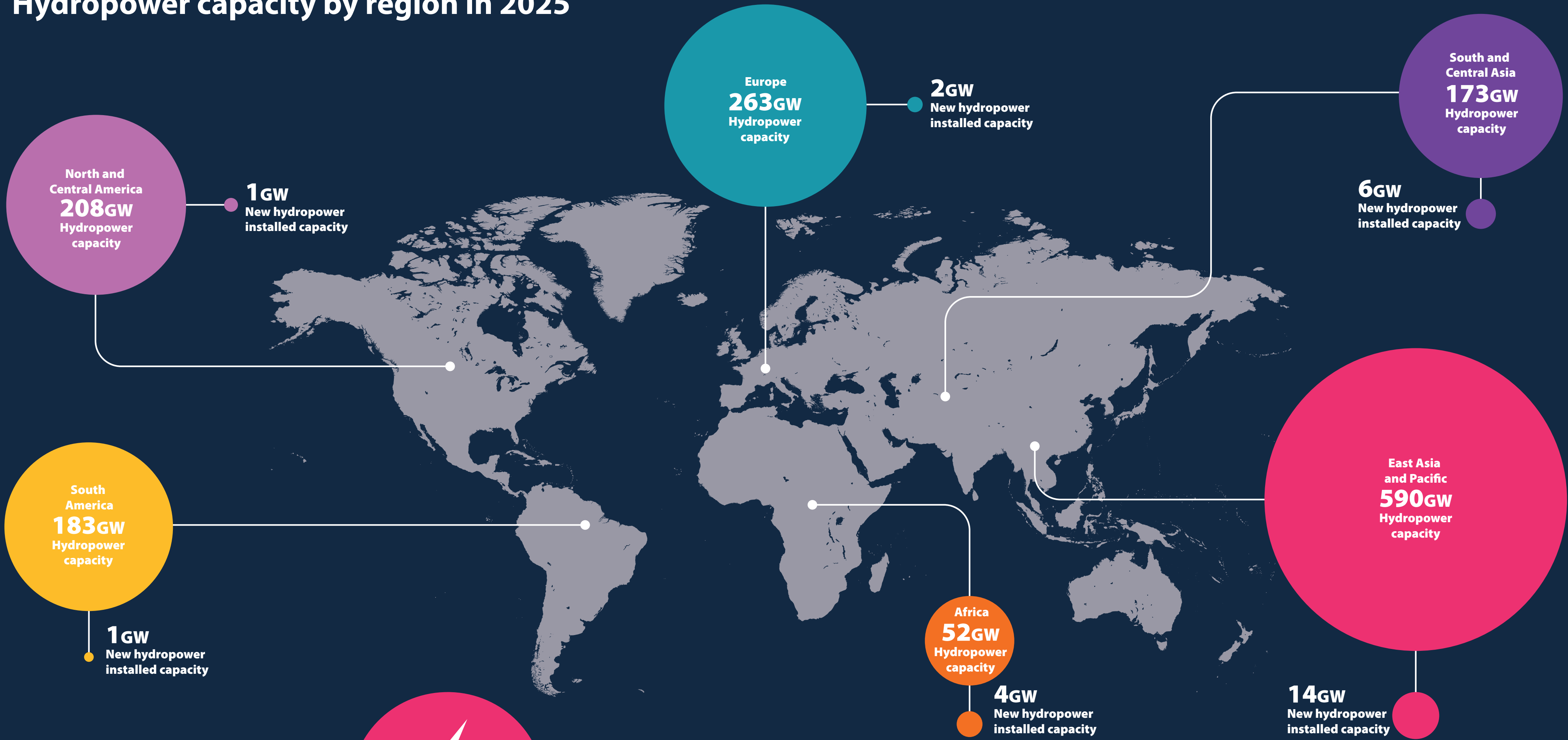
- North and Central America
- South America
- Europe
- Africa
- South and Central Asia
- East Asia and Pacific

	Country/region	Conventional (MW)	Pumped storage (MW)	Combined (MW)
1	China	4,670	7,480	12,150
2	India	1,837	2,430	4,267
3	Ethiopia	3,950		3,950
4	Indonesia	1,129		1,129
5	Canada	740		740
6	Austria	14	480	494
7	Vietnam	490		490
8	United States	158	320	478
9	Nepal	468		468
10	Israel		344	344
11	Brazil	267		267
12	Germany	238		238
13	United Arab Emirates		250	250
14	Spain		225	225
15	Peru	175		175
16	Lao PDR	156		156
17	Pakistan	156		156
18	Chile	153		153
19	New Zealand	128		128
20	Australia		125	125
21	Norway	124		124
22	Cameroon	120		120
23	Nigeria	120		120
24	Albania	112		112
25	Sweden	100		100
26	Türkiye	91		91
27	Switzerland	65	24	89
28	Uzbekistan	62		62
29	Tajikistan	59		59
30	Burundi	52		52
31	Kyrgyzstan	41		41
32	Syria	40		40
33	Azerbaijan	37		37
34	Bhutan	35		35
35	Russia	34		34
36	Italy	32		32
37	Kazakhstan	26		26
38	Philippines	25		25
39	Slovenia	20		20
40	Afghanistan	19		19
41	Tanzania	18		18
42	Zambia	12		12
43	El Salvador	12		12
44	Central African Republic	10		10
45	Papua New Guinea	9		9
46	Japan	7		7
47	Uganda	7		7
48	Romania	6		6
49	Cambodia	5		5
50	South Africa	5		5
51	Togo	4		4
52	Serbia	3		3
53	Guatemala	2		2
54	Bosnia and Herzegovina	2		2
55	Guyana	2		2
56	Hungary	1		1
57	Taiwan, China	1		1
58	Armenia		>1	>1
59	Kenya	>1		>1
60	Eswatini	>1		>1
61	Vanuatu	>1		>1

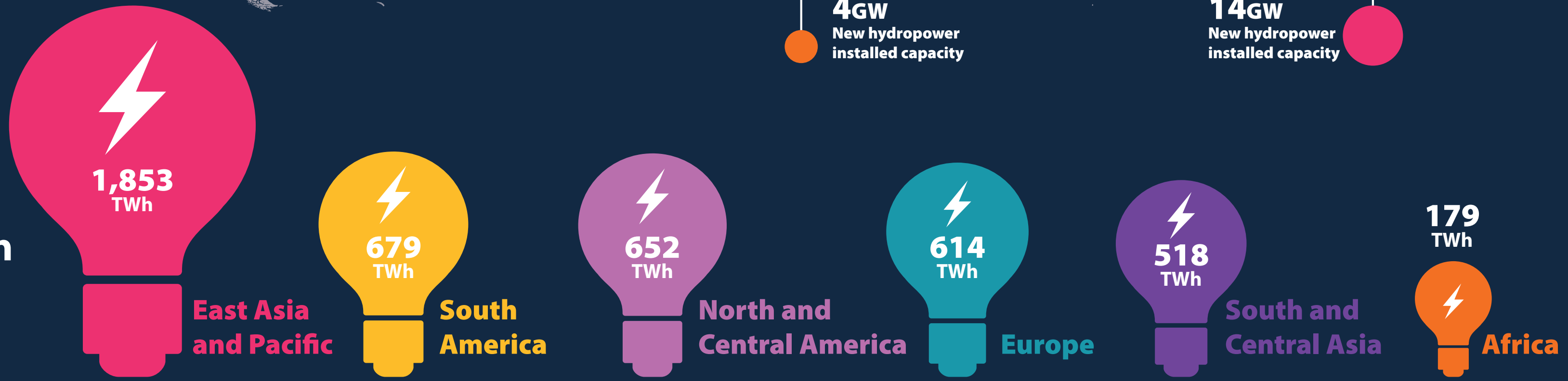
Top 20 countries by new installed capacity in 2025 (MW)



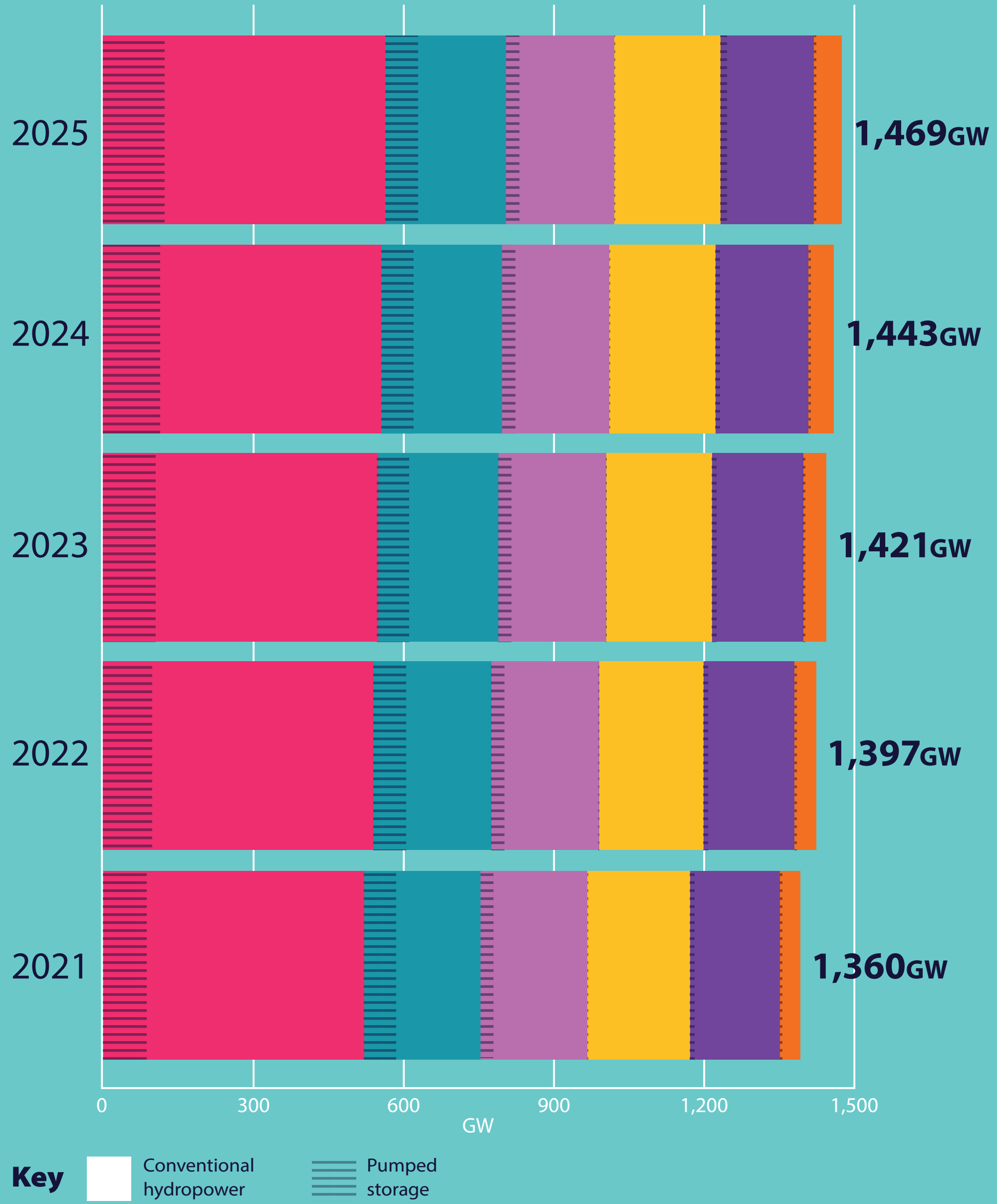
Hydropower capacity by region in 2025



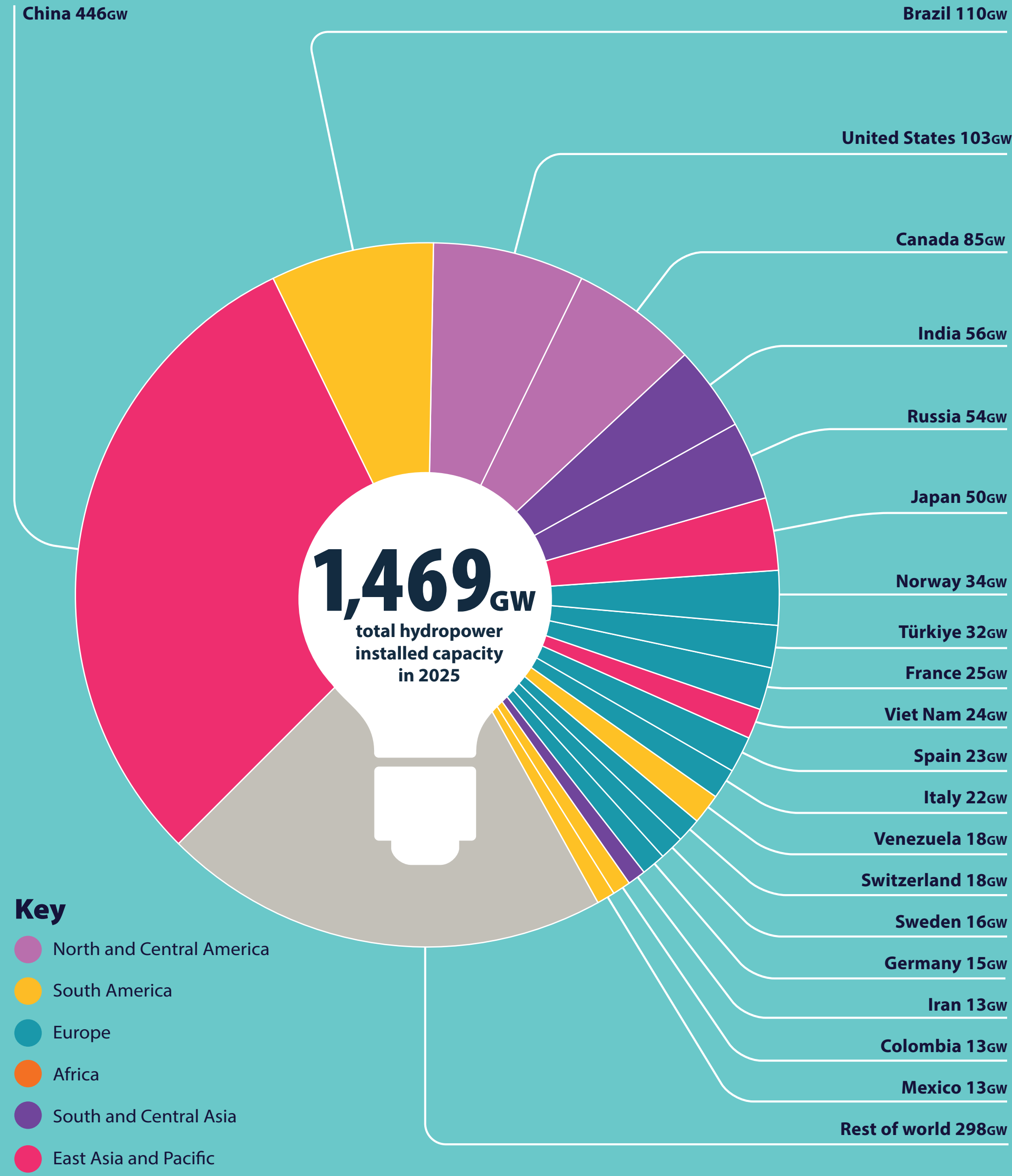
Hydropower generation by region in 2025



Hydropower installed capacity growth 2021–2025



Overall hydropower installed capacity 2025



Hydropower as a pillar of energy security and sovereignty in renewable-powered economies

Jirau hydropower plant, Brazil
Credit: Engie Brazil

Electrification as a pathway to energy security and sovereignty

Energy systems have undergone a profound transformation over the past two decades, driven primarily by the need to decarbonise and electrify national economies. This transition has been underpinned by a widely held assumption: that global energy markets would continue to deliver resources, fuels and technologies uninterruptedly, affordably and at scale.

Today, that assumption is being fundamentally challenged. The deterioration of geopolitical relationships, characterised by conflicts, trade tensions and supply chain disruptions, has exposed structural vulnerabilities in energy systems. As a result, the energy transition is entering a new phase in which security of supply and strategic autonomy are becoming, in the eyes of many policymakers, even more urgent than decarbonisation.

The world economy is riding on a fossil fuel roller-coaster. Recent volatility in global energy markets has brought this shift into sharp relief. The conflict in the Middle East and disruption to flows through the Strait of Hormuz pushed global oil prices up by nearly 50% in the months following December 2025, alongside steep increases in gas prices across Asia and Europe. IMF Managing Director Kristalina Georgieva warned that "as a rule of thumb, we see every 10% increase in oil prices – if persistent through most of this year – resulting in a 40 basis point increase in global headline inflation".

More broadly, an International Energy Agency report on Strategies for Affordable and Fair Clean Energy Transitions in June 2024 highlighted that energy history has been marked by sporadic oil price shocks, noting 13 episodes of sharp or sustained price increases since 1973, and that such shocks had become more frequent in the 21st century.

In this evolving context, the objective of the energy transition is broadening beyond the initial goal of reducing emissions. Governments are increasingly focused on strengthening the resilience and sovereignty of power systems, limiting exposure to external shocks, and reducing dependence on imported fossil fuels.

Electrification is amplifying this shift. According to the International Energy Agency, electricity could account for close to 50% of final energy consumption by 2050. As economies become increasingly reliant on electricity, the ability of power systems to operate

Francis turbine runner,
Rogun hydropower plant, Tajikistan.
Credit: Voith Hydro

reliably under uncertain market, geopolitical and climatic conditions becomes a defining element of energy security.

Within this new energy security paradigm, hydropower stands out as a uniquely strategic technology. As a provider of low-carbon electricity and essential system services, it has long been the backbone of many economies. But today, it also enables the use of domestic, renewable resources, without relying on complex and volatile international supply chains, while supporting a secure and resilient energy transition.

Crucially, conventional hydropower and pumped storage represent universally relevant solutions. While resource endowments and system needs vary across regions, the ability to harness or improve the utilisation of water resources for flexible, dispatchable generation and long-duration storage is applicable across all economic contexts. As such, these technologies offer scalable opportunities for countries at all stages of development to enhance system resilience, integrate variable renewables and advance both energy security and sovereignty objectives.

Domestic generation for generations

Conventional hydropower and pumped storage contribute directly to energy sovereignty by harnessing domestic, renewable water resources for generations. Unlike fossil fuel-based generation, it does not depend on the availability of imported or locally extracted commodities of which cost is highly influenced by external geopolitical factors. This, in turn, reduces countries' exposure from fuel price spikes and geopolitical supply risks.

Reducing import dependence and enhancing sovereignty

The expansion of wind and solar power is central to reducing emissions, but variable renewable energy alone cannot eliminate dependence on thermal generation, particularly for system balancing and peak supply. In the absence of sufficient non-fossil flexibility, power systems continue to rely on thermal peaking plants to ensure reliability during periods of low renewable output or high demand.

This structural dependence limits the extent to which countries can achieve true energy sovereignty. Even with high shares of wind and solar, reliance on imported fuels for balancing capacity exposes systems to price volatility and geopolitical risk.

As the world's largest source of renewable electricity, hydropower provides around 14% of global generation and approximately 60% of renewable electricity. However, its strategic importance lies not only in how many electrons are produced, but in when and how these are delivered.

Conventional hydropower and pumped storage offer a pathway to overcome this constraint thanks to their unmatched dispatchability, flexibility and storage capacity.

Pumped storage further enhances this role by absorbing surplus generation and supplying electricity during periods of deficit, preserving the business models of variable renewable energy sources and ensuring that their generation is not curtailed.

System reliability and resilience

Resilient and reliable power systems need to be fed with stable electricity generation, constantly controlled to keep frequency and voltage under control and restarted in the shorter possible time in the eventuality of a blackout.

The progressive retirement of thermal generation is reducing the available flexibility and inertia, while the booming integration of wind and solar plants is increasing the need for ancillary services such as frequency and voltage control. In 2025, over 800GW of solar and wind were added globally (EMBER), and, according to the International Energy Agency's (IEA) latest projections, circa 60% of the total electricity generation will be sourced by variable renewable technologies by 2050.

Governments and transmission system operators need to urgently identify non-fossil flexibility solutions and proactively plan to maximise their provision. **With nearly 1,500GW of installed capacity globally and over 1,100GW currently in the pipeline, hydropower represents a strategic solution for the whole range of critical grid services.**

Hydropower assets also provide blackstart capability, enabling plants to restart independently and support system restoration following major outages. For instance, during the Iberian blackout, a major grid outage that affected large parts of Spain and Portugal in April 2025, hydropower assets played a key role in re-energising the grids of both countries, illustrating the growing importance of this function in renewable-dominated systems.

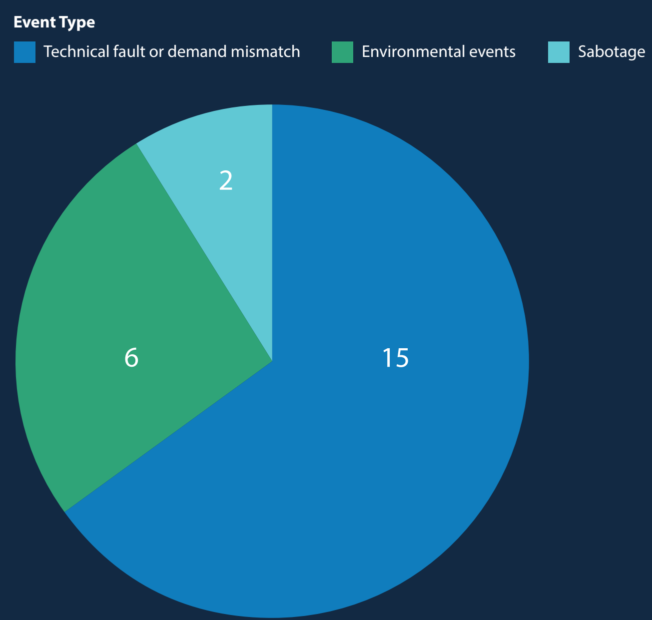
Taken together, these attributes position hydropower as a cornerstone of system reliability and resilience.

A recent IHA analysis examined major blackout events worldwide between 2015 and 2025. The analysis focused exclusively on large-scale incidents involving impacts on millions of people, disruption across entire countries or regions, or severe economic consequences. To ensure comparability, the assessment considered only power systems generally regarded as reliable, excluding systems characterised by chronic instability, recurrent large-scale outages, or structural grid weaknesses.

The analysis identified 23 major blackout events over the period. More than 60% were associated with supply–demand imbalances or failures in transmission and grid operations, while the remainder were triggered by natural hazards, sabotage, or a combination of factors.

As power systems continue to decarbonise, governments will need to carefully balance the rapid deployment of variable renewable energy and the retirement of coal-fired generation with adequate investment in non-fossil flexibility resources. Hydropower and pumped storage can play a central role in this transition, providing the reliability, resilience and system stability needed to maintain secure electricity supply while accelerating progress towards climate goals.

Major blackout events between 2015-25 (global).



Climate resilience and system risks

Climate change is increasingly reshaping the operating conditions of energy systems, introducing greater variability, uncertainty and exposure to extreme events that can disrupt supply and damage infrastructure.

Hydropower plays a dual role in addressing climate change by supporting both emissions reduction and climate resilience through flood protection and water security. Coping with climate change will necessitate significantly more water infrastructure, which should be powered whenever possible.

Closed-loop pumped storage, given its minimal need for freshwater access, can be less affected by climate change and seasonal flow dynamics.

Globally, hydropower generation avoids an estimated 2.2 gigatonnes of CO_2 emissions per year by displacing fossil fuel-based electricity. At the same time, hydropower infrastructure is closely linked to water management systems. Reservoirs provide flood control by regulating river flows and reducing peak discharge during extreme weather events, while also supporting drought mitigation by storing water for use during dry periods.

A clear example is China, where large-scale hydropower projects with significant water storage capacity such as the Three Gorges Dam combine power generation with flood protection for millions of people.

Policy priorities for secure and resilient power systems

As energy systems become more electrified and exposed to climatic and geopolitical risks, hydropower's role extends well beyond renewable generation. It is a cornerstone of system resilience, flexibility, energy sovereignty and climate mitigation.

However, its full value, particularly in providing flexibility, long-duration storage and blackstart capability, is still not adequately reflected in many policy and market frameworks. This risks underinvestment in infrastructure that is essential for a secure and sustainable energy transition.

Governments should therefore treat hydropower and pumped storage as strategic infrastructure and a core climate mitigation solution, embedding it into national energy and climate plans. This includes:

- Integrating hydropower into long-term capacity, resilience and decarbonisation strategies
- Recognising and valuing the provision of flexibility and system services
- Assessing both short and long-duration flexibility and storage needs separately, to effectively reduce strategic dependencies on thermal plants
- Supporting modernisation, expansion and conversion of existing hydropower assets

In an increasingly uncertain global context, sustainable hydropower is an issue of national security.

Commissioning of units 3 and 4 at the Ituango hydroelectric project, Colombia
Credit: EPM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Quantifying the benefits of pumped storage for economies and power systems

The increasing share of renewable energy is creating new challenges for power systems, such as curtailment, price volatility, reduced inertia, stability and availability of firm supply for several continuous hours and days. This makes long-duration electricity storage more important than ever. While electrochemical battery are effective for quick, short-term support, they are not enough on their own to meet the broader needs of a system with a high share of variable renewables.

When it comes to energy storage, countries will benefit from prioritising technologies that offer greater capacity and longer-duration electricity storage. However, the challenge lies in how to demonstrate and quantify these advantages. Many recent studies have explored the benefits of different storage options. A 2026

2x
system cost reduction

€915m vs €435m of system costs avoided annually, including avoided curtailment, gas consumption and CO2 emissions.

60%
curtailment reduction

~1,000 more operating hours per year, enabling:

- **+ 4TWh in stored renewable electricity**
- **60% reduction in curtailment**

3x
more hours of energy

3-to-4-times more hours of energy than electrochemical battery during periods of low renewable resource availability and high demand

59%
gas consumption reduction

- **Increased energy autonomy**
- **Reducing external dependence**
- **Avoided €180m of gas costs**

8%
avoided emissions

- **Reduction of emissions by 59%**
- **Equivalent to 8% decrease in the Spanish power system's emissions in 2025.**

study by EY, focused on Spain, examined two scenarios for developing 19GW of energy storage capacity by 2035. A first scenario included a more balanced mix of technologies, with 4GW of additional pumped storage, while a second scenario relied only on expanding electrochemical battery storage.

The results show that the scenario with more pumped storage delivers clear advantages. By shifting 4GW of planned storage capacity from batteries to pumped storage, the study identifies a range of benefits, as shown in the infographic below.

Furthermore, despite the noticeable benefits for the Spanish power system and consumers, according to the EY analysis electrochemical batteries received 12 times more public funding per unit of storable energy capacity than pumped storage.

The analysis concluded that to address these system challenges and capture the benefits of pumped storage, it is necessary to take immediate action across several areas, ensuring a level playing field through the introduction of revenue stabilisation mechanisms, reduced taxation burden, improved concession frameworks, and access to reserved grid capacity.

These are aligned with the core recommendations outlined by IHA in [Policy Frameworks for Pumped Storage Hydropower Development.]

La Muela II pumped storage plant, Spain
Credit: Shutterstock

Data drawn from EY Report The Strategic Role of Pumped Hydro in Today's Geopolitical Environment May 2026

Hydropower and the rise of large-scale data centres: opportunities and challenges

Credit: Shutterstock

The rapid rise of data centres is creating a new class of energy-intensive industry off-takers. According to a 2025 report by the International Energy Agency (IEA), data centres consumed around 415TWh in 2024, roughly 1.5% of global electricity demand, a figure comparable to the annual consumption of a large European economy such as France or Italy. This consumption is projected to more than double to 945TWh by 2030.

Rising demand from digital infrastructure creates a compelling opening for hydropower as a natural fit for digital industry off-takers seeking renewable energy. Hydropower offers firm, low-carbon, flexible electricity capable of serving 24/7 operations while supporting industrial development and wider energy system reliability. This capability is critical for AI workloads, which require uninterrupted electricity supply.

Hydropower as a partner for digital industry: early models

IEA's Energy and AI report shows that the US accounts for the largest share of increased demand from data centres by a substantial margin, followed by China. By 2030, electricity use by data centres in the US is set to surpass the combined consumption of all traditional energy-intensive manufacturing sectors, including aluminium, steel, cement and chemicals.

Technology firms are seeking new contract models to secure reliable power for their data centres, such as long-term capacity and power offtake agreements. This presents an opportunity for hydropower. For example, in the United States, Brookfield Renewable and Google established a first-of-its-kind Hydro Framework Agreement in 2025 to provide up to 3,000MW of carbon-free, round-the-clock hydropower.

The initial contracts involve Brookfield's Holtwood and Safe Harbor facilities in Pennsylvania, providing 670MW for a 20-year period to Google through long-term Power Purchase Agreements (PPAs) worth more than $3 billion. These arrangements enable Brookfield to extend and upgrade existing assets, balancing commitments to other consumers such as Amtrak, the national railroad company.

Smaller-scale projects also illustrate hydropower's synergy with digital industry. Current Hydro LLC in the Ohio River basin is supplying local data centre operator Digital Realty with renewable electricity from three upgraded lock-and-dam projects totalling 70MW. In Wisconsin, DPO, a developer of power dense data centres, and Consolidated Water Power Company are developing a 20MW AI computing facility co-located with hydropower generation. By leveraging existing transmission and distribution infrastructure, this project reduces deployment costs, accelerates timelines and generates incremental revenue for the utility without large-scale network expansion.

Pumped storage is also expected to play a major role in the US in meeting the needs of data centres through re-dispatching solar and wind generation and securing 24/7 renewable electricity supply. This is particularly relevant in the western US, where more than 24GW of coal, natural gas and nuclear capacity are scheduled to retire, and the resource mix replacing those units will predominantly be variable renewables and short-duration battery storage.

Emerging examples and strategies

Beyond the United States, data centre growth is influencing hydropower strategies worldwide. In Switzerland, Data Center Light operates with nearly all electricity supplied by an on-site hydroelectric plant. The facility generates 8GWh annually from a modest 1.65MW turbine, sufficient to power the co-located server.

In Canada, provinces including Québec, Ontario and British Columbia are considered attractive locations for data centres due to abundant low-cost hydropower and temperate climates that reduce energy required for cooling. Governments are developing frameworks to manage grid connections for large digital loads, balancing decarbonisation, reliability and economic benefits.

South America provides further cases of innovative partnerships. In Paraguay, HIVE Digital Technologies has secured long-term supply and substations to develop a 300-400MW high-performance computing hub powered predominantly by the Itaipú and Yacyretá hydropower plants. X8 Cloud Inc. is pursuing a similarly scaled AI data centre campus under a framework of reserved capacity and special electricity supply contracts. These arrangements allow operators to scale digital infrastructure rapidly while preserving flexibility and cost predictability.

Brazil illustrates an alternative approach through *"autoprodução por equiparação"* (equity self-supply), in which data centre operators gain long-term electricity control by acquiring shares in generation companies rather than outright ownership of hydropower plants. This model, used by Scala Data Centers with wind and hydropower partnerships, enables operators to meet hyperscale demand while participating in regulatory and tariff regimes without materially altering the underlying asset.

Managing impacts and system integration

Careful system planning is becoming increasingly important as energy demand from data centres accelerates. In Paraguay, large digital loads have

Cethana hydropower plant, Australia. Credit: Hydro Tasmania

prompted regulators to rethink how the grid handles intensive users. The national electricity administration has adjusted tariffs, introduced time-bound contracts running through to the end of 2027 and required guarantee deposits, all to manage exposure and prevent costs from shifting unfairly onto other consumers.

At the same time, delivering hundreds of megawatts of reliable power depends on robust transmission networks and dedicated substations. Grid-strengthening programmes supported by Itaipú Binacional have reinforced key lines and enabled exclusive connections for large-scale digital operations, keeping the system stable as hyperscale computing demand grows.

Hydropower and the future of digital energy

Coupling hydropower with a new generation of industrial off-takers builds on a long-established model in which energy-intensive industries and hydropower have developed side by side. Data centres are to hydropower today what heavy industries such as aluminium and pulp and paper were in the past, where reliable, affordable power shaped industrial location and investment.

This model could also help address one of the longstanding barriers to new hydropower development: the need for extensive transmission infrastructure to deliver electricity from often remote generation sites to major load centres. Enabling large electricity consumers such as data centres to locate closer to hydropower resources can substantially improve project economics by reducing the need for new long-distance grid infrastructure.

Hydropower is contributing to meeting the growing electricity needs of the technology sector. Innovative contracting models can facilitate this, such as long-term power purchase agreements and flexible frameworks that support investment in new generation, upgrades and grid infrastructure. Co-location of generation and consumption is another novel approach that will be particularly relevant in the case of data centres. Finally, in a rapidly digitising world, questions are being raised about resource allocation and infrastructure planning, particularly in regions with limited access to power. Digital loads should therefore be integrated into system planning.

The surge in data centre energy demand has the potential to be a transformative moment for hydropower. Technology providers seek round-the-clock, low-carbon energy supply and are willing to pay a premium for it, and the consumption point can often be chosen close to location with abundant energy resources. Hydropower checks all of the boxes.


Varosa hydropower plant, Portugal. Credit: EDP

Scaling up hydropower sustainability through strategic partnerships

Credit: Sarawak Energy

The Hydropower Sustainability Standard (HSS) is playing an increasingly central role in shaping how hydropower projects are planned, financed and operated worldwide. As of June 2026, 20 projects across all major continents have been certified under the HSS, with a growing pipeline of projects working towards certification. This steady growth reflects a broader shift across the sector, with sustainability moving from a project-level focus to a system-wide priority integrated across portfolios, institutions and national strategies.

A defining feature of this transition is the growing importance of partnerships. Governments, financial institutions, developers and international organisations are working together to integrate sustainability considerations earlier in the project lifecycle and across entire energy systems. These collaborations are expanding the reach of the HSS beyond individual assessments, helping to embed environmental, social and governance (ESG) principles into planning, financing and long-term asset management.

System-level integration of sustainability in hydropower

Historically, sustainability assessments in hydropower have often taken place once projects are already under development, limiting the ability to influence fundamental decisions such as site selection or system design. Recent initiatives are addressing this gap by bringing sustainability considerations into earlier stages of planning.

A notable example comes from Tajikistan, where the Hydropower Sustainability Alliance (HSA) has worked with national government partners to develop and launch a long-term Power System Plan (PSP) for the Gorno-Badakhshan Autonomous Oblast (VMKB) region to 2050. The plan integrates the HSS alongside HydroSelect, a new tool to guide early-stage decisions for hydropower development and investment.

The plan identifies a balanced mix of conventional hydropower, pumped storage and solar PV as the most resilient and cost-effective solution for a holistically planned energy system. HydroSelect is also being applied in Indonesia to strengthen project screening across the national hydropower pipeline, while financial institutions in Nepal are using the tool to support ESG due diligence and investment decisions.

Together, HydroSelect and the HSS extend sustainability considerations across the project lifecycle, from site selection and planning through to implementation and operation.

Partnerships with finance: sustainability guiding investment decisions

Financial institutions are playing a growing role in scaling hydropower sustainability. Banks and investors are increasingly integrating the HSS and HydroSelect into their due-diligence processes in recognition that strong ESG performance is closely linked to project viability and long-term risk management.

In Nepal, a partnership between HSA, NMB Bank and development finance partners is advancing how sustainability can be embedded into lending practices. Building on a memorandum of understanding signed in 2024, NMB Bank has carried out HydroSelect assessments across multiple projects, and is developing in-house expertise to strengthen ESG risk management.

The growing business case for sustainability certification is also becoming clearer. In New Zealand, for example, certification of Contact Energy's Clyde and Roxburgh projects enabled their inclusion in a green asset pool, unlocking significant additional capacity for climate-aligned borrowing. In Brazil, the Gold certification of the Mascarenhas Hydropower Plant in 2025, led by institutional investment firm Victory Hill, also shows how certification strengthens investor confidence in the management of long-standing hydropower assets within diversified infrastructure portfolios.

Industry partnerships: scaling to project portfolios

Collaboration with developers is also evolving, with an increasing focus on portfolio-wide integration of sustainability practices. In Greece, a partnership between HSA and PPC Group is working to embed ESG principles across the company's hydropower portfolio.

This partnership features a structured programme of training, self-assessment and capacity building that is equipping PPC's teams to apply the HSS across existing and planned assets. Recent engagement has expanded to include internal assessor training and portfolio-level analysis, reflecting a shift toward integrating sustainability into corporate strategy and reporting.

Similar efforts are taking effect in Indonesia, where nearly a decade of collaboration between government institutions, developers and international partners has trained more than 100 professionals in applying the HSS, contributing to the Asahan-3 Hydroelectric Power Project becoming country's first certified project in 2026.

Government leadership and system-wide commitments

In some cases, partnerships are leading to commitments at the system level. In Sarawak, the state government has announced plans for all major hydropower plants to be certified under the HSS by 2030. If implemented, this would represent one of the first examples of full portfolio certification at a jurisdictional scale.

Such commitments signal a shift toward integrating sustainability standards into energy policy and long-term planning, as governments look towards independent frameworks like the HSS to guide sector-wide development.

Partnerships are also extending the application of the HSS to new contexts. In Colombia, collaboration between HSA, CEERA and local developer Electropalmor supported the first certification of a

Ituango hydropower project, Colombia. Credit: EPM small-scale, community-led hydropower project under the HSS.

Recognition from energy buyers and global initiatives

The growing adoption of the HSS is also being reinforced by demand from energy buyers and international initiatives. It is now recognised within the technical criteria of RE100, enabling companies committed to 100% renewable electricity to source hydropower that meets defined sustainability requirements.

Corporate buyers are increasingly seeking assurance that renewable energy is developed responsibly. Tech giants like Google have indicated a preference for hydropower projects with third-party sustainability certification, including the HSS.

In parallel, the integration of the HSS into renewable energy certificate frameworks, such as through collaboration with the I-TRACK Foundation, is strengthening traceability and transparency. This enables buyers to verify that their electricity purchases are linked to projects meeting recognised sustainability standards.

In Europe, the HSS is also increasingly recognised as a valuable support tool for demonstrating alignment with the EU Taxonomy for sustainable activities. It already covers many of the ESG criteria relevant to hydropower projects under the Taxonomy framework, helping operators and financiers strengthen sustainability reporting and support access to green finance.

The HSS review: a collaborative opportunity for progress

Five years after its launch, the Hydropower Sustainability Standard is undergoing a comprehensive review involving stakeholders across government, industry, finance and civil society. The process aims to ensure the framework continues to reflect evolving expectations and emerging challenges, while strengthening alignment with complementary tools such as HydroSelect.

An updated version of the HSS is expected to be presented at the World Hydropower Congress in Sydney in April 2027, marking the next phase in the evolution of the framework.

Steps to strengthen hydropower sustainability

- Build internal capacity through Hydropower Sustainability Standard (HSS) training programmes for project teams and decision-makers.
- Apply HydroSelect during early-stage planning to help identify lower-risk and more sustainable development options.
- Certify your projects at all stages – design, implementation and operation – to ensure financial approval and to meet permitting requirements.
- Join the Industry Chamber of the Hydropower Sustainability Alliance, convened by IHA, to help shape and promote the HSS.


Ituango site visit.
Credit: Hydropower Sustainability Alliance

sarawak energy

Powering Sustainable Growth

Hydropower development in Sarawak has been a key enabler of sustainable development, contributing to the State's economic growth as well as the social and cultural prosperity of local communities. As the operator of the Bakun Hydroelectric Plant (HEP), Sarawak Energy continues to engage closely with surrounding communities through structured, long-term social investment programmes designed to support sustainable livelihoods and shared value creation.

Bakun HEP

2,520 MW Available Capacity

Commissioned in 2011

Hydropower Sustainability Standard

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Bakun: strengthening sustainability at one of Southeast Asia's largest hydropower plants

Hydropower projects operating in environmentally and socially sensitive regions often face some of the most complex sustainability challenges. In Sarawak, Malaysia, the Bakun Hydroelectric Plant (HEP) is an example of how sustainability practices can continue to evolve at large operational projects through long-term commitment and targeted improvement measures.

In 2025, Bakun HEP received the IHA Blue Planet Prize, recognising outstanding progress in sustainability performance. The project also achieved Silver certification under the Hydropower Sustainability Standard (HSS) following an independent assessment covering environmental, social and governance criteria including biodiversity, community engagement, labour conditions, infrastructure safety and climate resilience.

Bakun HEP is one of Southeast Asia's largest hydropower plants, with an available capacity of 2,520MW. The project was fully commissioned in 2014 and plays a major role in Sarawak's electricity system, supplying renewable power to homes, businesses and energy-intensive industries across the state.

Using sustainability frameworks to drive operational improvement

The certification of the Bakun HEP reflects a broader process of operational improvement following Sarawak Energy's acquisition of the project in August 2017. Since then, Sarawak Energy has expanded environmental management systems, strengthened biodiversity and dam safety programmes, and introduced more structured stakeholder engagement processes. Internal assessments carried out using the HSS identified areas requiring improvement, which led to targeted action plans and expanded ESG reporting.

Bakun HEP's experience also highlights the importance of community engagement . The project is located in a region with significant cultural diversity, including indigenous Orang Ulu communities and resettled longhouse communities connected to the Bakun Resettlement Scheme (BRS). In this context, sustainability efforts have included ongoing consultation processes, community liaison activities and long-term social investment programmes.

Community engagement and socioeconomic development

Sarawak Energy's community development and sustainability initiatives at Bakun are guided by its four Corporate Social Responsibility pillars: Education and Young People, Environmental Management and Conservation, Culture and Heritage Preservation, and Community Development and Entrepreneurship. These focus areas helped shape the programmes and improvement measures that contributed to Bakun HEP's sustainability performance, recognised through its HSS Silver certification and IHA Blue Planet Prize.

Since 2019, Sarawak Energy has implemented a five-year Longhouse Adoption Programme covering all 15 resettled longhouses within the BRS area, benefitting around 15,600 residents. The programme includes infrastructure upgrades, entrepreneurship support, cultural and heritage preservation initiatives, and community-led development projects.

The project has also placed significant emphasis on local education and livelihood support. Nearly 1,000 students from the Belaga area have benefited from education assistance programmes, bursaries and tertiary support initiatives. Furthermore, artisan and entrepreneurship programmes have supported women and young people through training linked to traditional weaving, contemporary design and small business development.

Rather than representing a fixed endpoint, the HSS process has been used at Bakun as a tool to identify gaps, guide corrective actions and strengthen long-term operational practices. Bakun HEP's recognition in 2025 shows how sustainability improvements at large operational projects can be gradual, complex and long-term, but still capable of delivering meaningful change for both society and the environment.

Future proof your hydropower

The Hydropower Sustainability Standard is a globally recognised framework for assessing and improving sustainability performance.

Through independent assessment and certification, it supports better risk management, stronger stakeholder trust and greater investor confidence.

17,850 MW
Certified hydropower

12 +
Capacity building programmes

330 +
Organisations trained

● Certified projects

Hydropower Sustainability Alliance

Access expert training
Build lasting capacity
Certify your project
www.hs-alliance.org

Advertisement

Regional trends

Cethana hydropower plant, Australia.
Credit: Hydro Tasmania

North and Central America

Key trends

- **Hydropower remains a backbone of electricity supply, but many facilities are ageing;** modernisation programmes are underway to improve efficiency and extend asset life.
- **Growth is focused on upgrading existing facilities and expanding pumped storage,** particularly in Canada and the US, with new pumped storage plans also advancing in the Dominican Republic
- **Governments in Canada and the US are advancing permitting reforms and fast-track measures** to support major electricity infrastructure and hydropower modernisation projects.

Key data

Generation by hydropower in 2025
652 TWh

Capacity added in 2025*
1,232 MW

Pumped storage capacity added in 2025
0 MW

Total installed capacity*
208 GW

Total pumped storage installed capacity
23 GW

*Includes pumped storage

Aerial view of the Robert-Bourassa generating facility (La Grande-2), Canada
Credit: Hydro-Québec

Regional outlook

Hydropower remains a cornerstone of power supply across North and Central America, providing over half of electricity in several countries. However, many facilities are decades old, and so modernisation is moving up the agenda as a high priority for operators and governments alike, alongside a modest pipeline of new development: 6.8GW of conventional hydropower is in the pipeline, of which circa 10% is currently under construction.

In Canada, the 1,100MW Site C project (later renamed John Horgan Dam and Generating station) in British Columbia reached full commissioning in 2025, following the phased commissioning of generating units beginning in 2024, and is expected to add about 5,100GWh annually to the provincial grid. Initial studies began for the Churchill Falls/Gull Island project, a joint Newfoundland and Labrador–Québec initiative announced in late 2024. The project, if it goes ahead, is expected to add 3,900MW of new hydropower generation capacity, a sign of continued large-scale investment.

Development in Canada is also increasingly linked to Indigenous partnerships. Ontario Power Generation is co-planning two new hydropower stations in Northern Ontario with Indigenous groups, alongside refurbishments adding 40MW of capacity. In Nunavut, the Iqaluit Nukkiksautiit Hydroelectric Project has been prioritised for fast-tracking as a nation-building project. The territory's first 100% Inuit-owned hydropower facility, it is designed to replace roughly 15 million litres of diesel annually and provide reliable, emissions-free electricity.

Federal funding is also supporting smaller Indigenous-owned developments in Québec, including the 7.5MW Innavik Remote Hydro Project and a potential 17MW plant at the existing Matawin dam. These developments signal a shift toward energy sovereignty, local benefits and socially grounded models.

In the US, growth is expected to come largely through modernisation of existing facilities. Meanwhile, new pumped storage projects are also gaining momentum, with more than 60GW in the development pipeline. In 2025, the Federal Energy Regulatory Commission granted a 40-year licence for the 1,200MW Goldendale Pumped Storage project in Washington State, being developed by Rye Development and Copenhagen Infrastructure Partners. Meanwhile, operators including the Tennessee Valley Authority and Georgia Power continue to upgrade existing hydropower and pumped storage assets to strengthen grid reliability.

Across Central America, countries including Honduras, Guatemala, Costa Rica, and Panama are pursuing new hydropower and modernisation projects to meet rising demand and reinforce grid stability, while the Dominican Republic is ramping up ambitious plans for pumped storage development.

Interesting fact

The first Canadian Waterpower Day was held on 16 October 2025, celebrating the country's long-standing leadership in hydropower. The date recalls the inauguration of the Grand Chaudière Dam in October 1868, one of Canada's earliest large-scale hydroelectric projects. More than 150 years later, hydropower remains central to the electricity system, supplying over 60% of power while supporting reliable, affordable energy for homes and industry.

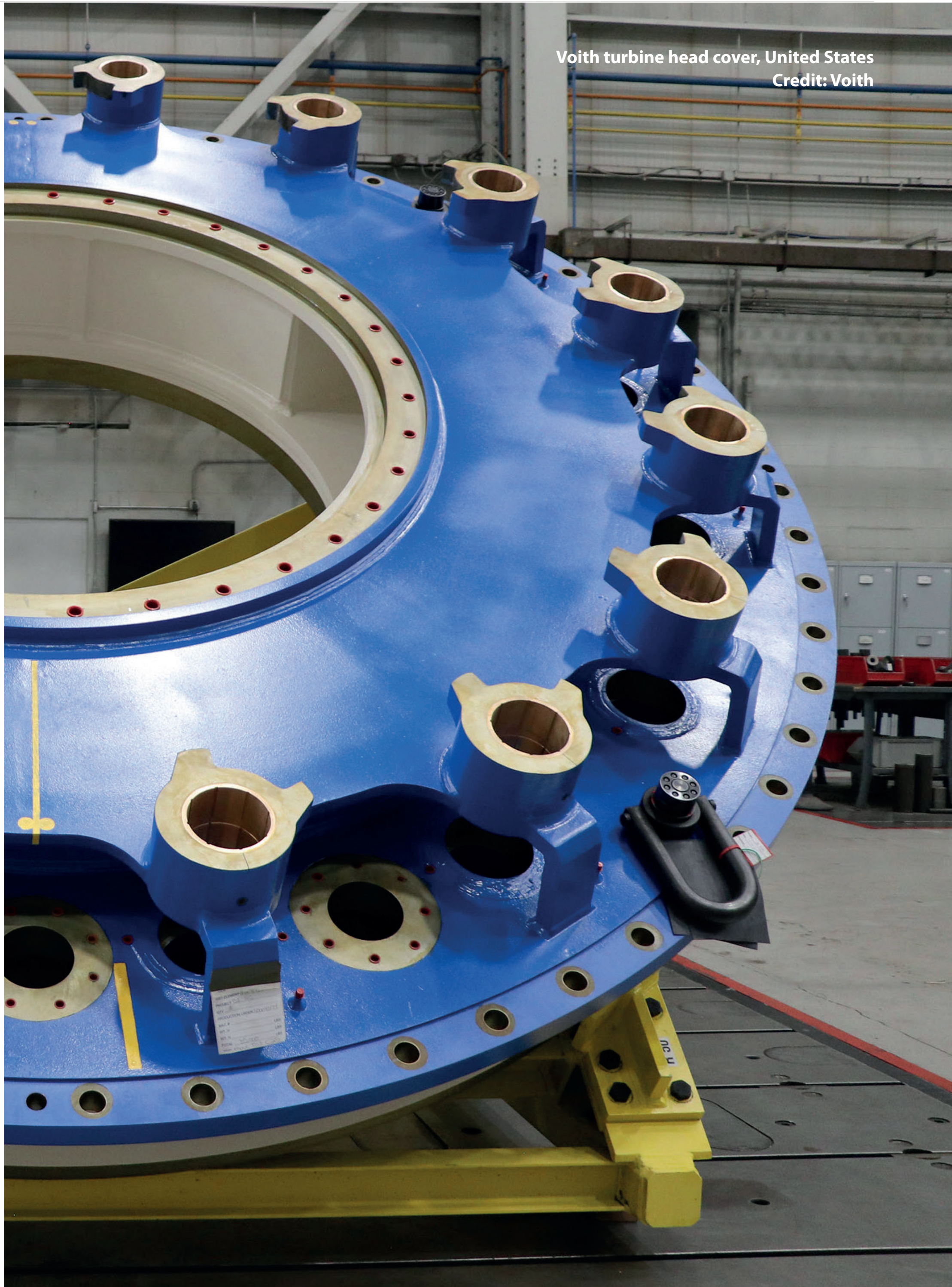
Hydropower's role in the next 10–15 years

Over the next decade and beyond, hydropower is expected to remain the backbone of flexible, renewable electricity across much of North and Central America. Interest in pumped storage is growing: Canada has multiple projects under consideration, and pre-development work continued through 2025 on the Ontario Pumped Storage Project following an investment from the Ontario government. As variable wind and solar capacity expands across the region, the ability to store excess electricity, ramp quickly and provide dependable output during periods of system stress will become increasingly valuable.

In the Dominican Republic, EGEHID's Hydropower and Pumped Storage Master Plan 2024–2028 provides a roadmap for expanding and modernising firm renewable generation through plant uprating, new hydropower development and pumped storage. The plan includes around 120MW of additional capacity from rehabilitation and repowering. Work on pumped storage is advancing, with bidders qualified to assess priority sites and move projects towards prefeasibility. These include locations in San Juan, Barahona and Independencia provinces.

A major emerging driver across the region is demand from data centres and other energy-intensive industries seeking reliable, carbon-free power. In 2025, marking one the largest corporate hydropower deals in history, Brookfield and Google announced a landmark Hydro Framework Agreement, enabling Google to procure up to 3,000MW of hydroelectric capacity across the US through relicensing, refurbishment and life-extension of existing assets. Brookfield also signed an additional 20-year supply contract with Microsoft for output at one of its facilities, stating that this "further demonstrates the increasing demand for hydropower from technology companies to deliver on their growth".

Smaller-scale agreements, such as Current Hydro's supply to Digital Realty from three new Ohio River projects, reinforce a trend that is accelerating in North America and will become increasingly relevant globally. Hydropower fleets, as strategic infrastructure, are poised to support electrification and growth as the demand for data surges, while data centres represent an opportunity to move reliable demand closer to projects' sites (see also "Hydropower and the rise of large-scale data centres: opportunities and challenges" on page 28).



Voith turbine head cover, United States
Credit: Voith

Modernisation continues to provide a significant opportunity across the region, and momentum is building on the ground. For example, large programmes in Costa Rica (ICE) and Mexico (CFE) are boosting efficiency and extending plant lifetimes.

Barriers to development and pathways forward

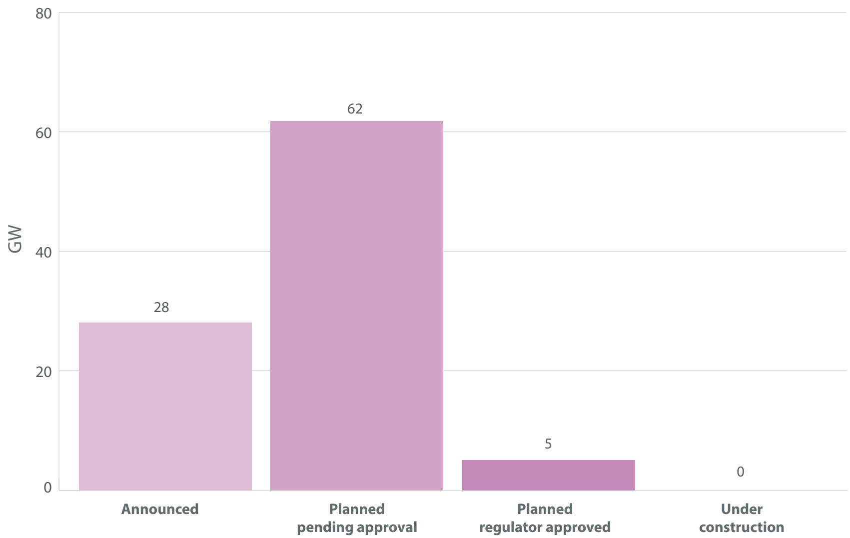
Despite these shoots of progress and new opportunities, licensing and regulatory processes remain a significant constraint, particularly in the US. Approximately 40% of the non-federal hydropower fleet, representing around 15,700MW, is set for license renewal between 2020 and 2035. At the end of 2025, 211 hydropower and pumped storage projects were in relicensing, with a further 33 in the license surrender process, often due to economic feasibility or ecological restoration requirements. Many of these are small (<5MW), but as they are concentrated in the Northeast of the country, their loss might have implications for local grid reliability.

Two bills passed by the US House of Representatives in late 2025 aim to accelerate permitting and reduce barriers. The Promoting Efficient Review for Modern Infrastructure Today (PERMIT) Act would streamline federal permitting for energy projects by reforming the Clean Water Act, clarifying state authority over water quality certifications and setting deadlines.

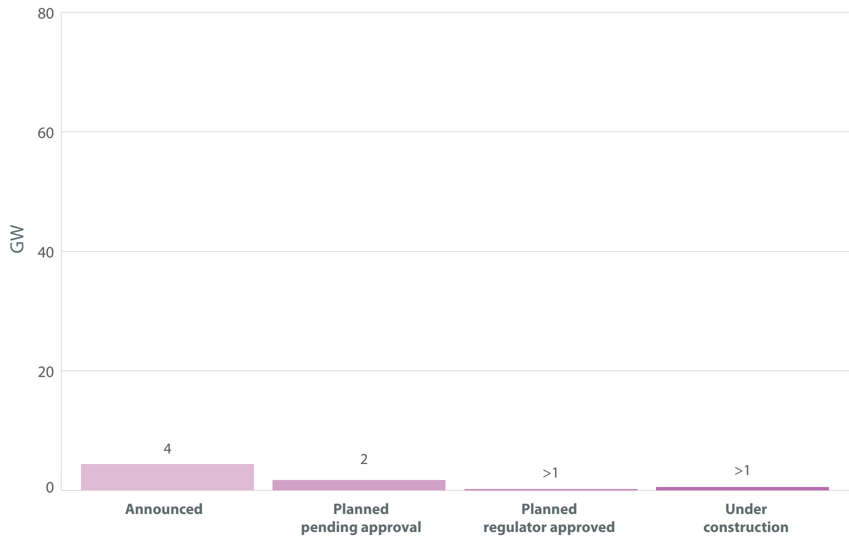
Meanwhile, the Standardizing Permitting and Expediting Economic Development (SPEED) Act would limit which projects are subject to environmental review, restrict consideration of certain environmental factors and reduce litigation risk. Both have been received in the US Senate for consideration.

Finally, the "Build More Hydro" bill was signed into law in May 2026. This legislation empowers the Federal Energy Regulatory Commission to extend construction deadlines for around three dozen delayed hydropower projects, totalling 2,600MW of baseload power and US$6.5 billion in private investment.

If enacted, these measures could significantly increase predictability, strengthen domestic hydropower production and accelerate clean energy deployment.

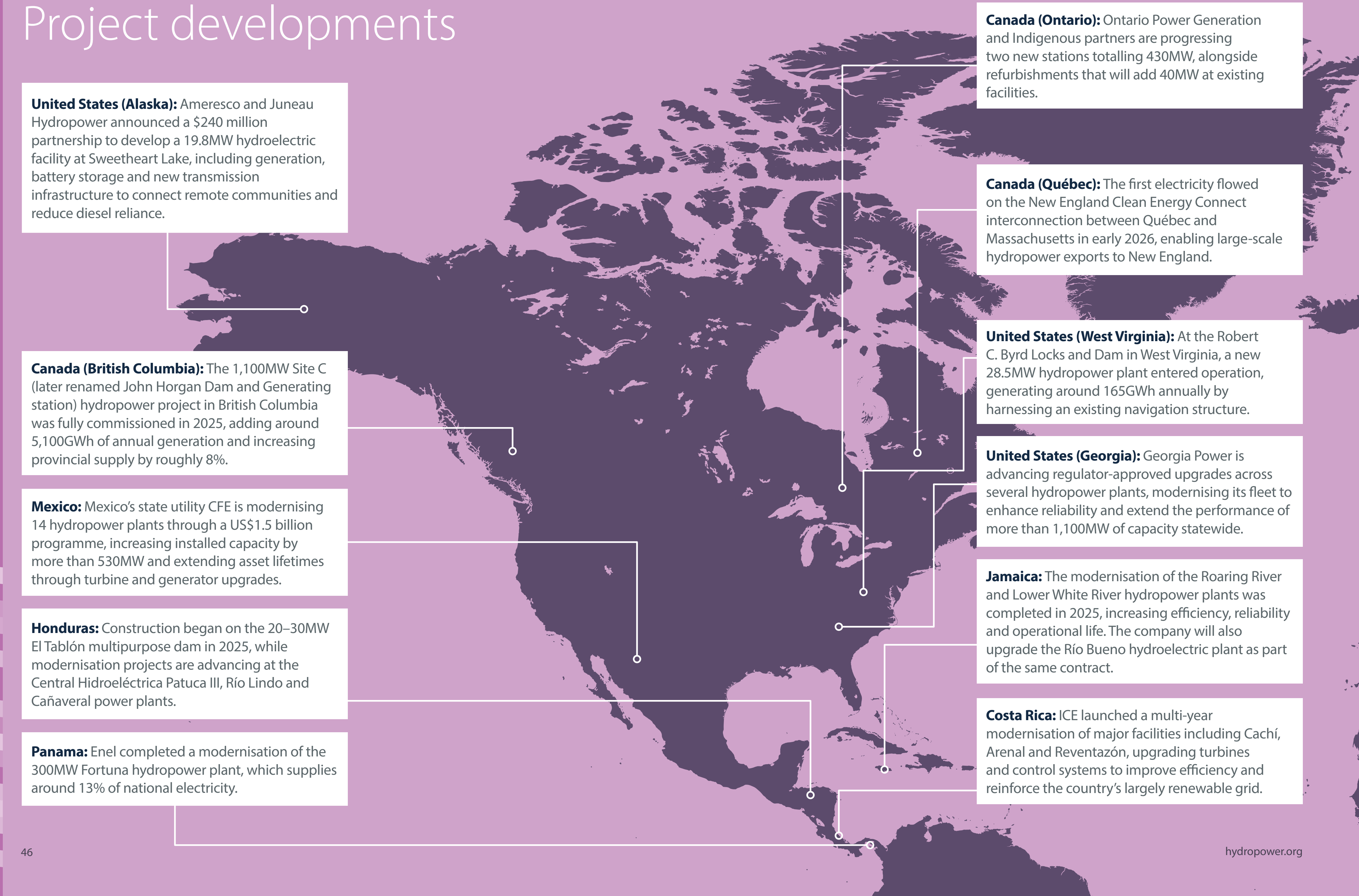


North and Central America pumped storage pipeline



North and Central America conventional pipeline

Project developments



United States (Alaska): Ameresco and Juneau Hydropower announced a $240 million partnership to develop a 19.8MW hydroelectric facility at Sweetheart Lake, including generation, battery storage and new transmission infrastructure to connect remote communities and reduce diesel reliance.

Canada (British Columbia): The 1,100MW Site C (later renamed John Horgan Dam and Generating station) hydropower project in British Columbia was fully commissioned in 2025, adding around 5,100GWh of annual generation and increasing provincial supply by roughly 8%.

Mexico: Mexico's state utility CFE is modernising 14 hydropower plants through a US$1.5 billion programme, increasing installed capacity by more than 530MW and extending asset lifetimes through turbine and generator upgrades.

Honduras: Construction began on the 20–30MW El Tablón multipurpose dam in 2025, while modernisation projects are advancing at the Central Hidroeléctrica Patuca III, Río Lindo and Cañaveral power plants.

Panama: Enel completed a modernisation of the 300MW Fortuna hydropower plant, which supplies around 13% of national electricity.

Canada (Ontario): Ontario Power Generation and Indigenous partners are progressing two new stations totalling 430MW, alongside refurbishments that will add 40MW at existing facilities.

Canada (Québec): The first electricity flowed on the New England Clean Energy Connect interconnection between Québec and Massachusetts in early 2026, enabling large-scale hydropower exports to New England.

United States (West Virginia): At the Robert C. Byrd Locks and Dam in West Virginia, a new 28.5MW hydropower plant entered operation, generating around 165GWh annually by harnessing an existing navigation structure.

United States (Georgia): Georgia Power is advancing regulator-approved upgrades across several hydropower plants, modernising its fleet to enhance reliability and extend the performance of more than 1,100MW of capacity statewide.

Jamaica: The modernisation of the Roaring River and Lower White River hydropower plants was completed in 2025, increasing efficiency, reliability and operational life. The company will also upgrade the Río Bueno hydroelectric plant as part of the same contract.

Costa Rica: ICE launched a multi-year modernisation of major facilities including Cachí, Arenal and Reventazón, upgrading turbines and control systems to improve efficiency and reinforce the country's largely renewable grid.

Policy developments

COUNTRY	POLICIES
Canada	Ontario's 2025 Integrated Energy Plan prioritises expansion and refurbishment of existing hydropower and advances pre-development for the 1,000MW Ontario Pumped Storage Project. BC Hydro's 2025 Integrated Resource Plan includes a sixth unit at Revelstoke (500MW) and potential upgrades at GM Shrum (100MW). The utility also issued a call for 5,000GWh of clean energy in 2025. Manitoba Hydro's 2025 Integrated Resource Plan adds 25MW from upgrades to existing hydro plants. Canada's 2025 Budget created the Major Projects Office to accelerate approvals and confirms access to the Clean Electricity Investment Tax Credit for provincial and territorial Crown corporations.
Dominican Republic	State utility EGEHID qualified bidders to conduct technical and economic prefeasibility studies on four priority pumped storage sites: Las Matas de Farfán 1 and 2, Paraiso, and La Descubierta.
Guatemala	The Ministry of Energy and Mines launched the PEG-5 tender to procure 1,400MW of firm power, including renewable sources such as hydropower, in the country's most ambitious energy project to date.
Honduras	The Ministry of Energy introduced a 1,500MW tender, including 975MW from renewables such as hydropower, to meet growing electricity demand.
Panama	The Government of Panama launched the National Energy Plan 2025–2050, reintroducing competitive renewable energy auctions, with the first tenders in 2026 for 20-year contracts from new hydropower and wind plants.
US	The PERMIT and SPEED Acts, both passed the House of Representatives in late 2025, aim to streamline permitting and reduce barriers for energy infrastructure projects, including hydropower and pumped storage. The US Department of Energy directed FERC to remove unnecessary burdens for preliminary hydroelectric permits, clarifying that third parties cannot veto permit issuance. The One Big Beautiful Bill Act, July 2025, preserves hydropower and pumped storage tax credits through 2033 for new projects, and modernised projects where 80% or more of the facility consists of upgraded components (by fair market value). The House passed the Schrier Bill, improving hydropower licensing transparency, requiring FERC to report to Congress annually on hydropower licensing and relicensing progress. DOE announced US$21 million funding for 11 projects, including pumped storage development and water quality studies. The "Build More Hydro" bill was passed into law in May 2026. This legislation empowers the Federal Energy Regulatory Commission to extend construction deadlines for around three dozen delayed hydropower projects.

Top 4 countries by capacity added in 2025

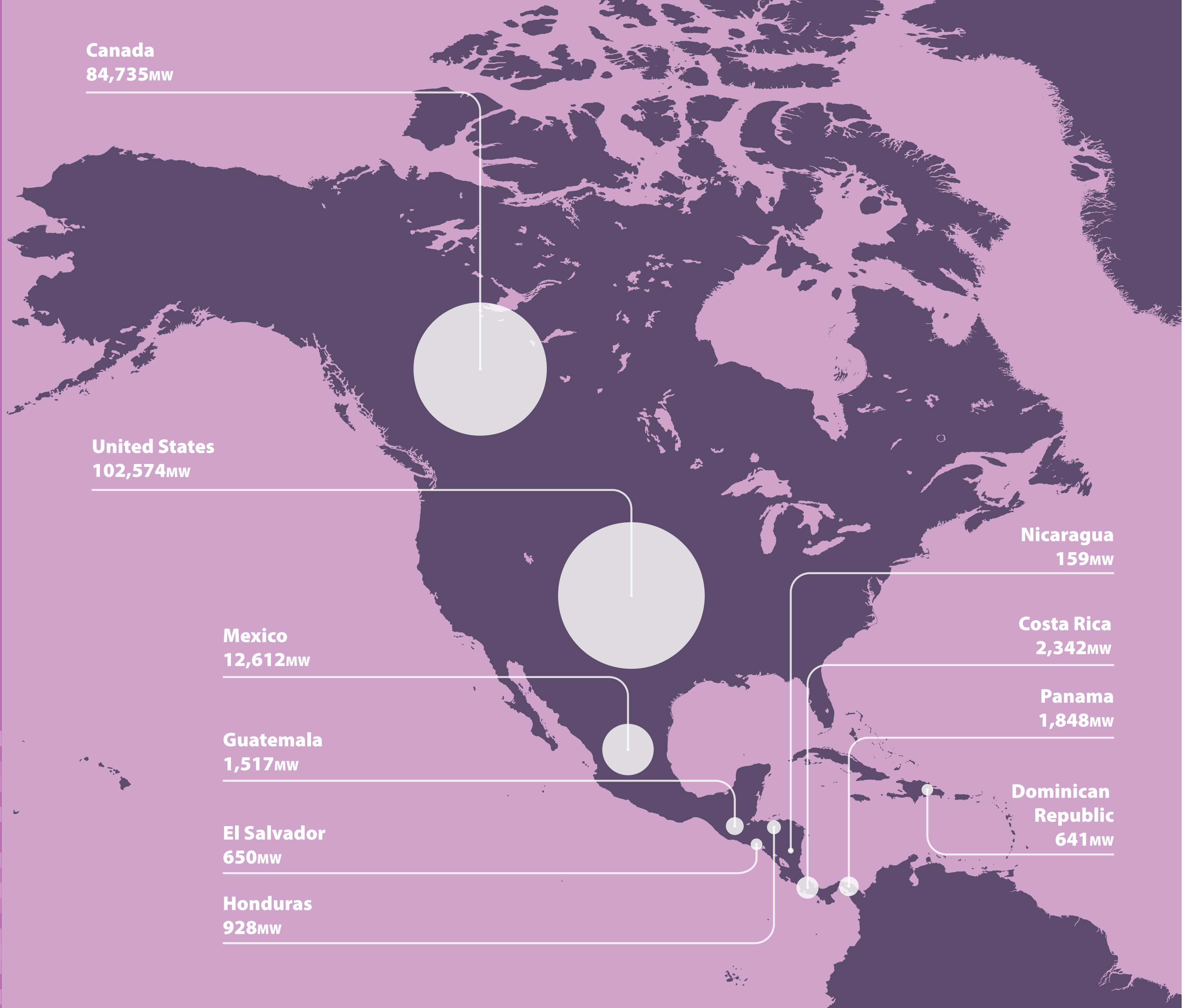
1
Canada
740MW

2
United States
478MW

3
El Salvador
12MW

4
Dominican Republic
2MW

Top 10 countries ranked by total installed hydropower capacity



Jirau hydropower plant, Brazil
Credit: Engie Brasil

South America
Key trends

- **Conventional hydropower deployment is regaining momentum** after several slower years, supported by a regional development pipeline of around 70GW.
- **Increased curtailment in the region** is driving debate around how to incentivise pumped storage and modernisation.
- **Hydropower is increasingly recognised for its system value**, shifting from purely baseload generation to providing flexibility, firming variable renewables and supporting electricity security.

Key data

Generation by hydropower in 2025
679 TWh

Capacity added in 2025*
597 MW

Pumped storage capacity added in 2025
0 MW

Total installed capacity*
183 GW

Total pumped storage installed capacity
994 MW

*Includes pumped storage

Regional outlook

South America's electricity landscape is being shaped by hydropower's dual role as a long-standing energy backbone and an increasingly strategic flexibility asset. Once viewed primarily as baseload generation, reservoir-based plants are now recognised as essential for balancing variable renewables and providing system resilience.

The current pipeline indicates that around 7.6GW of conventional hydropower capacity is currently under construction, suggesting that the 597MW of growth recorded in 2025 could be sustained and potentially exceeded in the coming years. This points to renewed momentum for conventional hydropower development in the region after several slower years.

Countries in the region face a climatic paradox: existing hydropower infrastructure already supports electricity systems with renewable shares exceeding 65%, yet extreme droughts in the Andes (notably Colombia and Ecuador) and the Southern Cone (particularly Chile, Argentina, and Brazil) have exposed vulnerabilities, underscoring the need to uprate and modernise ageing assets to better withstand increasingly variable hydrological conditions.

Ituango hydropower project, Colombia
Credit: EPM

More than 50% of South America's hydropower fleet is over 30 years old, with significant implications for the region's hydro-dependent power systems. This ageing asset base makes modernisation a strategic priority. The opportunity extends beyond life extension, however. It lies in repositioning existing hydropower plants to deliver greater operational flexibility, reliability and climate resilience, while providing the system services increasingly required by modern electricity grids.

As seen globally, the rapid deployment of wind and solar is reshaping energy planning in South America. Wind capacity is projected to double over the next decade, increasing from 40GW of installed capacity to roughly 79GW, while ambitious national renewable targets (including commitments by seven South American countries participating in the RELAC initiative to reach 80% renewable electricity by 2030) highlight the growing role of hydropower in complementing variable generation.

Sustainability performance is playing an increasingly important role in South America's hydropower sector, with growing emphasis on alignment with international good practice. In Brazil, the Mascarenhas and Santo Antônio projects achieved Gold certification under the Hydropower Sustainability Standard. In Colombia, the Chorreritas project earned Silver certification, while Electropalmor became the world's first small-scale, community-led hydropower project to be certified. Alongside the continued phased development of major projects such as Hidroituango, these developments reflect a broader regional focus on strengthening environmental, social and governance performance across the hydropower lifecycle.

Hydropower's role in the next 10–15 years

Hydropower will continue to underpin South America's clean electricity systems, allowing for more renewable energy to be added and fossil fuels to be phased out. Reservoir plants act as "natural batteries', storing water to balance renewable variability in real time. In Brazil, for example, northeastern reservoirs limit generation during wind surpluses and preserve water for generation during peak demand periods.

The region also retains significant untapped hydropower resources. Despite hydropower already accounting for approximately 45% of South America's electricity generation, only around 30% of the continent's economically viable hydropower potential has been developed. Across the region, 70GW of conventional hydropower is currently in the development pipeline. If developed and modernised sustainably, the remaining resource could provide a powerful combination of security of supply, low-carbon generation and the flexibility needed to integrate higher shares of wind and solar.

Hydropower is becoming increasingly relevant in the context of energy security and sovereignty in the region. Countries such as Colombia, Venezuela and Paraguay leverage hydropower to reduce fossil fuel imports, while regional grid integration supported by initiatives like the MERCOSUR–OLADE Memorandum (2025) will allow sharing of surpluses to buffer against droughts and enhance collective reliability.

Modernisation and digitalisation are accelerating globally, and are vital to South America's hydropower facilities. Upgrades to turbines, generators, protection systems, automation and control technologies can improve efficiency, reduce downtime and extend the life of existing assets without requiring new reservoirs. They also allow plants to operate more flexibly in systems with higher shares of wind and solar, supporting services such as ramping, frequency regulation, reserve provision and climate-adapted water management. In this context, modernisation should be understood as a way to convert existing hydropower plants into more reliable, flexible and digitally managed system assets.

This shift is already visible across different types of hydropower assets in the region. In Peru, the Mantaro complex is undergoing a modernisation programme of more than US$183 million to upgrade critical equipment and strengthen one of the country's core generation assets. In Ecuador, Coca Codo Sinclair returned to its full 1,500MW capacity after CELEC completed programmed maintenance works on Phase I, restoring the plant's full contribution to the national grid. Brazil illustrates the digitalisation dimension of this trend: Omexom signed an Engineering, Procurement and Construction (EPC) contract to modernise protection, control and instrumentation systems at the 450MW Amador Aguiar I and II complex, while AXIA Energia is modernising the automation systems at the 2,082MW Itumbiara plant.

Another example of modernisation efforts is the Yacyretá Aña Cuá expansion, which resumed in late 2025 after a two-year suspension. Once completed, the installation of three Kaplan turbines will add 270MW of new installed capacity,

Credit: Axia Energia

increasing the total installed capacity of the binational Argentina–Paraguay Yacyretá complex from 3,100MW to approximately 3,370MW. Together, these examples show that modernisation in South America is not limited to life extension; it also includes availability recovery, digital control, automation and operational reliability improvements that help existing hydropower assets remain central to future electricity systems.

Climate change adaptation remains a priority. Operators are adjusting spillways, revising operating curves and coordinating across basins to offset hydrological variability, such as wet Amazon years counterbalancing dry Andean conditions.

Barriers to development and pathways forward

Financing remains a core challenge in South America. Hydropower projects require large upfront investments and long development timelines, while revenues are vulnerable to hydrological variability and, in some market structures, electricity price volatility.

However, this risk should not be overstated. In most South American markets, the bulk of generation revenue is still secured through bilateral contracts or power purchase agreements (PPAs) rather than left fully exposed to spot prices. Support from traditional multilateral lenders for large hydropower has become more limited and selective, while Chinese state-backed finance helped fill part of that gap in several projects, including Ecuador's 1,500MW Coca Codo Sinclair, which was enabled by a US$1.68 billion loan from China Eximbank.

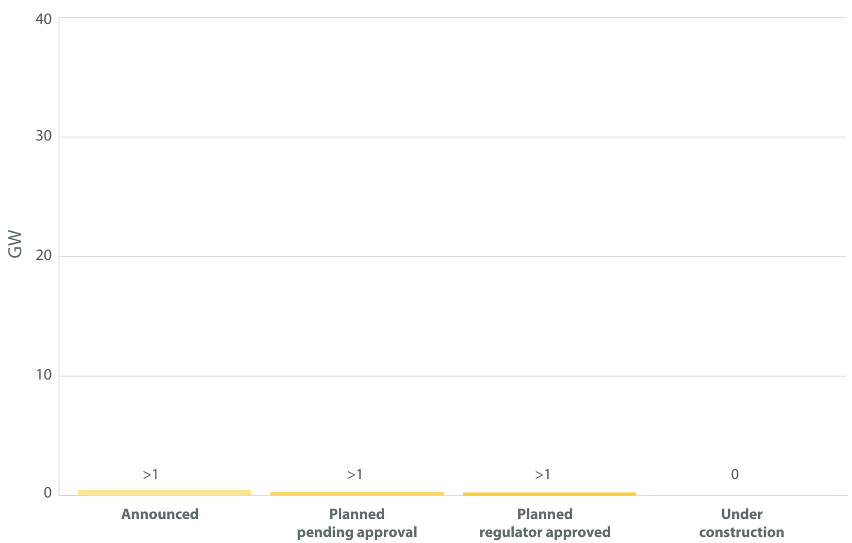
New mechanisms are emerging to mitigate risk and attract investment, including green funds, concessional climate finance and public–private partnerships.

Licensing and permitting processes can add years of delay to project pipelines. Environmental studies, public hearings and litigation contribute to uncertainty, as illustrated by Brazil's Bem Querer hydropower project. Environmental impact documentation was submitted to the federal environmental regulator in late 2024, but feasibility studies and licensing processes are expected to continue through to 2027, highlighting the long timelines involved in advancing large-scale hydropower projects from planning to approval.

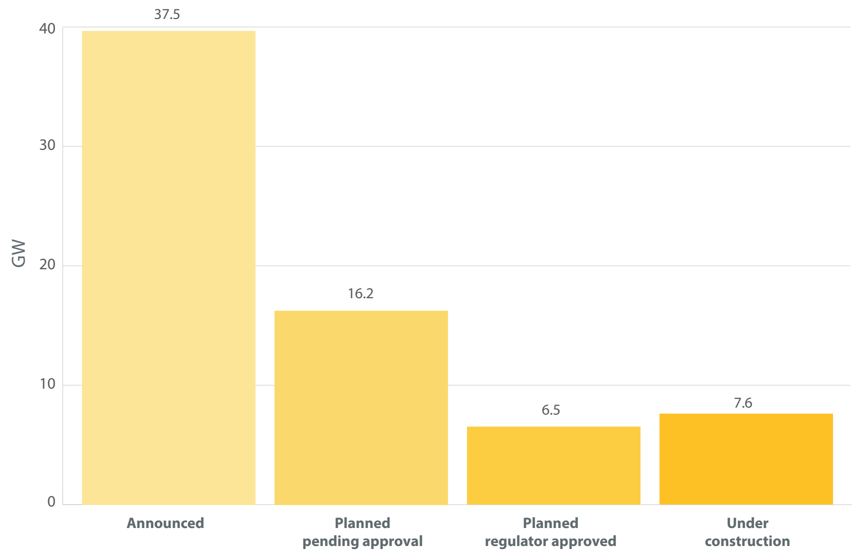
Internationally recognised frameworks like the Hydropower Sustainability Standard can mitigate these hurdles by providing investors and operators with assurance that projects meet rigorous social and environmental criteria.

Transmission bottlenecks continue to limit regional electricity integration. In Chile, grid congestion has already forced renewable curtailment on the order of 5.6–6.0TWh per year, while in Uruguay surplus renewable output regularly depends on limited export capability to Argentina and Brazil. Expanding interconnections and improving coordinated cross-border planning would increase resilience, reduce curtailment and enable surplus low-cost electricity to be used more efficiently across the region.

Finally, climatic and hydrological risks are rising. Prolonged droughts in recent years, such as those affecting Brazil and Paraguay, have reduced output for months at a time, while extreme events can necessitate sudden water releases downstream. Incorporating climate projections into operations and project design is becoming essential for ensuring reliable generation, financial viability and the long-term sustainability of the South American hydropower sector.



South America pumped storage pipeline



South America conventional pipeline

Project developments

Ecuador: The 204MW Alluriquín hydropower plant, the main component of the Toachi Pilatón Complex, was inaugurated and began commercial operation in April 2025.

Peru: Three hydropower plants entered operation in 2025, adding 231MW, including San Gabán III (209.3MW), Anashironi (20MW) and Tupurí (2.2MW), with a total investment of approximately USD 515 million.

Bolivia: The Ivirizu hydropower project, the country's largest, reached 91.5% physical completion in March 2025 and will add 290.2MW to Bolivia's National Interconnected System (SIN).

Chile: Enel's 153MW Los Cóndores hydroelectric plant in the Maule Region entered commercial operation in March 2025, using specialised construction technology to overcome challenging terrain.

Guyana: The government continued efforts to revive the long-delayed 165MW Amaila Falls, issuing revised tenders and receiving bids under a Build, Own, Operate and Transfer (BOOT) procurement model. If completed, the project would supply more than half of the country's electricity and reduce reliance on diesel.

Paraguay: Itaipu generated a record 72.8TWh in 2025, 8.6% above 2024, driven by a favourable hydrological year.

Brazil: The 2025 A-5 hydro-only auction contracted 65 new hydropower projects totalling 815.6MW, with supply expected from January 2030 under 20-year contracts, signalling renewed confidence in small and medium hydro as part of Brazil's long-term reliability mix.

Argentina: Construction of the 360MW La Barrancosa/Jorge Cepernic Dam in Santa Cruz resumed in October 2025 after a two-year halt, supported by Chinese financing and the state-owned company ENARSA.

Policy developments

COUNTRY	POLICIES
Argentina	The government advanced the re-concessioning of major hydropower assets in the Comahue region. Four plants (Alicurá, El Chocón, Cerros Colorados, and Piedra del Águila) were transferred to new operators in December 2025, securing clearer investment, maintenance and performance obligations.
Brazil	A new electricity-sector framework modernised the regulatory environment and explicitly recognised pumped storage hydropower. The law also facilitates the contracting of small hydropower through Brazil's regulated auction framework, while broader reforms seek to streamline environmental licensing for hydropower projects. Under A-5/2025, new and expanded hydropower projects up to 50MW were eligible; the auction attracted 225 registrations totalling 2,999MW, and ultimately contracted more than 815MW across 65 projects.
Chile	The country's updated Decarbonization Plan introduced measures to support flexibility and storage, defining rules for operation and remuneration of pumped storage hydropower and other energy storage systems.
Colombia	Updated regulations allow private generators to sell power via PPAs to ANDE or eligible consumers, facilitating the tender of 22 small hydropower projects totalling around 280MW in internal river basins.
Guyana	The 2025 Budget prioritised renewable expansion and firm generation for remote regions, including commissioning the 1.5MW Kumu Hydropower Station in Lethem.
Paraguay	The Government of Panama launched the National Energy Plan 2025–2050, reintroducing competitive renewable energy auctions, with the first tenders in 2026 for 20-year contracts from new hydropower and wind plants.

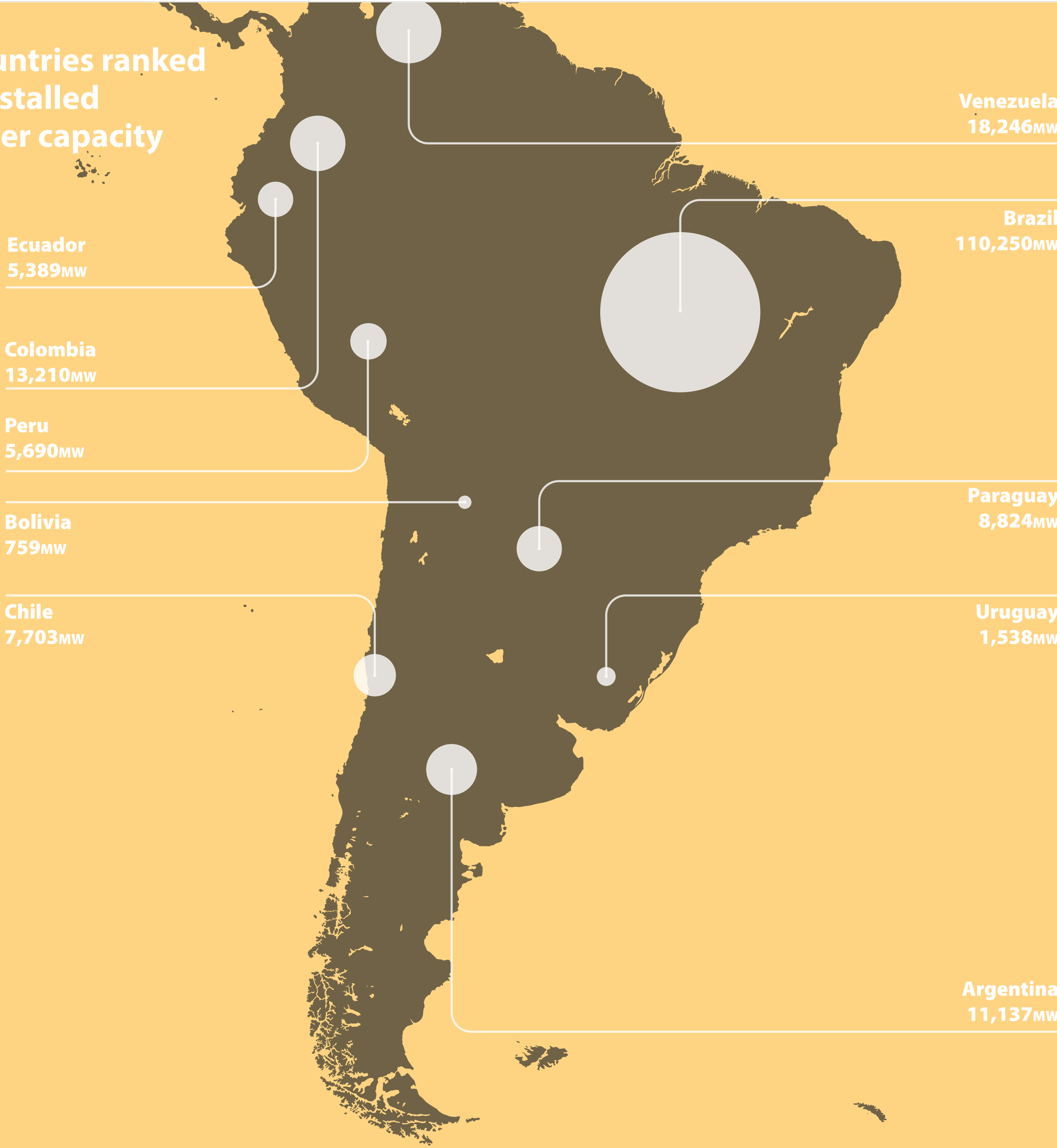
Interesting fact

A fully renewable electricity mix is already a reality in parts of South America. According to OLACDE, Paraguay and Uruguay are reported at 100% renewable electricity, while Costa Rica is around 98%, largely backed by hydropower and complemented by other renewables. The takeaway is that reliability can come from clean "firm" renewable resources such as hydropower.

Top 4 countries by capacity added in 2025

1. **Brazil** 267MW
2. **Peru** 175MW
3. **Chile** 153MW
4. **Guyana** 2MW

Top 10 countries ranked by total installed hydropower capacity



Europe

Key trends

- **Record growth of curtailment of solar and wind power, and other system stresses, are highlighting the need for pumped storage.** The shortfall in non-fossil flexibility and long-duration electricity storage are becoming the limiting factors of Europe's energy transition, independence and affordability.
- **Policy momentum is building for long-duration storage**, as EU-level reforms and national revenue stabilisation mechanisms like the UK's cap-and-floor scheme address long-standing market challenges.
- **Existing hydropower assets are being revalued as strategic infrastructure**, with a continuing shift of focus from new build to modernisation, expansion and system services.

Key data

Generation by hydropower in 2025
614 TWh

Capacity added in 2025*
1,533 MW

Pumped storage capacity added in 2025
725 MW

Total installed capacity*
263 GW

Total pumped storage installed capacity
57 GW

*Includes pumped storage

Pocinho hydropower project, Portugal. Credit: EDP

Regional outlook

Europe's power system is entering a decisive phase of the energy transition, defined by its ability to integrate and balance growing variable renewable generation while limiting its reliance on imported fossil fuels. Wind and solar capacity continue to grow rapidly across the continent, with solar generating 16% more electricity in 2025 compared to 2024. However, curtailment and lack of non-fossil flexibility are limiting the benefits experienced by consumers and are now central challenges for local power markets.

Europe's continued reliance on gas-fired power generation has heightened concerns around energy security, affordability and strategic dependence, particularly amid geopolitical instability and volatile fuel prices. This has accelerated calls for greater European energy sovereignty, bringing electrification, renewable generation, storage and grid flexibility to the forefront of policy and investment discussions.

The Paris Pledge, jointly coordinated by IHA and Eurelectric, announced in September 2025 and supported by more than 50 organisations, highlights the urgency of unlocking EU's pumped storage pipeline, estimated at over 35GW, to reinforce security of supply. It calls for faster permitting, revenue stabilisation mechanisms to de-risk projects, and a clearer policy recognition of long-duration electricity storage.

This was followed in November 2025 with a letter to European Commission President Ursula von der Leyen, signed by IHA President Malcolm Turnbull, Eurelectric, and several major European power industry players, calling for urgent action to unlock Europe's vast pumped storage potential and stressing the need for future legislation to prioritise long-duration electricity storage.

Further structural change is expected through the European Commission's Grids Package, outlined in December 2025. The proposals include a stronger EU role in grid planning, prioritisation of cross-border "energy highways", default acceptance of grid connection requests and strict timelines for permitting energy storage projects. If implemented, these measures could significantly reduce delays that have historically constrained infrastructure build-out.

New oil-free Kaplan runner installation at Faslefoss, Norway
Credit: ANDRITZ Hydro

Complementing these reforms, the European Storage Tripartite Agreement is under development as a contractual framework between the public sector, the energy sector and the demand side. Announced in September 2025, it aims to set out responsibilities and guiding principles to support the expansion of storage technologies, including pumped storage, while helping to de-risk investment and unlock flexible, long-duration electricity resources without distorting short-term market signals.

Hydropower's role in the next 10–15 years

Over the next decade and beyond, hydropower's role in Europe's electricity system is expected to continue evolving. While total generation will continue to be influenced by hydrological variability, the strategic value of hydropower will increasingly lie in its ability to provide indigenous flexibility, security of supply, and system services to balance the growth of variable renewables. This shifting role is reflected in Europe's development pipeline, which includes 59GW of pumped storage alongside 8GW of new conventional hydropower projects.

Rising levels of renewable curtailment across major European markets underline the growing need for flexibility and long-duration electricity storage. Several of Europe's largest economies saw record curtailment rates in 2025, with wind and solar output exceeding grid capacity or demand during certain periods.

Countries throughout Europe, including the Netherlands, Germany, Sweden, Spain, Belgium and France, recorded more than 500 hours of negative electricity pricing in 2025, mainly driven by limited system flexibility, transmission constraints and periods of renewable oversupply. Including near-zero pricing would increase the total amount of hours significantly.

Pumped storage offers a direct response, absorbing surplus generation and releasing it during periods of scarcity. This not only improves overall power system efficiency but also helps reduce excessive fluctuations in electricity prices, often caused by the overreliance on gas plants and the extreme volatility of fossil fuels prices on the international market.

Meanwhile, the large-scale Iberian blackout affecting Spain and Portugal in April 2025 demonstrated the critical role of hydropower plants. These facilities had a key role during system restoration due to their black-start capabilities and substantial reserves of energy, which are available at any time regardless of when such events occur. As electrification of transport, heating and industry accelerates, hydropower's grid stabilisation functions will become even more important.

Europe's mature hydropower fleet provides a strong foundation for this transition. Modernisation and expansion of existing facilities offer opportunities to increase capacity and improve efficiency, while existing reservoirs can also be used to develop new pumped storage facilities by adding a hydraulic circuit and power plant. Both approaches unlock additional flexibility with very limited environmental impact. In parallel, a substantial pipeline of pumped storage projects has been identified, potentially positioning hydropower as a cornerstone of Europe's long-duration storage strategy over the coming 10–15 years.


Amfilochia hydropower project, Greece
Credit: Aecom

Barriers to development and pathways forward

Despite the growing recognition of hydropower's system value, significant barriers continue to hold back development in Europe. Lengthy and complex permitting processes remain a primary challenge, with many projects stalled for years at the approval stage. Regulatory uncertainty around license renewals and asset control further discourages investment in brownfield expansion and modernisation.

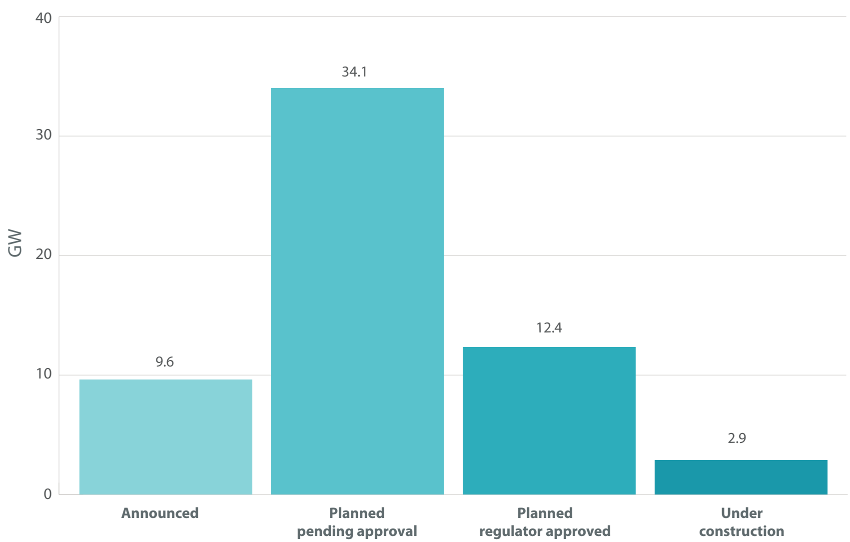
Market design also presents structural obstacles. Ancillary services markets often fail to remunerate the full range of services hydropower provides, including inertia, frequency regulation and black-start capability, while spot markets are not capable of providing the long-term signals and visibility needed by asset owners and investors.

Policy definitions add another layer of complexity. The widespread tendency of treating all storage technologies as a single category disregards the specific role of pumped storage and weakens investment signals for assets designed to operate over multi-hour or multi-day timescales. This forces the sector towards short-term storage solutions, which offer little contribution to security of supply and increase reliance on imported technologies.

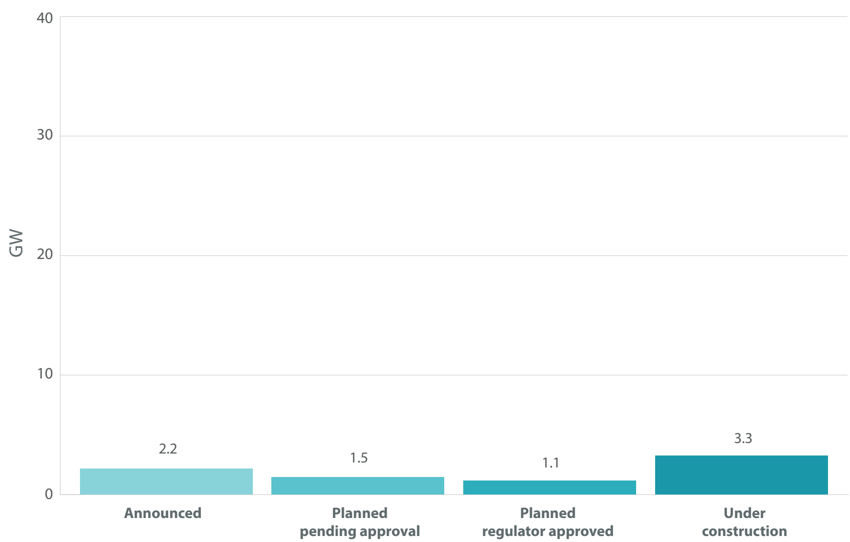
There are clear opportunities to overcome these constraints. Applying Renewable Energy Directive (RED) III provisions to designate storage as being of overriding public interest could enable fast-tracked permitting. The Electricity Market Design Reform enables EU member states to set up revenue stabilisation mechanisms that can provide the long-term visibility required to reduce project risk and attract private capital. However, responsibility lies with member states to implement appropriate measures and ensure that the relevant authorities are adequately resourced, particularly to help accelerate lengthy permitting procedures.

The UK's public commitment to reinforce the national long-duration electricity storage capacity and intention to introduce a dedicated cap-and-floor scheme, which advanced through Parliament in 2025, illustrates how such measures can quickly revitalise the local market and attract the attention of private financiers. The scheme sets a guaranteed minimum price for storage operators while limiting maximum returns, providing long-term revenue visibility that encourages investors and can reduce capital costs.

Finally, Europe's leadership in hydropower technology and supply chains positions the sector to deliver both system resilience and unmatched economic value as the energy transition accelerates and the need for indigenous power generation increases.



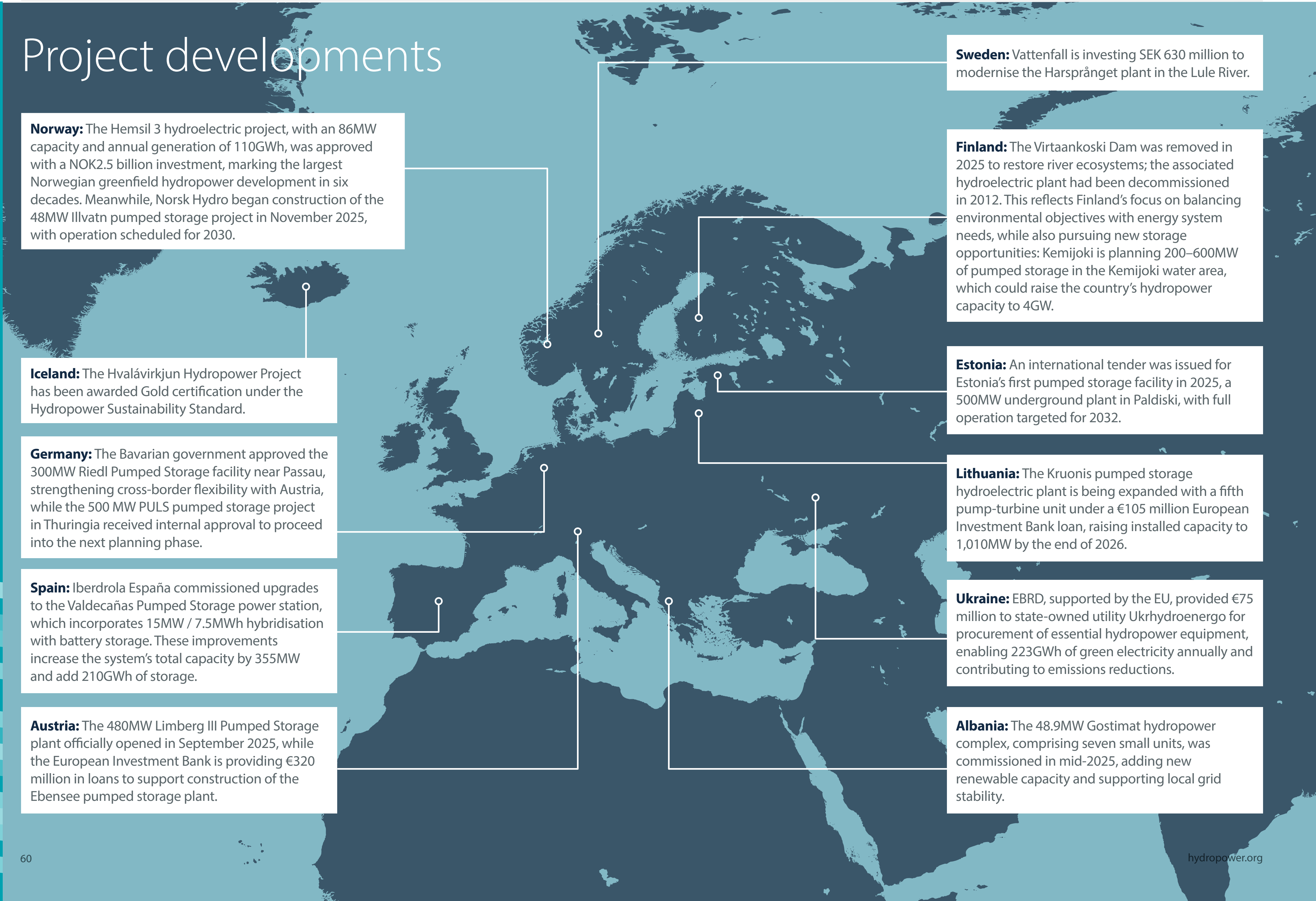
Europe pumped storage pipeline



Europe conventional pipeline

Europe

Project developments



Norway: The Hemsil 3 hydroelectric project, with an 86MW capacity and annual generation of 110GWh, was approved with a NOK2.5 billion investment, marking the largest Norwegian greenfield hydropower development in six decades. Meanwhile, Norsk Hydro began construction of the 48MW Illvatn pumped storage project in November 2025, with operation scheduled for 2030.

Iceland: The Hvalávirkjun Hydropower Project has been awarded Gold certification under the Hydropower Sustainability Standard.

Germany: The Bavarian government approved the 300MW Riedl Pumped Storage facility near Passau, strengthening cross-border flexibility with Austria, while the 500 MW PULS pumped storage project in Thuringia received internal approval to proceed into the next planning phase.

Spain: Iberdrola España commissioned upgrades to the Valdecañas Pumped Storage power station, which incorporates 15MW / 7.5MWh hybridisation with battery storage. These improvements increase the system's total capacity by 355MW and add 210GWh of storage.

Austria: The 480MW Limberg III Pumped Storage plant officially opened in September 2025, while the European Investment Bank is providing €320 million in loans to support construction of the Ebensee pumped storage plant.

Sweden: Vattenfall is investing SEK 630 million to modernise the Harsprånget plant in the Lule River.

Finland: The Virtaankoski Dam was removed in 2025 to restore river ecosystems; the associated hydroelectric plant had been decommissioned in 2012. This reflects Finland's focus on balancing environmental objectives with energy system needs, while also pursuing new storage opportunities: Kemijoki is planning 200–600MW of pumped storage in the Kemijoki water area, which could raise the country's hydropower capacity to 4GW.

Estonia: An international tender was issued for Estonia's first pumped storage facility in 2025, a 500MW underground plant in Paldiski, with full operation targeted for 2032.

Lithuania: The Kruonis pumped storage hydroelectric plant is being expanded with a fifth pump-turbine unit under a €105 million European Investment Bank loan, raising installed capacity to 1,010MW by the end of 2026.

Ukraine: EBRD, supported by the EU, provided €75 million to state-owned utility Ukrhydroenergo for procurement of essential hydropower equipment, enabling 223GWh of green electricity annually and contributing to emissions reductions.

Albania: The 48.9MW Gostimat hydropower complex, comprising seven small units, was commissioned in mid-2025, adding new renewable capacity and supporting local grid stability.

Policy developments

COUNTRY	POLICIES
European Union	The EU, through the Connecting Europe Facility (CEF), has allocated €650m to cross-border energy projects, with a large portion being directed towards pumped storage projects.
Baltics	Estonia, Latvia, and Lithuania were disconnected from the Russian BRELL grid system and have been fully synchronised with Continental Europe since February 2025.
Italy	The Italian government is preparing a decree-law on strategic assets, which could define rules for the reassignment or extension of concessions. This measure may bring Italy closer to the European average concession length of 30–40 years, providing greater long-term certainty for hydropower operators and investors.
Norway	The Norwegian Government amended regulations to simplify and streamline administrative procedures for large power lines and hydropower facilities. The reform reduces license processing times, accelerating the development of critical clean energy infrastructure.
Poland	Poland's water authority, Wody Polskie, has proposed 4,000 existing dams and reservoirs for hydropower development, unlocking around 655MW of potential capacity. The country's draft National Energy and Climate Plan targets 1.2GW of hydropower by 2040.
Slovakia	Slovakia launched a €350 million call for renewable energy production, including hydropower plants with more than 10MW capacity. The initiative targets both established operators and other entities involved in thermal or renewable energy.
Spain	The Spanish Government provisionally awarded €165 million to support the development of nearly 2.2GW (seven projects) of new pumped storage capacity by 2035. Each project was eligible for a grant up to €50 million.
Switzerland	From April 2026, Switzerland is accelerating planning and approval procedures for large renewable energy projects, including hydropower plants, under a new government decree. Cantons will now carry out a consolidated approval process, and only one appeal will be allowed at the cantonal level, simplifying development of new storage and hydropower capacity.
UK	Five long-duration electricity storage schemes have successfully passed Ofgem's eligibility assessment, moving toward the next stage of cap-and-floor award consideration in 2026.

Interesting fact

According to reporting by S&P Global, Spain's grid operator reported that technical curtailment costs surged in May 2025, peaking at over €18.5 million in a single day and totalling €386.5 million for the month. This is more than double the curtailment costs in May 2024 and is the equivalent cost of building a 300MW brownfield pumped storage plant. These growing costs highlight the economic impact of grid constraints when renewable generation cannot be fully absorbed.

Top 5 countries by capacity added in 2025

1 Austria 494MW

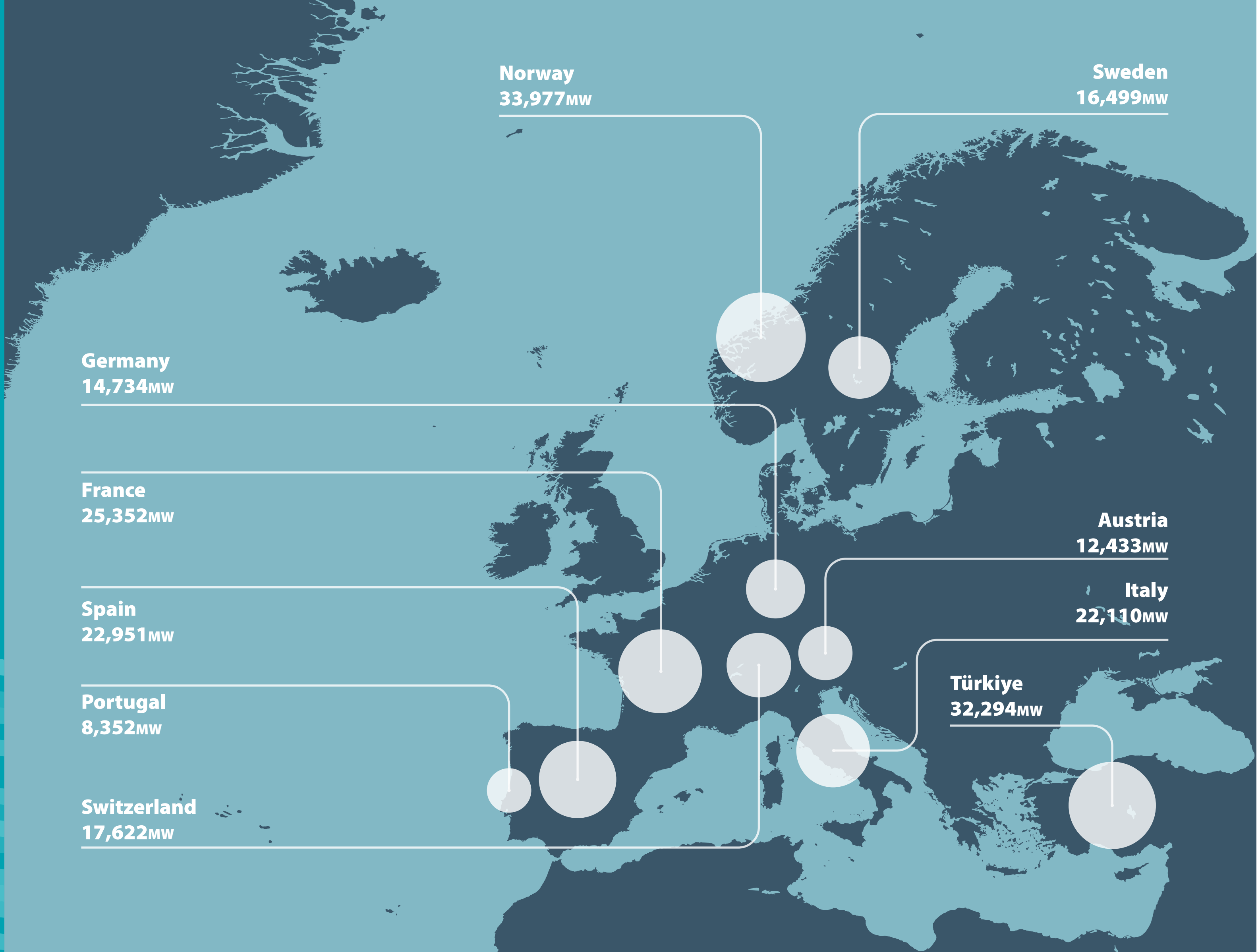
2 Germany 238MW

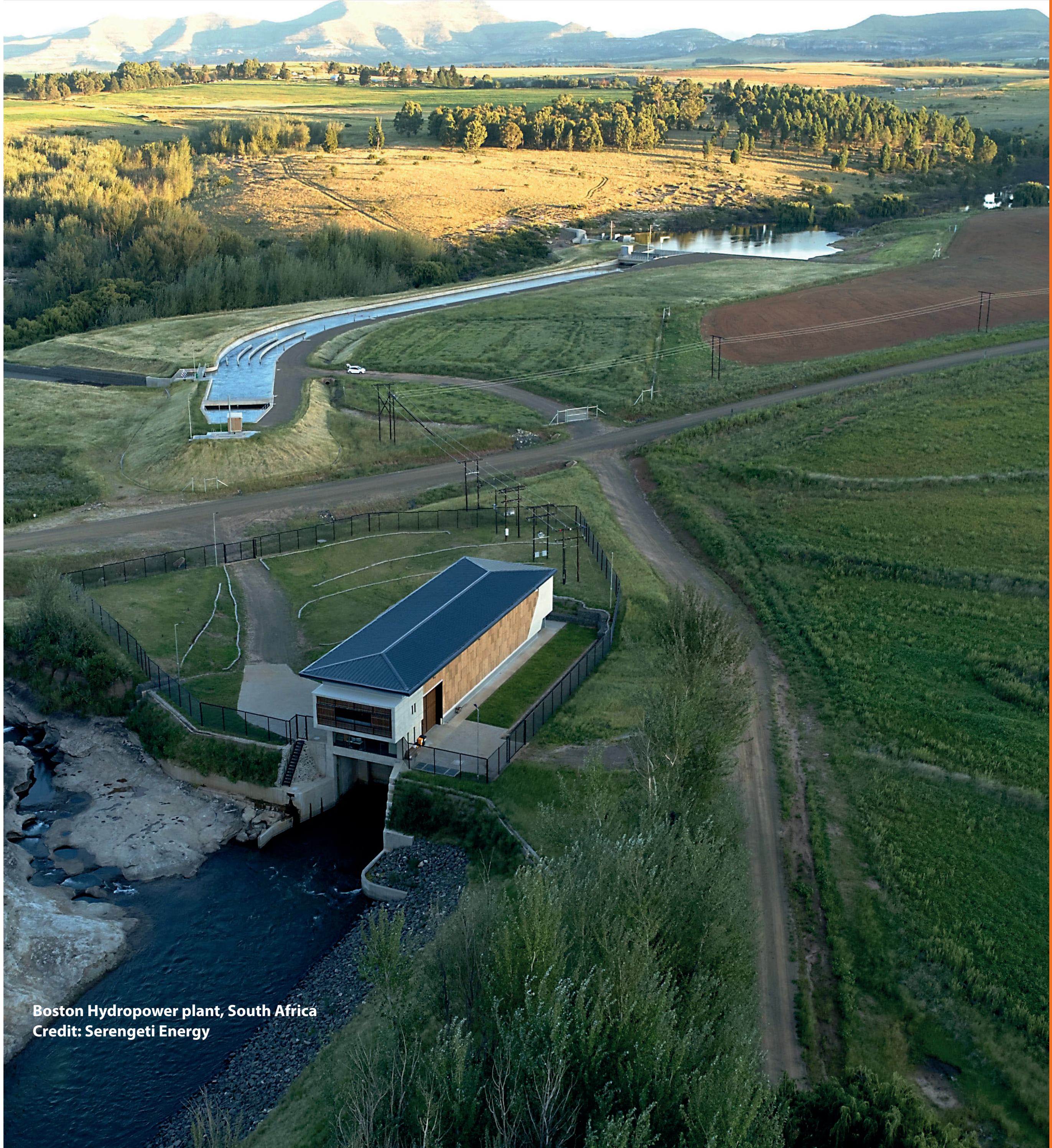
3 Spain 225MW

4 Norway 124MW

5 Albania 112MW

Top 10 countries ranked by total installed hydropower capacity





Boston Hydropower plant, South Africa
Credit: Serengeti Energy

Africa

Key trends

- **Africa continued to be a key driver for new conventional hydropower additions in 2025, with more than 4GW installed for a second consecutive year,** reflecting rising electricity demand and the need for reliable renewable generation.
- **Regional transmission infrastructure development is critical to unlocking Africa's hydropower potential,** with interconnectors such as Tanzania–Zambia, Ethiopia–Somalia and Angola–DR Congo expected to enhance cross-border trade and grid reliability.
- **Rising energy demand is driving private and hybrid investment in hydropower,** particularly for industrial users seeking dedicated, reliable supply.

Key data

Generation by hydropower in 2025
179 TWh

Capacity added in 2025*
4,297 MW

Pumped storage capacity added in 2025
0 MW

Total installed capacity*
52 GW

Total pumped storage installed capacity
3,726 MW

*Includes pumped storage

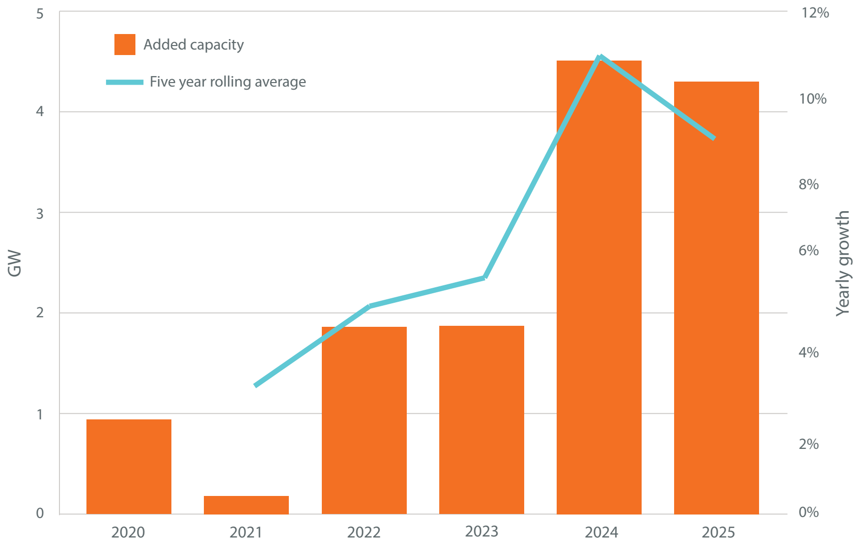
Africa

Regional outlook

Africa continues to represent the world's largest share of untapped hydropower potential, together with the lowest levels of electricity access and per-capita energy consumption. This combination is driving a strong focus on greenfield hydropower development, which has a pivotal role to play in expanding reliable and affordable supply. As a result, Africa has been among the regions at the forefront of conventional hydropower capacity additions for a second consecutive year.

At the same time, modernisation of hydropower assets is becoming increasingly important in Africa, with almost half of installed capacity commissioned more than 25 years ago and recent studies indicating that two out of three plants on the continent could benefit from modernisation. Refurbishment and life-extension of existing plants can deliver significant benefits, improving performance and resilience while strengthening energy security and widening access.

Progress during 2025 reflected both these trends. More than 4GW of new conventional hydropower capacity was added across the continent, including the completion of landmark projects that significantly reshape national and regional power systems, especially in East Africa. Ethiopia fully inaugurated the 5,150MW Grand Ethiopian Renaissance Dam, now the largest power station in Africa, while Tanzania's Julius Nyerere Hydropower Project was also completed, significantly reducing dependence on diesel generators.



Annual added capacity, Africa (GW)

Beyond these headline large-scale developments, targeted modernisation projects contributed significantly to capacity additions in 2025: Nigeria's Kainji plant commissioned a new 80MW unit to extend its total capacity to 600MW; and Inga II in DR Congo added an initial 50MW to supply the Kamoa-Kakula Copper Complex, with further increases expected as rehabilitation and transmission upgrades continue. Ongoing refurbishment at South Africa's Steenbras Pumped Storage Scheme is also enhancing reliability and maintaining its unique role in protecting Cape Town against load shedding.

Despite these impressive results, only 9.1GW of Africa's 111.5GW conventional hydropower pipeline is currently under construction, suggesting that near-term deployment may slow compared with the strong additions recorded over the past two years.

Transmission and market integration are increasingly central to unlocking Africa's hydropower capacity. In Southern Africa, constrained or fragmented networks often prevent power from being transferred efficiently between resource-rich zones and demand centres. West Africa marked a milestone in 2025 with the synchronisation of cross-boundary grid interconnections, while East Africa has continued to expand cross-border trade through high-voltage interconnections coordinated by the Eastern Africa Power Pool.

Hydropower's role in the next 10–15 years

Over the coming decade, hydropower is expected to play a central role in meeting rapidly rising energy demands. Africa's population is growing at roughly twice the global average, with many economies pursuing industrialisation, urbanisation and expanded energy access simultaneously. Meeting these needs will require large volumes of dependable, low-cost generation that can be deployed at scale, with hydropower well placed to deliver it.

Hydropower's value in providing the backbone for renewable systems is likely to increase as solar and wind deployment accelerates. Renewable output fluctuates significantly with weather patterns in many parts of the continent, especially the equatorial belt encompassing countries in Central and East Africa, creating challenges for grid stability. Conventional hydropower provides dispatchable power that can quickly ramp up or down to balance variability, support frequency control and reduce reliance on expensive and carbon-intensive thermal backup plants. As Africa's grids become more complex, dispatchability and controllability will be just as important as installed power.

Pumped storage is also regaining attention in Africa as countries explore longer-duration storage solutions. While no new schemes were commissioned in 2025, feasibility studies and announcements signal increasing political and industry focus on pumped storage, including plans to develop new capacity in South Africa and proposals to convert existing assets in Ghana.

At the same time, hydropower is increasingly linked to economic development strategies, with mining and industrial operators seeking dedicated, reliable supply through privately backed or hybrid schemes.

Zungeru Hydropower Plant, Nigeria
Credit: Mainstream Energy Solutions Limited

Africa

Barriers to development and pathways forward

Structural barriers continue to slow the delivery of hydropower in Africa. Over 90% of the existing pipeline is at the pending approval stage or currently seeking financial arrangement. Transmission and distribution constraints are among the most immediate challenges, with significant volumes of existing generation underutilised because networks cannot reliably transport electricity from remote hydropower sites to demand centres.

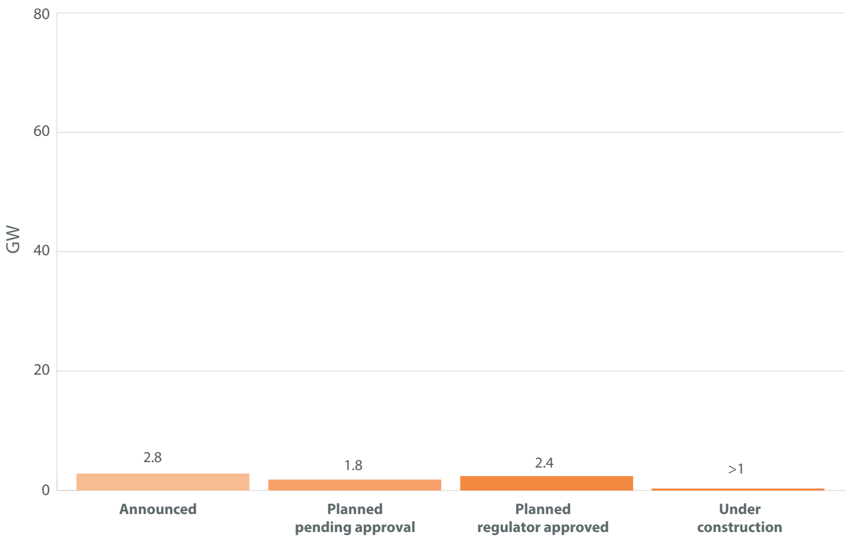
Fragmented grids in several countries limit both domestic reliability and opportunities for regional trade, but some progress is visible. The 1,065 km Eastern Electricity Highway between Ethiopia and Kenya has seen regional trade burgeon since becoming operational in 2022. A new milestone was marked in West Africa in November 2025, where all national grids were successfully synchronised for four hours, validating the feasibility of a fully coordinated regional network. Elsewhere on the continent, several planned interconnectors, including Tanzania–Zambia, Ethiopia–Somalia and Angola–DR Congo, aim to further strengthen regional trade and integration.

Market and financing conditions also present obstacles. Single-buyer models, regulated tariffs and financially constrained utilities can make long-term power purchase agreements difficult to secure, complicating investment decisions and delaying financial close. Some governments are pursuing broader policy initiatives to address this. Nigeria's Sustainable Power and Irrigation (SPIN) project backed by the World Bank enhances hydropower planning alongside dam safety and water management, while the Republic of Congo's National Energy Pact strengthens sector governance and investment readiness, helping to lay the foundation for more bankable projects.

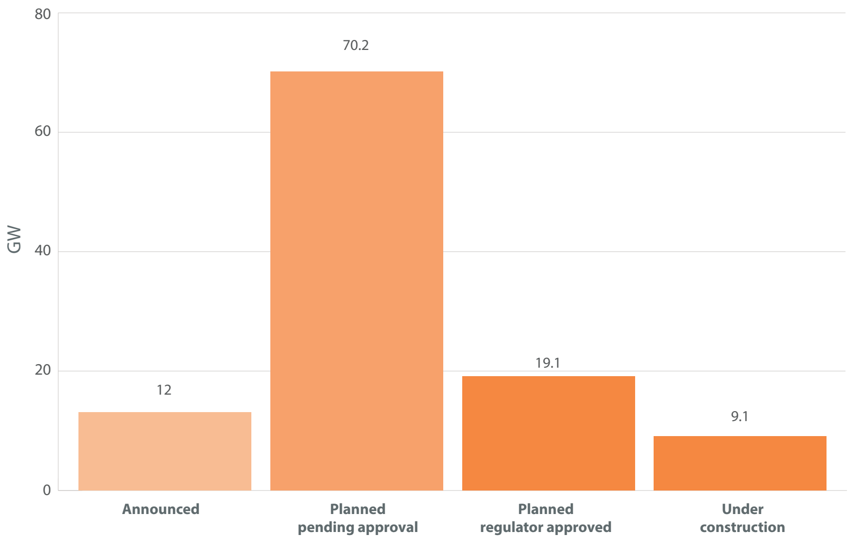
Environmental, social and geopolitical considerations add further complexity, especially on shared river basins where projects require careful coordination and robust safeguards. Climate change is increasing hydrological uncertainty, while political instability and institutional capacity gaps in some markets can further elevate risk perceptions among investors.

The Hydropower Sustainability Standard (HSS) provides a framework for projects in Africa to align with international best practice and reduce investment risk. After Zambia's Ngonye Falls Hydroelectric Project became the first African Gold-certified project in December 2024, further projects are in the certification pipeline, including the 2,075MW Cahora Bassa South Bank Hydropower Project, which completed public consultation for certification in May 2026.

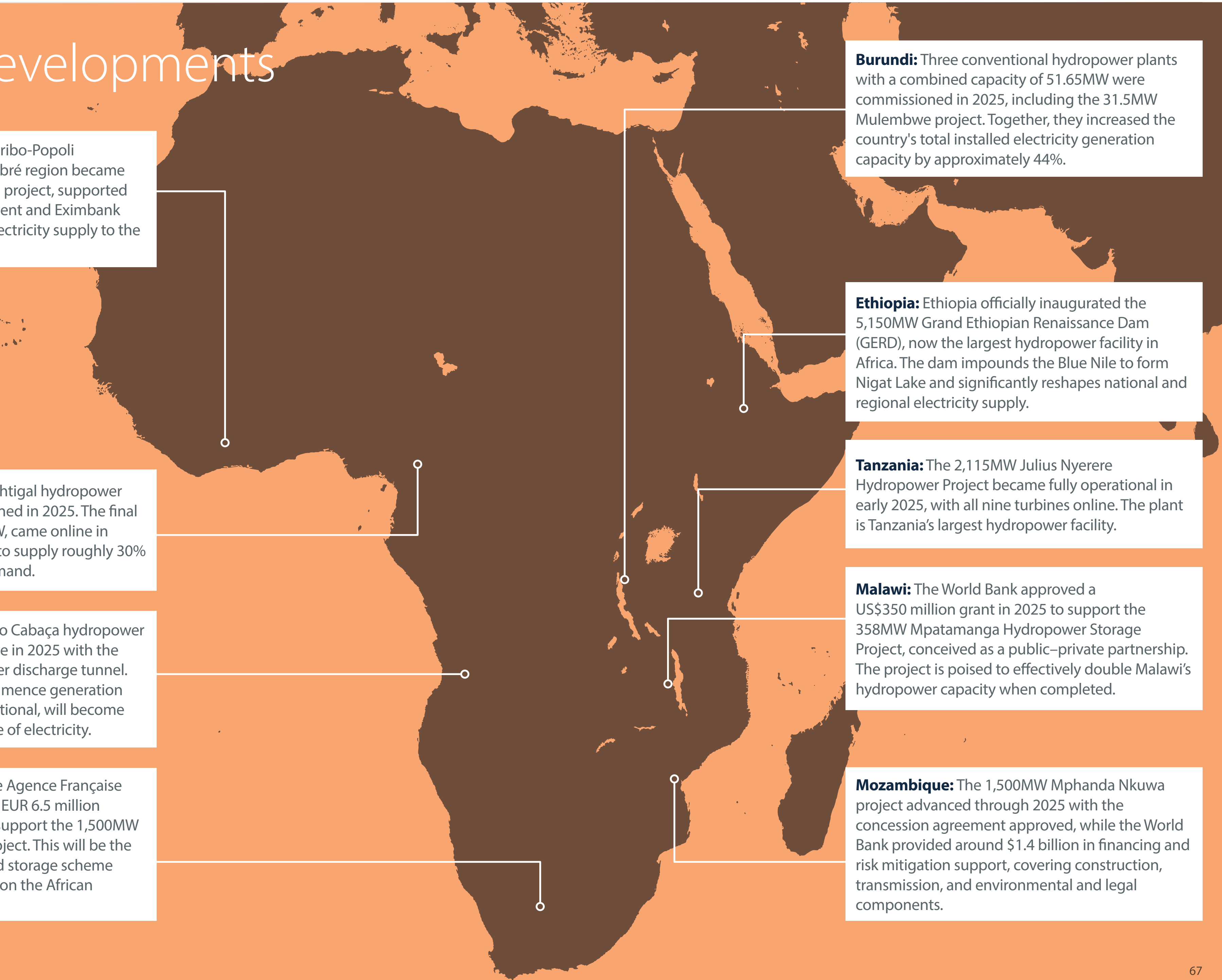
Africa pumped storage pipeline



Africa conventional pipeline



Project developments



Côte d'Ivoire: The 112MW Gribo-Popoli hydropower plant in the Soubré region became operational in May 2025. The project, supported by both the Ivorian government and Eximbank China, is set to strengthen electricity supply to the country's southwest.

Cameroon: The 420MW Nachtigal hydropower scheme was fully commissioned in 2025. The final unit, with a capacity of 60MW, came online in March, enabling the project to supply roughly 30% of Cameroon's electricity demand.

Angola: The 2,172MW Caculo Cabaça hydropower plant reached a key milestone in 2025 with the completion of its critical water discharge tunnel. The plant is expected to commence generation in mid-2027 and, once operational, will become Angola's largest single source of electricity.

South Africa: Eskom and the Agence Française de Développement signed a EUR 6.5 million grant agreement in 2025 to support the 1,500MW Tubatse pumped storage project. This will be the fifth grid-connected pumped storage scheme in South Africa and the sixth on the African continent.

Burundi: Three conventional hydropower plants with a combined capacity of 51.65MW were commissioned in 2025, including the 31.5MW Mulembwe project. Together, they increased the country's total installed electricity generation capacity by approximately 44%.

Ethiopia: Ethiopia officially inaugurated the 5,150MW Grand Ethiopian Renaissance Dam (GERD), now the largest hydropower facility in Africa. The dam impounds the Blue Nile to form Nigat Lake and significantly reshapes national and regional electricity supply.

Tanzania: The 2,115MW Julius Nyerere Hydropower Project became fully operational in early 2025, with all nine turbines online. The plant is Tanzania's largest hydropower facility.

Malawi: The World Bank approved a US$350 million grant in 2025 to support the 358MW Mpatamanga Hydropower Storage Project, conceived as a public–private partnership. The project is poised to effectively double Malawi's hydropower capacity when completed.

Mozambique: The 1,500MW Mphanda Nkuwa project advanced through 2025 with the concession agreement approved, while the World Bank provided around $1.4 billion in financing and risk mitigation support, covering construction, transmission, and environmental and legal components.

Africa

Policy developments

COUNTRY	POLICIES
Central African Republic	The government launched a Small Hydro / Mini-Hydro Rural Electrification Program under the National Development Plan. Eight mini-hydro plants are planned across the country in a two-phase programme, financed through public–private partnerships, to expand electricity access in rural areas.
Democratic Republic of the Congo	The World Bank approved a US$250 million credit as part of the first phase of a broader ~US$1 billion programme for Inga 3 under the National Energy Compact framework, aiming to modernise the energy sector and attract private investment.
Guinea	Guinea initiated a national consultation on the Mission 300 initiative, mobilising US$272 million, including IDA/World Bank support, to expand electricity access through renewable energy generation.
Liberia	Liberian authorities signed a Memorandum of Understanding with Arthur Energy Africa to develop the St. John River Basin, targeting up to 300MW of hydropower capacity, a move designed to address the country's electricity deficit and expand renewable energy generation.
Nigeria	The SPIN project was launched in 2025 with US$500 million World Bank backing. The programme enhances dam safety, water management, irrigation and hydropower development, including the creation of a National Hydropower Masterplan and a Strategic Environmental & Social Assessment (SESA), providing a framework for climate-resilient, socially inclusive energy planning.
Republic of the Congo	The government formally approved its National Energy Pact in September 2025, outlining strategic goals to transform the energy sector, increase electricity access and mobilise investment, including for hydropower, to support universal electrification.
Rwanda	The 5.43MW Mushishito-Rukarara V Hydro project became Rwanda's first hydropower facility registered with the Global Carbon Council in early 2025, strengthening the country's clean energy credentials and engagement with international carbon credit frameworks.

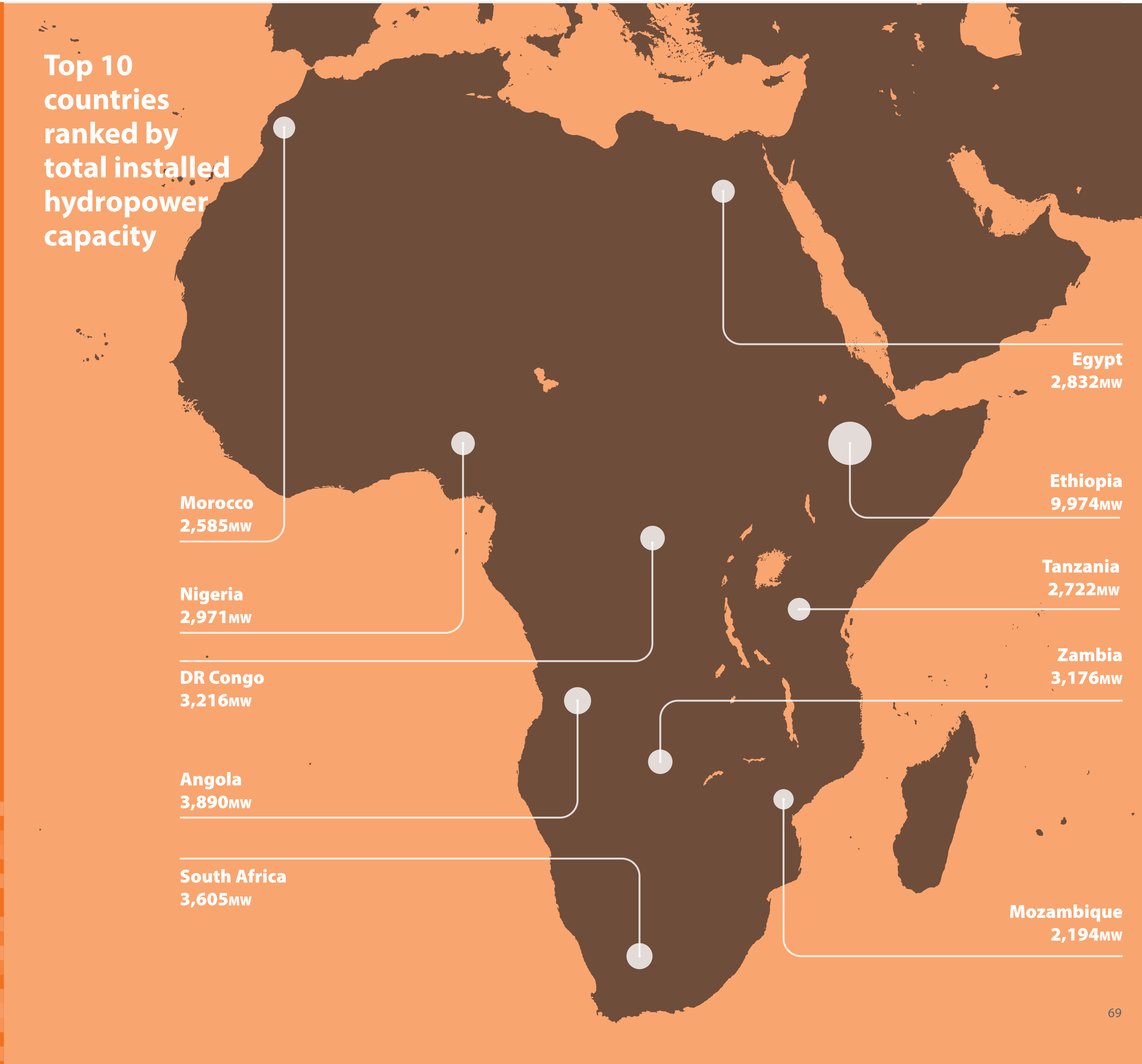
Interesting fact

Almost half of hydropower capacity in Africa is more than 25 years old, reflecting that much of the continent's fleet is ageing. Modernisation and refurbishment can help maintain efficiency, extend plant lifespans and support growing electricity demand. A study conducted by IHA for the African Development Bank published in 2023 found that around 12% of the total fleet has high modernisation needs, with a further 10GW across 36 plants assessed as medium priority, highlighting the potential for targeted upgrades to deliver significant operational and system

Top 5 countries by capacity added in 2025

1. **Ethiopia** 3,950MW
2. **Cameroon** 120MW
3. **Nigeria** 120MW
4. **Burundi** 52MW
5. **Tanzania** 18MW

Top 10 countries ranked by total installed hydropower capacity



South and Central Asia

Key trends

- **Sustained hydropower growth is expected across the region,** driven by strong development activity and a healthy 306GW project pipeline.
- **Policy momentum is building, with India leading the way** through pumped storage auctions, renewable integration incentives and long-term hydropower planning.
- **Cross-border coordination is strengthening to improve water and energy security,** particularly in Central Asia, through shared reservoir management and electricity trade agreements.

Key data

Generation by hydropower in 2025
518 TWh

Capacity added in 2025*
5,839 MW

Pumped storage capacity added in 2025
3,024 MW

Total installed capacity*
173 GW

Total pumped storage installed capacity
11 GW

*Includes pumped storage

Jorethang hydropower plant, India
Credit: Dans Energy

Regional outlook

South and Central Asia faces a rapidly evolving energy landscape shaped by dual challenges of meeting rising electricity demand from a growing population and managing shared water resources. Hydropower is well placed to play a central role in the region's energy transition, but growing climatic variability is putting pressure on infrastructure and reinforcing the need for climate-resilient planning.

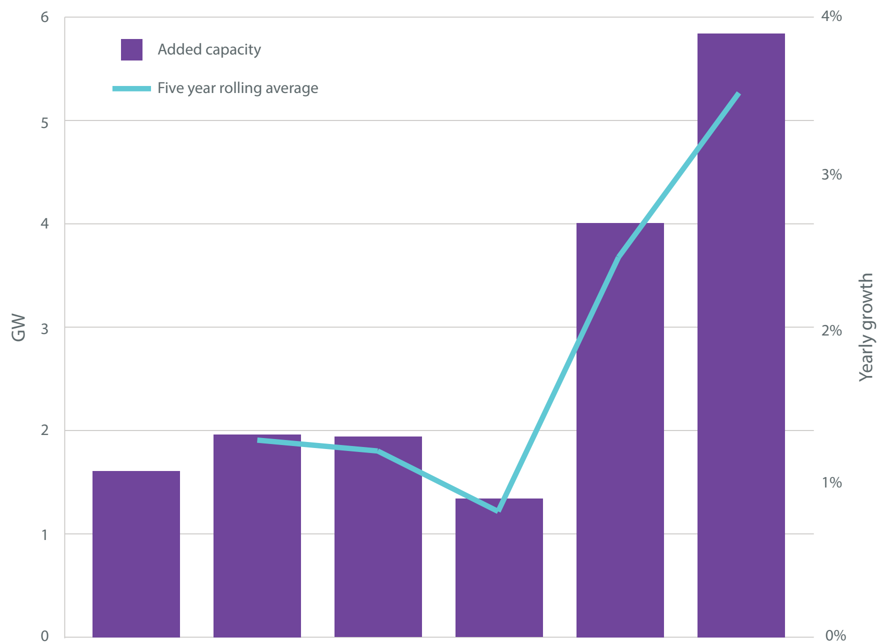
Driven by strong progress in Pakistan, India, Nepal and Bhutan, the current pipeline includes 51GW of projects under construction, alongside a further 33GW at advanced stages of development. This points to strong expectations for hydropower deployment to accelerate in the region over the next five to ten years, with annual additions potentially persisting at the level recorded in 2025.

With extreme weather events becoming more frequent and intense, conventional hydropower plants are being called upon to provide flexibility and system services in addition to their traditional baseload generation role. At the same time, prolonged droughts in 2025, followed in some cases by severe flooding, have exposed vulnerabilities in ageing hydropower assets. Many governments faced electricity shortages as ongoing droughts reduced water availability and reservoir levels.

One way in which governments are responding is by stepping up cross-border cooperation. In November 2025, Kazakhstan, Kyrgyzstan and Uzbekistan agreed on key parameters for water and energy coordination, committing to mutual electricity support and joint reservoir management through heating and agricultural seasons. The heads of the Energy Departments met again in February 2026 to continue discussions on cooperation in energy and water. Kazakhstan, Tajikistan and Uzbekistan also signed a temporary allocation agreement for the Bahri Tochik reservoir during the summer season, while Iran, Iraq and Türkiye coordinated water releases to maintain critical supply. Comparable dynamics can be seen in South Asia, where India, Nepal and Bhutan are deepening hydropower cooperation and electricity trade, highlighting the interdependence of water and energy systems and the role of hydropower in strengthening regional resilience and security.

Hydropower modernisation and infrastructure renewal present low-risk pathways to adapt to shifting hydrological patterns in the region while extending output and improving efficiency. For example, in Tajikistan, the Qairokkum hydropower plant reopened in 2025 after a major upgrade that increased the capacity of the facility from 126MW to 174MW. Modernisation continues to be important to Russia's hydropower fleet, with RusHydro and other operators updating equipment to deliver regular increases in capacity. In India, where roughly one-third of the hydropower fleet is over 30 years old, renovation and modernisation programmes are increasingly focused on upgrading ageing assets to improve efficiency, extend operational life and unlock additional capacity .In India, where roughly one-third of the hydropower fleet is over 30 years old, renovation and modernisation programmes are increasingly focused on upgrading ageing assets to improve efficiency, extend operational life and unlock additional capacity.

Annual added capacity, South and Central Asia (GW)



Sustainable long-term planning is gaining traction as countries look to scale up hydropower development to support more resilient, low-carbon power systems. Tajikistan has partnered with the Hydropower Sustainability Alliance to develop a 2050 power system plan for the Gorno-Badakhshan Autonomous Region, integrating climate resilience, energy security and regional development objectives, and utilising tools like the Hydropower Sustainability Standard and HydroSelect to plan at system scale.

Hydropower's role in the next 10–15 years

Hydropower will remain a cornerstone of energy security and climate adaptation in South and Central Asia, acting as a "water battery" to store and release energy in response to seasonal and climate variability. Regional reservoirs provide crucial flexibility, balancing domestic demand and cross-border electricity flows.

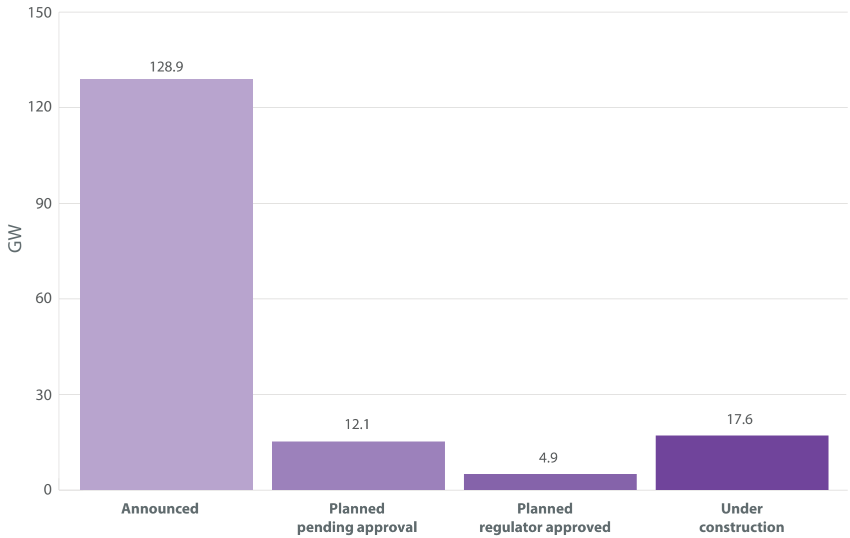
India is cementing its role as a global leader in stimulating pumped storage development for grid stability and long-duration storage. The country's pumped storage capacity is set to expand from from over 7GW today to reach around 76GW by 2032 and over 100 GW by 2035-36, supported by competitive bidding frameworks, integrated tariff structures and central government incentives.

Plans in the Brahmaputra basin, for example, outline 64.9GW of conventional hydropower alongside 11.1GW of pumped storage, as part of a strategy to balance solar and wind growth, reduce curtailment and enhance system reliability. In addition to Government of India policies, many states are considering, or have implemented, policies to support pumped storage development. This includes Gujarat, Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Odisha, and many others.

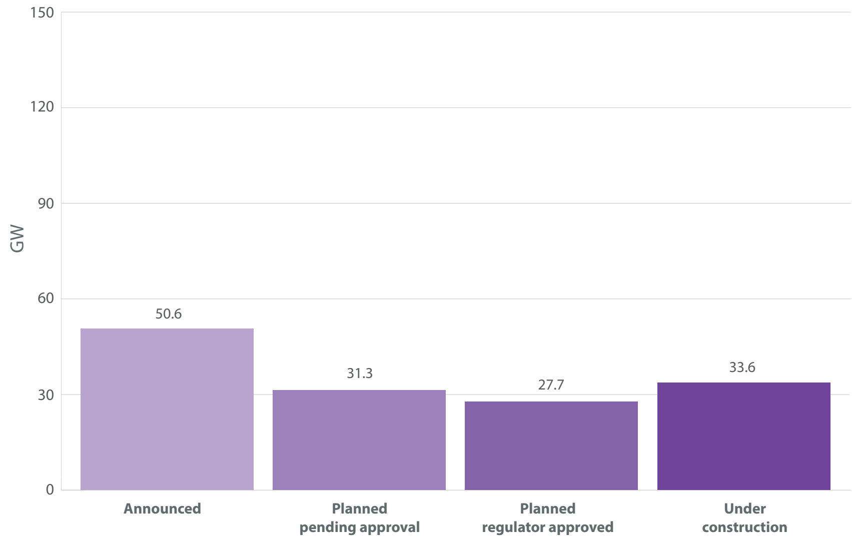
Pumped storage is also emerging as a strategic energy security solution in parts of the Middle East with limited conventional hydropower resources. In 2025, Israel commissioned the 344MW Kokhav Hayarden pumped storage plant, taking the country's total pumped storage capacity to 644MW despite having only minimal conventional hydropower generation. The UAE advanced trial operations at the 250MW Hatta facility, the first pumped storage project in the Arabian Peninsula, while Jordan announced plans to explore a 450MW pumped storage project as part of efforts to strengthen grid flexibility and renewable integration.

Barriers to development and pathways forward

Water scarcity and financing constraints are mutually reinforcing barriers to



South and Central Asia pumped storage pipeline



South and Central Asia conventional pipeline

hydropower development across South and Central Asia, by increasing project risk and uncertainty. Reduced water availability is a significant constraint on generation.

In 2025, Iran's rainfall was 40% below its long-term average, causing reservoir capacity to fall to around 12%. Across Central Asia, precipitation in 2025 fell to around 80% of the long-term average, one of the driest years in the region in decades. Kyrgyzstan's Toktogul plant and Tajikistan's Nurek plant neared historic lows, prompting both countries to implement electricity demand restrictions to prevent blackouts.

In South Asia, the pattern is equally apparent. Despite recent capacity additions in Nepal and seasonal hydropower surpluses in Bhutan, both countries continue to rely on electricity imports during the winter months. Reduced river flows lead to sharp declines in generation, offsetting gains made during the monsoon season.

Generation risk compounds the financing challenge. Tajikistan's Rogun Hydropower Project saw World Bank financing suspended in 2025 pending a credible debt strategy and resolution of downstream concerns over reduced Amu Darya flows. The case illustrates how physical water stress and water use disputes raise the cost and conditionality of capital to stall project construction.

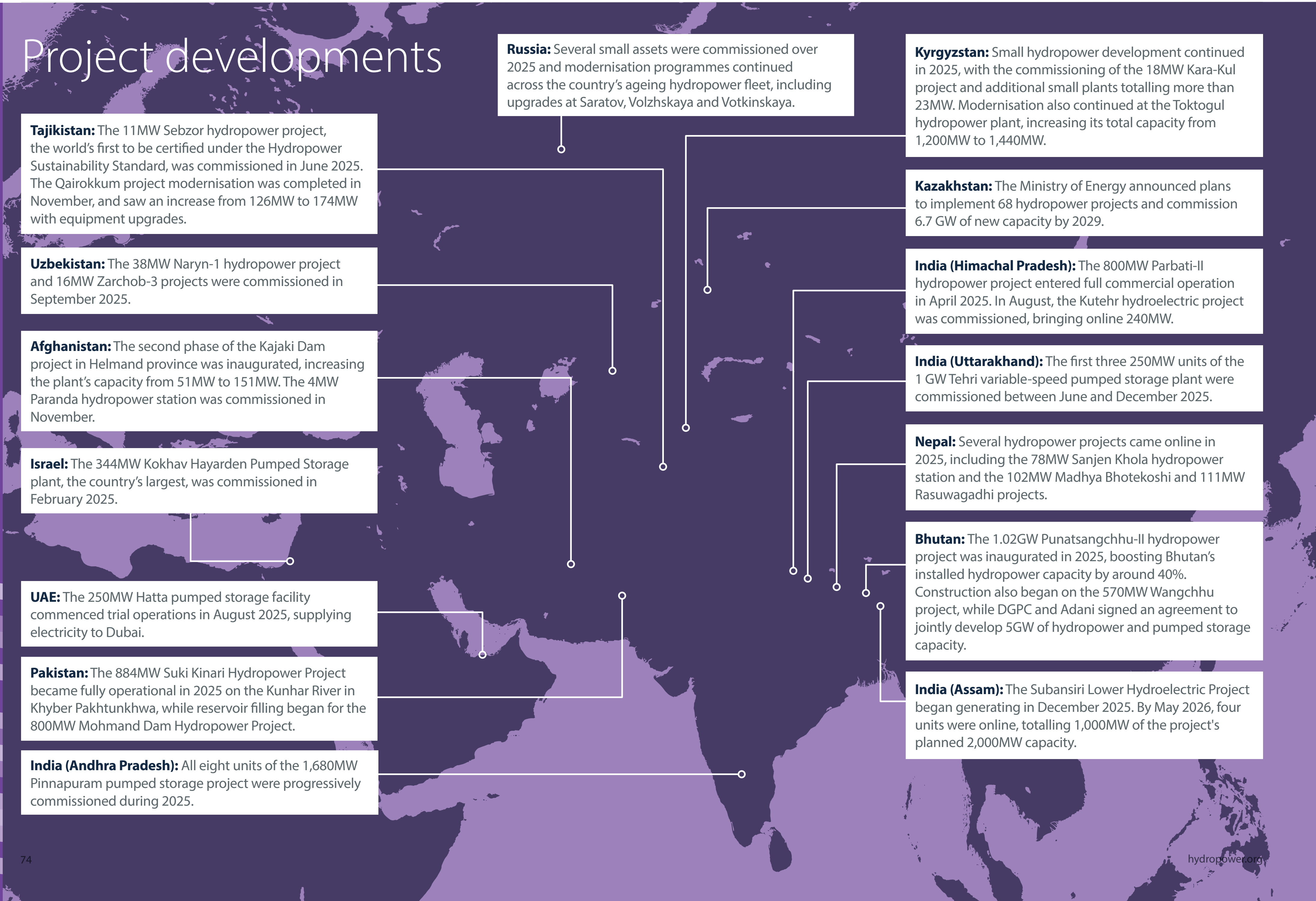
Unresolved water sharing arrangements underline both challenges. In South Asia, the suspension of the Indus Waters Treaty in May 2025 removed cooperative frameworks on water sharing. However, another part of the region encouragingly saw Kazakhstan, Kyrgyzstan and Uzbekistan agree parameters in November 2025 for joint reservoir management, an institutional response to manage scarcity.

Interesting fact

Following its full commissioning in 2025, Pakistan's 884MW Suki Kinari Hydropower Project provides clean, renewable electricity to over 1 million homes and has created more than 6,000 jobs, supporting local communities and boosting industry.

Chitravathi hydropower project, India
Credit: Adani

Project developments



Russia: Several small assets were commissioned over 2025 and modernisation programmes continued across the country's ageing hydropower fleet, including upgrades at Saratov, Volzhskaya and Votkinskaya.

Tajikistan: The 11MW Sebzor hydropower project, the world's first to be certified under the Hydropower Sustainability Standard, was commissioned in June 2025. The Qairokkum project modernisation was completed in November, and saw an increase from 126MW to 174MW with equipment upgrades.

Uzbekistan: The 38MW Naryn-1 hydropower project and 16MW Zarchob-3 projects were commissioned in September 2025.

Afghanistan: The second phase of the Kajaki Dam project in Helmand province was inaugurated, increasing the plant's capacity from 51MW to 151MW. The 4MW Paranda hydropower station was commissioned in November.

Israel: The 344MW Kokhav Hayarden Pumped Storage plant, the country's largest, was commissioned in February 2025.

UAE: The 250MW Hatta pumped storage facility commenced trial operations in August 2025, supplying electricity to Dubai.

Pakistan: The 884MW Suki Kinari Hydropower Project became fully operational in 2025 on the Kunhar River in Khyber Pakhtunkhwa, while reservoir filling began for the 800MW Mohmand Dam Hydropower Project.

India (Andhra Pradesh): All eight units of the 1,680MW Pinnapuram pumped storage project were progressively commissioned during 2025.

Kyrgyzstan: Small hydropower development continued in 2025, with the commissioning of the 18MW Kara-Kul project and additional small plants totalling more than 23MW. Modernisation also continued at the Toktogul hydropower plant, increasing its total capacity from 1,200MW to 1,440MW.

Kazakhstan: The Ministry of Energy announced plans to implement 68 hydropower projects and commission 6.7 GW of new capacity by 2029.

India (Himachal Pradesh): The 800MW Parbati-II hydropower project entered full commercial operation in April 2025. In August, the Kutehr hydroelectric project was commissioned, bringing online 240MW.

India (Uttarakhand): The first three 250MW units of the 1 GW Tehri variable-speed pumped storage plant were commissioned between June and December 2025.

Nepal: Several hydropower projects came online in 2025, including the 78MW Sanjen Khola hydropower station and the 102MW Madhya Bhotekoshi and 111MW Rasuwagadhi projects.

Bhutan: The 1.02GW Punatsangchhu-II hydropower project was inaugurated in 2025, boosting Bhutan's installed hydropower capacity by around 40%. Construction also began on the 570MW Wangchhu project, while DGPC and Adani signed an agreement to jointly develop 5GW of hydropower and pumped storage capacity.

India (Assam): The Subansiri Lower Hydroelectric Project began generating in December 2025. By May 2026, four units were online, totalling 1,000MW of the project's planned 2,000MW capacity.

Policy developments

COUNTRY	POLICIES
Afghanistan	The government extended its electricity import agreement with Uzbekistan through 2026, ensuring continued supply of around 800MW as Afghanistan remains heavily reliant on imported electricity.
Azerbaijan	EBRD has supported preparation of policy and technology recommendations to decarbonise Azerbaijan's energy sector, aligned with the country's Nationally Determined Contribution and climate targets.
Bhutan	The National Energy Policy 2025 sets a target of 25GW installed capacity by 2040, including 20GW hydropower and 5GW solar/wind, and opens the sector to private investment, with measured participation from experienced Indian developers.
Georgia	Major hydropower projects including Namakhvani, Nenskra, Khudoni and Enguri were designated "strategic" by the government in 2025, with additional state support expected as Georgia targets 5.5GW of hydropower capacity by 2030.
India	India continued expanding policy support for hydropower and pumped storage in 2025–26 through new storage procurement mechanisms, transmission incentives and revised approval frameworks, alongside major long-term capacity targets for both conventional hydropower and pumped storage. Further detail is explored in the India policy case study later in this section.
Iraq	A 2025 "oil-for-water" agreement with Türkiye established new cooperation on river management while financing dam, irrigation and water infrastructure development in Iraq.
Kyrgyzstan	Kyrgyzstan expanded policy support for hydropower in 2025 through plans for large-scale small hydro deployment, modernisation of existing assets, and a new agreement to develop the 2.2GW Kazarman Hydroelectric Projects.
Nepal	Fiscal year 2025–26 saw Nepal shift from "take-or-pay" to "take-and-pay" PPAs for run-of-river projects, while British International Investment extended financing support aligned with the country's target of developing 15GW of hydropower by 2035.
Pakistan	WAPDA submitted a proposal to increase its FY26 revenue requirement by 85–91%, including claims related to historical regulatory gaps, provincial payments and other cost components. The proposal is under review by the National Electric Power Regulatory Authority.
Russia	A new Energy Strategy approved in 2025 targets a 17% increase in hydropower generation by 2050, alongside measures to improve investment conditions and expand regional cooperation on hydropower and water management across Central Asia.
Tajikistan	Tajikistan announced a new power system plan for the VMKB province for the period up to 2050, integrating use of HydroSelect and the Hydropower Sustainability Standard into long-term planning.
Uzbekistan	In early 2026, Uzbekistan presented long-term hydropower plans including 73 proposed projects expected to add 3.6GW of capacity as part of broader energy sector expansion plans.

South and Central Asia

Top 5 countries by capacity added in 2025

1 India 4,267MW

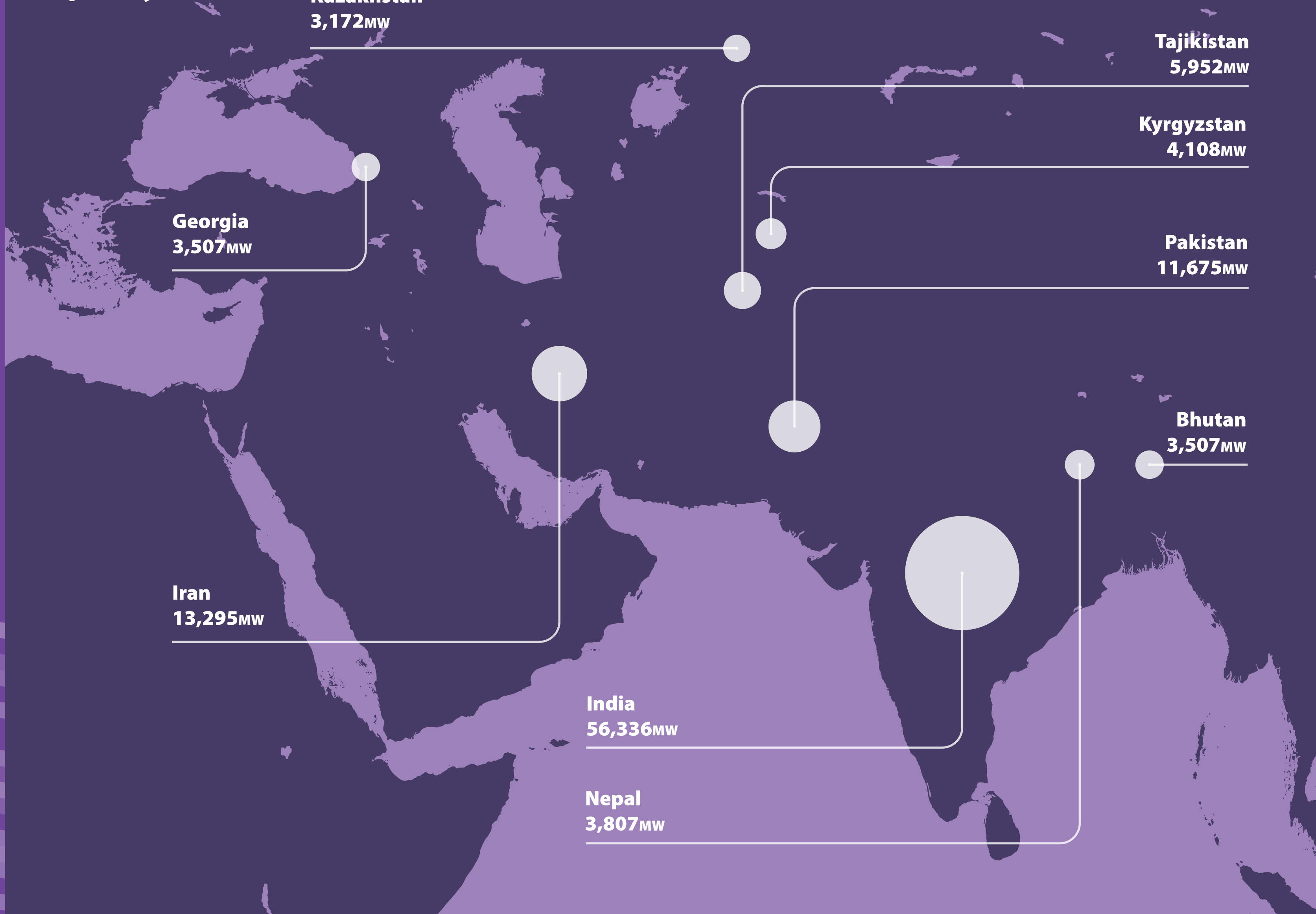
2 Nepal 468MW

3 Israel 344MW

4 United Arab Emirates 250MW

5 Pakistan 156MW

Top 10 countries ranked by total installed hydropower capacity



CASE STUDY

India's pumped storage push: building towards 100GW

India's power system is changing rapidly. As one of the world's fastest-growing renewable energy markets, the country is scaling up solar and wind generation at unprecedented speed while pursuing long-term energy security and industrial growth. Installed solar PV capacity stood at 150GW as of March 2026 and is targeted to exceed 500GW by 2035–36, while wind capacity is expected to almost triple from 56GW to 155GW over the same period.

This transformation is creating a growing need for flexible generation and long-duration electricity storage capable of balancing variable renewable energy and supporting grid reliability. In response, India's hydropower sector, particularly pumped storage, is entering a new phase of accelerated development supported by ambitious government targets, policy reforms and private sector investment.

India added over 4GW of new hydropower capacity in 2025, surpassing Russia to become the world's 5th largest country for total installed hydropower capacity.

Accelerated momentum for pumped storage

According to the Central Electricity Authority (CEA), India has an estimated pumped storage potential of almost 288GW, one of the largest opportunities globally.

Momentum has accelerated significantly in recent years. As of March 2026, around 16GW of pumped storage projects were under construction, while a further 6.5GW of Detailed Project Reports (DPRs) had already been appraised.

Major new projects have also begun entering operation. During 2025, three 250MW units were commissioned at the Tehri pumped storage project in Uttarakhand as part of the project's first 1GW phase, while the 1.68GW Pinnapuram project in Andhra Pradesh completed commissioning of all units.

India's long-term ambitions extend far beyond the current pipeline. The CEA has outlined a roadmap targeting 100GW of pumped storage capacity by 2035–36.

Growth is being driven by both public and private sector participation. Major Indian energy companies including Adani Group, Tata Power, JSW Energy, Torrent Power and Greenko are all advancing pumped storage pipelines, alongside state utilities and public sector developers.

Policy support and energy security

Government policy is advancing India's hydropower expansion. Recent reforms have focused on accelerating approvals, reducing development barriers and improving project economics.

Measures introduced to support pumped storage include financial support for enabling infrastructure, waivers on inter-state transmission system charges for eligible projects, and faster approvals, with DPR timelines reduced to 50 days. Regulatory changes have also simplified approval processes for off-stream pumped storage projects and eased certain concurrence requirements. Additional incentives include relief from some free power obligations, water cess payments and upfront royalties.

These reforms reflect the growing recognition of pumped storage's strategic role. Unlike some battery supply chains, pumped storage development can draw heavily on domestic engineering capability, construction expertise and locally available materials, reducing exposure to global supply chain risks.

Further policy measures under consideration include viability gap funding mechanisms and market reforms that would better reward services such as peak balancing, system flexibility and grid stability.

With significant untapped potential and a robust domestic ecosystem, pumped storage has emerged as a critical enabler of renewable integration and a key pillar of India's energy transition and long-term energy security.

East Asia and Pacific

Key trends

- **China is shifting focus to ensuring grid stability and accelerating hydro-wind-solar synergy,** elevating hydropower's role as critical infrastructure for reliability and flexibility.
- **Cross-border hydropower trade is driving regional integration in Southeast Asia,** with coordinated planning and targeted financing enabling growing exports from Lao PDR, Myanmar and Sarawak (Malaysia).
- **In Australia and New Zealand, hydropower development is increasingly centred on pumped storage,** with close to 15GW progressing through the development pipeline.

Key data

Generation by hydropower in 2025
1,854 TWh

Capacity added in 2025*
14 GW

Pumped storage capacity added in 2025
7,605 MW

Total installed capacity*
590 GW

Total pumped storage installed capacity
106 GW

Asiga hydropower plant, Philippines
Credit: Voith Hydro

Regional outlook

The East Asia and Pacific region remains at the forefront of global hydropower development, led by China, which continues to expand both scale of deployment and technological capability. Over 300GW of hydropower is currently under construction in the country, including 217.5GW of pumped storage. In 2025, construction officially began on the Yarlung Zangbo River Hydropower Project, projected to become the world's largest hydropower facility. With an estimated annual output capability of 300TWh, it would generate roughly three times as much electricity as the Three Gorges Dam.

China also commissioned the first unit of the 1,700MW Zhejiang Tiantai Pumped Storage Plant and fully commissioned the 1,400MW Ninghai Pumped Storage facility, while making significant progress with Shuangjiangkou, which is poised to become the world's tallest dam. Overall, China accounted for more than 40% of global hydropower capacity additions in 2025, reflecting the country's continued global leadership and a hydropower build-out that shows no signs of slowing.

Beyond China, hydropower is increasingly shaping regional energy integration. Across the East Asia and Pacific region, 52.6GW of conventional hydropower and 38.2GW of pumped storage are at various stages of the development pipeline. Population growth, industrialisation and rising energy demand are driving countries in Southeast Asia to pursue the integration of flexible, renewable-ready systems, with grid balancing, cross-border trade and long-duration storage emerging as central priorities.

The ASEAN Power Grid (APG) has been strengthened through renewed frameworks and a five-year action plan to accelerate cooperation, harmonise standards and align policy strategies. These efforts are reinforced by new coordinated financing with support from multilateral institutions including the World Bank, and European Union and the Asian Development Bank. Lao PDR, Myanmar and Malaysia are advancing plans to expand electricity exports. In Malaysia, interconnections linking Sarawak with Sabah and Indonesia, alongside proposed links to Brunei and an undersea transmission link to Singapore, and Malaysia–Singapore cross-border trading arrangements, are supporting a more integrated and flexible regional grid. These expanding interconnections increase hydropower's role in regional balancing and flexibility, while also creating new opportunities for pumped storage and cross-border renewable integration.

Pumped storage continues to gain momentum as a key tool for system flexibility and renewable integration. In the Philippines, the Green Energy Auction 3 saw more than 6GW of pumped storage awarded alongside 300MW of conventional hydropower. Cambodia also launched construction of the 1,000MW Upper Tatay facility, its first large-scale pumped storage project, while Thailand plans around 2.5GW of new pumped storage, and Korea Hydro & Nuclear Power has resumed construction on multiple plants, marking the Republic of Korea's first major build-out in 14 years.

Across the Pacific, Australia is also prioritising long-duration electricity storage to manage variable hydrology, with a draft Integrated System by the Australian Energy Market Operator highlighting the need for 40GW of grid-scale storage and hydropower by 2050. Growing use of existing pumped storage assets reflects the increasing need to support Australia's expanding solar capacity, with 2025 recording the highest annual pumped storage consumption on record at more than 2GWh.


Gordon stator lift, Australia. Credit: Hydro Tasmania

Meanwhile, work continues on major projects. The flagship Snowy 2.0 project surpassed 70% completion, with its fourth tunnel-boring machine commissioned, while Queensland's Kidston was registered to the national electricity grid ahead of wet commissioning expected in 2026, marking Australia's first new pumped storage project in 40 years. This progress comes as Sydney prepares to host the World Hydropower Congress in April 2027.

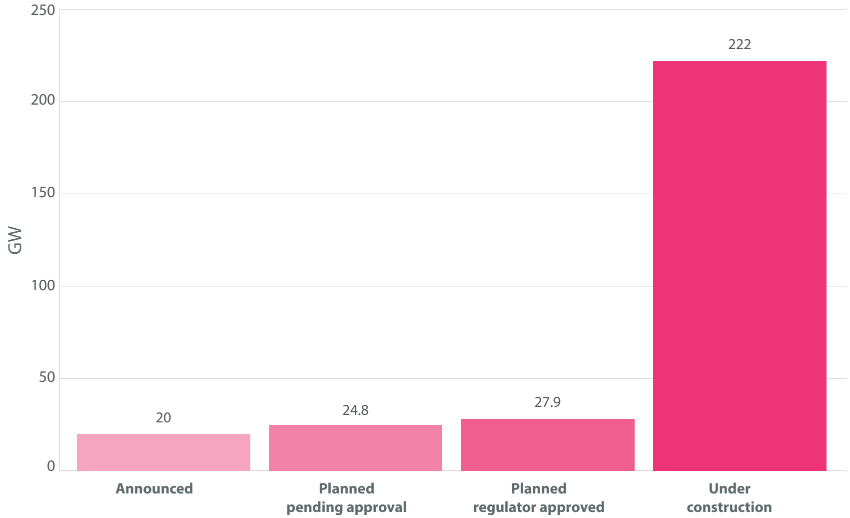
Hydropower's role in the next 10–15 years

Hydropower is expected to remain central to meeting the region's growing demand and supporting renewable integration, while becoming a core instrument for energy security. In China, the strategic challenge has shifted from building new hydropower capacity to providing grid flexibility, with conventional hydropower and pumped storage facilities critical to balancing variable renewables, deepening the hydro-wind-solar synergy model. Revised Renewable Energy Law regulations ensure that hydropower is fully recognised as a flexible system-balancing resource.

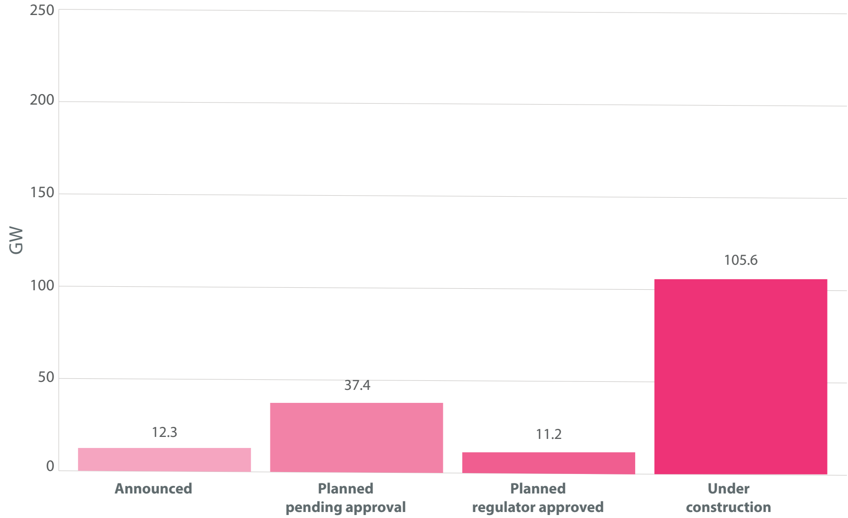
In Southeast Asia, hydropower will continue to underpin regional trade, with new infrastructure enabling electricity flows to high-demand centres. Investments through the APG Financing Initiative, backed by the World Bank and Asian Development Bank (ADB), are mobilising capital for grid expansion and interconnection, while national initiatives such as Vietnam's generation price ceiling (including pumped storage) and Indonesia's Green Super Grid accelerate domestic deployment.

New hydropower development remains a major opportunity for countries in the region to extend energy access. In Papua New Guinea, for example, untapped hydropower potential exceeding 14,000MW could support the government's aim of electrifying 70% of households by 2030.

Elsewhere, countries including Japan and New Zealand are using hydropower to manage variability in renewable output. In Japan, curtailment of wind and solar rose by more than 38% in 2025 to 1.77 TWh across nine regional grids, tracking towards record levels. The country's 7th Strategic Energy Plan places conventional hydropower and pumped storage as key system assets, with an emphasis on the value of flexibility and balancing. In New Zealand, hydropower reservoir storage is at the centre of efforts to maintain reliable supply and energy security through intensifying swings between dry and wet years.



East Asia and Pacific pumped storage pipeline



East Asia and Pacific conventional hydropower pipeline

The importance of hydropower as a system resilience asset was demonstrated during a major outage affecting parts of Sumatra, Indonesia in May 2026. According to state utility PLN, hydropower stations were among the first generating assets able to support grid restoration, providing rapid-response capacity while coal-fired power plants required many more hours to return to operation.

Barriers to development and pathways forward

Development across the East Asia and Pacific region faces structural, regulatory and social challenges. While there are signs that cross-border integration is stepping up in Southeast Asia, fragmented legal frameworks and financing constraints are slowing progress. Physical interconnections alone cannot guarantee resilience without robust institutional and legal mechanisms.

Geopolitical volatility remains a risk, with three major hydropower projects stalled in Myanmar due to instability. Elsewhere, hydropower projects in Indonesia and Cambodia are navigating challenges with environmental management and community consent.

In response, countries are increasingly adopting tools to align with international best practice and reduce risk. State-owned utility Sarawak Energy has pledged full Hydropower Sustainability Standard certification across its fleet by 2030, while Indonesia is stepping up engagement with assessments and training programmes in collaboration with the Hydropower Sustainability Alliance. In China, hydropower developers are advancing ESG and sustainability practices through improved basin management, digital monitoring, green finance mechanisms and strengthened ecological protection.

Countries are increasingly turning to pumped storage as a source of system flexibility, but the scale and long-term nature of many projects require careful planning and coordination. Initiatives across the region, including in Australia, China and the Philippines, highlight the importance of supportive regulatory frameworks and long-term investment certainty. Streamlined permitting processes, early stakeholder engagement and targeted policy and financing support can help accelerate deployment while maintaining high standards of project performance.

Murum hydropower plant, Malaysia. Credit: Sarawak Energy

Project developments

China: The 1,400MW Ninghai Pumped-Storage Plant (State Grid Xinyuan Co. Ltd) in Zhejiang became fully operational, completed on schedule three years after installation began. In addition, the 1,700MW Zhejiang Tiantai Pumped Storage Power Station (China Three Gorges Corporation) commissioned its first unit in 2025.

Thailand: EGAT plans three new pumped storage plants totalling 2,472MW, with the first expected by 2034, and is developing hydro–floating solar hybrid projects, targeting 2.7GW by 2030 across operational and under-construction sites.

Lao PDR: The 156MW Nam Sam 3 hydropower plant entered commercial operation in 2025, while construction began on the 124MW Nam Neun 1 project, and reservoir filling commenced at the Nam Mo 2 project as it entered its final construction phase.

Cambodia: Construction began on the 150MW Upper Stung Tatay Hydropower Station, led by Sinomach, with power generation expected in 2026. The project will support flood control, disaster relief and regional development.

Republic of Korea: Construction began on the 500MW Yeongdong Pumped Storage Plant, the first major pumped storage project in the country.

Vietnam: Phase 2 construction commenced on the 1,200MW Bac Ai Pumped-Storage Hydropower Plant in Ninh Thuan, a flagship project within the national Power Plan 8 for long-duration electricity storage.

Philippines: The Department of Energy confirmed bid award acceptances under the third Green Energy Auction (GEA-3), covering multiple conventional hydropower and pumped storage projects. Total capacity under GEA-3 could exceed 6.6GW by 2035.

Malaysia: Sarawak advanced feasibility studies for pumped storage at Bakun, Murum and Padawan as part of its 15GW by 2035 roadmap under the Sarawak Energy Transition Plan, supporting regional renewable integration and future hydrogen deployment.

Indonesia: Two EU-funded feasibility studies were awarded for large-scale pumped storage projects: the 500MW Sumatra pumped storage plant and 1,000MW Grindulu pumped storage plant. Meanwhile, the 174MW Asahan 3 Hydroelectric Project was inaugurated in January 2025 and certified under the Hydropower Sustainability

Australia: Queensland's 250MW Kidston pumped storage project connected to the national electricity grid ahead of planned wet commissioning in 2026. Snowy 2.0 continues to progress, with the fourth tunnel-boring machine commissioned as the project passes 70% completion.

Policy developments

COUNTRY	POLICIES
Australia	The 2025/26 Budget established an Energy Roadmap supporting long-term investment across generation, storage and transmission, while AEMO's draft Integrated System Plan highlighted the need for 40GW of grid-scale storage and pumped hydro by 2040 to manage variable wind and solar. Australia introduced environmental permitting reforms in early 2026, and streamlined tender frameworks. Several states are accelerating approvals for smaller pumped storage projects.
China	Policy priorities in 2025 continued to support integrated hydro-wind-solar development, accelerated pumped storage deployment and coordinated basin-scale planning, as China advanced the development of its evolving power system with hydropower as the backbone. Green modernisation, intelligent upgrading, the optimisation of cross-regional clean energy transmission and new market mechanisms to support energy storage capacity also remained central themes for the sector.
Indonesia	PT PLN published its 2025–2034 Electricity Supply Business Plan (RUPTL), outlining 11.7GW of conventional hydropower and 4.3 GW of pumped storage to be added by 2034, providing a roadmap for renewable expansion.
Japan	Amendments to the GX (Green Transformation) Act strengthen carbon reduction measures, support offshore wind and introduce frameworks for hydrogen and CO_2 storage, advancing flexible low-carbon energy. The Ministry of Economy, Trade and Industry also clarified that refurbishment and repowering of geothermal and small/medium hydro projects are treated equivalently to new projects under certification schemes.
New Zealand	The Fast-Track Approvals Act 2024 created a permanent, streamlined process for infrastructure consents. In November 2025, Tekapo A (30MW) and B (160MW) received the first fast-track approvals for renewable energy projects under the Act.
Philippines	The Department of Energy signed a new circular for the Kalayaan Pumped-Storage Project (KPSPP), setting a framework for "optimal utilisation" and settlement mechanism based on available capacity. This new capacity-style treatment is an important market signal for pumped storage in the Philippines.
Vietnam	The revised Power Development Plan in April 2025 raised 2050 targets for conventional hydropower, circa 41GW, and pumped storage, circa 21GW, separating pumped storage from battery storage in planning. The Ministry of Industry and Trade also issued a generation price ceiling specifically for pumped storage for 2025, providing investment certainty.

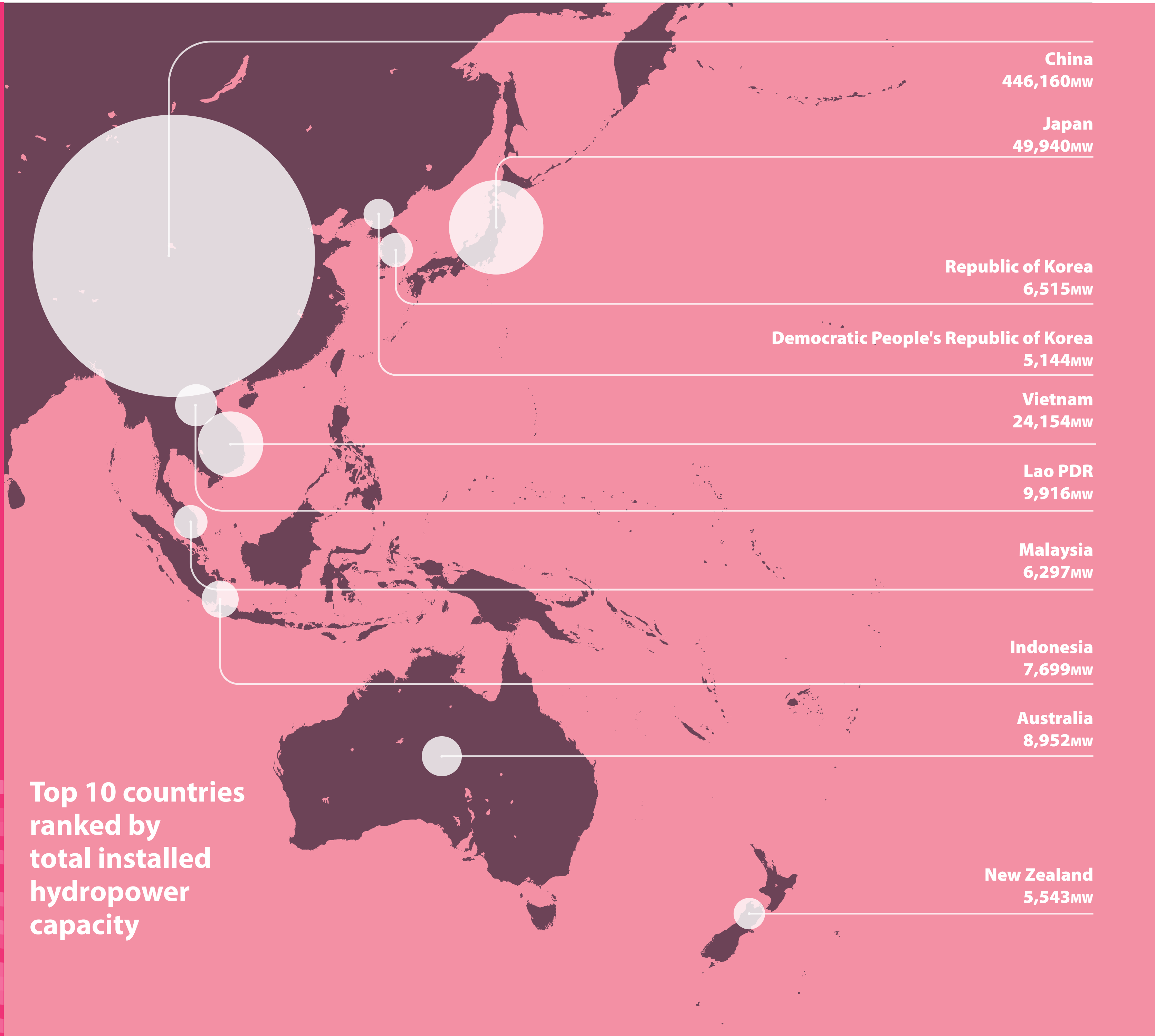
Interesting fact

Tenaga Nasional Berhad has launched a 100kW floating solar pilot at Tasik Kenyir, the largest man-made lake in mainland Southeast Asia. The project demonstrates how up to 10% of the lake's 36,900-hectare surface could host floating solar, unlocking an estimated 2.2GW of clean energy. The pilot also supports a green hydrogen hub in Kertih, developed with Petronas, showcasing the potential of hybrid hydro–solar systems to expand renewable generation without disrupting local ecosystems.

Top 5 countries by capacity added in 2025

1. China 12,150MW
2. Indonesia 1,129MW
3. Vietnam 490MW
4. Lao PDR 156MW
5. New Zealand 128MW

Top 10 countries ranked by total installed hydropower capacity



CASE STUDY

A new future for legacy hydropower at Tarraleah, Tasmania

Australia's energy sector is changing. In late 2025, renewables and energy storage supplied more than 50% of energy demand in the National Electricity Market for the first time, an impressive milestone towards the target of 82% renewables by 2030. The need for energy firming and grid support services is accelerating as variable wind and solar increases and traditional coal-fired generation retires. This creates a need to reconsider the role of Australia's hydropower, especially for schemes approaching the end of their design life.

Tasmania's extensive hydropower system demonstrates this shift. The island state has long been powered almost exclusively by hydropower. With 54 major dams and 30 power stations, Hydro Tasmania has more than 2.3GW of hydropower capacity.

In 1994, an undersea interconnector enabled Tasmania to start trading in Australia's National Electricity Market. A second interconnector is planned, which could enable greater participation of Tasmanian hydropower and help meet evolving system needs.

Against this backdrop, Hydro Tasmania is exploring two major projects to add more energy generation, flexibility and storage: redeveloping the historic Tarraleah hydropower scheme and exploring potential for a new pumped storage project.

New life for one of Australia's oldest hydropower schemes

Constructed in the late 1930s in Tasmania's central highlands, the iconic Tarraleah hydropower scheme regulates flows to six other stations downstream. Water travels from Lake King William via a complex 30km network of canals, flumes, tunnels, pipelines and ponds, dropping 290m through steel penstocks to the art deco power station housing six Pelton turbines (93.6MW).

While the scheme was originally designed for continuous generation, Australia's evolving electricity market increasingly values rapid flexibility and dispatchability to complement variable renewables. With elements of Tarraleah approaching end of life, Hydro Tasmania considered how it could be modernised for a new operating context.

A feasibility study supported by the Australian Renewable Energy Agency assessed options to redevelop Tarraleah into a more flexible and higher-capacity scheme suited to modern grid needs. The concept centres on a new water intake and connecting tunnel at Lake King William and a pressurised water conveyance feeding a modern power station conceived for rapid start–stop sequences and power regulation. Beside the augmented flexibility, the redevelopment could increase peak generating capacity from around 90MW to 190MW, while increasing annual generation from approximately 630GWh to 830GWh using the same water resource.

Since the feasibility study was completed in 2021, work has progressed on commercial assessment of the proposed full redevelopment and a staged programme of upgrade works. Entura has supported this effort as part of Hydro Tasmania's integrated project team, contributing to system design, upgrade works and ongoing activities related to approvals and commercial assessment. This includes development of a general arrangement addressing constructability, operational continuity, environmental considerations, and geotechnical and project risks associated with modernising an ageing scheme.

Tarraleah has powered Tasmania for generations and is now poised to enter a new phase. Its proposed redevelopment highlights how legacy hydropower assets can be adapted into modern infrastructure suited to a more flexible and reliable renewable energy system.

Installed capacity and generation 2025

North and Central America

Country/Region	Total Installed capacity including pumped storage	Pumped storage (MW)	Generation (TWh)
Anguilla	0	0	0
Antigua and Barbuda	0	0	0
Aruba	0	0	0
Bahamas	0	0	0
Barbados	0	0	0
Belize	55	0	<1
Bermuda	0	0	0
Canada	84,735	177	343
Cayman Islands	0	0	0
Costa Rica	2,342	0	10
Cuba	65	0	<1
Dominica	7	0	<1
Dominican Republic	641	0	1
El Salvador	650	0	2
Grenada	0	0	0
Guadeloupe	11	0	<1
Guatemala	1,517	0	5
Haiti	78	0	<1
Honduras	928	0	4
Jamaica	30	0	<1
Martinique	0	0	0
Mexico	12,612	0	29
Montserrat	0	0	0
Nicaragua	159	0	<1
Panama	1,848	0	8
Puerto Rico	98	0	<1
Saint Bartholemy	0	0	0
Saint Kitts And Nevis	0	0	0
Saint Lucia	0	0	0
Saint Pierre and Miquelon	0	0	0
Saint Vincent and The Grenadines	6	0	<1
Trinidad And Tobago	0	0	0
Turks and Caicos Islands	0	0	0
United States	102,574	22,586	247
Virgin Islands, British	0	0	0
Virgin Islands, U.S.	0	0	0
TOTAL	**208,355**	**22,763**	**652**

South America

Country/Region	Total Installed capacity including pumped storage	Pumped storage (MW)	Generation (TWh)
Argentina	11,137	974	32
Bolivia	759	0	3
Brazil	110,250	20	372
Chile	7,703	0	21
Colombia	13,210	0	68
Ecuador	5,389	0	28
French Guiana	119	0	<1
Guyana	5	0	<1
Paraguay	8,824	0	42
Peru	5,690	0	33
Suriname	180	0	<1
Uruguay	1,538	0	6
Venezuela	18,246	0	73
Total	**183,049**	**994**	**679**

Europe

Country/Region	Total Installed capacity including pumped storage	Pumped storage (MW)	Generation (TWh)
Albania	2,315	0	7
Andorra	46	0	<1
Austria	12,433	3,992	37
Belarus	96	0	<1
Belgium	1,452	1,308	1
Bosnia and Herzegovina	2,299	420	4
Bulgaria	3,211	1,404	3
Croatia	2,155	281	6
Cyprus	0	0	0
Czechia	3,457	1,172	3
Denmark	7	0	<1
Estonia	8	0	<1
Faroe Islands	41	0	<1
Finland	3,190	0	12
France	25,352	5,061	62
Germany	14,734	9,384	17
Gibraltar	0	0	0
Greece	3,407	699	3
Greenland	91	0	<1
Hungary	62	0	<1
Iceland	2,289	0	13
Ireland	534	292	<1
Italy	22,110	7,245	30
Kosovo	115	0	<1
Latvia	1,558	0	3
Liechtenstein	90	10	<1
Lithuania	1,029	900	<1
Luxembourg	1,332	1,296	<1
North Macedonia	644	0	1
Malta	0	0	0
Moldova	64	0	<1
Monaco	0	0	0
Montenegro	649	0	1
Netherlands	38	0	<1
Norway	33,977	1,344	145
Poland	2,676	1,761	3
Portugal	8,352	3,707	15
Romania	6,779	92	12
San Marino	0	0	0
Serbia	3,181	642	8
Slovakia	2,623	993	3
Slovenia	1,325	180	4
Spain	22,951	5,875	34
Sweden	16,499	99	68
Switzerland	17,622	4,079	34
Türkiye	32,294	0	65
Ukraine	5,629	1,470	9
United Kingdom	4,723	2,833	6
Total	**263,440**	**56,538**	**614**

Africa

Country/Region	Total Installed capacity including pumped storage	Pumped storage (MW)	Generation (TWh)
Algeria	0	0	<1
Angola	34	0	11
Benin	170	0	<1
Botswana	1,234	0	0
Burkina Faso	0	0	<1
Burundi	29	0	<1
Cameroon	0	0	10
Cape Verde	1	0	0
Central African Republic	214	0	<1
Chad	992	0	0
Comoros	3,216	0	<1
Congo (republic)	0	0	1
Côte d'Ivoire	2,832	0	3
Democratic Republic of the Congo	128	0	13
Djibouti	0	0	0
Egypt	64	0	17
Equatorial Guinea	9,974	0	<1
Eritrea	331	0	0
Eswatini	0	0	<1
Ethiopia	1,584	0	25
Gabon	1,156	0	<1
Gambia	0	0	0
Ghana	840	0	5
Guinea	74	0	3
Guinea-Bissau	93	0	0
Kenya	0	0	4
Lesotho	189	0	<1
Liberia	391	0	<1
Libya	0	0	0
Madagascar	451	0	<1
Malawi	48	0	2
Maldives	61	0	0
Mali	2,585	0	<1
Mauritania	2,194	0	<1
Mauritius	347	0	<1
Morocco	0	814	<1
Mozambique	2,971	0	15
Namibia	134	0	2
Niger	110	0	0
Nigeria	3	0	13
Reunion	81	0	<1
Rwanda	0	0	<1
São Tomé and Príncipe	64	0	<1
Senegal	0	0	<1
Seychelles	3,605	0	0
Sierra Leone	0	0	<1
Somalia	1,923	0	0
South Africa	2,722	2,912	2
South Sudan	69	0	0
Sudan	66	0	12
Tanzania	2,114	0	8
Togo	0	0	<1
Tunisia	0	0	<1
Uganda	3,176	0	7
Yemen	0	0	0
Zambia	3,176	0	12
Zimbabwe	1,086	0	0
Total	**51,545**	**3,736**	**179**

South and Central Asia

Country/Region	Total Installed capacity including pumped storage	Pumped storage (MW)	Generation (TWh)
Afghanistan	487	0	<1
Armenia	1,336	0	2
Azerbaijan	1,444	0	3
Bahrain	0	0	0
Bangladesh	230	0	<1
Bhutan	3,507	0	12
Georgia	3,507	0	11
India	56,336	7,176	177
Iran	13,295	1,040	13
Iraq	2,816	240	1
Israel	651	644	<1
Jordan	10	0	<1
Kazakhstan	3,172	0	10
Kuwait	0	0	0
Kyrgyzstan	4,108	0	13
Lebanon	282	0	<1
Nepal	3,807	0	3
Oman	0	0	0
Pakistan	11,675	0	39
Qatar	0	0	0
Russia	54,361	1,385	194
Saudi Arabia	0	0	0
Sri Lanka	2,099	0	7
Syria	1,545	0	<1
Tajikistan	5,952	0	23
Turkmenistan	2	0	<1
United Arab Emirates	250	250	0
Uzbekistan	2,444	0	7
Yemen	0	0	0
Total	**173,316**	**10,735**	**518**

East Asia and Pacific

Country/Region	Total Installed capacity including pumped storage	Pumped storage (MW)	Generation (TWh)
American Samoa	0	0	0
Australia	8,952	2,837	14
Brunei	0	0	0
Cambodia	1,801	0	8
China	446,160	65,940	1,462
Cook Islands	0	0	0
Fiji	138	0	<1
French Polynesia	49	0	<1
Guam	0	0	0
Indonesia	7,699	0	27
Japan	49,940	27,470	81
Kiribati	0	0	0
Lao PDR	9,916	0	40
Malaysia	6,297	0	35
Marshall Islands	0	0	0
Micronesia, Federated States Of	2	0	<1
Mongolia	23	0	<1
Myanmar	3,225	0	10
Nauru	0	0	0
New Caledonia	82	0	<1
New Zealand	5,543	0	24
Niue	0	0	0
Democratic People's Republic of Korea	5,144	0	16
Papua New Guinea	318	0	1
Philippines	4,450	729	11
Samoa	20	0	<1
Singapore	0	0	0
Solomon Islands	0	0	<1
Republic of Korea	6,515	4,700	9
Taiwan, China	4,726	2,602	5
Thailand	4,569	1,531	8
Timor-leste	0	0	<1
Tonga	0	0	0
Tuvalu	0	0	0
Vanuatu	2	0	<1
Vietnam	24,154	0	102
Total	**589,726**	**105,808**	**1,854**

World

	Total Installed capacity Including pumped Storage	Pumped storage (MW)	Generation (TWh)
Total	**1,469,413**	**200,574**	**4,495**

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Acknowledgements

Researched, written, edited and produced by the team at IHA.

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In collaboration with:

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