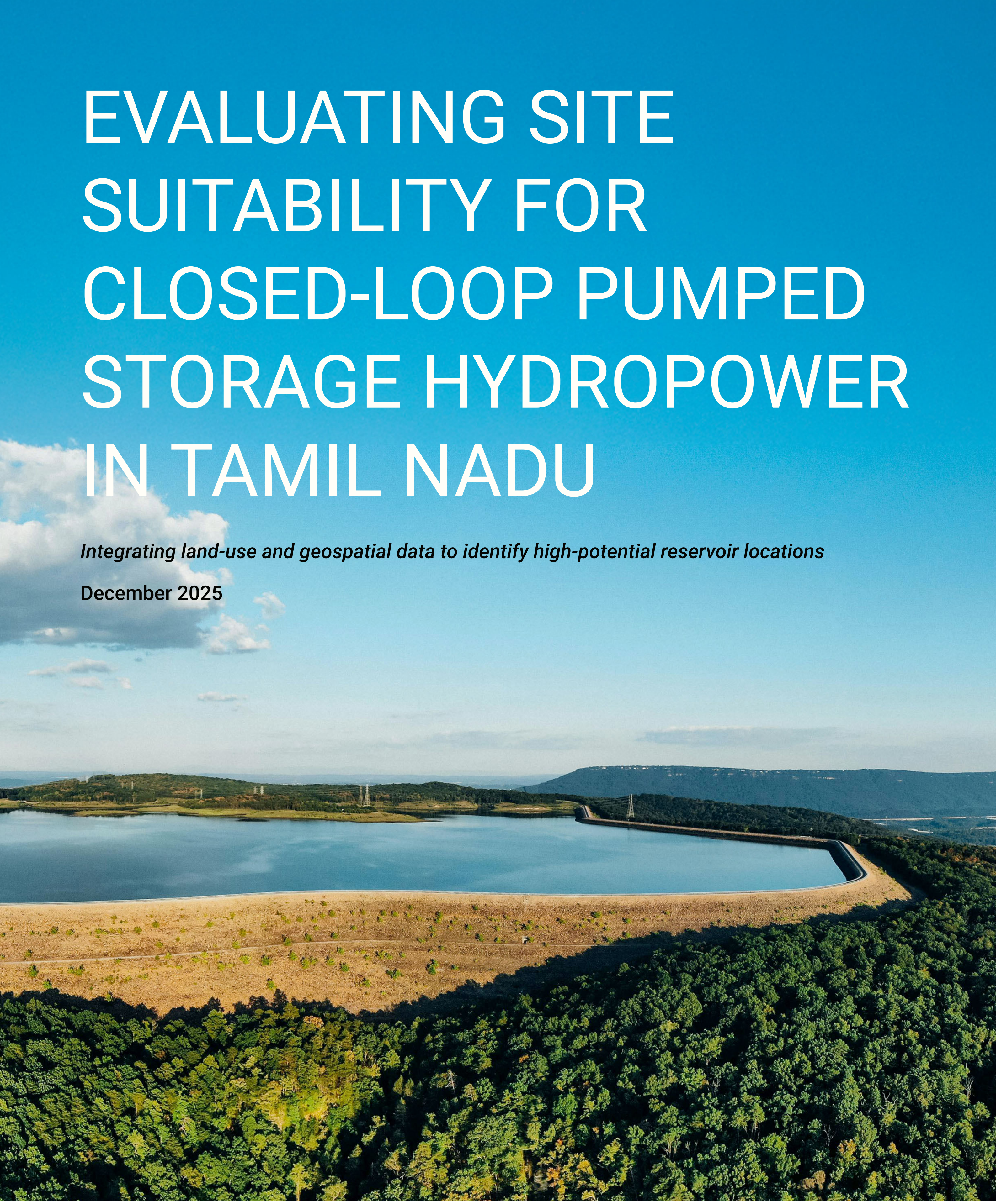
EVALUATING SITE SUITABILITY FOR CLOSED-LOOP PUMPED STORAGE HYDROPOWER IN TAMIL NADU

Integrating land-use and geospatial data to identify high-potential reservoir locations

December 2025



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PUMPED STORAGE HYDROPOWER

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Acknowledgement

This publication forms a part of the Assessment of Renewable Energy, Tamil Nadu (ARE-TN) series of documents and activities. ARE-TN aims to facilitate higher clean energy deployment in the State by working with all stakeholders to find sustainable and equitable solutions. ARE-TN is a collaborative initiative by Auroville Consulting (AVC) and the World Resources Institute India (WRI).

Authors:
Subham Mandal
Dr Sukanya Randhawa

Reviewers:
Martin Scherfler

Designer:
Vimal Bhojraj

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Key findings

Overall PSH potential in Tamil Nadu

- Tamil Nadu's closed-loop pumped storage hydropower (PSH) potential is estimated at a staggering 1,32,386 GWh, derived from 572 non-overlapping reservoir pairs.
- Large capacity sites (≥500 GWh), though fewer in number, represent over 60% of the total potential, indicating concentration of energy in fewer but more viable sites.
- The 150 GWh category contributes the largest single share of 33.5% of the total potential i.e. 44,400 GWh of storage capacity.
- Smaller capacity sites (≤50 GWh) together contribute less than 6% of the total potential.
- No standalone 500 GWh reservoirs exist; such sites overlap with larger reservoir systems.

Spatial distribution of PSH potential

- Most potential sites are concentrated along the Western and Eastern Ghats, especially in the Nilgiris, Coimbatore, Erode, Dindigul, and Theni districts.
- Northern and central hill regions, such as the Shevaroy and Javadi hills, and parts of Kanyakumari, also show potential due to suitable topography and strong geological foundations with gneiss, granite and charnockite rocks.
- Plains and coastal areas exhibit no PSH potential due to flat terrain and limited natural reservoirs.
- Kallakurichi district contains the reservoir with 2 GWh storage capacity, with the least EIA score of 3 out of 14, whereas Erode district has the largest reservoir with 5000 GWh, with the lowest EIA score of 7 out of 14.

Relationship with renewable energy hubs

- There is a spatial clustering of solar and wind installations and PSH potential in the southern and western parts of the state. Wind energy dominates in the districts of Tirunelveli, Coimbatore, and Thoothukudi, while solar energy is concentrated in Nagapattinam and Ramanathapuram.
- Renewable energy-rich plains and coastal districts have low PSH potential, whereas hilly districts have high PSH potential.

EIA insights

- 75% of identified reservoirs have EIA scores between 5–7, indicating moderate environmental impact, with fewer in the high or low categories.
- The lower reservoirs generally have slightly higher EIA scores, possibly due to greater interaction with settlements, croplands and other infrastructure.
- Only one reservoir recorded a high EIA score of 12, whereas only one reservoir scored a low EIA score of 3.

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₹	Indian Rupee
ARENA	Australian Renewable Energy Agency
BESS	Battery Energy Storage System
CEA	Central Electricity Authority
CEEW	Council On Energy, Environment and Water
CERC	Central Electricity Regulatory Commission
CSMRS	Central Soil and Materials Research Station
CTU	Central Transmission Utility
CWC	Central Water Commission
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DISCOM	Distribution Company
EIA	Environmental Impact Assessment
FRA	Forest Rights Act
GSI	Geological Survey of India
GW	Gigawatt
GWh	Gigawatt hour
HT	High tension
IHA	International Hydropower Association
IRENA	International Renewable Energy Agency
KRS	Krishna Raja Sagara (Dam)
kV	Kilo Volts
kW	Kilowatt
kWh	Kilowatt Hours
LCoS	Levelised cost of storage
LiDAR	Light Detection and Ranging
MoEF&CC	Ministry of Environment, Forest and Climate Change
MRPH	Mount Rawdon Pumped Hydro
MW	Megawatt
NBWL	National Board for Wildlife
NHPC	National Hydroelectric Power Corporation
NOC	No Objection Certificate
PESO	Petroleum and Explosives Safety Organization
PIB	Press Information Bureau
PSH	Pumped Storage Hydropower
PSP	Pumped Storage Project
PV	Photovoltaic
RE	Renewable Energy
RE	Renewable Energy
RHP	Reventazón Hydroelectric Project
SEIAA	State Level Environment Impact Assessment Authority
SERC	State Electricity Regulatory Commission
SPCB	State Pollution Control Board
SSNNL	Sardar Sarovar Narmada Nigam Ltd.
STU	State Transmission Utility
THDC	Tehri Hydro Development Corporation
TVA	Tennessee Valley Authority
WEC	World Energy Council

01 Introduction

Closed-loop pumped storage hydropower (PSH) represents an up-and-coming technology because it provides multi-hour to multi-day storage with fast response, long lifetimes, and low operating costs (IHA, 2025; NHA, 2025). It closes key gaps that lithium-ion struggles with at the bulk scale, such as long-duration storage, large energy shifting, and system strength (U.S. Department of Energy, 2023). Unlike conventional open-loop systems that rely on natural water bodies, closed-loop PSH facilities operate with isolated reservoirs that are not connected to naturally flowing water sources (U.S. Department of Energy, 2021). This design characteristic offers significant advantages in reducing environmental impact and enhancing siting flexibility, making it especially suitable for regions where ecological sensitivity and land-use conflicts are major concerns. Recent international studies have demonstrated that closed-loop PSH systems generate substantially lower environmental impacts compared to their open-loop counterparts, with effects being more localised and of shorter duration (Renewable Energy World, 2020; U.S. Department of Energy, 2023).

This report aims to quantify the potential of closed-loop PSH in Tamil Nadu by identifying non overlapping reservoir pairs, prioritising larger storage opportunities, and applying environmental screening to select low impact sites.

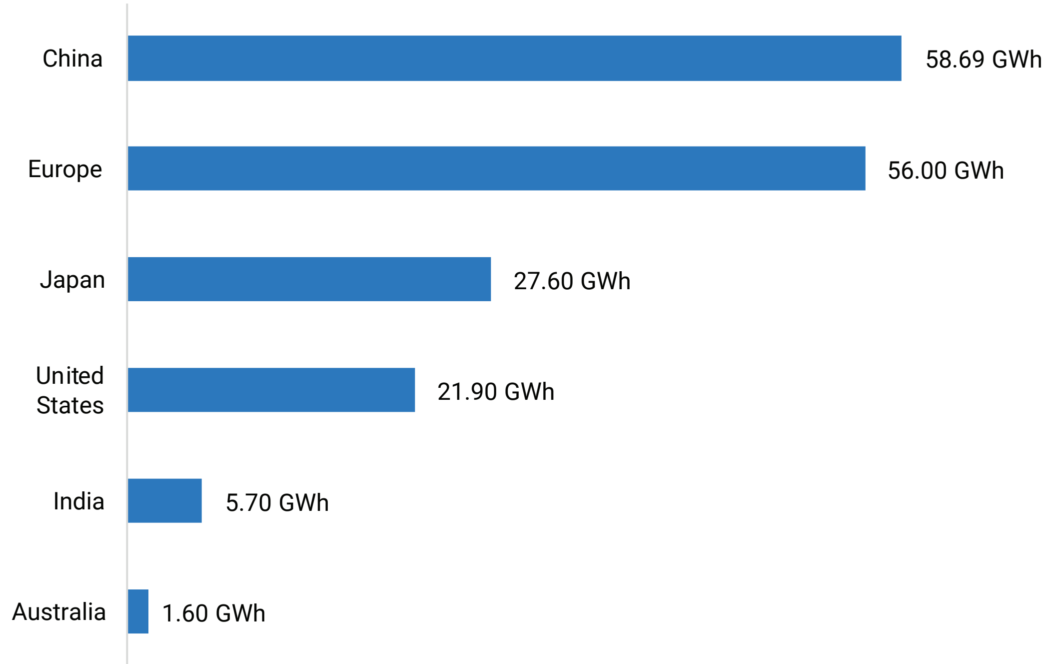
1.1 Global landscape and emerging trends in PSH

China, Japan, and the United States currently account for the largest cumulative PSH capacities worldwide. Together, they make up almost half of global PSH installations, anchoring the world's long-duration energy storage and supporting large-scale renewable power integration.

Between 2001 and 2021, global hydropower capacity grew by 70%, with off-stream PSH accounting for approximately 67% of the total hydropower market, largely due to its higher permitting success rate and faster environmental clearances (DataM Intelligence, 2025). In 2024, global PSH capacity reached 189 GWh, marking a 5% increase from 2023 (International Water Power, 2025; Mordor Intelligence, 2024). Of the 24.6 GWh of new hydropower capacity added globally in 2024, 8.4 GWh came from pumped storage projects (International Water Power, 2025; Mordor Intelligence, 2024). From 2021 to 2030, pumped storage is projected to account for about 30% of additional global hydropower capacity, around 65 GWh, making this the strongest decade for PSH growth so far (IEA, 2021).

The global PSH development pipeline exceeds 1,075 GWh, with approximately 600 GWh consisting of projects at various stages of development, highlighting strong growth potential (Mordor Intelligence, 2024). Closed-loop PSH has emerged as the dominant configuration for new developments, representing 67–70% of projects in the pipeline as of 2025. Looking ahead, the Asia-Pacific region is projected to lead the global PSH market from 2025 to 2032, with an estimated 44% market share (Coherent Market Insights, 2024).

Figure 1 Total installed PSH capacities of some regions in the world.



China: As of 2024, China's PSH capacity stands at 58.69 GWh (IHA, 2025). The country aims to increase this to 80 GWh by 2027 and reach a total hydropower capacity of 120 GWh by 2030 (International Water Power, 2024). Demonstrating its leadership in the sector, China recently completed the world's largest pumped storage facility, the 3.6 GWh Fengning Pumped Storage Power Station (International Water Power, 2024).

Europe: PSH in Europe is undergoing a transformation, with a strong emphasis on modernising the existing hydropower fleet to enhance efficiency, flexibility, and climate resilience, without increasing design flow or constructing new dams (European Commission, 2024). The total pumped storage installed capacity in Europe now stands at 56 GWh, with 201 MWh added in 2024 (ETIP Hydropower, 2025). Due to environmental and financial constraints, large-scale greenfield PSH developments are limited. Instead, current strategies focus on retrofitting existing infrastructure, interconnecting reservoirs, and repurposing abandoned mines. Projections estimate Europe could achieve 70–75 GWh of PSH capacity by 2050. The overall trend is toward smarter, more flexible, and multi-functional PSH systems that align with the region's broader sustainability objectives (European Commission, 2024).

Japan: As of 2018, Japan had a total PSH capacity of 27.6 GWh, making it the second-largest installed capacity globally (IEA Hydropower, 2021). Japan has a long-standing history of hydropower development, with many large-scale projects built in earlier decades. However, land constraints have limited opportunities for further large-scale expansion. In response, recent efforts have shifted toward small-scale hydropower projects that harness the potential of smaller rivers and streams (Markets and Data, 2025).

United States of America (USA): The United States has the third-largest PSH capacity globally, with 43 operational PSH plants totalling 21.9 GWh (U.S. Department of Energy, 2023). The country's development pipeline includes 79 closed-loop PSH projects with a combined capacity of 50.9 GWh, and 17 open-loop projects totalling 21.7 GWh (U.S. Department of Energy, 2023). Notably, closed-loop projects account for 70% of the proposed new capacity, signalling a significant shift in both industry strategy and regulatory preference.

Australia: Australia currently has a total PSH capacity of 1.6 GWh, generated from three operational schemes: Wivenhoe Dam, Tumut 3, and Shoalhaven (Systra Australia, 2024). Several major projects are in the pipeline, including Kidston Pumped Hydro, Borumba Pumped Hydro Energy Project, Snowy 2.0, and Tarraleah. Remarkably, studies have identified up to 22,000 potential PSH sites across the country, with a combined theoretical storage capacity of 67,000 GWh (100% RE group, 2025).

1.2 India's PSH expansion

India's energy landscape is undergoing a profound transformation as the nation pursues ambitious renewable energy targets to meet growing electricity demand while addressing climate change concerns. This transformation has brought pumped storage hydropower (PSH) to the forefront as a critical technology for grid stability and renewable energy integration.

India's journey in PSH development began in 1970 with the commissioning of its first project at Nagarjuna Sagar in Telangana, having an installed capacity of 705 MWh. Up until the early 2000s, PSH development in the country was relatively limited. Some of the early installations included the Kadana project in Gujarat and Kadamparai in Tamil Nadu, both commissioned in 1987, followed by Bhira in Maharashtra and Panchet in Jharkhand, each commissioned in 1995 (Forum of Regulators, 2025).

A more active phase of PSH deployment began in the 2000s with the commissioning of larger projects. Notable examples include the Srisailam LBPH project in Telangana with a capacity of 900 MWh in 2000, the 1.2 GWh Sardar Sarovar project in Gujarat in 2006, the 900 MWh Purulia PSH project in West Bengal in 2007, and the 250 MWh Ghatghar project in Maharashtra in 2008 (IESA, 2023; Fortune India, 2024; Forum of Regulators, 2025).

In recent years, several PSH projects have entered the construction phase. These include the Tehri PSH project in Uttarakhand (1 GWh) and the Kundah PSH project in Tamil Nadu (500 MWh), both expected to be commissioned by 2025. Additionally, the Upper Sileru project in Andhra Pradesh (1.35 GWh) and the Sharavathy project in Karnataka (2 GWh) are anticipated to be operational by 2029 (CEA, 2025).

Beyond ongoing construction, a large number of PSH projects are currently under survey and investigation, reflecting the growing interest in long-duration energy storage. These include the 1.6 GWh Saundatti project in Karnataka, 1.8 GWh Shirwata and 1.5 GWh Tarali projects in Maharashtra, the 2.56 GWh Sukhpura project in Rajasthan, 3.66 GWh UP01 in Uttar Pradesh, 500 MWh Balimela in Odisha, and the 960 MWh Serula project in Gujarat, among others (CEA, 2025). These developments indicate a significant momentum in India's PSH landscape, aimed at supporting its renewable energy integration and grid stability objectives.

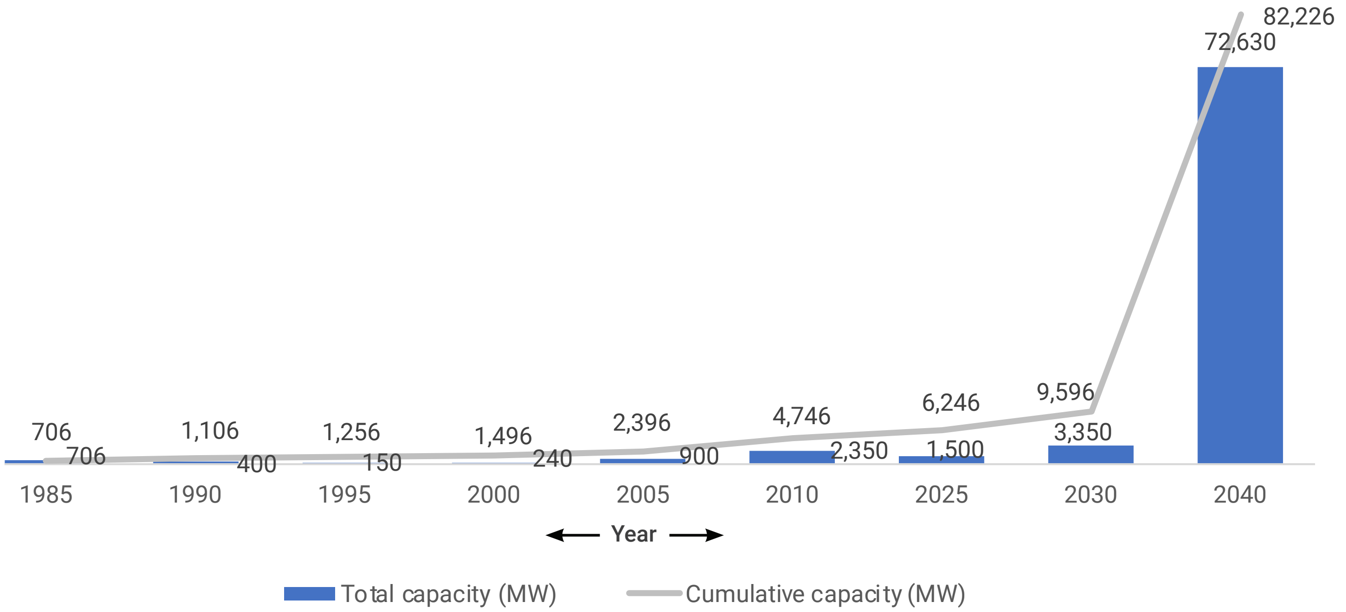
India's PSH pipeline surges forward: India is witnessing a significant surge in PSH development during 2024, driven by strong policy support, growing private sector participation, and ambitious renewable energy targets. As of 2024, the country has 4.7 GWh of installed PSH capacity. To accelerate the energy transition, six new PSH projects totalling approximately 7.5 GWh have been announced. These include Upper Indravati (600 MWh, Odisha), Sharavathy (2 GWh, Karnataka), Bhivpuri (1 GWh, Maharashtra), Bhavali (1.5 GWh, Maharashtra), MP-30 (1.9 GWh, Madhya Pradesh), and Chitravathi (500 MWh, Andhra Pradesh) (PIB, 2025). Looking ahead, the Central Electricity Authority (CEA) plans to approve at least 13 additional projects with a combined capacity of 22 GWh in 2025–26, many of which are expected to be commissioned by 2030.

India aims to develop 38 PSH projects exceeding 50 GWh in total capacity by 2032, aligning with the Central Electricity Authority's (CEA) projected need for 26.7 GWh of PSH and 47.2 GWh of battery storage to support renewable energy integration (Fortune India, 2024). Several of these projects, particularly in Andhra Pradesh, Uttarakhand, and Tamil Nadu, are scheduled for phased commissioning between 2025 and 2032.

With over 200 GWh of PSH potential identified nationwide, India has already commissioned 10 PSH plants (6.2 GWh). Currently, 8 projects (10 GWh) are under construction, 5 projects (5.8 GWh) have received DPR concurrence, and 46 more (66 GWh) are under survey and investigation (PIB, 2025). While projected PSH growth is reported to exceed 82 GWh (CEA, 2025; Finance Department, 2025), other estimates indicate a much larger pipeline. Proposals received by the MoEFCC suggest up to 87 new PSH projects, with a combined capacity exceeding 104 GWh (PIB, 2025). Closed-loop configurations are central to this growth strategy, offering long-duration storage, improved grid stability, and lifespans exceeding 70 years (PIB, 2025).

PSHs are unevenly distributed across the regions of the country. Annexure II presents a comprehensive overview of all major PSH projects in India, as of 1 February 2025 (CEA, 2025). This compilation highlights the sector's gradual beginnings, its recent acceleration, and the emergence of a new phase marked by rapid capacity

Figure 2 Projected PSH development over selected years in MWh



Source CEA 2025, Finance Department, 2025

Tehri innovation: India achieved a technological milestone with the commissioning of its first variable speed pumped storage hydropower (PSH) unit at THDC's Tehri project (GE Vernova, 2025). Unlike conventional fixed-speed PSH plants, Tehri's doubly-fed induction machines allow turbine speed to adapt precisely to grid requirements. This enables faster, finer control in switching between pumping and generation, greatly enhancing grid flexibility, supporting long-duration energy storage, and facilitating renewable integration. Additionally, the Tehri system continues to supply essential irrigation and drinking water to Uttarakhand during non-monsoon months.

1.3 Tamil Nadu's growing role in PSH and clean energy storage

Among Indian states, Tamil Nadu stands out as a pioneer in renewable energy development, with a total installed capacity of 43.46 GWh and renewable energy capacity exceeding 28.23 GWh as of 2025 (CEA, 2025).

1.3.1 Policy incentives to boost PSH and renewable integration

As of 2025, Tamil Nadu generates 23.62 GWh from wind and solar sources and an additional 2.17 GWh from hydro projects (CEA, 2025). The state currently has one operational pumped storage hydropower (PSH) facility at Kadamparai with a capacity of 400 MWh, and the Kundah PSH project, where two units are scheduled for commissioning in July and August 2025, followed by two more in November 2025 (Tamil Nadu Electricity Regulatory Commission, 2025).

The State's anticipated maximum demand for the current year will be 22.15 GWh which is 6 % higher than the previous year peak demand. Reflecting its strong commitment to clean energy, Tamil Nadu has introduced a comprehensive policy framework designed to accelerate PSH development. Tamil Nadu's policy note 2025-2026 supports large-scale renewable energy storage aimed at strengthening grid reliability and attracting investments. Key incentives include up to 50 % concessions on stamp duty and registration fees, a 10-year electricity tax exemption, and a waiver of water cess. These measures are intended to fast-track renewable energy integration, create employment opportunities, and help the state achieve its clean energy goals (Energy Department; 2024, 2025).

1.3.2 Public-private push for PSH

Tamil Nadu has committed to develop 15 pumped storage projects (PSHs) with a total capacity of 14,500 MWh by 2030 (Energy Department, 2025). In the state budget for 2025–2026, two major pumped storage projects were announced: one at Aliyar with a capacity of 700 MW and another at Vellimalai with 1,100 MWh (Energy Department, 2025; Finance Department, 2025). Both projects will be developed through the Public-Private Partnership (PPP) model (Finance Department, 2025).

As part of the Tamil Nadu Pumped Storage Projects (PSP) Policy 2024 (Energy Department, 2024), TANGEDCO plans to implement the following PSHs: Upper Bhavani with a capacity of 1,000 MWh, Sillahalla (I, II) with a capacity of 2,000 MWh and Sandy-Nallah with a capacity of 1,200 MWh at Nilgiris, Manalar with a capacity of 1,200 MWh and Manjalar with a capacity of 500 MWh in Theni, Kodayar with a capacity of 1,500 MWh and Chattar with a capacity of 1,100 MWh in Kanyakumari, Palar Poranthalar with a capacity of 1,100 MWh and Athur with a capacity of 300 MWh in Dindigul, Karaiyar with a capacity of 1,000 MWh in Tirunelveli and Mettur in Salem with a capacity of 1,000 MWh (Energy Department, 2025). Private sector participation is also expanding, with Greenko proposing to develop three pumped hydro storage projects with a combined capacity of 3.3 GWh in the Tirupathur, Salem, and Tiruvannamalai districts (ESS News, 2024).

1.3.3 Enabling policy for a storage-driven future

Tamil Nadu's PSP Policy 2024 establishes a robust framework for environmental clearances, stakeholder engagement, and project implementation, aligning PSH with broader renewable energy and conservation goals (TNPSC Thervupettagam, 2024; Mercom India, 2024). Building on this foundation, an analytical approach that integrates technical, environmental, social, and policy considerations, supported by geospatial analysis and impact assessment tools, can identify sites that strengthen energy security while safeguarding ecological and cultural values. With strategic site selection and active stakeholder participation, Tamil Nadu is well positioned to lead India's transition toward sustainable, storage-based energy systems.

1.4 Central government policy support for PSHs

Nationally, a strategic shift is underway although current PSH capacity is entirely open-loop, nearly all new projects tendered since 2023 are closed-loop. Their commissioning between 2026 and 2030 will significantly reshape India's energy storage landscape. While energy storage policy is still in its early stages compared to mature renewable energy frameworks, it is increasingly recognized as central to achieving energy transition goals.

To accelerate PSH deployment, India has introduced a suite of enabling policy measures. These include budgetary support for enabling infrastructure, streamlined guidelines issued by the Ministry of Power (MoP) in April 2023 for site allotment and environmental clearances, and waiver of inter-state transmission charges for projects awarded before June 2028 (PIB, 2025). The Central Electricity Authority (CEA) has reduced the DPR concurrence timeline from 90 to 50 days and launched the "Jal Vidyut DPR" portal for real-time approval tracking. Transparent procurement has been encouraged through tariff-based competitive bidding, while regulatory reforms in August 2024 extended forest area drilling provisions to PSHs, aligning them with mining activities (PIB, 2025).

Table 1 Timeline of policy development in energy storage

Year	Policy change	Importance for PSH in India
January 2017	CERC issues staff paper on introduction of electricity storage system	Recognises PSHs as mature, cost-effective technologies vital for large-scale grid storage and renewable integration.
February 2018	Government of India constitutes expert committee to draft National Energy Storage Mission	Advanced sector support, fostering coordinated PSH policies within broader energy storage roadmap.
March 2019	Cabinet approves National Mission on Transformative Mobility and Battery Storage	Elevated storage, including PSHs, as key to India's energy transition goals and grid reliability strategies.
March 2019	Ministry of Power (MoP) recognises PSHs with capacity more than 25 MW as part of renewable energy (RE)	Allows PSHs to qualify as renewable energy, unlocking incentives (RECs, HPOs), improving project economics.
September 2019	NITI Aayog releases Roadmap for Energy Storage Systems (ESS), 2019–2032	Strategic roadmap emphasized large-scale PSHs as essential for handling solar/wind variability and grid balancing.
October 2021	MoP notifies rules granting must-run status to RE power plants	Gives PSHs grid priority during operation, improving dispatch and revenue certainty.
November 2021	MoP orders waiver of ISTS charges for BESS and PSHs commissioned up to 30.06.2025	Reduces transmission costs, greatly improves commercial viability of new PSHs by removing a key financial barrier.
January 2022	Ancillary Services Regulations brought under scope of energy storage	Supports PSHs as grid-balancing assets, enabling new revenue from ancillary service markets.
March 2022	MoP notifies Guidelines for Procurement and Utilisation of BESS	Indirectly supports PSHs as part of integrated grid storage procurement strategies.
July 2022	MoP notifies Energy Storage Obligation (ESO) Trajectory till 2032	Mandates energy storage procurement, increasing demand and potential investment in PSH projects.
December 2022	Electricity (Amendment) Rules mandate ESS as part of the power system; clarify delicensed status	Eases regulatory barriers for PSH deployment by mandating storage in power system planning.
January 2023	National Green Hydrogen Mission contemplates pilot projects in the energy storage sector	Opens avenues for PSHs to participate in future green hydrogen–storage hybrid pilots.
March 2023	Ministry of New and Renewable Energy notifies bidding trajectory for RE projects	Includes PSHs in future procurement, fostering market growth.
May 2023	CEA prepares National Electricity Plan outlining storage requirements (PSHs and BESS) till 2032	Explicitly quantifies PSH capacity needs for 2032, directing policy and investment focus to large-scale projects.
April 2023	MoP notifies Guidelines for Development of PSHs	Establishes standard procedures, incentives, and regulatory clarity for PSH developers.
June 2023	Resource Adequacy Guidelines allow inclusion of storage in resource planning and contracting	Enables PSHs as qualifying resources for planning and contracting, strengthening market integration.
August 2023	MoP releases National Framework for Promoting ESS to support energy transition and security	Calls for acceleration of PSHs for India's energy goals and security.
January 2024	Electricity (Amendment) Rules eliminate licensing requirement for transmission lines for independent ESS projects	PSH developers can build transmission links without separate licensing, reducing project delays and complexity.
March 2024	MoP notifies Viability Gap Funding scheme for development of BESS	While focused on BESS, policy signals support for PSH financing where applicable.
August 2024	MoP releases Draft Guidelines for Procurement of Storage Capacity or Stored Energy from PSHs	Directs states/utilities to procure stored energy, improving offtake security for pumped hydro projects.

Source: Borah, U. et al., 2025

India is undertaking an ambitious global expansions of grid-scale pumped hydro storage, backed by progressive national and state-level policies, accelerated clearances, and substantial public and private sector investments.

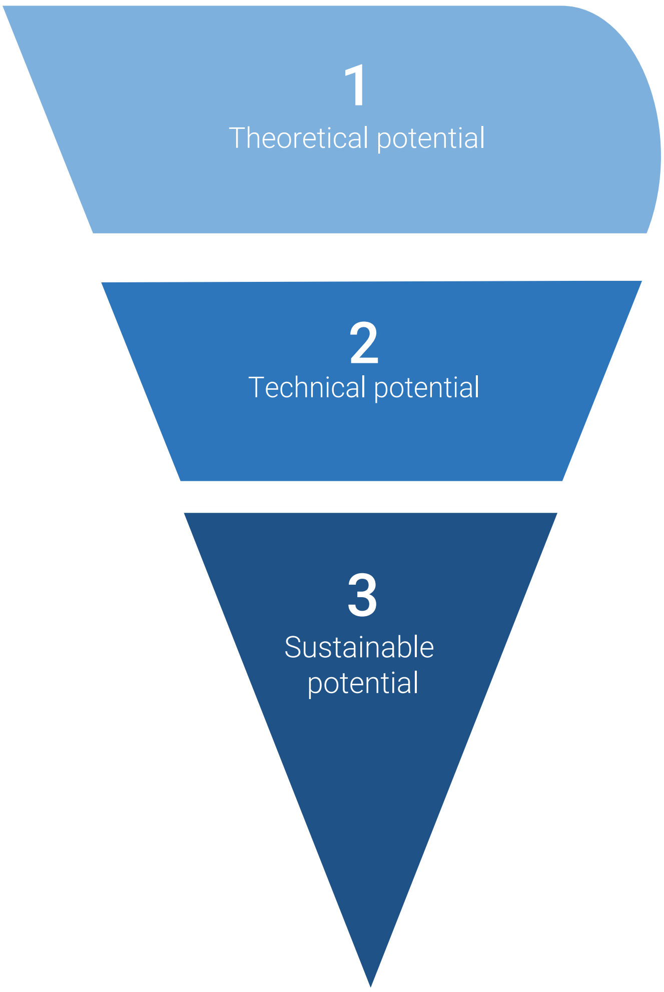
02 Methodology

The successful implementation of closed-loop PSH projects in Tamil Nadu requires sophisticated site selection methodologies that can simultaneously address technical feasibility, environmental concerns, and socio-economic considerations. Geographic Information Systems (GIS) has emerged as an indispensable tool for this purpose, enabling the integration of diverse spatial datasets and stakeholder preferences into robust decision-making frameworks (Bahrami, M. et al., 2024; Kazemi Rad, L. et al., 2014).

Tamil Nadu's diverse topography, spanning from the Western Ghats to coastal plains, presents both opportunities and challenges for PSH development. The state encompasses critical biodiversity hotspots, including portions of the Western Ghats UNESCO World Heritage Site, extensive agricultural lands that support millions of livelihoods, and rapidly growing urban centres (UNESCO World Heritage Centre, 2012). This complexity necessitates comprehensive geospatial analysis that can identify optimal sites while minimising conflicts with existing land uses and ecological systems.

2.1 Evaluation steps

The site suitability assessment is undertaken in a 3-step filtration process to identify reservoirs that consecutively meet theoretical, technical and sustainable potential criteria (refer to tables below).



Theoretical Potential: Potential reservoirs with a minimum 1 GL volume capacity were identified using a digital elevation model (DEM). The DEM is a 3D computer graphics representation of elevation data to represent terrain or overlaying objects. The DEM helps determine flow direction and finds flow accumulation, virtual streams and pour points.

Technical Potential: All best paired reservoirs meeting a minimum set of technical criteria are filtered. Pairings are made based on separation distance (head-to-distance ratio < 0.05), minimum head height of 100 m, slope greater than 3%, dam wall below 150 m and water-to-rock ratio greater than 1.50.

Sustainable potential: Reservoir pairs with technical potential are further analysed to assess the environmental impact if PSH were to be developed. Reservoirs with a low environmental impact score are shortlisted

The following table summarises the criteria for theoretical potential assessment. An initial requirement is a minimum altitude for the upper reservoir and a minimum reservoir capacity. The first step relates to identifying all potential reservoirs in Tamil Nadu. After the identification of the reservoirs that meet the theoretical potential, a set of criteria to identify the technical potential of the reservoirs is considered for further filtration.

Theoretical potential

Table 2 Criteria for theoretical potential

Criteria	
Minimum reservoir capacity	1 GL
Minimum height (upper)	200 m

The technical potential detects the best paired reservoirs, and then the highest potential follows this for further filtering of the lands most suitable for PSH. When aggregating cumulative storage from non overlapping pairs, reservoir pairs were prioritised in descending order of storage capacity. Reservoirs without data are unshaded.

Technical potential

Table 3 Criteria for technical potential

Criteria	
Head	200-750 m
Conveyance length/head height	12/1
Search radius	2,200-8,250 m
Volume similarity	90 %
Dam height	>100 m

Head (Head height): The term "head" refers to the vertical distance (elevation) between the upper and lower reservoirs in a pumped storage hydropower system. The specified head range is between 200 meters and 750 meters. This indicates that potential PSH sites should have this difference in elevation between the upper and lower reservoirs.

Conveyance length to head height ratio: This ratio represents the length of the water conveyance system (such as penstocks or tunnels) compared to the height (head) of the system. A higher ratio typically implies a longer conveyance system relative to the elevation difference.

Search radius: The search radius specifies the maximum distance within which potential PSH sites will be considered from a given location, typically based on geographic or topographic constraints. Suitable PSH sites should be located within a specified radius (2,200 meters to 8,250 meters) from a reference point (centre of the reservoir), ensuring feasibility in terms of access and infrastructure development.

Volume similarity: Volume similarity refers to the degree of similarity or closeness in terms of reservoir storage capacity between the upper and lower reservoirs. A volume similarity of 90% indicates that the upper and lower reservoirs should have reservoir capacities that are relatively close (minimum 90% similarity) to ensure efficient energy storage and discharge operations.

Dam height: Dam height refers to the vertical dimension of the dam structure that creates the upper reservoir in a pumped storage hydropower system. This criterion specifies that potential PSH sites should have a significant dam height exceeding 100 meters, which is indicative of a large-scale infrastructure suitable for PSH operations (taken from ANU PSH Model).

Sustainable potential

A systematic, multi-criteria environmental impact assessment (EIA) methodology has been applied, covering 7 impact categories and 14 parameters. The categories assess: land use, water resources, socioeconomic indicators, environmental monitoring, infrastructure, cultural and protected areas, and biodiversity. PSH development with no or low impact against each parameter is assigned a score of 0, while those with higher impact receive 1. Each category can score a maximum of 2 points, giving a total possible score of 14 for the entire assessment.

Table 4 Environmental impact assessment score

Categories	Subcategories	Value	Maximum value	Minimum value
Landuse and landcover	Treecover	1/0	2	0
	Unused or barren lands	1/0		
Water resources	Surface waterbodies	1/0	2	0
	Run-off potential	1/0		
Socioeconomic context	Agricultural landuse	1/0	2	0
	Human settlements	1/0		
Environmental quality	Ambient air quality (PM 2.5)	1/0	2	0
	Seismic hazard	1/0		
Infrastructure proximity	Road & railway connectivity	1/0	2	0
	Power infrastructure proximity	1/0		
Cultural and legal protection zone	Cultural heritage sites	1/0	2	0
	Legally protected conservation areas	1/0		
Biodiversity and ecology	Significant flora	1/0	2	0
	Significant fauna (Includes birds)	1/0		

Based on the overall EIA score for each reservoir, they will be assigned into three groups: a high impact, a medium impact and a low impact group. Reservoirs with the grade of low EIA have the highest sustainable potential, followed by medium EIA and then high EIA. Reservoirs that are partially outside of the Tamil Nadu administrative boundaries have not been considered for the EIA assessment and are ungraded.

Table 5 EIA impact groups

Low EIA	Medium EIA	High EIA
1-5	5-8	8-14

2.2. Definition of EIA parameters

The section below outlines the specific criteria, thresholds, and scoring methods used to evaluate potential reservoir sites for closed-loop pumped storage hydropower (PSH) projects in Tamil Nadu, organised into the following categories: land use and land cover, water resources, socioeconomic context, environmental quality, infrastructure proximity, cultural and legal protection zones, and biodiversity and ecology.

2.2.1 Land use and landcover

Unused or barren land: The prioritisation of unused lands represents a crucial strategy for minimising conflicts with productive land uses. Lands that have been unused and are in barren condition for a period of five years have been identified (Auroville Consulting, 2025). Reservoirs having a share of 30 % or less unused land by area will be assigned a value of 1, if not a 0.

Treecover: If tree cover accounts for 20 % or less of the total area of the reservoir, the site will be assigned a value of 0, low impact. If tree cover exceeds 20%, it will be assigned a value of 1, high impact. Tree cover here includes forests and plantations.

2.2.2 Water resources

Runoff potential: Water body and runoff considerations are particularly important for closed-loop PSH systems, despite their reduced dependency on natural water sources. The analysis must account for potential impacts on Tamil Nadu's numerous rivers, tanks, and coastal water bodies, which support both ecological functions and human livelihoods (Gobika Shree, N., & Meiaraj, C., 2025). Hence, stormwater runoff was selected as a proxy indicator to determine the runoff. The following formula is used:

Ve = ***C × Re × A***

Ve = *The runoff volume*

C = *The Runoff Coefficient. This coefficient is influenced by factors like vegetation cover, ground surface slope, soil infiltration rate, and depression storage loss. Various sources provide values for C, which represents the ratio of runoff to rainfall.*

Re = *Rainfall Depth. This is the depth of rainfall in a given area.*

A = *The area receiving the rainfall.*

To consider the runoff as high, the average yearly runoff measured in m3 per pixel should be greater than 70 m^3. We calculate runoff at the pixel level, then aggregate and average these values to determine the total runoff for the reservoir. If the yearly runoff of the reservoir is high, we assign the value 0; if it is low, the value is 1.

Surface waterbodies: Already existing waterbodies can disrupt local hydrology, reduce water availability for dependent communities, and negatively affect aquatic ecosystems. Any waterbodies such as ponds, lakes or tanks intersecting the reservoir area will be assigned a value of 1 indicating high impact if not a 0, low impact.

2.2.3 Socioeconomic context

Agricultural landuse: Protection of agricultural land is paramount in Tamil Nadu, where agriculture and allied activities employ 60 % of the total people in the state and contributes significantly to food security (MOFPI, 2025). Reservoir sites are assessed for overlap with agricultural land. Reservoirs having a share of 20 % or more agricultural land by area will be assigned a value of 1, if not a 0.

Human settlements: Tamil Nadu exhibits diverse human settlement patterns, with numerous villages, towns, and cities distributed across a range of ecological zones. The potential for displacement and social disruption from PSH development requires careful assessment, particularly in areas with high population density or vulnerable communities (Times of India, 2018; The New Indian Express, 2025). Reservoir sites are assessed for their proximity to densely populated settlements. Sites located within 1 kilometre of villages or urban clusters are assigned a score of 1, indicating high impact, while those farther away receive a score of 0, reflecting a lower risk of social disruption.

2.2.4 Environmental quality

Ambient air quality: Air quality is a growing concern in Tamil Nadu due to rapid industrialisation and urbanisation. PSH development, particularly during construction, can add to local pollution. For each potential reservoir site, the average PM2.5 concentration over the past 10 years is calculated from pixel-level data. A threshold of 30 μg/m³ is used: sites at or below this level are scored 0, while those above are scored 1. This ensures site selection reflects long-term air quality conditions and potential impacts.

Seismic hazard: Assessing seismic hazards is vital for PSH safety and longevity. India has four seismic zones: II (low), III (moderate), IV (high), and V (very high). Zones IV and V should be avoided, while Zone III can be used with detailed seismic studies, robust structural design, and monitoring. Tamil Nadu spans Zones II and III. Northern and western districts, including Chennai and Coimbatore, are in Zone III; the rest are mostly Zone II. In our scoring, sites in Zones IV, V, or III receive a 1 due to higher structural risk (Zone III is acceptable only with safeguards). Zone II sites receive a 0 and are preferred.

2.2.5 Infrastructure Proximity

Railway and road connectivity: Transportation infrastructure assessment involves analysing proximity to roads and railways, which can significantly influence construction costs and environmental impacts. Tamil Nadu's extensive road and rail networks provide good connectivity to most regions (Unni Ravisankar et al., 2019; Tamil Nadu Forest Department, 2023). Sites located within a proximity of 0.5 km to railways or major roads (national highways, state highways, or arterial roads) and 1 km to highways are scored 0, otherwise 1, as they offer logistical advantages and reduced construction costs. Proximity to operational railway lines also influences transportation efficiency for materials and equipment.

Power infrastructure proximity: Sites located within 1 km of existing transmission lines or substations are assigned a score of 0, while those beyond this distance receive a score of 1. Substations rated at 110 kV or higher and corresponding high-tension (HT) lines are useful for PSH

2.2.6 Cultural and legal protection zone

Cultural heritage sites: Tamil Nadu, due to its2,500-year-old heritage, now has numerous archaeological sites, ancient temples, and protected cultural landscapes. Many are listed under UNESCO, national and state heritage registers, or local inventories. Protecting these sites preserves cultural identity and delivers social and spiritual value to communities. For assessment, the presence of any culturally important site within 1 km of a reservoir area is scored 1; areas with none are scored 0.

Legally protected conservation areas: Tamil Nadu has a robust legal framework for conservation, covering wildlife sanctuaries, national parks, biosphere and conservation reserves, and 13 Ramsar sites. Over 1,355 km² have been added to the protected area network in recent years, reflecting the state's strong biodiversity commitment. PSH development must avoid adverse impacts on these zones and align with conservation objectives through careful siting and design. For scoring, any reservoir area which is less than 1 km in a legally protected sites such as reserve forests, national parks, wildlife sanctuaries, biosphere reserves, mangroves, or bird sanctuaries are assigned 1; otherwise, 0.

2.2.7 Biodiversity and ecology

Significant fauna: Fauna refers to animal life, including species of mammals, birds, reptiles, and amphibians that inhabit the landscape. The presence of critically endangered (CR) & endangered (EN) species is a key indicator for evaluating a region (IUCN, 2024). For our analysis, we use data on the geographical distribution of critically endangered and endangered species of Tamil Nadu as per the IUCN Red List. Reservoirs that serve as natural habitats for eight or more of the shortlisted species, as per IUCN, receive a value of 1. Otherwise, a value of 0 is assigned.

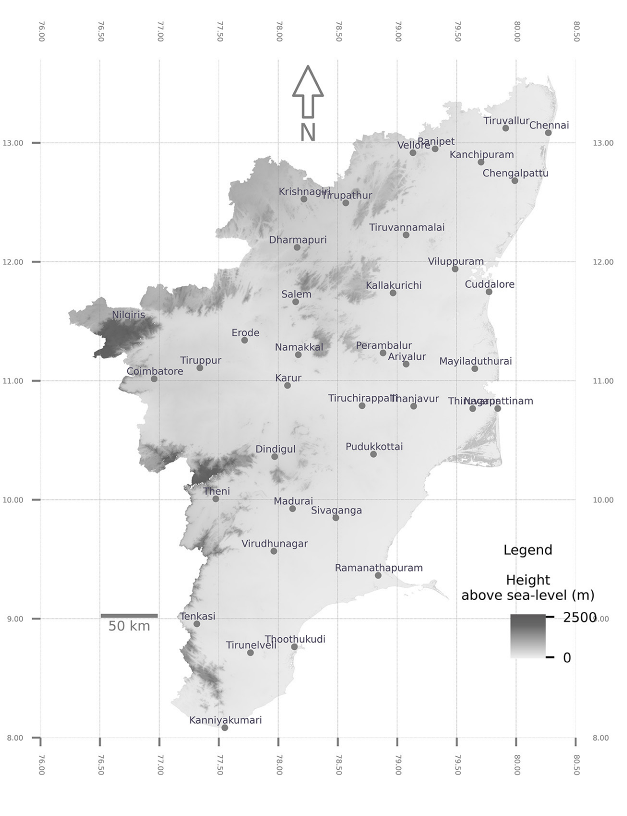
Significant flora: Flora encompasses all types of vegetation, including trees, shrubs, grasses, and aquatic plants, and plays a crucial role in biodiversity, ecosystem services, and climate resilience. The presence of critically endangered (CR) & endangered (EN) plant species is a key indicator for evaluating a region's ecological value (IUCN, 2024). For our analysis, we use data on the geographical distribution of critically endangered and endangered species of Tamil Nadu as per the IUCN Red List. Reservoirs that serve as natural habitats for at least four or more of the shortlisted species, as per IUCN, receive a value of 1. Otherwise, a value of 0 is assigned.

Key data layers

Slope

Slope tells us about the ideal sites for the development of PSH. Lands with a steeper slope will be suitable for the development of PSH.

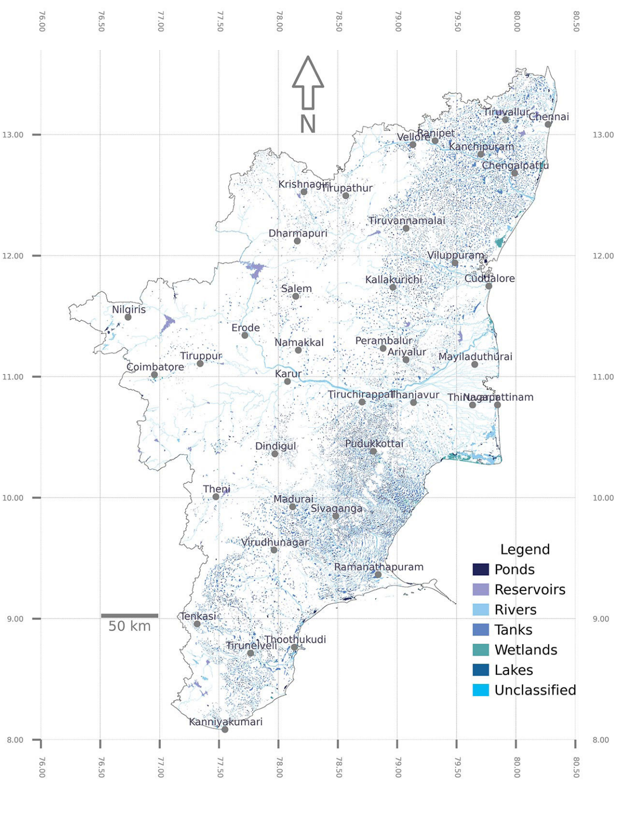
Figure 4 Slope of Tamil Nadu.



Surface waterbodies

Large water bodies, if available, could be utilised for the recharge of the reservoir.

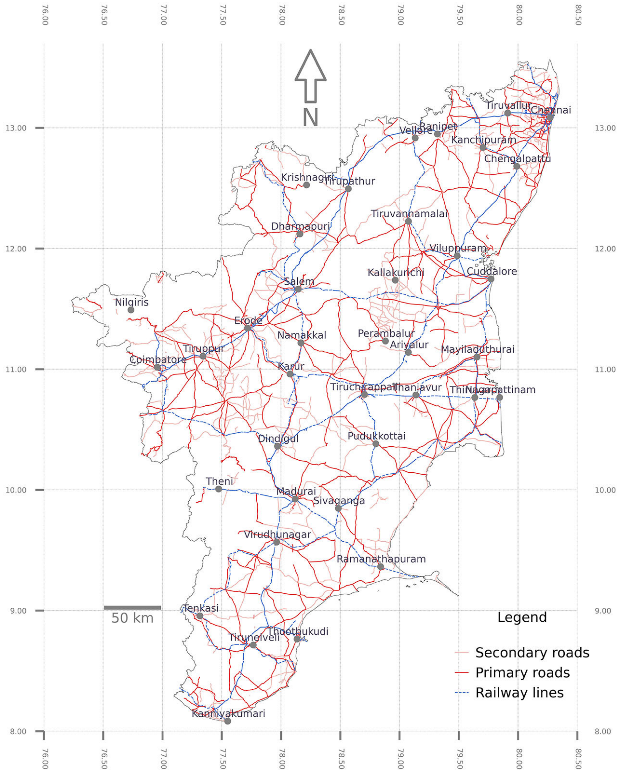
Figure 5 Various waterbodies in Tamil Nadu.



Road & railway network

Vicinity to a road that can accommodate load carriers provides direct access to the site. It provides the possibility of transporting equipment that might be necessary for the maintenance.

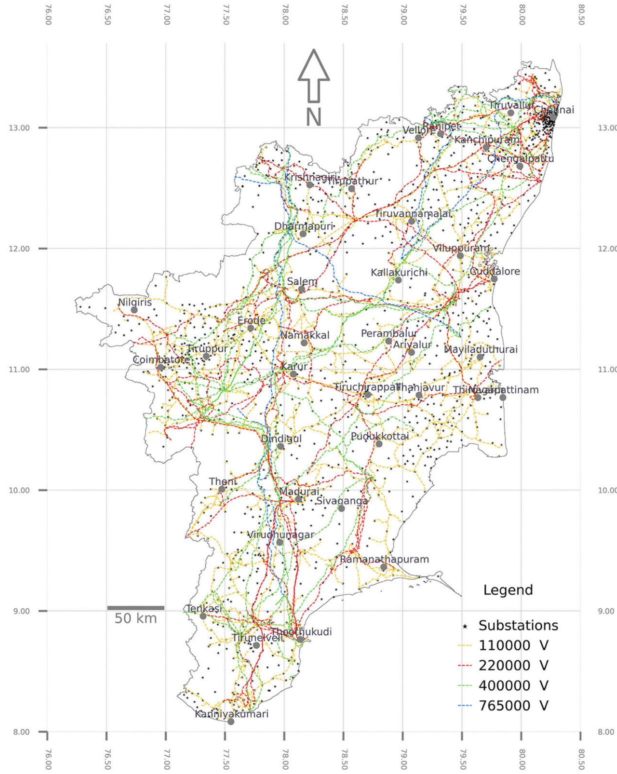
Figure 6 Road and railway connectivity of Tamil Nadu.



Power infrastructure

Substations and powerlines are critical nodes in the power distribution sector and indicate development zones for PSH.

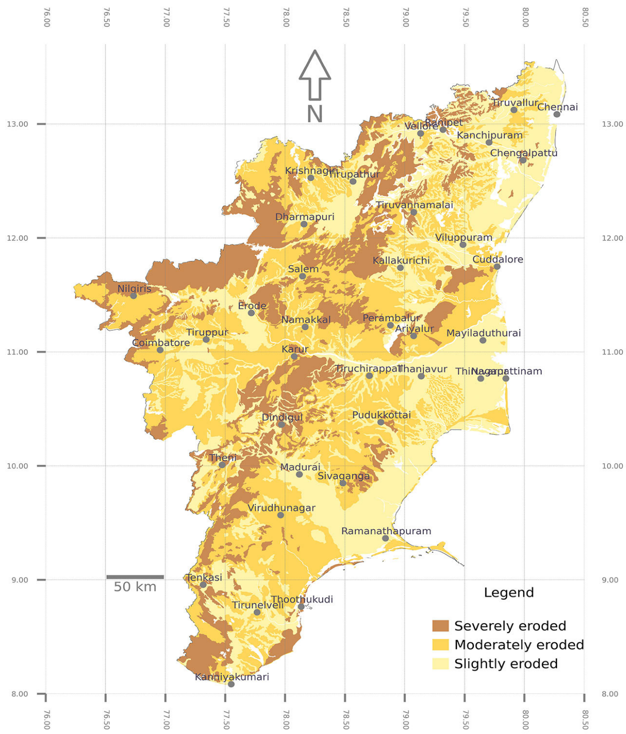
Figure 7 Power infrastructure of Tamil Nadu.



Soil risk

Soil vulnerability tells which sites are suitable and at a lower risk for PSH development

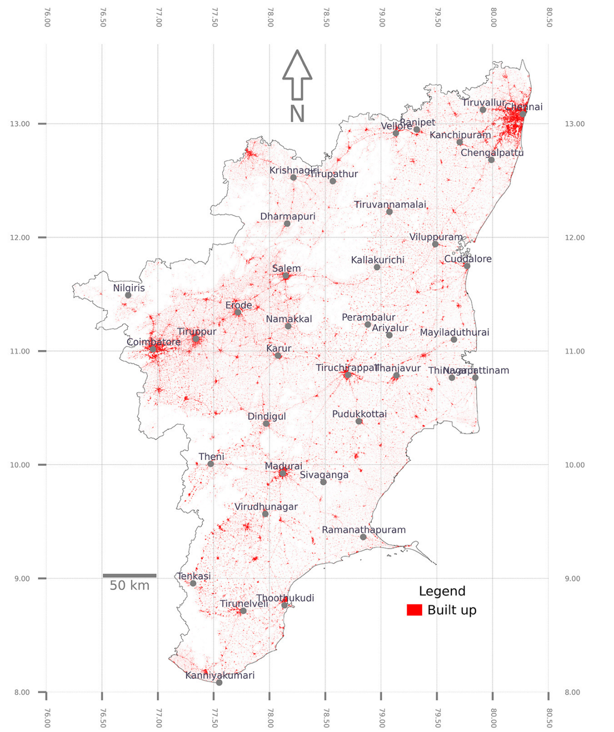
Figure 8 Soil erosion in Tamil NaduTamil Nadu.



Built-up

Built-up area indicates areas that should be away from any pumped storage site.

Figure 9 Built up areas in Tamil Nadu.



03 Fast-tracking pumped hydro storage

Pumped storage hydro (PSH) projects in India face much longer commissioning periods than other renewables. The median completion time is nearly 17 years, compared to typically 2 years for solar or wind projects, a gap that is both substantial and statistically significant (Borah et al., 2025). While PSH inherently involves more complex engineering and siting challenges, the international average completion time is only 5-10 years, highlighting the extent of procedural and regulatory delays in India (IEA, 2021).

To address this, the Central Electricity Authority (CEA) has, since 2022, introduced a series of reforms aimed at accelerating PSH project timelines. Key changes include fast-tracking approvals and standardizing technical documentation. CEA has reduced the timeline for Detailed Project Report (DPR) preparation from 900 to 690 days for non-Himalayan projects and shortened the concurrence (final approval) period to just 50 days for all PSH projects by 2024 (CEA, 2022; 2023). The requirements for supporting documents from project developers have also been minimised and standardised, cutting paperwork and administrative delays.

To further incentivize development, PSH projects benefit from waivers on Inter-State Transmission System (ISTS) charges, exemption from free power obligations, and elimination of the previously required upfront premium for project allotment. CEA has also called on Electricity Regulatory Commissions to advance market reforms and recognize ancillary services provided by PSH projects (CEA, 2022; 2023).

On the regulatory front, major simplifications in environmental clearance procedures have been implemented since 2023. The Ministry of Environment, Forest and Climate Change (MoEFCC) has introduced a new appraisal framework for closed-loop PSH, treating those sited on existing reservoirs or off-river locations as a distinct category (MoEFCC, 2023). The revised guidelines now allow these projects to be assessed with dedicated Terms of Reference and a more predictable review pathway.

Environmental impact assessments (EIA) for PSH must comprehensively document project and site characteristics, baseline environmental and socio-economic conditions, biodiversity and geology, meteorology, hydrology and water quality, noise and air assessments, as well as GIS-based spatial analyses. Crucially, the EIA process now requires explicit mitigation strategies, environmental cost-benefit analysis, and a detailed management plan covering both ecological and community impacts. This streamlining supersedes prior, more protracted regulatory frameworks, substantially reducing uncertainty and clearing bottlenecks for qualifying PSH sites.

Together, these CEA-led procedural reforms and the simplification of environmental clearances represent a coordinated push to shorten PSH commissioning timelines, align Indian practices with global benchmarks, and unlock faster deployment of large-scale grid storage essential for renewable integration and energy security.

Moreover, such projects can generate significant employment opportunities for local populations, not just in plant operations but also in roles like drivers and labourers. They also boost the local economy by creating demand in sectors such as tourism, material supply, and transport services (de Faria et al., 2017). For instance, Australia's Snowy 2.0 PSH project is expected to create 4,000 direct jobs during its construction phase (Snowy Hydro Limited, 2025). Additionally, the development process often enhances local infrastructure, including roads and bridges. When implemented responsibly, these initiatives can promote sustainable livelihoods and help curb migration by fostering long-term economic opportunities (CEEW, 2025).

Table 6 Measures expediting commissioning of PSHs

Year / Period	Reform / Initiative	Implementing agency	Impact on PSH development
2022	Reduced timeline for preparation of Detailed Project Reports (DPRs) from 900 to 720 days	CEA	Speeds up initial project design and planning
2022	Reduced concurrence (final approval) period to 75 days for competitively allotted projects, 125 days for others	CEA	Reduces approval delays
2022 (Ongoing)	State governments allowed to allocate projects directly to CPSUs/SPSUs on nomination basis	CEA/State governments	Accelerates project allotment
2022–2023	Waiver of Inter-State Transmission System (ISTS) charges for PSH	CEA/MoP	Improves project financial viability
2022–2023	Exemption from free power obligations	CEA/MoP	Improves revenue potential
2022–2023	Removal of upfront project premium	CEA/MoP	Lowers entry barrier
2023	DPR preparation timeline reduced to 690 days for non-Himalayan projects	CEA	Optimises project timeline
2023	Concurrence period reduced to 50 days for competitive projects, 90 days for others	CEA	Brings timelines closer to global standards
2024	Standardised concurrence period to 50 days for all PSH	CEA	Predictable and quicker approvals
2024	Checklist of documents for developers simplified and shortened	CEA	Lower administrative burden
2023 (Regulatory)	New appraisal framework for closed-loop PSH on existing reservoirs/off-river sites	MoEFCC	Enables faster, less complex Environmental Clearance (EC)
2023 (Regulatory)	Dedicated Terms of Reference for PSH EIAs	MoEFCC	Predictable EIA process
2023 (Regulatory)	Comprehensive EIA requirements defined (biodiversity, geology, hydrology, socio-economics, mitigation strategies, cost-benefit analysis)	MoEFCC	Reduces clearance uncertainty
2023	Market reforms to monetise ancillary services from PSH	CEA/SERCs	Improves long-term project bankability
2024	Shorter DPR submission with 12 chapters. Earlier it was more.	CEA	Accelerates DPR preparation
2024	Encouragement for parallel activities by appraising agencies through timely submission of investigation reports	CEA	Minimises idle time and overlaps tasks for faster clearances
2024	For closed loop PSH, removed the requirement to submit alternative location plans for reservoirs	CEA	Simplifies documentation and expedites approval for site-specific proposals

Source: Borah et al., 2025; CEA, 2022; 2023; 2024

3.1 Complexity and delay: Understanding the bottlenecks facing pumped storage in India

Pumped storage hydropower (PSH) projects in India face significant challenges due to complex clearances, land acquisition hurdles, environmental and social impacts, high upfront costs, and competition from faster, modular battery energy storage systems. These issues, combined with technical risks and delays in approvals, have led many PSH projects to experience severe time overruns, often exceeding a decade.

3.1.1 Site constraints in protected and ecologically sensitive areas

Developing sites for pumped storage hydropower (PSH) is increasingly challenging as many potential locations fall within protected areas such as national parks, wildlife sanctuaries, reserve forests, and heritage sites. These protections complicate the development of land-intensive reservoir projects, as they require complex and time-consuming approvals (Tripathi and Sumana, 2022). Additionally, conflicts with biodiversity conservation goals and community dependence on forest landscapes have led to increased scrutiny of PSH proposals in ecologically sensitive regions (MoEFCC, 2021). For instance, the Sharavathi and Varahi pumped storage projects in Karnataka are situated within officially designated wildlife sanctuaries, thereby breaching essential provisions of the Wildlife (Protection) Act. These projects have been proposed in the dense, landslide-prone evergreen forests of the Western Ghats, an area recognised as vital carbon sinks and habitats of exceptional biodiversity (SANDRP, 2025).

3.1.2 Investment risks and battery competition

In 2019, the Standing Committee on Energy (Chair: Dr. Kambhampati Haribabu) reported that out of 37 hydropower projects, 16 were stalled, of which 10 were stalled because of financial constraints. PSH projects carry significant risks due to their high upfront capital requirements, extended development timelines (5-7 years) and complex regulatory and approval processes (WEC India, 2022). These challenges are further compounded by the rapid decline in battery energy storage system (BESS) costs. BESS technologies offer modular, flexible, and faster deployment solutions for short to medium term energy storage, making them increasingly attractive to investors and utilities. Consequently, the capital and land intensive nature of PSH often makes it less appealing compared to the more agile BESS alternatives (IRENA, 2017). Moreover, hydroelectric dams have the greatest amount and frequency of cost overruns and with a mean cost escalation of 70.6 % (Sovacool, B.K. et al., 2014).

Despite this, India's transition towards a renewable energy-based grid requires robust and large-scale energy storage. PSH and BESS are the two primary technologies competing in this space. BESS offers quick deployment and high responsiveness, ideal for short duration balancing. As of 2023, lithium-ion battery prices for BESS have fallen to USD 139 per kWh, a dramatic reduction from USD 780 per kWh in 2013 (ICRA Limited, 2024). This cost is expected to decline further due to the continued scaling up of global battery manufacturing and deployment. While BESS typically involves higher capital costs per unit of capacity compared to PSH, its operational expenditure per kilowatt-hour is lower. However, for long-duration energy storage, PSH stands out as the most cost-effective and scalable solution (ICRA Limited, 2023; NDTV Profit, 2024). Additionally, PSH incurs primarily maintenance-related costs over its longer lifespan, whereas BESS requires periodic capital expenditure for battery replacements. Table 7 compares the capital costs and levelised cost of storage (LCoS) for the two technologies (ICRA Limited 2023)

Table 7 Cost comparison between BESS and PSH

Parameter	BESS	PSH
Capital Cost	1.50-1.70 (INR crore per MWh)	1 (INR crore per MWh)
Typical duration	2-4 hrs	8 hrs
Levelised cost of storage	5.50-6.00 (INR/kWh)	4.50-5.00 (INR/kWh)

Sources: ICRA Limited 2023

3.1.3 Institutional approval hurdles

Approval delays are compounded by centralised testing requirements at agencies such as the Central Water Commission (CWC), Geological Survey of India (GSI), and Central Soil and Materials Research Station (CSMRS). The CWC reviews hydraulic and structural designs of dams and spillways, requiring hydraulic model studies and flood analyses (CEA, 2022). The GSI conducts geological, geotechnical, and seismological investigations to assess site suitability and seismic risks (Forum of Regulators, 2025). The CSMRS evaluates the properties of soil, rock, concrete, and construction materials. Samples must often be sent to central laboratories which further creates logistical challenges that delay the projects by months (The Economic Times, 2013). Accepting results from NABL accredited regional and private testing labs for soil, rock, concrete and materials, will save time as by avoiding to ship most samples to central labs.

3.1.4 Land acquisition challenges

PSH projects typically require large tracts of land, often impacting agricultural fields or village territories. The land acquisition process is frequently prolonged due to disputes over compensation and resistance from local communities (WEC India, 2022). These challenges are further intensified by law-and-order concerns and objections raised under the Forest Rights Act (FRA), particularly when Gram Sabhas deny the No Objection Certificates (NOCs) necessary for utilizing forest land (Forum of Regulators, 2025; The Hindu, 2023). PSH projects have encountered mounting resistance from communities and environmental advocates in multiple Indian states including Rajasthan, Karnataka, Andhra Pradesh, Madhya Pradesh, and Maharashtra (SANDRP, 2025).

3.1.5 Geological and infrastructure challenges

Geological risks such as unexpected rock formations, landslide-prone zones, and unstable soil add complexity and cost. Without a standardised framework for geological and forest surveys, there may be an increased likelihood of differing requirements from officials, potentially leading to delays. Many PSH sites are in remote hilly areas with poor infrastructure, making it difficult to transport equipment and workers. Moreover, unpredictable weather patterns further hinder construction, and prolonged contract award processes can push commissioning timelines beyond a few years (Powerline, 2017).

3.1.6 Environmental impacts

The development and functioning of PSH systems, including related infrastructure such as power lines, can greatly impact land, water resources, local geology, and ecosystems. PSH projects may worsen soil erosion, land degradation, seismic activity, and ground sinking, particularly from tunnelling and groundwater extraction. They can also disturb wildlife movement, predator-prey relationships, and habitat links. Elevated noise and light levels may further hinder animal behaviour (Karambelkar et al., 2025). Dust and emissions from construction worsen air quality, while surface and groundwater systems may experience changes in quantity and quality. Initial water extraction can disrupt local hydrology, and continuous operations may change water chemistry, temperature, and oxygen levels in the water, raising dissolved solids, nutrients, and metals (Karambelkar et al., 2025).

3.1.7 Social and cultural trade-offs

PSH projects can create local employment, recreational opportunities, tax revenues, and improve regional energy security. However, they can also displace people, change land use patterns, reduce recreational access, and alter the visual character of landscapes. The influx of workers during construction strains local infrastructure, such as schools, hospitals, and housing (Karambelkar et al., 2025). PSH development can impact tribal and cultural resources, including sacred sites. Damage to land, water, and biodiversity can limit access to culturally significant areas. Often, community consultations occur late in the process, after developers have heavily invested in a site, reducing opportunities for meaningful public influence (Karambelkar et al., 2025). For example, the Greenko Group is developing a pumped storage project (PSP) in the Shahbad forest, which poses a threat to the livelihoods of thousands of Sahariya Adivasis and Dalits who rely on the forest for their daily needs (SANDRP, 2025).

3.1.8 Environmental and forest clearance delays

One of the major sources of delay in PSH projects are environmental and forest clearances. Obtaining a No Objection Certificates (NOCs) from Gram Sabhas under the Forest Rights Act (FRA) requires extensive community consultations, which can be slowed by conflicting interests, or lack of consensus (Forum of Regulators, 2025). Projects requiring forest land must also provide details of compensatory afforestation sites in their forest diversion proposals. These requirements, coupled with slow approval processes for surveys, add uncertainty and prolong timelines (WEC India, 2022; Forum of Regulators, 2025).

Table 8 shows some of the requirements of multiple statutory approvals for hydropower and PSH projects along with their regulatory body. On average, these processes contribute to hydropower projects in India facing significant time overruns of several years, despite incentives to accelerate green energy development (Powerline, 2017).

Table 8 List of clearances and their regulatory bodies

No.	Clearance	Regulatory body	Relevant law/policy
1	Site Allocation	State Nodal Agency	State Hydro Policies; MoP Guidelines for PSHs (MoP, 2023)
2	DPR Concurrence	CEA	Electricity Act, 2003 Section 8 (MoLJ, 2003); CEA DPR Guidelines for PSHs v2.0 (CEA, 2023)
3	Techno-Economic Clearance	CEA, CWC, GSI, CSMRS	Electricity Act, 2003 (MoLJ, 2003); CWC Guidelines (CEA, 2015)
4	Environmental Clearance (EC)	MoEFCC (PARIVESH, 2023), SEIAA	EIA Notification 2006 S.O. 1533(E) (MoEFCC, 2006; PIB, 2022, 2024); Amendment for PSH B2 Category S.O. 2226(E) (MoEFCC, 2023)
5	Forest Clearance	MOEF&CC, State Forest Departments	Forest Conservation Act, 1980 Act No. 69; Forest Conservation Rules, 2022 G.S.R. 480 (E) (MoEFCC, 2022)
6	Wildlife Clearance	MoEF&CC, National / State Wildlife Boards	Wildlife Protection Act, 1972 (MoEFCC, 1972)
7	Land Acquisition	State Government / District Administration	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 Act No. 30 (MoRD, 2013)
8	Rehabilitation & Resettlement (R&R)	State Administration, R&R Committees	National Rehabilitation and Resettlement Policy, 2007 (MoRD, 2007)
9	Power Purchase Agreements (PPA) Approval	CERC / SERC	Electricity Act, 2003 (MoLJ, 2003)
10	Transmission Approval	CEA, CTU, POSOCO	Central Electricity Regulatory Commission Regulations (CERC, 2022)
11	Tariff-Based Competitive Bidding (TBCB)	MoP	TBCB Guidelines for PSHs (MoP, 2025)
12	Explosives Licence	PESO	Explosives Rules 2008 (PESO, 2025)

3.2 Case studies: Common challenges across Indian hydroelectric projects

Several major hydropower projects in India exemplify recurring challenges such as prolonged delays, land acquisition disputes, clearance bottlenecks, and community resistance, highlighting systemic issues in project planning and execution.

3.2.1 Abandoned due to resettlement conflicts

Maheshwar power project, Maheshwar, Madhya Pradesh

The combination of compliance failures and financial opacity eroded credibility with regulators, courts, lenders, and the public. Consequently, the project's contract was terminated in 2022, and it is now likely to be abandoned (Times of India, 2020; Down To Earth, 2022).

Source: The Hindu, 2012 (photo by Mahim Pratap Singh)

The Maheshwar hydroelectric project in Madhya Pradesh has been delayed for approximately 17 years, primarily because of challenges related to resettlement and rehabilitation, compounded by a strong resistance from the Narmada Bachao Andolan (Powerline, 2017). Also, a large cost overrun pushed consumer affordability, undermining bankability for the project (Hindustan Times, 2015). Originally, the projected was estimated to cost Rs 1,569 crore; later rose to Rs 4,700 crore, with officials reporting that the actual cost has already touched Rs 6,000 crore (Hindustan Times, 2015). Financial difficulties eventually prompted lenders to take control of Shree Maheshwar Hydel Power Corporation Ltd. in 2016 (Powerline, 2017). Approximately 61 villages faced full or partial submergence, and 9,500 families were not provided proper resettlement (Down To Earth, 2022). Additionally, allegations of irregularities and misuse of public funds drew criticism from public bodies (Down To Earth, 2022).

3.2.2 Delays due to forest clearance and tunnel issues

Uhl III power project, Mandi, Himachal Pradesh

Cost escalations from Rs 431 crore to Rs 1259 crore was another drawback faced by this project (SANDRP, 2020). Moreover, a penstock burst on 2020 flooded the downstream power house and further delayed the project (SANDRP, 2020).

Source: The Tribune, 2024

The Uhl III hydroelectric project in Himachal Pradesh, developed by NHPC Ltd., has experienced an 11-year delay, mainly due to challenges securing forest land clearance, setbacks in the contracting process, and structural issues with the head race tunnel (Powerline, 2017). Structural issues forced redesigns and re-tendering and prolonged underground excavation under adverse ground conditions. Delays in receiving the necessary forest clearances resulted from complex administrative procedures and stringent environmental regulations. The contracting phase also faced hurdles such as prolonged tendering, re-bidding, and disputes, while unforeseen geological conditions in the head race tunnel required significant redesigns and remedial work (Powerline, 2017).

3.2.3 Poor access and community opposition

Tuirial power project, Kolasib, Mizoram

The plant was finally commissioned in 2017, with two 30 MW units at a total cost of approximately ₹1,300 crore, but only after significant mitigation efforts in a socially and environmentally sensitive region (PIB, 2017).

Source: Zalen, 2024

The Tuirial Hydroelectric Project in Mizoram, developed by the North Eastern Electric Power Corporation Ltd. (NEEPCO), experienced an 11-year delay due to poor road connectivity, unstable slopes, and sustained opposition from local communities (Powerline, 2017). Geological challenges such as unstable terrain and frequent slope failures, caused repeated excavation delays. Moreover, villagers from Saipum protested against inadequate public consultations and compensation (SANDRP, 2017).

The project's remote location and limited infrastructure further hindered equipment transport and workforce mobilisation. Addressing landslide-prone conditions required extensive remedial engineering, adding to costs and delays (Powerline, 2017).

3.2.4 Stalled by safety concerns

Subansiri hydroelectric project, Kamle, Arunachal Pradesh

This project is anticipated to commence operations once it receives final safety clearance (Economic Times, 2013; Powerline, 2017; Urban Acres, 2024).

Source: Urban Acres, 2024

The Subansiri Hydroelectric Project in Arunachal Pradesh, developed by NHPC Ltd., has faced prolonged delays due to law-and-order issues, sustained protests from AASU (All Assam Students' Union) and KMSS (Krishak Mukti Sangram Samiti), and ongoing concerns about downstream impacts (Powerline, 2017). The project has also been hindered by risks related to seismic safety, peaking flow variations, and erosion. The project's cost has escalated sharply from ₹6,285 crore in 2002 to ₹18,064 crore in 2015, amid prolonged suspension, leading to significant daily financial losses due to non-completion (Indian Express, 2017)

3.2.5 Geology and contractor delays

Tehri hydroelectric project, New Tehri, Uttarakhand

Difficult underground geology has complicated excavation and construction activities, necessitating additional engineering interventions. Simultaneously, contractor-related issues such as delays in preparing detailed designs and insufficient deployment of manpower and equipment have further hindered project progress. (Economic Times, 2013; Powerline, 2017; Renewable Watch, 2024).

Source: Britannica, 2025

The Tehri Pumped Storage Hydropower Project, developed by THDC India Ltd., has faced multiple delays due to challenging geological conditions, the contractor's unpreparedness in finalising critical designs and drawings, and insufficient mobilisation of resources at the project site (Economic Times, 2013; Powerline, 2017; Renewable Watch, 2024). Early progress was particularly hindered by delays in finalising the powerhouse layout (Lok Sabha Secretariat, 2017).

Further setbacks arose during the COVID-19 pandemic, which disrupted labour availability, logistics, and cash flows, exacerbating existing delays in underground civil works and associated packages (Renewable Watch, 2024). Additionally, local agitations at designated dumping yards led to work stoppages and forced re-sequencing, further complicating site management and extending project timelines (Renewable Watch, 2024).

3.2.6 Tunnelling issues and natural disasters

Parbati II hydroelectric project, Kullu, Himachal Pradesh

The project has faced repeated failures of tunnel boring machines, necessitating costly repairs and replacements. Recurring natural calamities have only intensified these difficulties, leading to significant extensions of the project timeline. (Powerline, 2017; Moneycontrol, 2024).

Source: NHPC, 2025

The Parbati II hydroelectric project has experienced substantial delays, chiefly due to complex tunnelling challenges, persistent seepage of water and silt, and a series of natural disasters including flash floods and cloudbursts. Unfavourable geological conditions and frequent landslides have further complicated construction, contributing to prolonged stoppages and heightened engineering risks (Powerline, 2017; Moneycontrol, 2024).

Cloudbursts, flash floods, and frequent landslides repeatedly disrupted project activities, damaging access roads and supporting infrastructure and further delaying commissioning. The situation worsened after fresh flood events that affected the Parbati facilities and storage areas, compounding setbacks to construction progress (SANDRP, 2025b).

3.3 Strategies for scalable and sustainable PSH

Key challenges in Pumped Storage Hydropower (PSH) development—such as ecological impacts, land acquisition, regulatory delays, and financial risks can be addressed through strategies like repurposing degraded sites, streamlined approvals, hybrid RE-PSH models, and community benefit-sharing. Global and Indian case studies demonstrate how integrated planning, technical innovation, and participatory approaches enable sustainable and bankable PSH deployment.

3.3.1 Eco-sensitive siting strategies

Eagle Mountain PSH, California, USA

The absence of existing aquatic habitats within the Eagle Mountain PSH pits, along with its remote location, collectively minimizes ecological sensitivity and results in a lower environmental impact compared to greenfield or river-connected sites (Eagle Mountain Pumped Storage Project, 2012).

Source: GEI Environmental

To reduce conflicts with protected areas, PSH site selection can prioritise degraded lands, abandoned quarries, or areas with minimal ecological sensitivity. In India, integration of a pumped storage into existing reservoirs (e.g., Tehri PSH, Uttarakhand) avoided the need for new land-intensive reservoirs. Developing early-stage environmental screening tools can help developers avoid sensitive zones (THDC India Limited, 2025).

Closed-loop PSH systems that do not require river diversions offer a promising solution, as demonstrated by the Eagle Mountain PSH Project in California, which repurposes a former iron mine, minimising ecological impact (U.S. Environmental Protection Agency 2011).

3.3.2 Enhancing PSH financial viability

Kidston PSH-solar hybrid project, Kidston, Australia

Hybrid models combining PSH with solar or wind power plants can enhance revenue streams and reduce costs, as seen in Australia's Kidston PSH-Solar Hybrid Project (GENEX, 2021; ARENA, 2024).

Source: NAIF, 2019

Addressing financial viability requires targeted policy support, such as viability gap funding, tax incentives, and preferential grid access for PSH projects. In India, the proposed National Electricity Plan (2022–2027) includes guidelines for incentivising long-duration storage like PSH through competitive tariffs. Strengthening long-term offtake contracts and mandating grid services procurement from PSH can provide revenue certainty and improve bankability (CEA, 2023).

When comparing costs with Battery Energy Storage Systems (BESS), an optimised generation-storage system can greatly smooth out fluctuations in power output. Additionally, studies indicate that pumped storage hydropower (PSH)-based systems, when optimised, tend to be more cost-effective than BESS solutions. This is because BESS faces limitations due to its shorter discharge duration, which affects long-term economic viability (IET, 2016).

3.3.3 Streamlining PSH approvals

Red John PSH, Inverness, Scotland

Red John (PSH) project serves as a strong example of how early and comprehensive planning can address environmental and community concerns (Brodies LLP, 2021).

Source: The Scotsman, 2018

To streamline clearances, India could adopt single-window approval systems, similar to those used for highways under the Parivesh portal, which reduces redundancy and processing times (MoEFCC, 2023). Compensatory afforestation plantations are established to offset forest land diverted for non-forestry purposes under the Forest Conservation Act, 1980. These sites are often degraded and require sustained efforts to develop into forest-like vegetation for which state governments are responsible for identifying and managing these lands according to their own rules and guidelines (MoEFCC, 2017; PIB, 2024).

Internationally, Scotland's Red John PSH project tackled issues related to water level fluctuations, downstream ecology, protected habitats and species, woodland loss, flood risk, water resources, landscape impacts, construction noise, and cultural heritage during project development (AECOM, 2018). These measures helped ensure that the project balanced renewable energy objectives with environmental stewardship and community trust.

3.3.4 Digitising and decentralising approvals

Jingping II mega hydropower project, Sichuan, China

Decentralising testing facilities and accrediting regional laboratories for soil, rock, and material testing can ease bottlenecks and reduce logistical delays as seen in China's Jingping II PSH project (Zhang et al., 2016).

Source: InfraGlobal

Digital submission and monitoring of design approvals, as piloted in India's Brahmaputra Board dam safety clearance system, can improve transparency and reduce processing time (Department of Water Resources, 2023). Additionally, encouraging parallel processing of technical documents by different agencies, rather than strictly sequential reviews, and the use of pre-certified design templates for key components have streamlined technical evaluations and reduced objection (NREL, 2021; PwC India, 2017). These measures can prove effective in reducing delays and improving the efficiency of the project delivery. .

3.3.5 Equity models and early engagement

Nant de Drance pumped storage, Valais, Switzerland

Early and continuous community engagement, as seen in Switzerland's Nant de Drance PSH, helped build trust and mitigate opposition (AFRY, 2022).

Source:Nau.ch, 2024

Land acquisition challenges can be addressed through consensual land pooling models, used in India's Andhra Pradesh Capital Region Development where landowners became equity holders in the project's value creation (The Economic Times, 2024). The Renuka Dam project also illustrates the success of direct benefit-sharing mechanisms (e.g., jobs, revenue-sharing) in reducing resistance (Department of Water Resources, 2025).

The Nant de Drance operator continues environmental compensation initiatives in collaboration with local NGOs and authorities, including invasive-species control, restoration monitoring, and school-led awareness programs, reflecting a commitment that goes beyond statutory requirements (International Water Power, 2023).

3.3.6 Infrastructure readiness and resilient contracting

Hongrin-Léman pumped storage, Veytaux, Switzerland

To manage geological risks, developers can adopt advanced geotechnical survey tools, such as LiDAR mapping and remote sensing, to improve site characterisation, as successfully applied in the Hongrin-Léman PSH project in Switzerland (Andritz, 2025).

Source:Forces Motrices Hongrin-Léman SA

Developing essential site infrastructure, such as roads, worker camps, warehouses, sewage, medical, and storage facilities during early project stages, as demonstrated in the Teesta III hydropower project, helps mitigate logistical challenges (NHPC Limited, 2025). Project records highlight land acquisition for dam related infrastructure, emphasizing that early provisioning of these assets is critical for successful execution in remote valleys (IBON International & The Centre for Research and Advocacy Manipur, 2022). Additionally, contracting reforms introducing modular contracting and parallel work packages, exemplified by Japan's Kannagawa PSH, can minimize time overruns caused by weather disruptions and award delays (Power, 2006).

3.3.7 Mitigation by design

Limberg II PSH, Salzburg, Austria

The project connects two existing Alpine reservoirs through an underground water conveyance system and power cavern, with nearly all new infrastructure built inside the mountain. Its underground machine hall, long headrace, and inclined pressure shaft effectively minimize visual disturbance and ecological impact in the environmentally sensitive region (PORR Group, 2011; Voith).

Source: Voith

Implementing robust soil and slope management during construction helps reduce erosion and landslide risks, as demonstrated by New Zealand's Clyde Dam (Nathan, 2021). Detailed remapping, extensive drilling, and rapid stabilisation through investigation and gravity drainage kept slope movements within predicted limits after reservoir filling. Proactive geotechnical management minimizes long-term risks (Nathan, 2021).

Wildlife corridors, noise barriers, and controlled lighting help mitigate impacts on fauna, as demonstrated by Portugal's Frades II PSH (POWER, 2018). The project further minimized surface disturbance by locating the powerhouse in an underground cavern, thereby reducing its footprint in ecologically sensitive zones. Austria's Limberg II PSH has also shown how environmental impacts can be reduced through design innovations such as underground reservoirs and minimized surface footprints (AFRY, 2022).

3.3.8 Shared planning, shared benefits

Ulla-Førre hydropower complex, Rogaland, Norway

Social impacts can be addressed through participatory planning frameworks, as in Norway's PSH projects, where local municipalities co-develop benefit-sharing plans (Saha, P. and Idso, J. 2016).

Source: Wikipedia, 2025 (photo by Martin NH)

Early disclosure of project plans and inclusion of local wisdom can enhance community ownership (SSNNL, 2023). Infrastructure upgrading such as schools, clinics, and hospitals as part of corporate social responsibility, helps absorb population influxes and reduce pressure on services (IHA, 2019).

In Norway, hydropower developers are mandated to provide concessionary power to host municipalities and pay license fees based on production capacity, ensuring that local governments receive a fair and regulated share of project benefits (Thommessen, 2022). Host municipalities also derive revenue from natural resource and property taxes levied on hydropower assets, which together form a significant source of annual income to support local services and community development priorities (Lund, 2012; Andersen et al., 2022). Furthermore, Norway's regulatory framework emphasizes transparent disclosure, accessible grievance mechanisms, inclusive decision-making, and periodic performance audits throughout the project lifecycle, starting from planning to operation (IHA, 2020a; 2020b).

3.4 Collocating PSH with other productive systems

Collocating pumped storage hydropower (PSH) with wind and solar technologies, as seen in projects like Gaildorf (Germany), Montalegre (Portugal), and Kidston (Australia), enables efficient land use, optimizes renewable energy output, and enhances grid flexibility. Beyond energy benefits, such hybrid systems can generate local employment, improve infrastructure, and offer opportunities for education, tourism, and recreation through thoughtfully designed public access and visitor programs.

3.4.1 Wind-hydro hybrid plant

Source Stainless Steel World

Naturstromspeicher Gaildorf, Gaildorf, Germany

The upper reservoirs beneath the wind towers are interconnected and linked to the lower reservoir through underground penstocks, creating a hydraulic head of 200 meters (Frydrychowicz-Jastrzębska, 2019). This approach offers benefits such as reduced investment costs and faster build times, and the potential for integration with other renewables like solar power alongside wind (HydroWIRES, 2022; IRENA, 2020).

A hybrid wind and PSH plant can be done by building small concrete reservoirs around the foundations of wind turbines positioned on a hill. Together, these reservoirs form a segmented upper reservoir, which connects via conduits to a lower reservoir at the hill's base. This concept was implemented in a pilot project in Gaildorf, Germany, featuring four wind turbines with concrete towers surrounded by concrete reservoirs at their bases. The Gaildorf project includes four 3.4 MW wind turbines (total 13.6 MW) and a 16 MWh closed-loop PSH system.

3.4.2 Floating PV system

Source: French Renewable Energy

Alto Rabagão dam, Montalegre, Portugal

This innovative setup allows the solar panels to generate electricity during the day while conserving hydropower for use during peak evening demand (Carr, 2017). Demonstrating its success, the facility exceeded its initial annual generation target of 300 MWh by approximately 5% in its first year of operation (EDP, 2017). This integration not only optimizes energy production but also adds significant value by balancing supply and demand efficiently (IRENA, 2020).

PSH scheme coupled with a floating PV system in Montalegre, Portugal, is a hybrid PV and hydroelectric dam power plant system has a total capacity of 68 MWh. The dam further enhances its output with an additional 220 kWh from the floating PV installation (Prouvost, 2017).

3.4.3 Wind-solar-hydro hybrid

Kidston hybrid PSH, Kidston, Australia

This innovative design captures surplus solar power during daylight hours and releases it via hydro turbines during peak demand periods in the morning and evening. By supplying on-demand renewable electricity, the project strengthens grid stability and reduces reliance on imported power for PSH operations (IRENA, 2020).

Source:NAIF, 2019

The Kidston hybrid renewable energy project in Australia integrates pumped hydro storage (PSH) with solar PV and a proposed wind system. At its core is a 250 MWh PSH system capable of storing energy for 8-10 hours, complemented by 320 MW of solar PV and 120 MW of wind capacity (Infrastructure Pipeline, 2025; Lannunzio, 2018).

3.4.4 Recreation and educational tours

Raccoon Mountain reservoir, Tennessee, USA

The Raccoon Mountain PSH at Tennessee, USA is another such system with a visitors' centre. It provides access to nearly 30 miles of biking and hiking trails on the dam reservation. They also host annual running events (TVA, 2025). The Cruachan PSH offers visitors guided tours and interactive sessions on the power station operation. They demonstrate the way in which power will be generated well into the future. The Ffestiniog Power Station also has a similar hiking ascent of 3.2 km for visitors to reach the upper reservoir (ENGIE UK, 2025).

Source:Tennessee River Valley Geotourism

The reservoirs can also be developed as tourist destinations, especially when aesthetic design, environmental integration, and public access are thoughtfully planned. This opens that body of water up to recreational activities, such as fishing, boating, kayaking etc (Just Energy, 2023). It can be an educational trip with interactive models and real-time control room displays for school and university groups. For example, Bath County PSH and Goldisthal PSH (Otto-von-Guericke University, 2018; Dominion Energy, 2025).

3.4.5 Co-located renewable energy parks on former mine sites

Source:Energy Matters, 2016

Glenmuckloch Pumped Storage, Gairloch, Scotland

The project aims to restore a former opencast coal mine site. This energy park intends to support local jobs and deliver new investment, through the combination of pumped storage and on-site wind generation (SLR Consulting, 2020)

The Glenmuckloch Pumped Storage project in Scotland, UK, involves a pumped storage hydro scheme upto 400 MW and proposal for a co-located wind farm with eight turbines (SLR Consulting, 2020). The layout uses an upper reservoir on the hillside and a lower reservoir formed within the opencast former mine, minimising new land take by leveraging existing disturbed terrain.

3.5 Integrating nature-based solutions (NbS)

Closed-loop pumped storage hydropower (PSH) systems offer environmentally contained solutions by repurposing inactive mines, integrating water management, supporting aquaculture, and enabling saline or high-density fluid operation to expand site suitability and minimise ecological impact. Enhancing biodiversity through reforestation, habitat restoration, and sustainable land use, along with responsible spoil disposal practices, further strengthens PSH's role in sustainable energy and environmental stewardship.

3.5.1 Reclaiming mines for energy storage

Source: ABC, 2025

Mount Rawdon pumped hydro project, Queensland, Australia

The Mount Rawdon Pumped Hydro Project will repurpose a gold mine and additionally will generate 800 direct jobs during the construction phase and is likely to create 30 to 50 permanent jobs during the operational phase (MRPH, 2024).

Developing a PSH at inactive mines and underground caverns can significantly reduce environmental impacts (Avaada, 2024; REGLCBAL, 2021). For example, the Kidston PSH project in Australia utilises abandoned gold mines as reservoirs, making efficient use of previously disturbed land (ARENA, 2024). Similarly, the Eagle Mountain PSH project in California repurposes a former iron mine, thereby minimising additional ecological disruption (U.S. Environmental Protection Agency, 2011). In another case, the planned closure of the Mt Arthur coal mine by 2030, due to the site reaching the end of its economic viability, includes proposals to explore the development of a pumped storage hydropower (PSH) project at the location, supporting a responsible and sustainable energy transition (IRENA, 2020; BHP, 2025). Other such examples with plans to reuse inactive mines for reservoirs are Pyhäsalmi mine in Finland and a coal mine in Australia to develop the Muswellbrook PSH (ESS News, 2024; DCCEEW, 2025).

3.5.2 Aquaculture integration in PSH reservoirs

Source:Wikiwand

Kulekhani Reservoir, Makwanpur, Nepal

In Nepal's Kulekhani Reservoir, cage fishing has been introduced which is a form of aquaculture where fish are reared in enclosures within natural water bodies such as lakes and reservoirs. This model can be adapted in reservoirs used for PSH projects with further research. This practice utilises the reservoir's natural productivity to support displaced communities, improve food and income security, and maintain ecological balance with minimal external inputs (Pantha, B. 2022).

Establishing an aquaculture system for resilient fishes requires the design of reliable water circulation, the integration of mechanical and biological filtration to remove waste, and the installation of systems for oxygenation and temperature control. Effective water management further involves periodic water changes to reduce nitrate buildup and the use of buffers to stabilize pH and alkalinity. This integrated approach helps maintain a stable and healthy aquatic environment, enabling efficient and sustainable fish farming while minimising water use (Finnforel, 2025).

3.5.3 Integration of biodiversity

Source:Wikipedia, 2025

The Kerry Falls Hydro-Electric project, Gairloch, Scotland

This project promoted sustainable farming practices, such as reduced stocking densities and alternative livestock watering systems, to minimise erosion and nutrient pollution. Monitoring showed reduction in silt and less algal growth, though challenges like peat erosion in forestry areas persisted. By integrating peatland restoration, land-use management, and community engagement, demonstrated how nature-based approaches can enhance water quality and habitat stability for freshwater biodiversity (KerryLIFE, 2022).

The Reventazón Hydroelectric Project (RHP) in Costa Rica adopted reforestation strategies around the reservoir using native vegetation to reduce erosion and sedimentation, thereby enhancing the reservoir's longevity. These measures also helped stabilise slopes and establish ecological corridors, supporting diverse species such as amphibians, reptiles, birds, insects, and mammals. The project further involved local communities through initiatives like environmental education, participatory monitoring, payments for ecosystem services, and agroforestry training (IHA, 2017). For example, farmers learned to confine pigs in certain areas rather than letting them roam freely. This allows the waste to be transformed into fertilizer and biogas, protecting water quality, and reducing the risk of wildlife predation, which in turn helped ease tensions between agricultural and conservation interests (Normyle, A., & Pittock, J. 2019)

The Lanark hydropower facilities operate under a biodiversity action plan and have installed oil interceptor systems to prevent potential oil spills from contaminating nearby water bodies. They also focus on reducing resource consumption and actively minimise and recycle operational waste to lessen environmental impact. Additionally, they collaborate with wildlife trusts to carry out ecological surveys and support conservation efforts (ScottishPower, 2011).

The Kerry Falls Hydro-Electric project sought to conserve the endangered freshwater pearl mussel. Key interventions included rewetting degraded peatlands through drain blocking, establishing riparian buffers to filter agricultural runoff, and converting commercial conifer forests to native woodlands to stabilize soils and improve hydrology (KerryLIFE, 2022).

3.5.4 Spoil reuse and management

Loch Kemp storage, Whitebridge, Scotland

The Loch Kemp Storage pumped storage hydropower (PSH) scheme primarily produces spoil composed of granitic rock and peat. The project targets reusing 82% of the excavated material, with typical applications including backfilling, structural slope stabilisation, concrete production, and landscaping.

Source: Statera Energy, 2025

Spoil disposal is essential in construction projects due to regulatory compliance, environmental protection, and safety requirements. Excavated materials, if improperly managed, can cause soil erosion, water pollution, and habitat destruction, while also posing risks through acid rock drainage and contamination (AlSyed Construction, 2024; Designing Buildings, 2023).

3.6 Innovations to reduce PSH impact

Newer approaches like seawater-based and high-density fluid PSH offer innovative ways to reduce land and freshwater use while expanding site flexibility. These systems enable compact, low-head designs but also require careful management of corrosion, fluid handling, and equipment wear. Alongside these, advances in high-efficiency turbines, smart controls, and real-time environmental monitoring help lower energy losses and minimise ecological impacts. Combined with battery storage integration, thorough assessments, and community benefit-sharing, these technologies make PSH cleaner, more flexible, and socially responsible.

3.6.1 Seawater-based PSH systems

Yanbaru PSH, Okinawa, Japan

Between 1999 and 2016, J-Power in Japan ran the 30 MW Yanbaru PSH plant in Okinawa, which stored energy by pumping seawater from the Philippine Sea up to a reservoir located 450 feet above sea level. To safeguard local groundwater from contamination, the 460-acre-foot upper reservoir was sealed with an impermeable liner (Southwest Research Institute, EPCM Holdings).

Source:LinkedIn, 2025

Using saline water to fill and run a PSH unit may be another alternative to fresh water. While seawater poses a risk of corrosion to the penstock, this can be addressed by constructing it with fibre-reinforced plastic, and using austenitic stainless steel for components in direct contact with rapidly flowing seawater (Southwest Research Institute, EPCM Holdings).

3.6.2 High-density fluid PSH

RheEnergise Ltd., a startup with operations in the UK and Canada, relies on a specialized high-density fluid instead of water for its closed loop PSH system. The primary advantage of using a denser fluid is that it enables the same power output from a much smaller system, reducing space requirements, environmental impact and costs. Compared to traditional PSH plants using water, high-density fluid PSH can deliver equivalent power at a lower hydraulic head and with less turbine flow, meaning the upper and lower reservoirs can be significantly smaller while still storing the same amount of energy (Crosher, 2021). Using high-density fluid allows for smaller penstocks, conduits, and reversible pump-turbines. Because of its low head height, this technology could work in many more locations than traditional PSH, and it doesn't require proximity to water sources, since the system uses manufactured fluid instead of natural water (HydroWIRES, 2022).

The startup asserts that standard PSH reversible pump-turbines designed for water can operate with high-density fluids without needing special redesigns. However, despite the fluid's relatively low viscosity, it is still higher than water's, which could lead to increased abrasion, cavitation, and faster wear of hydraulic components, potentially raising maintenance costs compared to conventional PSH. Additionally, the system needs specialized fluid management, which could add complexity and expenses (HydroWIRES, 2022).

3.7 Summary of challenges and possible solutions

The development of pumped storage hydropower (PSH) in India faces a range of technical, environmental, and socio-economic barriers that slow its large-scale deployment. This section summarizes the key challenges encountered across different aspects of PSH projects and outlines potential solutions to mitigate them, improve project viability, and ensure sustainable implementation.

Table 9 Summary of challenges and possible solutions.

Category	Challenges	Solution
Protected areas and site constraints	Many PSH sites overlap with protected zones (e.g., national parks, wildlife sanctuaries), leading to complex and lengthy approvals.	Focus on degraded land or abandoned quarries (e.g., Tehri PSH, Eagle Mountain PSH USA). Use early-stage screening tools like GIS to map the location and plan NbS during project development.
Financial and market risks	High capital costs, long development timelines, and competition from cheaper and faster BESS. Shorter deployment of BESS	Provide viability gap funding, tax reduction, grid priority, competitive tariffs and long-term power purchase agreements.
Environmental and forest clearances	Multiple layers of clearance and public hearings cause project delays.	Use degraded land, low-impact design approaches, streamlined approval processes, and plans for compensatory afforestation to reduce project delays. Since 2018, the PARIVESH portal has improved the efficiency of obtaining clearances. Have a government body which finishes all the clearances and floats the tender for bidding
Centralised testing and technical clearances	Design, safety and material approvals require central testing, causing logistical delays and backlogs.	Decentralize routine clearances to regional offices, standardise approval guidelines, predefine timelines to help streamline technical evaluations.
Land acquisition, resettlement, and local opposition	Acquiring land and relocating communities is slow and contentious, with frequent protests and legal challenges.	Engage communities early. Fair compensation and share project benefits. Prefer government sites.
Geological, infrastructure, and weather challenges	Difficult terrain, seismic risks, poor site accessibility, landslides extend construction timelines.	Geotechnical surveys, prefer sites with access to road and grid, resilient designs, modular construction techniques.
Environmental impacts	Habitat disruption, loss of forest cover, water quality issues, and effect on local biodiversity	Manage slopes and erosion using NbS like reforestation and biodiversity corridors.
Social impacts	Projects can displace people, strain local services from the influx of construction workers, and affect cultural and scenic values.	Conduct thorough social impact assessments, ensure fair compensation, provide alternative livelihoods, and implement community benefit-sharing programs. Early engagement and participatory planning help build trust and support for the project.
Water quality challenges	Stagnation, algal growth, concentration of pollutants or minerals. These can reduce the life of the turbines.	Regular water quality monitoring, periodic flushing or treatment, and careful reservoir design

04 Results

This section presents a comprehensive assessment of Tamil Nadu's closed-loop pumped storage hydropower (PSH) potential, based on detailed analysis of reservoir capacities across the state. The findings highlight both the concentration and geographic patterns of storage capacity, emphasizing the dominance of a few large-capacity reservoir pairs and the critical role of the Western and Eastern Ghats in shaping the state's PSH landscape.

4.1 Reservoir capacity results

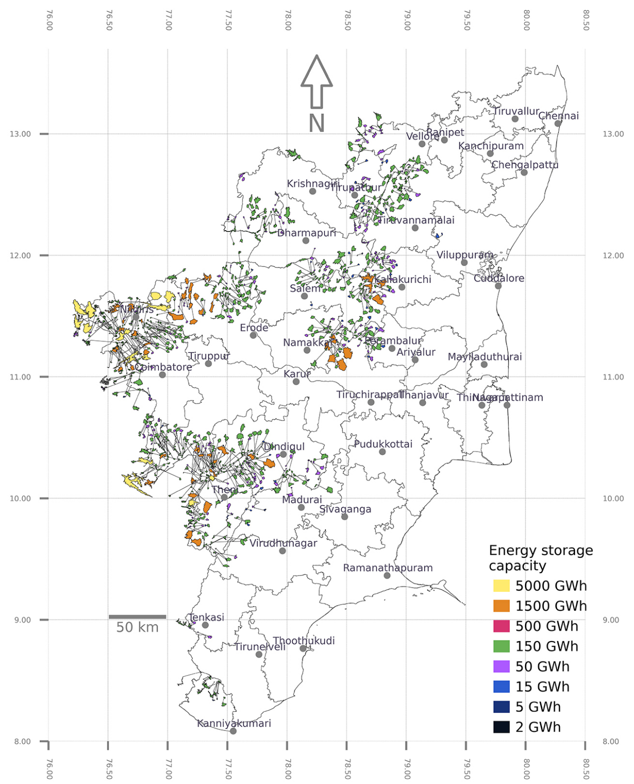
Tamil Nadu's closed-loop PSH potential is estimated at 1,32,386 GWh, derived from 572 non-overlapping reservoir pairs. Table 11 presents the distribution of potential across different storage capacity ranges. The 150 GWh category contributes the largest share, with a cumulative potential of 44,400 GWh, accounting for about 33.5 % of the state's total storage capacity. Although large-capacity sites (≥ 500 GWh) are fewer in number, they collectively represent over 60 % of the total potential. In contrast, smaller-capacity sites (≤ 50 GWh) contribute less than 6 %. The lowest contribution comes from the 2 GWh category, with only 16 GWh of total capacity. Notably, there are no standalone 500 GWh reservoirs in the state that do not overlap with larger reservoir systems.

Table 10 Pumped hydro storage distribution by sizes

PSH potential categories (GWh)	Count of reservoir pairs (Nos)	Cumulative energy capacity (GWh)
5,000	8	40,000
1,500	27	40,500
500	0	0
150	296	44,400
50	123	6,150
15	77	1,155
5	33	165
2	8	16
Total	**572**	**1,32,386**

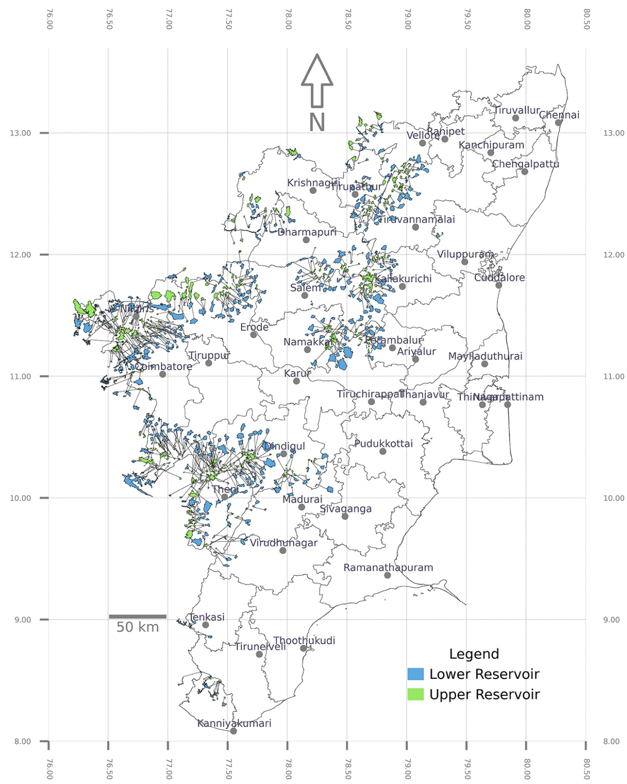
Figure 10 illustrates the distribution of various sizes of closed-loop PSH potential across Tamil Nadu based on non-overlapping reservoirs. Figure 11 shows the spatial distribution of upper and lower reservoirs in the state. Most potential PSH sites are located along the Western and Eastern Ghats. Districts, particularly Nilgiris, Coimbatore, Erode, Dindigul and Theni contain the highest concentration of reservoirs in the state.

Figure 10 Distribution of potential PSH capacities.



Note - Some reservoirs lie fully or partially outside the state boundary

Figure 11 Distribution of the upper and lower reservoirs



Note - Some reservoirs lie fully or partially outside the state boundary

Significant PSH potential is also observed in the northern and central hill regions, such as the Shevaroy and Javadi hills of the Eastern Ghats. In the far south, the Kanyakumari district also presents some opportunities for PSH development due to the extension of the Western Ghats within its boundaries. The presence of ancient Precambrian basement rocks such as gneiss, charnockite, and granite provides strong and stable foundations for dams, tunnels, and caverns, making these regions geologically favourable for PSH projects (Department of Geology and Mining, n.d; Yuvaraj & Dolui, 2023).

In contrast, the regions between the Ghats are largely composed of upland plateaus and gently undulating Deccan plains, offering limited scope for reservoir development. The central and south-central plains, along with the low-lying eastern coastal areas, have few natural reservoirs due to their flat terrain and coastal proximity, resulting in minimal PSH potential. The northern plains and coastal districts such as Chennai, Cuddalore, and Nagapattinam also show little to no potential, while Dindigul, Salem, and Tiruppur exhibit moderate potential for PSH development.

4.2 High RE districts and their PSH potential

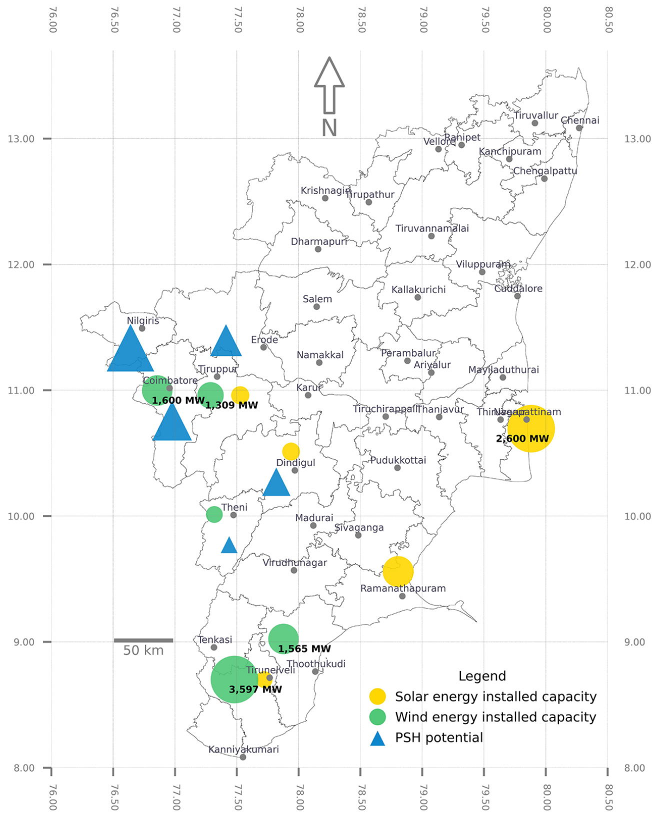
Closed-loop pumped storage hydropower (PSH) potential is unevenly distributed across Tamil Nadu, primarily because suitable sites must meet strict technical criteria such as steep slopes, significant elevation differences, and adequate reservoir capacity. These conditions are typically found in hilly or mountainous regions. Similarly, the actual installed capacities of wind and solar power plants vary widely among districts. Locating PSH facilities close to major renewable energy generation hubs can offer substantial advantages for grid management, particularly by alleviating transmission constraints and improving overall energy stability.

Figure 12 illustrates the spatial distribution of top 5 districts in terms of their installed renewable energy capacity (wind and solar capacity combined) and their respective PSH potential as well as the top 5 PSH potential districts. The varying marker sizes indicate the relative magnitudes of their respective energy capacities.

Table 11 Top 5 districts with the highest installed intermittent renewable energy capacity and PSH potential.

District	Solar capacity (MW)	Wind capacity (MW)	Total RE capacity (MW)	PSH potential (GWh)
Tirunelveli	42	3,555	3,597	0
Nagapattinam	2,600	0	2,600	0
Coimbatore	36	1,564	1,600	34,456
Thoothukudi	10	1,556	1,566	0
Tiruppur	104	1,206	1,310	7,870
Ramanathapuram	923	17	940	0
Theni	0	587	587	13,005
Dindigul	89	280	368	21,685
The Nilgiris	0	0	0	45,950
Erode	2	0	2	25,340

Figure 12 Top 5 districts with clusters of highest installed solar and wind energy capacity and PSH potential



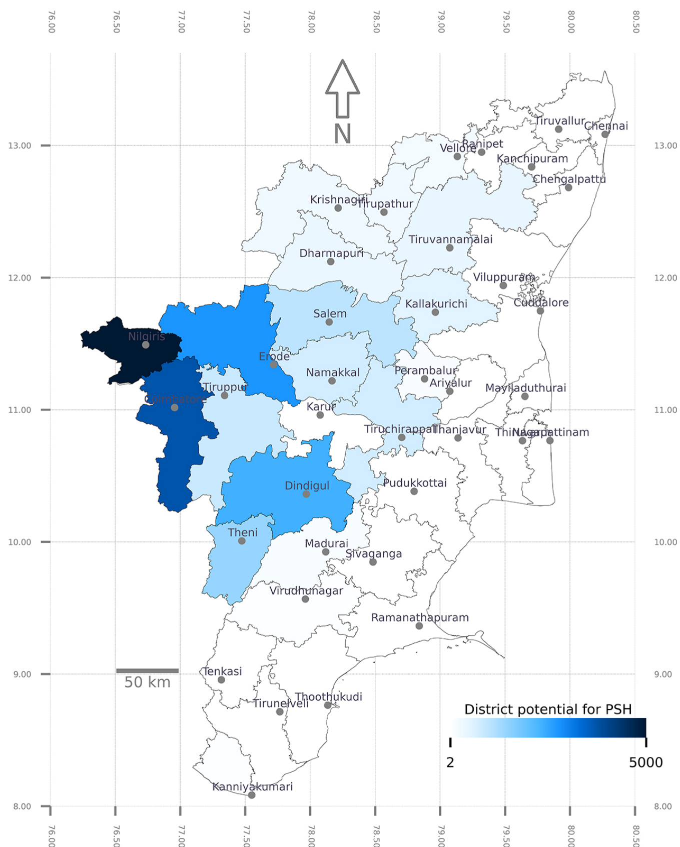
There is a spatial clustering of renewable energy installations and PSH potential along the southern and western parts of the state. Nagapattinam leads in installed solar capacity with 2,600 MW, followed by Ramanathapuram with 923 MW and Tiruppur with 104 MW. Wind installations are concentrated in the western and southern districts, with Tirunelveli having 3,555 MW, Coimbatore with 1,564 MW, and Thoothukudi with 1,556 MW installed capacity forming the dominant wind corridors (Space Applications Centre, 2023).

The district-wise PSH potential from Figure 13 shows strong correspondence with topographic regions of the Western Ghats, particularly in The Nilgiris, which exhibits the highest potential of 45,950 GWh, followed by Coimbatore having 34,456 GWh, Erode having 25,340 GWh, then Dindigul with 21,685 GWh and Theni with 13,005 GWh. These high values coincide with the presence of steep elevation gradients, which are suitable for PSH development. Large solar and wind resources are primarily distributed in the plains and coastal districts, while the most significant PSH opportunities lie in the hilly western regions.

Table 12 District wise PSH potential in descending order.

District	PSH potential (GWh)
The Nilgiris	45,950
Coimbatore	34,456
Erode	25,340
Dindigul	21,685
Theni	13,005
Salem	9,195
Tiruppur	7,870
Tiruchirapalli	6,877
Namakkal	6,735
Kallakurichi	4,914
Thiruvannamalai	3,852
Dharmapuri	3,300
Tirupattur	2,707
Krishnagiri	2,700
Vellore	1,865
Madurai	1,400
Perambalur	1,095
Kanniyakumari	697
Virudhunagar	665
Tenkasi	255
Villupuram	15
Tirunelveli	0
Thoothukudi	0
Ramanathapuram	0
Thanjavur	0
Kancheepuram	0
Ariyalur	0
Tiruvallur	0
Karur	0
Chennai	0
Chengalpattu	0
Cuddalore	0
Mayiladuthurai	0
Nagapattinam	0
Pudukkottai	0
Ranipet	0
Sivagangai	0
Tiruvarur	0

Figure 13 District potential for PSH in GWh.



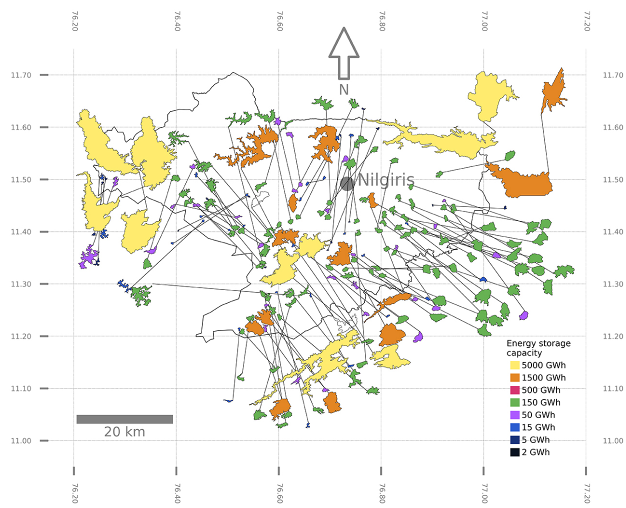
Locating PSH projects near major solar and wind hubs enables efficient use of surplus renewable generation, reducing curtailment and providing reliable power during peak demand (IRENA, 2020). Close proximity to RE clusters and industrial corridors also allows shared grid connections, faster system response, and reduced transmission losses and congestion (IHA, 2025; GE Vernova; NACAA). Additionally, nearby industries such as green hydrogen and clean power projects can directly utilise stored energy, improve off-peak power usage and deliver local economic benefits as capacity expands (Powerline, 2024).

4.2.1 The Nilgiris

The Nilgiris district holds the highest potential for pumped storage hydropower (PSH) in Tamil Nadu, with an estimated capacity of 45,950 GWh. The Western Ghats in this region range from about 900 to 2,600 meters above sea level. These high mountain blocks create steep elevation differences over short distances, making the area highly suitable for PSH development. However, the combination of heavy monsoon rainfall and steep slopes increases the risk of landslides (CGWB, 2008; National Water Mission, n.d; District Administration, n.d). Feasibility studies in the Nilgiris must include careful site selection, strict environmental safeguards, and detailed impact assessments. The presence of sensitive highland ecosystems, Mudumalai Wildlife Sanctuary, Mukurthi National Park, Sathyamangalam Wildlife Sanctuary and extensive tea estates further limits construction footprints and calls for strong environmental management and stakeholder engagement (Yuvaraj & Dolui, 2023).

The district's terrain is largely rolling and steep, with much of the Western Ghats spread across it, hosting a high concentration of reservoirs. Many of these reservoirs lie within reserve forest areas. Notably, Nilgiris has the largest number of 5,000 GWh storage-capacity PSH pairs, five in total, and several additional sites with 1,500 GWh and 150 GWh storage capacities. There are PSHs planned in Nilgiris, such as the Sillahalla PSH with a capacity of 1,000 MWh for 6 hours and the Upper Bhavani with a capacity of 1.000 MWh (Energy Department, 2025).

Figure 14 Distribution of potential PSH capacity in the Nilgiris.



Note - Some reservoirs lie fully or partially outside the district boundary

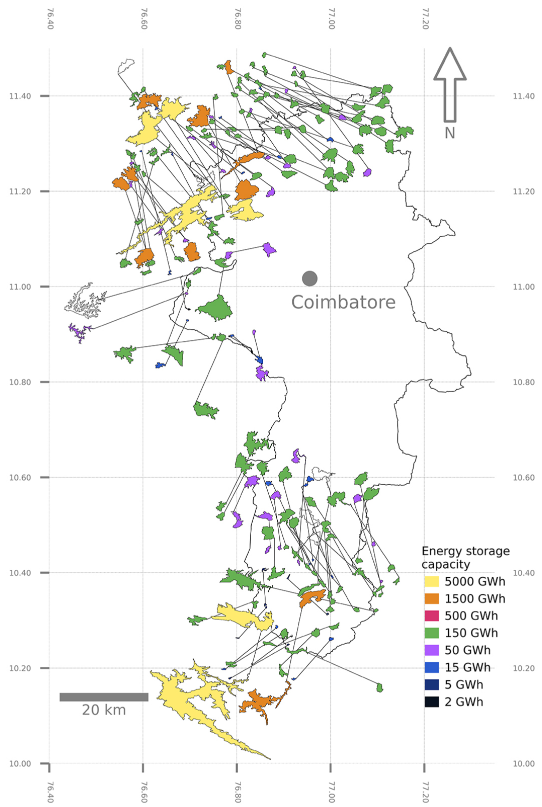
4.2.2 Coimbatore

The district has the second-highest pumped storage hydropower (PSH) potential in Tamil Nadu, estimated at 34,456 GWh. Located along the Noyyal River, the district is bordered on three sides by the Western Ghats, with rugged hill ranges to the west, northwest, and south, and gently sloping plains to the east (Coimbatore District Mineral Foundation Trust, 2025). The Palghat Gap, a key mountain pass, shapes both local climate and drainage. Elevations range between 400 to 600 m across the plateau near the city to over 2,500 m in the Nilgiri and Anaimalai ranges, creating sharp elevation gradients suitable for PSH development (CGWB, 2008).

Forests in the district are dominated by teak, sandalwood, rosewood, and bamboo, and support diverse wildlife including elephants, tigers, leopards, Indian bison, Nilgiri tahr, and sloth bears (Topographic Map, n.d). The south-west monsoon, channelled through the Palghat Gap, low mountain pass, brings rainfall between June and August, followed by the north-east monsoon from October to early November. The district receives an average annual rainfall of about 600 mm, with the two monsoons contributing roughly 28% and 47%, respectively (Coimbatore District Mineral Foundation Trust, 2025). Major rivers include the Bhavani, Noyyal, Amaravathi, and Aliyar, while Siruvani provides high-quality drinking water from the western hills (Ideal Habitats, n.d).

Coimbatore contains several high-capacity PSH pairs of around 5,000 GWh, along with multiple sites offering 1,500 GWh and 150 GWh potential. Sites around 150 GWh are the most numerous, as illustrated in Figure 15.

Figure 15 Distribution of potential PSH capacity in Coimbatore

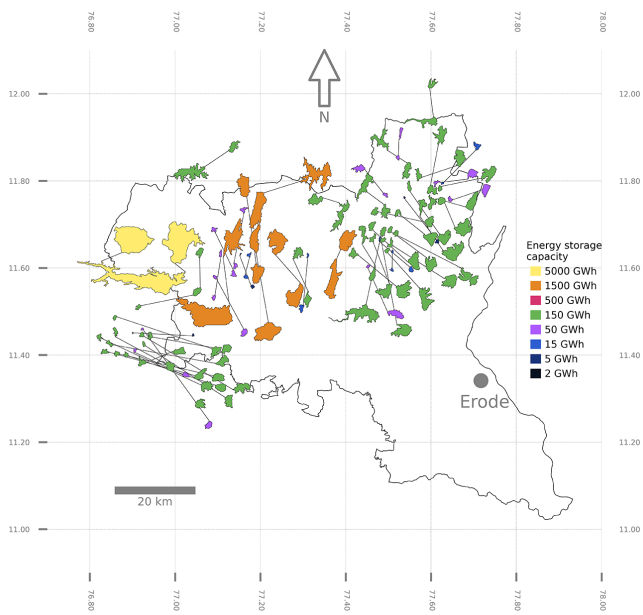


Note - Some reservoirs lie fully or partially outside the district boundary

4.2.3 Erode

Erode district in Tamil Nadu shows the third highest potential for pumped storage hydropower (PSH), with an estimated capacity of 25,340 GWh. Geographically, the district lies between the Western and Eastern Ghats, separated by the Moyar River. The terrain gradually slopes from the highlands in the north to gently rolling plains in the south (Topographic Map, n.d). As shown in Figure 5, most reservoirs are concentrated in the northern part of the district. The Bhavani River runs west to east through the centre, feeding major dams such as Bhavanisagar. Other important rivers, like the Noyyal and Amaravati, originate in the western hills and join the Kaveri River downstream (Topographic Map, n.d). Several identified reservoirs are located within reserve forest areas. Erode also features a notable number of reservoirs with 150 GWh storage capacity, along with larger ones reaching up to 1,500 GWh and 5,000 GWh.

Figure 16 Distribution of potential PSH capacity in Erode.

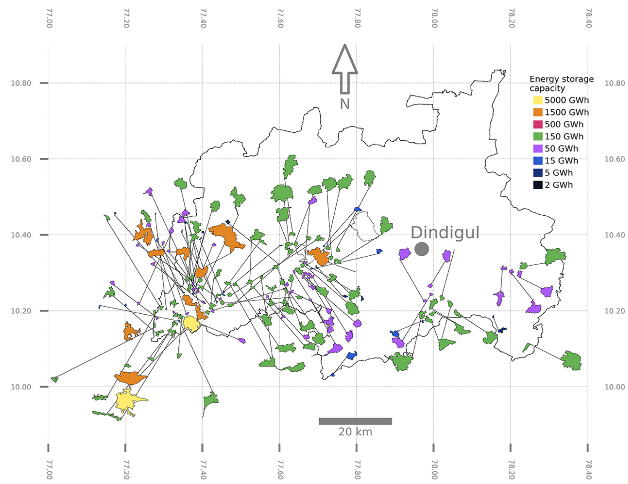


Note - Some reservoirs lie fully or partially outside the state boundary

4.2.4 Dindigul

Dindigul district holds the fourth-highest potential for pumped storage hydropower (PSH) in Tamil Nadu, with an estimated capacity of 21,685 GWh. The district includes the Palani, Kodaikanal, and Natham hills, parts of the Western Ghats, where most reservoirs are located. There is also the Kodaikanal Wildlife Sanctuary and Kasampatty sacred grove, which has been declared a biodiversity heritage site in Tamil Nadu. These areas feature steep hill ranges (Palani, Kodaikanal, and Sirumalai) surrounded by piedmont zones and plains (CGWB, 2008), making the terrain highly suitable for PSH development. The land's sharp elevation drop from high hills to broad plains naturally supports the construction of upper and lower reservoirs, enabling efficient water flow and energy generation (National Water Mission, n.d). Several reservoirs are situated within reserve forest areas. Dindigul also contains many 150 GWh storage reservoirs, along with larger sites of 1,500 GWh and one reservoir pair with a 5,000 GWh storage capacity.

Figure 17 Distribution of the potential PSH capacity in Dindigul.

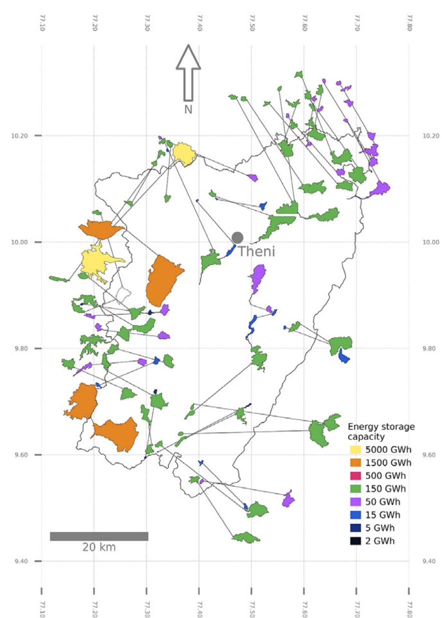


Note - Some reservoirs lie fully or partially outside the state boundary

4.2.4 Theni

Theni district ranks fifth in Tamil Nadu for pumped storage hydropower (PSH) potential, with an estimated capacity of 13,005 GWh. The terrain rises from 105 m to 2,632 m (average 735 m) and is drained by the Vaigai, Kottagudi, Suruliyar, Varaganathi, Manjalar, and Varattaru rivers (Topographic Map, n.d). Major reservoirs include Vaigai, Manjalaru, Sothuparai, Sanmughanathi, Manalaru, and Melmanalaru dams, supported by hydropower stations at Periyar, Suruliyar, and Vaigai (Department of Geology and Mining, n.d). Originating in the Western Ghats near Gandamanayakanur, the Vaigai River and its tributaries form a dendritic, eastward-draining network (Department of Geology and Mining, n.d). The district features red gravelly soils with patches of red loamy, black, and brown soils. The district also hosts diverse tropical forests, including the Megamalai Wildlife Sanctuary, home to a rich biodiversity and the Paliyar tribal community (Department of Geology and Mining, n.d). Figure 18 illustrates the distribution of PSH potential across Theni district, showing one 5,000 GWh reservoir pair, two 1,500 GWh pairs, and several 150 GWh reservoir pairs.

Figure 18 Distribution of the potential PSH capacity in Theni.



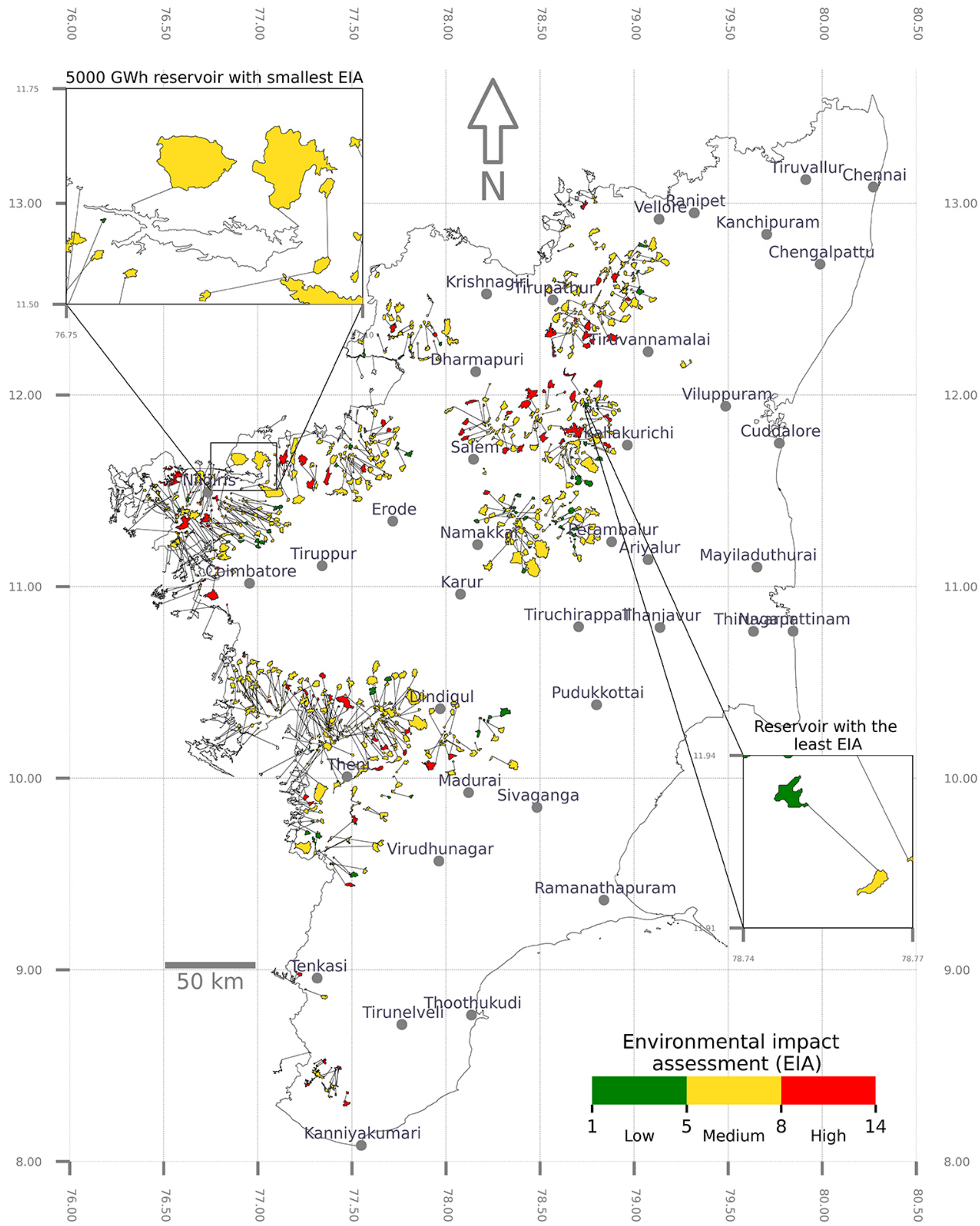
Note - Some reservoirs lie fully or partially outside the state boundary

4.3 Environmental Impact Assessment (EIA)

The EIA parameters include displaced flora and fauna, vicinity to legally protected sites, settlements, transmission lines, roads and railways, heritage sites, landcover categories such as cropland, treecover, waterbodies and unused land, as well as air quality, runoff and seismicity. The total number of common unused lands identified in Tamil Nadu from 2019 and 2023 sums up to 23,816 km^2 (58,85,057 acres).

Figure 19 shows that most reservoirs have a medium environmental impact, followed by a smaller number with high impact, while a few exhibits low impact.

Figure 19 Identified PSH reservoirs with their EIA.



Note - Some reservoirs lie fully or partially outside the state boundary

The EIA results are summarised in table 14. The EIA score of upper and lower reservoirs shows that 58 pairs score an EIA value of 6 for both the reservoirs, whereas 59 pairs have an upper reservoir with an EIA score of 6 and a lower reservoir with a score of 7. Only one pair has an EIA score of 10. There is no reservoir pair with an EIA score exceeding 10. Reservoirs within an EIA score in the range of 0-5 are considered low-impact options. Whereas the reservoirs within the range of 5-8 have a moderate impact, and 8-14 will have a high impact on the environment. This distribution is asymmetrical, showing a distinct tendency for the lower reservoir in a pair to have a slightly higher EIA score than its corresponding upper reservoir. Possibly due to the lower reservoirs having more settlements, waterbodies and agricultural lands.

Table 13 EIA score of the upper and lower reservoir pairs.

Upper reservoir EIA score

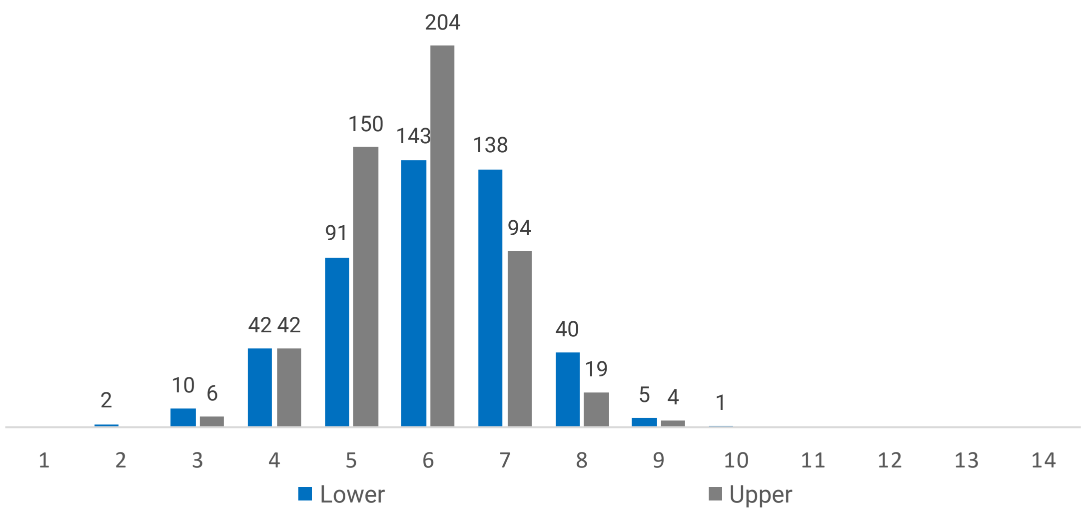
Lower reservoir EIA score	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	3	3	2	0	0	0	0	0	0	0
4	0	0	0	4	15	16	5	0	0	0	0	0	0	0
5	0	0	1	7	23	28	19	8	1	0	0	0	0	0
6	0	0	3	9	40	58	30	0	0	0	0	0	0	0
7	0	0	0	8	40	59	21	5	1	0	0	0	0	0
8	0	0	0	2	10	10	9	3	2	0	0	0	0	0
9	0	0	0	0	2	2	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0

LOW IMPACT

HIGH IMPACT

Figure 20 below shows the distribution of the upper and lower reservoirs based on the EIA score. The chart shows that 75% of all identified reservoirs have an EIA score in the range of 5 to 7. This bell curve illustrates that 75% of all identified reservoirs have an EIA score in the range of 5 to 7. The peak of the curve shows the most frequent value where the majority of data points are concentrated. As you move away from the centre towards either tail, the probability of occurrence decreases.

Figure 20: Distribution of upper and lower reservoirs based on EIA score.



05 Recommendations and conclusion

Pumped Storage Hydropower (PSH) is rapidly emerging as an essential solution for Tamil Nadu's clean energy transition, ensuring grid reliability and resilience alongside rapidly growing solar and wind capacity. This chapter summarises actionable recommendations drawn from a detailed geospatial assessment of PSH site opportunities, emphasizing how strategic classification, targeted site selection, and modern implementation models can unlock scalable, cost-effective storage across the state.

Classification and functional importance of PSH sites
Large capacity (≥ 500 GWh) sites are rare but can be considered national infrastructure assets, essential for grid balancing and long-duration energy storage. Moderate-capacity sites (≥ 50 GWh) are more common and practical, offering strong potential for distributed storage. These sites are well-suited for daily peak shaving and integrating intermittent renewable energy. Smaller-capacity sites (≤ 15 GWh), on the other hand, can enhance localised grid stability or support decentralised microgrid systems, providing reliable power to remote communities.

Co-location of PSH with solar and wind for grid efficiency
The key benefits of having a storage unit closer to the generation of variable renewable energy are:

- Co-located PSH acts as behind-the-meter storage, charging from nearby variable renewable energy output to minimise curtailment and shift energy to peak demand periods (IRENA, 2020).
- Avoiding long-haul transfers eases grid congestion and reduces transmission upgrade requirements (IRENA, 2020).
- Co-location leverage existing grid connections and related infrastructure, improving utilization and reducing costs (IRENA, 2020). PSH provides fast ramping, frequency regulation, and reactive power services most effective when delivered close to VRE sources (GE Vernova, 2022).

Enabling targeted PSH site selection and scaling
The report emphasizes the need for a geospatial, multi-criteria approach to identify suitable PSH sites in Tamil Nadu by integrating technical, environmental, and socio-economic parameters. It recommends using GIS and advanced remote sensing tools to map and prioritize reservoir pairs that minimise ecological and social conflicts, aligning with Tamil Nadu's SDG and climate objectives. Additionally, some reservoirs located near urban centres could generate local employment opportunities, contributing to regional socio-economic development. However, the findings require validation through detailed ground-truthing, comprehensive environmental impact assessments (EIA), and meaningful consultation with local communities before any project implementation.

State entity for clearances and tendering fully permitted sites
To overcome fragmented oversight and regulatory delays, the report recommends establishing a dedicated state-level agency to manage project clearances, coordinate across departments, and centrally tender sites that have already undergone technical and environmental due diligence. This approach would enable faster, parallel development of multiple pre-vetted projects

Policies for co-located renewables, biodiversity, and safeguards
The report highlights the importance of designing PSH sites that support hybrid renewable clusters (e.g., solar + hydro) to make better use of land and enhance economic value, as demonstrated by projects like Australia's Kidston PSH-Solar hybrid. Every project should include a clear biodiversity management plan, strong upfront environmental safeguards to avoid protected areas and sensitive habitats, and the integration of nature-based solutions. Ecological impacts can be further reduced through innovative design approaches and the use of sustainable construction materials.

Future work
A financial modelling for PSH projects could directly connect site selection with project bankability, power offtake, and procurement to ensure only viable sites progress (MoP, 2023b). Each potential site can be given a bankability score based on key factors such as capital costs and operational performance, such as storage duration and efficiency.

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Annexure I

Table 14 Key terms

Term	Description
Accessibility	Refers to the roads and railway lines within the district.
Ancillary services	Capacity and energy services (e.g., non-spinning operating reserve, frequency support, voltage support) provided by power plants that are able to respond on short notice, such as hydropower plants, and are used to ensure stable electricity delivery and optimised grid reliability. Also called grid services.
Baseload	Minimum energy demand on a given electrical power system over a specific period of time.
Biodiversity	The variety of life in the world or in a particular habitat or ecosystem.
Built-up	Land covered by buildings. Buildings include both residential and industrial building.
Bulk power	Power from generation facilities necessary to maintain reliability of the transmission system.
Closed-loop	Consists of two reservoirs that are not connected to naturally flowing sources of water.
Competing use	The suitability of unused lands for other purposes, such as water harvesting, forestation, industrialisation, housing, agriculture, and solar development.
Cropland	The annual cropland produces a herbaceous cover and is sometimes combined with some tree or woody vegetation. Note that perennial woody crops will be classified as the appropriate tree cover or shrub land cover type. Greenhouses are considered as built-up.
Distributed generation	Small, grid-connected energy generation systems located close to the load they serve.
Electrical demand	Rate at which electricity is being consumed at a given instant or averaged over a specified period of time.
Electricity generation	The amount of electricity a generator produces during a specific period of time.
Elevation	Elevation is often used as a criterion, which considers the height of the area of interest relative to the highest point of the watershed it is in. Ex: lands with elevation > 0.7 are lands that lie above 70% of the region's watershed elevation, and lands with elevation < 0.3 are lands that lie below 30% of the region's watershed elevation. Elevation of lands are also provided in terms of their height in meters from mean-sea-level.
Evacuation infrastructure	Includes transmission lines and substations. The nearest distance to either is considered.
High potential	A sub-category of technical potential criteria that ensure the most preferable conditions based on the purpose of the evaluation. The criteria vary based on the type of assessment.
Hydraulic head	A measure of liquid pressure, expressed in terms of the height of a column of water, which represents the total energy of the water.
Hydropower	The harnessing of flowing water—using a dam or other type of diversion structure—to create energy that can be captured via a turbine to generate electricity. Also called hydroelectric power.
Land use	The LiLa algorithm identifies 6 categories of land use: unused/barren, sparse vegetation, cropland, tree cover, water and built-up. Land is recognized under each of these categories by the algorithm based on the pixel properties obtained through satellite imagery.
Load	The amount of electrical power delivered or required at any specific point or points on a system.
Load shifting	Ability of a hydropower plant to adjust its power output as electricity demand changes throughout the day.

Low potential	A sub-category of technical potential criteria. This is a minimum criterion.
Medium potential	A sub-category of technical potential criteria, satisfying a higher number of criteria than 'low'. The criteria very based on the type of assessment.
Peaking	Operating mode in which power is produced only during periods of peak demand.
Penetration	Fraction of energy produced by select generating sources (such as wind and solar) compared with total generation.
Power	The rate of production or consumption of energy; electric power is the rate at which electrical energy is transferred by an electric circuit.
Powerhouse	The structure that houses generators and turbines at a hydropower facility.
Protected areas	These are areas allocated for reserve forests and other such classified lands.
Pumped storage hydropower (PSH):	Type of hydropower project where energy can be stored and generated by moving water between two reservoirs of differing elevations.
Ramp rate	Rate at which flows from the powerhouse into the tailwater and downstream into the natural waterway are increased or decreased.
Ramping capability	Ability of a power station to change its output over time.
Roads	Different types of pathways are recognized as roads, including highways, primary, secondary, tertiary and residential roads. The roads included in this analysis consider those sufficient to allow mini-trucks to pass.
Seclusion	The distance from populated areas.
Sparse Vegetation	Includes scrubs, grassland and sparse vegetation. Land covered with annual cropland that is sowed/planted and harvestable at least once within the 12 months after the sowing/ planting date.
Storage	The storing of water in a reservoir during periods of high inflow that can be used later to generate electricity.
Theoretical potential	A set of criteria that characterizes unused lands that have a basic potential depending on the purpose of evaluation. The criteria vary based on the type of assessment.
Transmission	Conveyance of electrical energy from generation facilities to local distribution systems.
Treecover	This class includes any geographic area dominated by trees with a cover of 10% or more. Other land cover classes (shrubs and/or herbs in the understorey, built-up, permanent water bodies, …) can be present below the canopy, even with a density higher than trees. Areas planted with trees for afforestation purposes and plantations (e.g. oil palm, olive trees) are included in this class. This class also includes tree covered areas seasonally or permanently flooded with fresh water.
Unused Lands	Lands that have been unused throughout the year (in terms of cultivation/built-up/ water/trees) and does not belong to any of the other categories, and could be in barren condition sometimes.
Forest diversion	process of converting forest land for non-forest purposes, such as infrastructure development, mining, or agriculture
Open-loop	Consists of two reservoirs that are connected to naturally flowing sources of water.
Public private partnership	The collaboration between a government agency and a private-sector company to finance, build, and operate large projects
Viability gap funding	Financial support to partially fund the development.

Annexure II

Table 15 Status of PSH in India.

Name	Status	Commissioning year	State	Capacity (MW)
Nagarjuna Sagar	Operational	1985	Telangana	705.6
Srisailam LBPH	Operational	2003	Telangana	900
Kadamparai	Operational	1989	Tamil Nadu	400
Bhira	Operational	1995	Maharashtra	150
Ghatgar	Operational	2008	Maharashtra	250
Purulia	Operational	2007	West Bengal	900
Kadana	Operational	1998	Gujarat	240
Sardar Sarovar Project	Operational	2006	Gujarat	1,200
Tehri PHP	Operational	2025	Uttarakhand	1,000
Kundah (Stg I,II,III, IV)	Under Construction	December 2025 (likely)	Tamil Nadu	500
Upper Sileru	Under Construction	February 2029 (likely)	Andhra Pradesh	1,350
Sharavathy	Under Construction	December 2029 (likely)	Karnataka	2,000
Turga	DPR concurred by CEA	N/A	West Bengal	1,000
Bhavali	DPR concurred by CEA	N/A	Maharashtra	1,500
Indira Sagar	Under Survey & Investigation	N/A	Madhya Pradesh	640
Pinnapuram	Under Construction	N/A	Andhra Pradesh	1,200
MP30 Gandhisagar	Under Construction	N/A	Madhya Pradesh	1,920
Upper Indravati	DPR concurred by CEA	N/A	Odisha	600
Bhivpuri	DPR concurred by CEA	N/A	Maharashtra	1,000
Narihalla	Under Survey & Investigation	N/A	Karnataka	300
Saundatti	Under Survey & Investigation	N/A	Karnataka	1,600
Gandikota	Under Survey & Investigation	N/A	Andhra Pradesh	1,000
OWK	Under Survey & Investigation	N/A	Andhra Pradesh	800
Chitravathi	Under Survey & Investigation	N/A	Andhra Pradesh	500
Tarali	Under Survey & Investigation	N/A	Maharashtra	1,500
Shirwata	Under Survey & Investigation	N/A	Maharashtra	1,800
Somasila	Under Survey & Investigation	N/A	Andhra Pradesh	900
Paidipalem East	Under Survey & Investigation	N/A	Andhra Pradesh	1,200
Singanamala	Under Survey & Investigation	N/A	Andhra Pradesh	800
Sukhpura Off-Stream	Under Survey & Investigation	N/A	Rajasthan	2,560
Paidipalem North	Under Survey & Investigation	N/A	Andhra Pradesh	1,000
Shahpur	Under Survey & Investigation	N/A	Rajasthan	1,800
Sirohi	Under Survey & Investigation	N/A	Rajasthan	1,200
Pane	Under Survey & Investigation	N/A	Maharashtra	1,500
Veeraballi Off-stream	Under Survey & Investigation	N/A	Andhra Pradesh	1,800
Vempalli	Under Survey & Investigation	N/A	Andhra Pradesh	1,500
Kandhaura	Under Survey & Investigation	N/A	Uttar Pradesh	1,680

UP01	Under Survey & Investigation	N/A	Uttar Pradesh	3,660
Musakhand	Under Survey & Investigation	N/A	Uttar Pradesh	600
Raiwada	Under Survey & Investigation	N/A	Andhra Pradesh	900
Malshej Ghat Bhorande	Under Survey & Investigation	N/A	Maharashtra	1,500
Kamalapadu	Under Survey & Investigation	N/A	Andhra Pradesh	950
Warasgaon warangi	Under Survey & Investigation	N/A	Maharashtra	1,500
Koyna Nivakane	Under Survey & Investigation	N/A	Maharashtra	2,700
Rayavaram	Under Survey & Investigation	N/A	Andhra Pradesh	1,500
Gadikota	Under Survey & Investigation	N/A	Andhra Pradesh	1,200
Nayagaon	Under Survey & Investigation	N/A	Maharashtra	2,000
Shoma	Under Survey & Investigation	N/A	Uttar Pradesh	2,400
Pedakota	Under Survey & Investigation	N/A	Andhra Pradesh	1,800
Jhariya	Under Survey & Investigation	N/A	Uttar Pradesh	1,620
Chichlik	Under Survey & Investigation	N/A	Uttar Pradesh	1,560
Karjat (Saidongar-1)	Under Survey & Investigation	N/A	Maharashtra	3,000
Hasdeo Bango	Under Survey & Investigation	N/A	Chhattisgarh	800
Bilaspur	Under Survey & Investigation	N/A	Chhattisgarh	1,000
Maval (Saidongar-2)	Under Survey & Investigation	N/A	Maharashtra	1,200
Serula	Under Survey & Investigation	N/A	Gujarat	960
Brahmani	Under Survey & Investigation	N/A	Rajasthan	600
Panaura	Under Survey & Investigation	N/A	Uttar Pradesh	1,500
Balimela	Under Survey & Investigation	N/A	Odisha	500
Juni Kayaliwel	Under Survey & Investigation	N/A	Gujarat	300
Amalpada	Under Survey & Investigation	N/A	Gujarat	300
Juni Bavli	Under Survey & Investigation	N/A	Gujarat	450
Satkashi	Under Survey & Investigation	N/A	Gujarat	330
Ukai	Under Survey & Investigation	N/A	Gujarat	1,600
Kamod	Under Survey & Investigation	N/A	Maharashtra	2,000
Aliyar	Under Survey & Investigation	N/A	Tamil Nadu	1,800
Vellimalai	Under Survey & Investigation	N/A	Tamil Nadu	1,100

Source: CEA, 2025; Finance Department, 2025

Annexure III

Table 16 Potential reservoirs and their evaluation based on the EIA.

Note - Reservoirs fully or partially outside the state boundary are ungraded.

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
1	Upper	540	3.3	16	4,442	5,000	1	0	1	1	0	1	0	0	0	0	0	1	1	1	7
	Lower						0	0	1	1	0	1	0	0	0	0	0	1	1	1	
2	Upper	1,470	16.8	9	1,622	5,000	1	1	1	1	0	1	0	1	0	1	0	1	1	1	10
	Lower						0	1	1	1	0	0	0	1	0	0	0	1	1	1	
3	Upper	850	5.9	14	2,825	5,000	1	1	0	0	0	1	0	1	0	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	1		1	
4	Upper	1,593	23.6	7	1,507	5,000	1	1	0	0	1	1	0	1	0	0	0	1	1	1	8
	Lower						1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
5	Upper	781	8	10	3,071	5,000	1	1	1	0	0	1	0	1	0	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
6	Upper	530	5.6	9	4,525	5,000	0	0	1	1	1	1	0	0	0	1	0	1	1	1	8
	Lower						0	0	1	1	0	1	0	0	0	0	0	1	1	1	
7	Upper	1,222	23	5	1,963	5,000	0	1	1	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	1		1	
8	Upper	794	10.4	8	3,021	5,000	1	1	1	0	0	0	0	1	0	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
9	Upper	910	12.1	8	759	1,500	1	1	1	1	0	1	0	0	0	1	0	1	0	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
10	Upper	1,000	11.6	9	707	1,500	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
11	Upper	521	5.1	10	1,376	1,500	1	1	1	1	1	0	0	0	0	1	0	1	0	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
12	Upper	480	5	10	1,492	1,500	1	1	1	1	1	1	0	0	0	1	0	1	0	1	9
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	0	1	8
13	Upper	810	9.8	8	885	1,500	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	0	0	0	0	1	0	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
14	Upper	660	12	5	1,074	1,500	1	1	1	1	0	1	0	0	0	1	0	1	1	1	9
	Lower						0	0	1	1	0	1	0	0	0	0	0	1	1	1	6
15	Upper	562	9.5	6	1,281	1,500	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	0	0	0	0	1	1	0	1	0	1	
16	Upper	921	18	5	780	1,500	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	1	0	1	1	0	0	0	0	0	1	1	1	8
17	Upper	602	2.6	23	1,194	1,500	1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
	Lower						1	1	1	1	0	1	1	0	0	1	0	1	0	1	9
18	Upper	880	17.1	5	818	1,500	0	1	0	1	0	0	0	0	0	1	0	1	0	1	
	Lower						1	0	1	1	0	0	0	0	0	1	0	1	1	1	7
19	Upper	550	9.5	6	1,307	1,500	1	1	1	1	1	1	0	0	0	1	0	1	0	1	9
	Lower						1	1	1	0	1	1	1	0	0	1	0	1	0	1	9
20	Upper	1,515	15	10	475	1,500	1	1	1	0	1	1	0	1	0	1	0	1	1	1	10
	Lower						0	1	1	0	0	1	0	1	0	0	0	1	1	1	7
21	Upper	1,415	15.6	9	506	1,500	1	1	1	0	0	0	0	1	0	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	1	0	1	0	1	1	1	10
22	Upper	1,550	14.1	11	465	1,500	0	1	1	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
23	Upper	1,484	18.8	8	485	1,500	1	1	1	0	0	0	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
24	Upper	1,312	8.5	15	540	1,500	0	0	1	0	0	0	0	1	0	0	0	1	1	1	5
	Lower						0	1	1	1	0	1	0	1	0	0	0	1	1	1	8
25	Upper	1,581	19.4	8	454	1,500	1	1	0	0	1	1	0	1	0	1	0	1	1	1	9
	Lower						1	1	1	0	0	0	0	1	0	0	0	1	1	1	7
26	Upper	1,385	22.9	6	517	1,500	0	1	0	1	0	0			1	1	0	1		0	
	Lower						0	1	1	1	0	1	0	1	0	0	0	1	1	1	8
27	Upper	841	9	9	835	1,500	0	1	0	1	0	0			0	1	0	1		1	
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
28	Upper	841	8	11	845	1,500	1	1	1	0	0	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
29	Upper	1,490	7.7	19	473	1,500	0	1	0	0	1	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	1	1	1	0	0	0	1	0	1	1	1	9
30	Upper	1,519	13.1	12	474	1,500	0	1	1	0	0	1	0	0	0	1	0	1	1	1	7
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
31	Upper	1,488	13.3	11	484	1,500	0	1	1	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
32	Upper	870	17.3	5	827	1,500	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
33	Upper	622	1.4	44	1,154	1,500	0	1	1	0	0	0	0	0	0	1	0	1	1	1	
	Lower						1	1	1	0	1	1	0	0	0	0	0	1	1	1	8
34	Upper	1,512	28.9	5	476	1,500	1	1	1	0	0	1	0	1	0	0	0	1	1	1	8
	Lower						1	1	1	1	0	0	0	1	0	0	0	1	1	1	
35	Upper	850	14.1	6	841	1,500	1	1	1	0	0	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	1	1	7
36	Upper	263	4.2	6	261	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	0	0	1	0	1	0	1	0	1	0	1	
37	Upper	270	2.8	10	258	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	0	0	0	0	1	1	1	0	1	0	1	
38	Upper	354	5.4	7	204	150	0	1	0	0	1	1	0	1	0	1	0	1	0	1	7
	Lower						1	1	1	0	0	1	0	1	0	1	0	1	0	1	8
39	Upper	460	2.2	21	150	150	1	1	0	0	0	0	0	1	1	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	0	1	0	1	0	1	0	1	8
40	Upper	423	7.5	6	168	150	1	0	0	0	0	0	0	1	0	1	0	1	0	1	5
	Lower						1	1	0	0	0	0	0	1	0	0	0	1	0	1	5
41	Upper	512	9.4	5	135	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	0	1	6
42	Upper	461	8.6	5	153	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	0	0	1	0	1	7
43	Upper	361	3.1	12	197	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	0	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	**Type**	**Metres**	**Kilometres**	**%**	**Gigalitres**	**GWh**	**Treecover**	**Unused land**	**Surface waterbodies**	**Run-off**	**Agricultural land**	**Human settlement**	**Air quality**	**Seismic activity**	**Road and railway**	**Power infrastructure**	**Heritage sites**	**Protected areas**	**Endangered flora**	**Endangered fauna**	**Total**
44	Upper	490	4.1	12	144	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	1	0	1	0	0	1	0	1	0	1	0	1	8
45	Upper	360	5.7	6	199	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	0	0	0	0	0	1	0	0	0	1	0	1	5
46	Upper	600	9.5	6	118	150	1	1	0	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	1	1	0	0	0	1	0	1	8
47	Upper	303	3.7	8	232	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	1	0	1	0	1	8
48	Upper	510	9.6	5	134	150	0	1	0	0	1	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	1	1	0	0	0	1	0	1	8
49	Upper	530	3.8	14	135	150	0	1	0	0	1	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	1	0	1	0	1	0	1	10
50	Upper	451	3.1	14	156	150	0	1	0	0	1	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	1	0	1	0	1	8
51	Upper	333	3.6	9	215	150	0	1	0	0	1	0	0	1	0	1	0	1	0	1	6
	Lower						1	0	0	0	0	0	0	1	0	1	0	1	0	1	5
52	Upper	570	7.4	8	121	150	1	1	1	0	1	1	0	1	0	1	0	1	0	1	9
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	0	1	6
53	Upper	601	5.5	11	115	150	1	1	0	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	1	1	0	0	0	1	0	1	8
54	Upper	360	6.6	5	198	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	1	0	0	0	0	1	0	1	0	1	0	1	7
55	Upper	433	6.8	6	163	150	1	1	0	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
56	Upper	250	3.5	7	285	150	0	1	0	1	0	0			0	1	0	1		0	
	Lower						0	1	0	0	0	0	0	1	0	1	0	0	0	1	
57	Upper	270	4.3	6	266	150	1	1	1	0	1	1	0	1	0	1	0	1	0	1	9
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
58	Upper	441	7.9	6	161	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	1	0	1	0	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
59	Upper	500	5.1	10	144	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	0	1	7
60	Upper	621	11.3	5	117	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
61	Upper	278	4.5	6	255	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	0	0	0	0	1	1	1	0	1	0	1	
62	Upper	470	9	5	152	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	1	1	0	0	0	1	0	1	8
63	Upper	540	7.3	7	129	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
64	Upper	365	2.7	13	198	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	1	0	0	0	0	1	0	1	0	1	0	1	7
65	Upper	292	3.8	8	243	150	1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
	Lower						0	1	1	1	1	1	1	0	0	1	0	1	0	1	9
66	Upper	451	5	9	160	150	1	1	0	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						1	1	1	0	0	0	0	1	0	1	0	1	0	1	7
67	Upper	480	6.7	7	149	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	1	1	0	1	0	1	0	1	9
68	Upper	150	1.1	14	477	150	0	1	1	1	1	1	1	0	0	0	0	1	0	1	8
	Lower						0	0	1	1	1	1	1	0	0	0	0	1	0	1	7
69	Upper	493	8.4	6	144	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
70	Upper	160	1.8	9	437	150	0	1	1	0	1	1	0	0	0	0	0	1	0	1	
	Lower						0	1	0	0	0	1	0	0	0	0	0	1	0	1	
71	Upper	230	1.5	15	312	150	1	1	1	0	1	1	0	1	0	1	0	1	0	1	9
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
72	Upper	562	8.1	7	125	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	1	0	1	1	0	0	1	0	1	0	1	
73	Upper	640	8.4	8	111	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	0	1	1	0	0	1	0	0	1	0	1	0	1	

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
74	Upper	450	7.9	6	159	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	0	1	1	0	0	1	0	1	1	0	1	0	1	8
75	Upper	587	10.5	6	122	150	0	0	1	1	1	1	0	0	0	1	0	1	0	1	7
	Lower						1	0	0	1	0	0	1	0	1	1	0	1	0	1	7
76	Upper	420	7.3	6	170	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	0	1	0	0	0	0	1	1	0	1	0	1	
77	Upper	850	7.8	11	83	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						1	0	1	1	0	0	1	0	0	1	0	1	0	1	7
78	Upper	600	8.7	7	120	150	1	1	0	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						1	0	0	1	0	0	1	0	1	1	0	1	0	1	7
79	Upper	250	1.8	14	287	150	0	0	1	1	1	1	0	0	0	1	0	1	0	1	7
	Lower						0	0	1	1	1	1	1	0	0	1	0	1	0	1	8
80	Upper	320	2.6	12	224	150	0	0	0	1	1	1	1	0	0	1	0	1	0	1	7
	Lower						0	0	0	0	0	0	1	0	0	1	0	1	0	1	4
81	Upper	444	5.4	8	161	150	1	1	0	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						1	0	0	1	0	0	1	0	0	1	0	1	0	1	6
82	Upper	541	9.9	5	133	150	0	1	0	1	1	0	0	0	0	1	0	1	0	1	6
	Lower						1	0	0	0	0	0	1	0	0	1	0	1	0	1	5
83	Upper	180	1.7	11	395	150	0	1	1	1	1	1	0	0	0	1	0	1	0	1	8
	Lower						0	0	1	1	0	0	1	0	0	1	0	1	0	1	6
84	Upper	551	10.7	5	131	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	0	0	1	0	0	1	0	0	1	0	1	0	1	6
85	Upper	308	4.9	6	228	150	0	1	1	1	1	1	0	0	0	1	0	1	0	1	8
	Lower						0	1	1	1	1	1	1	0	0	1	0	1	0	1	9
86	Upper	1,042	12.8	8	67	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	0	0	0	0	0	0	1	7
87	Upper	792	13.5	6	91	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	0	1	5
88	Upper	621	9.3	7	114	150	1	1	0	0	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	1	0	0	0	0	0	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
89	Upper	877	10.1	9	79	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	0	1	6
90	Upper	1,091	12.4	9	64	150	1	1	1	1	0	0	0	1	0	1	0	1	0	1	8
	Lower						0	1	1	0	1	1	1	1	0	1	0	1	0	1	9
91	Upper	793	4.2	19	89	150	1	1	1	1	0	0	0	0	0	1	0	1	0	1	7
	Lower						1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
92	Upper	480	2.9	17	148	150	0	0	1	1	1	0	0	0	0	1	0	0	0	1	5
	Lower						1	1	1	1	1	0	0	0	0	1	0	0	0	1	7
93	Upper	541	9	6	132	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
94	Upper	452	3.5	13	157	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	0	1	1	1	0	0	0	1	0	1	8
95	Upper	530	10.5	5	129	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
96	Upper	700	9.2	8	102	150	1	1	1	1	0	0	0	0	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	0	1	6
97	Upper	952	11.7	8	73	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	1	1	0	1	0	1	0	1	9
98	Upper	500	5.5	9	138	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
99	Upper	582	6.7	9	124	150	1	1	0	0	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
100	Upper	730	8.5	9	97	150	1	1	0	1	1	0	0	1	0	1	0	1	0	1	8
	Lower						0	1	0	1	1	1	1	1	0	1	0	1	0	1	9
101	Upper	300	3.6	8	235	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
102	Upper	412	2.8	15	167	150	0	1	0	1	1	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	1	1	1	1	1	1	0	1	0	1	0	1	11
103	Upper	780	12.9	6	89	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
104	Upper	570	9.3	6	125	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						1	0	1	0	0	1	1	1	0	1	0	1	0	1	8
105	Upper	390	6	7	178	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						1	1	1	1	1	1	0	1	0	0	0	1	0	1	9
106	Upper	512	4	13	138	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
107	Upper	1,010	12.6	8	71	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
108	Upper	770	13	6	91	150	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	1	1	0	1	0	1	0	1	9
109	Upper	750	14.9	5	95	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	1	0	1	0	1	0	1	10
110	Upper	461	3.2	14	156	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
111	Upper	1,151	22	5	60	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	0	1	8
112	Upper	457	6.4	7	157	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						1	1	1	1	0	1	0	1	0	0	0	1	0	1	8
113	Upper	775	8.1	10	90	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	0	1	6
114	Upper	524	4.4	12	132	150	1	0	0	1	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	0	1	8
115	Upper	480	9.4	5	149	150	1	1	0	0	1	0	0	0	0	1	0	0	0	1	5
	Lower						1	1	1	1	1	1	0	0	0	1	0	1	0	1	9
116	Upper	901	18.1	5	77	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	0	1	5
117	Upper	840	15.8	5	83	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
118	Upper	691	8.6	8	101	150	1	1	0	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	**Type**	**Metres**	**Kilometres**	**%**	**Gigalitres**	**GWh**	**Treecover**	**Unused land**	**Surface waterbodies**	**Run-off**	**Agricultural land**	**Human settlement**	**Air quality**	**Seismic activity**	**Road and railway**	**Power infrastructure**	**Heritage sites**	**Protected areas**	**Endangered flora**	**Endangered fauna**	**Total**
119	Upper	720	14.3	5	98	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	0	1	6
120	Upper	792	5	16	89	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
121	Upper	360	6.4	6	199	150	1	1	0	1	1	0	0	1	0	1	0	1	0	1	8
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
122	Upper	560	11	5	127	150	1	1	0	1	1	0	0	0	0	1	0	0	0	1	6
	Lower						0	1	1	1	1	1	1	0	0	1	0	1	0	1	9
123	Upper	421	4.8	9	168	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	0	1	8
124	Upper	852	16.1	5	84	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	0	0	1	1	1	0	0	0	0	0	0	0	1	4
125	Upper	641	11.8	5	109	150	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	0	1	8
126	Upper	520	6.5	8	135	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	0	1	6
127	Upper	361	6.5	6	199	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
128	Upper	510	2.2	24	141	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						1	1	1	1	0	0	0	0	0	1	0	1	0	1	7
129	Upper	720	11.6	6	98	150	1	0	0	0	0	0	0	0	0	1	0	1	0	1	4
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
130	Upper	471	9.1	5	150	150	1	1	1	1	0	0	0	1	0	1	0	1	0	1	8
	Lower						0	1	1	1	1	1	1	1	0	1	0	1	0	1	10
131	Upper	646	10.4	6	109	150	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
132	Upper	359	3.3	11	200	150	1	1	0	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						1	1	1	1	1	0	0	0	0	1	0	1	0	1	8
133	Upper	635	10	6	112	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
134	Upper	361	4.1	9	198	150	0	1	0	1	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	0	1	0	1	0	1	0	1	8
135	Upper	487	7.7	6	148	150	1	1	0	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						1	1	1	1	0	0	0	0	0	1	0	0	0	1	6
136	Upper	380	7.2	5	189	150	1	1	1	1	1	1	0	0	0	1	0	1	0	1	9
	Lower						0	1	1	1	1	0	0	0	0	1	0	1	0	1	7
137	Upper	500	9.5	5	143	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
138	Upper	463	4.1	11	153	150	0	1	0	0	1	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	0	1	0	0	0	0	1	0	1	0	1	5
139	Upper	560	5.8	10	127	150	1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
	Lower						0	0	1	1	0	0	1	0	0	1	0	1	0	1	
140	Upper	971	17.6	6	74	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	0	0	1	0	0	0	1	8
141	Upper	645	10.3	6	110	150	1	1	0	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	0	0	0	0	0	0	1	7
142	Upper	670	6.7	10	104	150	0	1	1	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
143	Upper	1,170	19	6	60	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	0	0	0	0	0	0	1	7
144	Upper	713	12.5	6	97	150	1	0	0	1	0	0	0	0	0	1	0	1	0	1	5
	Lower						1	1	1	1	1	1	1	0	0	0	0	0	0	1	8
145	Upper	442	5.5	8	162	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	1	1	0	0	0	0	1	0	1	0	1	
146	Upper	450	6	7	160	150	1	0	0	0	0	0	1	0	0	1	0	1	0	1	5
	Lower						0	0	1	0	1	1	1	0	0	0	0	0	0	1	5
147	Upper	981	12	8	74	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	0	0	0	0	0	0	1	7
148	Upper	566	10.3	5	127	150	0	1	0	1	1	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	0	1	0	0	0	0	1	1	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
149	Upper	720	7.6	9	100	150	1	0	0	1	0	0	0	0	1	1	0	1	1	1	7
	Lower						1	0	1	1	0	0	0	0	1	1	0	1	1	1	8
150	Upper	451	7.5	6	158	150	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	1	0	0	1	0	1	0	1	8
151	Upper	930	9.3	10	76	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	0	0	1	0	0	0	1	8
152	Upper	732	12.1	6	97	150	0	1	0	1	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	0	0	1	0	1	0	1	9
153	Upper	1,114	21.4	5	65	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						1	1	1	1	0	1	1	0	0	0	0	0	0	1	7
154	Upper	460	6.5	7	156	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						1	1	0	1	0	0	1	0	0	1	0	1	0	1	7
155	Upper	729	7.6	10	94	150	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	0	1	1	1	1	1	0	0	1	0	1	0	1	8
156	Upper	399	7.4	5	178	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	0	1	0	1	0	0	0	1	0	0	0	1	
157	Upper	872	15.4	6	81	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	1	0	0	0	0	0	0	1	6
158	Upper	653	11.3	6	110	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						1	1	0	1	1	1	1	0	0	0	0	1	0	1	8
159	Upper	485	9.2	5	146	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	1	1	1	1	0	0	1	0	1	0	1	9
160	Upper	270	4.3	6	267	150	0	1	0	1	1	1	0	0	0	1	0	1	0	1	7
	Lower						1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
161	Upper	663	13.1	5	105	150	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	0	1	1	1	1	1	0	0	1	0	1	0	1	8
162	Upper	641	12.2	5	112	150	0	1	0	1	1	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	0	1	0	0	1	0	1	1	0	1	0	1	8
163	Upper	740	10.2	7	96	150	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	1	0	0	0	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
164	Upper	520	9.1	6	137	150	1	1	0	1	0	1	0	0	0	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	1	0	0	1	0	1	0	1	8
165	Upper	603	9.4	6	115	150	1	0	0	0	0	0	0	0	0	1	0	1	0	1	4
	Lower						0	1	0	1	1	1	1	0	0	0	0	0	0	1	6
166	Upper	1,205	17.7	7	58	150	0	0	0	0	0	0	0	1	0	1	0	1	1	1	5
	Lower						1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
167	Upper	1,361	12.9	11	53	150	0	1	1	1	0	0	0	1	0	1	0	1	1	1	8
	Lower						1	1	1	0	0	0	0	1	1	1	0	0	1	1	8
168	Upper	1,407	9.7	15	51	150	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
169	Upper	1,220	17.4	7	58	150	1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
	Lower						0	0	0	0	1	1	0	1	0	0	0	1	1	1	6
170	Upper	1,440	14.1	10	49	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
171	Upper	1,184	18.9	6	58	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	1	1	7
172	Upper	1,557	31.1	5	46	150	1	1	1	0	0	1	0	1	0	1	0	1	1	1	9
	Lower						0	1	0	1	0	0			1	1	0	0		0	
173	Upper	1,201	10.7	11	60	150	1	1	0	0	0	1	0	1	1	0	0	1	1	1	8
	Lower						0	1	1	1	0	0	0	1	1	1	0	1	1	1	
174	Upper	1,548	11.1	14	47	150	0	0	1	0	0	0	0	1	0	1	0	1	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
175	Upper	1,493	20.7	7	48	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
176	Upper	1,274	20.4	6	55	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	1	1	0	1	0	1	0	1	0	1	1	1	
177	Upper	1,560	17.2	9	46	150	1	1	0	0	1	1	0	1	0	1	0	1	1	1	9
	Lower						0	0	0	0	0	1	0	1	0	0	0	1	1	1	5
178	Upper	1,521	27.6	6	46	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	0	1	0	1	1	0	1	0	1	0	0	1	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
179	Upper	1,564	10	16	46	150	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						1	1	1	0	0	0	0	1	0	1	0	0	1	1	7
180	Upper	1,370	22.7	6	51	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	0	0	0	1	1	0	1	0	0	0	1	1	1	6
181	Upper	1,232	22.7	5	58	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
182	Upper	1,551	15.3	10	47	150	0	1	1	1	0	1	0	1	0	1	0	1	1	1	9
	Lower						0	1	1	1	0	0	0	1	0	0	0	1	1	1	7
183	Upper	1,581	26.6	6	45	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	1	0	0	1	1	0	1	0	1	0	1	1	1	8
184	Upper	1,374	15.4	9	51	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	0	0	0	0	1	0	0	0	1	0	1	1	1	5
185	Upper	1,590	9.3	17	45	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
186	Upper	1,464	28.1	5	48	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	0	0	0	1	1	0	1	0	0	0	0	1	1	5
187	Upper	1,586	15.9	10	45	150	1	1	0	0	1	1	0	1	0	0	0	1	1	1	8
	Lower						0	0	1	1	0	0	0	1	1	1	0	1	1	1	8
188	Upper	1,527	21	7	47	150	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
189	Upper	1,401	19.3	7	50	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	0	0	1	0	1	0	0	0	0	1	1	5
190	Upper	1,490	26.4	6	47	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	0	0	0	0	1	0	1	0	0	0	0	1	1	4
191	Upper	1,173	20.2	6	60	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
192	Upper	1,569	26.9	6	46	150	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
193	Upper	1,515	26.3	6	47	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	1	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
194	Upper	1,566	24.6	6	46	150	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
195	Upper	1,207	22.7	5	60	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	0	1	0	0			1	1	0	0		0	
196	Upper	1,361	23.5	6	52	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	0	0	0	1	1	0	1	0	0	0	0	1	1	5
197	Upper	1,554	6	26	46	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						1	1	1	0	0	1	0	1	0	0	0	1	1	1	8
198	Upper	1,550	29.9	5	45	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	0	1	0	1	1	0	1	0	0	0	0	1	1	6
199	Upper	1,600	23.8	7	44	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
200	Upper	1,481	28.2	5	48	150	1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
	Lower						0	0	0	0	0	1	0	0	0	1	0	1	1	1	5
201	Upper	1,581	29.9	5	45	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
202	Upper	1,240	24.4	5	56	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	1	0	0	1	1	0	1	0	0	0	0	1	1	6
203	Upper	1,363	13.5	10	52	150	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						1	0	1	1	0	0	0	0	1	1	0	1	1	1	8
204	Upper	1,482	13.8	11	49	150	0	1	1	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	0	0	1	0	0	0	1	1	1	0	1	1	1	7
205	Upper	1,091	13.8	8	66	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
206	Upper	1,540	24.1	6	46	150	1	1	0	0	1	1	0	1	0	1	0	1	1	1	9
	Lower						1	0	0	0	0	1	0	1	0	1	0	1	1	1	7
207	Upper	1,203	23.5	5	60	150	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						0	1	0	0	1	1	0	1	0	0	0	0	1	1	6
208	Upper	1,560	26.7	6	46	150	1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
209	Upper	1,318	21.1	6	53	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0	0	1	0	1	0	1	1	1	
210	Upper	1,475	29.2	5	49	150	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						1	1	1	1	0	0	0	1	1	1	0	1	1	1	10
211	Upper	1,300	24.3	5	55	150	1	1	0	0	0	1	0	1	0	1	0	0	1	1	7
	Lower						0	0	0	0	0	1	0	1	0	1	0	1	1	1	6
212	Upper	873	17.4	5	82	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
213	Upper	1,058	14.3	7	68	150	0	1	0	1	0	0			1	1	0	1		0	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
214	Upper	1,271	25.1	5	55	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	0	0	0	1	1	0	1	0	0	0	0	1	1	5
215	Upper	1,347	17.9	8	53	150	1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
	Lower						1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
216	Upper	1,414	25.6	6	50	150	0	0	0	0	1	1	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
217	Upper	1,189	10.3	12	60	150	1	1	0	1	0	1	0	1	0	0	0	1	1	1	8
	Lower						0	1	1	1	0	0	0	1	0	1	0	1	1	1	8
218	Upper	1,268	24.2	5	55	150	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	0	1	1	0	1	0	0	0	0	1	1	6
219	Upper	1,123	14.5	8	63	150	1	1	1	0	0	1	0	1	0	1	0	1	1	1	9
	Lower						0	0	0	0	0	1	0	1	0	0	0	1	1	1	5
220	Upper	1,103	18.8	6	64	150	0	1	0	0	1	1	0	1	0	0	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
221	Upper	350	6.4	6	198	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	
	Lower						1	1	1	1	0	1	0	1	0	1	0	1	1	1	10
222	Upper	612	7.1	9	117	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	0	0	0	0	0	0	1	1	1	0	1	1	1	7
223	Upper	560	7.3	8	128	150	1	1	0	0	0	1	0	0	0	1	0	0	1	1	6
	Lower						1	1	1	1	0	0	0	0	0	1	0	1	1	0	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	**Type**	**Metres**	**Kilometres**	**%**	**Gigalitres**	**GWh**	**Treecover**	**Unused land**	**Surface waterbodies**	**Run-off**	**Agricultural land**	**Human settlement**	**Air quality**	**Seismic activity**	**Road and railway**	**Power infrastructure**	**Heritage sites**	**Protected areas**	**Endangered flora**	**Endangered fauna**	**Total**
224	Upper	640	9.6	7	109	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	1	1	1	1	0	0	0	1	0	1	1	0	9
225	Upper	762	13.8	6	94	150	1	1	1	0	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
226	Upper	492	9.7	5	144	150	1	1	0	1	0	0	0	0	1	1	0	1	1	0	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	0	6
227	Upper	360	5	7	196	150	1	1	0	0	0	0	0	0	0	1	0	1	0	0	4
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	0	0	5
228	Upper	436	8.2	5	165	150	1	1	0	0	0	0	0	0	1	1	0	1	1	0	6
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	1	0	8
229	Upper	1,163	6.7	17	62	150	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
230	Upper	1,260	15.8	8	56	150	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						0	1	0	1	0	0			1	1	0	0		0	
231	Upper	1,600	11.8	14	45	150	0	1	1	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	1	1	0	0	0	0	1	0	1	1	1	8
232	Upper	970	6.4	15	73	150	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	0	0	1	0	1	1	1	9
233	Upper	960	5.4	18	73	150	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						1	1	1	1	0	0	0	0	0	1	0	1	1	1	8
234	Upper	1,468	13.3	11	49	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	1	1	0	1	0	1	0	1	0	1	1	1	9
235	Upper	1,510	12.7	12	45	150	1	1	1	0	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	1	0	1	1	1	9
236	Upper	1,313	16.6	8	55	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	1	1	1	1	0	0	0	1	0	1	1	1	10
237	Upper	1,210	23.6	5	57	150	1	1	0	0	1	1	0	0	0	1	0	0	1	1	7
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	1	1	9
238	Upper	1,575	17.2	9	46	150	0	0	0	0	1	0	0	1	1	1	0	1	1	1	7
	Lower						0	1	1	1	0	1	0	1	0	0	0	1	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
239	Upper	1,393	20.1	7	52	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	1	0	0	0	0	1	1	8
240	Upper	885	17.5	5	82	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	1	0	0	0	0	1	0	1	0	1	1	1	
241	Upper	1,593	10	16	45	150	0	1	1	0	0	1	0	0	0	1	0	1	1	1	7
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
242	Upper	1,480	22.8	6	49	150	1	1	0	0	1	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
243	Upper	1,584	18.9	8	45	150	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						1	1	1	1	0	0	0	0	0	1	0	1	1	1	8
244	Upper	1,410	28.2	5	51	150	0	1	0	1	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
245	Upper	1,600	10.6	15	45	150	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
246	Upper	1,593	21	8	45	150	1	1	0	0	1	1	0	0	0	1	0	0	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
247	Upper	1,410	19.8	7	49	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	1	0	0	0	0	1	1	8
248	Upper	1,580	24.4	6	45	150	0	1	0	0	1	1	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
249	Upper	1,570	11.8	13	45	150	0	0	0	0	0	0	0		0	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
250	Upper	1,362	19.2	7	51	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	0	1	1	0	0	0	1	0	0	1	1	7
251	Upper	1,594	13.3	12	45	150	1	0	0	0	0	0	0	1	1	1	0	1	1	1	7
	Lower						0	1	1	1	0	1	0	1	0	0	0	1	1	1	8
252	Upper	1,392	26.6	5	51	150	1	1	0	0	1	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	1	0	1	0	0	1	1	9
253	Upper	1,496	28.2	5	48	150	0	1	0	0	0	1	0	0	0	1	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	0	0	1	0	1	1	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
254	Upper	770	11.3	7	93	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	1	1	9
255	Upper	1,440	27.3	5	48	150	1	1	0	0	0	1	0	0	0	1	0	0	1	1	6
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	1	1	9
256	Upper	1,489	29.5	5	48	150	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						0	1	0	1	0	0			1	1	0	0		0	
257	Upper	940	17.3	5	75	150	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	1	1	7
258	Upper	1,260	12	11	57	150	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	1	1	0	1	0	0	0	0	0	1	1	1	7
259	Upper	1,552	13.4	12	46	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	1	1	0	1	0	0	0	1	1	1	8
260	Upper	771	5.4	14	93	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	1	1	1	1	0	0	0	1	0	1	1	0	9
261	Upper	641	11.8	5	112	150	1	1	1	0	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
262	Upper	973	14.1	7	74	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
263	Upper	1,592	30	5	45	150	1	1	0	1	0	0			1	1	0	1		1	
	Lower						0	1	0	1	1	1	0	1	0	0	0	0	1	1	7
264	Upper	1,080	15.9	7	67	150	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
265	Upper	797	12.8	6	91	150	1	1	1	0	0	0	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
266	Upper	1,518	28.9	5	48	150	0	1	1	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
267	Upper	1,420	20.5	7	51	150	0	1	1	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
268	Upper	1,531	28	5	47	150	0	1	0	1	0	1	0	0	0	1	0	1	1	1	7
	Lower						1	1	0	0	0	0	0	0	0	1	0	1	1	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
269	Upper	678	5.2	13	102	150	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	1	1	9
270	Upper	952	13.3	7	76	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	0	0	0	0	1	0	1	1	0	0	1	1	1	7
271	Upper	1,530	22.9	7	46	150	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	0	1	0	0	0	0	0	0	1	1	6
272	Upper	1,414	26.9	5	50	150	0	1	0	1	0	0	0		1	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
273	Upper	1,555	31.1	5	46	150	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						0	1	0	1	0	0			1	1	0	0		0	
274	Upper	690	7.3	10	102	150	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	1	0	0	0	1	0	1	1	1	7
275	Upper	1,483	24.3	6	48	150	1	0	0	0	0	0	0	1	0	1	0	1	1	1	6
	Lower						0	1	1	0	0	0	0	1	1	1	0	1	1	1	
276	Upper	1,363	22	6	53	150	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
277	Upper	1,011	18.7	5	68	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	0	0	1	0	1	0	1	0	0	1	1	8
278	Upper	1,021	16.8	6	71	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
279	Upper	862	11.5	7	81	150	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	1	1	0	0	0	0	1	0	1	1	1	8
280	Upper	1,423	25.6	6	49	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	1	0	1	0	0	0	0	1	1	6
281	Upper	851	15.5	5	85	150	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
282	Upper	774	11.8	7	90	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	1	1	0	1	0	1	0	0	0	0	1	1	7
283	Upper	1,266	23.9	5	56	150	1	1	1	0	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	1	1	0	1	0	0	0	0	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
284	Upper	1,152	21.8	5	61	150	1	1	0	0	0	1	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	1	1	0	0	0	1	0	1	1	1	8
285	Upper	780	6.6	12	90	150	1	1	0	0	0	0	0	0	0	1	0	0	1	1	5
	Lower						1	1	1	1	0	0	0	0	0	1	0	1	1	0	7
286	Upper	1,003	18.9	5	72	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
287	Upper	1,051	19.7	5	69	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	1	1	7
288	Upper	762	8.5	9	92	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	0	1	1	0	0	0	0	0	0	1	1	5
289	Upper	1,080	15.9	7	65	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	1	1	1	1	0	0	0	1	0	1	1	1	10
290	Upper	604	11	5	119	150	1	1	1	0	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	0	1	0	1	0	0	0	1	1	1	8
291	Upper	800	14.3	6	86	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	0	1	1	0	0	0	0	0	0	1	1	5
292	Upper	636	1.6	40	113	150	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
293	Upper	669	10.6	6	106	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	0	1	1	1	0	1	0	0	0	0	1	1	7
294	Upper	681	13.2	5	102	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	1	0	1	0	0	0	0	1	1	6
295	Upper	980	5.9	17	70	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	1	0	0	0	0	1	1	8
296	Upper	655	11.1	6	110	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
297	Upper	685	8.9	8	105	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	1	1	0	1	0	1	0	0	0	1	1	1	8
298	Upper	831	11.9	7	87	150	1	1	0	0	0	0	0	1	0	1	0	0	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
299	Upper	871	15.3	6	81	150	1	1	0	1	0	0	0	1	0	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
300	Upper	711	10	7	101	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	0	0	1	0	1	0	1	0	0	1	1	
301	Upper	1,130	18.1	6	64	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	1	1	0	1	0	1	0	0	0	0	1	1	8
302	Upper	600	11.9	5	117	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	1	0	0	0	1	0	1	0	0	1	1	
303	Upper	931	18.3	5	74	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	1	0	0	1	0	1	0	1	0	0	1	1	8
304	Upper	351	6.6	5	205	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	0	0	0	0	1	0	0	0	1	1	1	7
305	Upper	1,000	19.2	5	70	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	1	0	1	0	0	0	0	1	1	6
306	Upper	901	17.3	5	79	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	0	1	0	1	0	1	0	0	0	1	1	1	8
307	Upper	1,043	17	6	66	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	1	0	1	0	0	0	0	1	1	
308	Upper	930	17.6	5	75	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
309	Upper	531	9.9	5	136	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
310	Upper	784	13.3	6	91	150	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	0	0	0	1	0	1	0	0	0	0	1	1	6
311	Upper	586	11	5	123	150	1	1	0	0	0	0	0	1	1	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
312	Upper	1,123	11	10	63	150	1	1	0	0	0	0	0	0	0	0	0	0	1	1	4
	Lower						1	1	1	0	0	1	0	0	0	1	0	0	1	1	7
313	Upper	1,123	15.4	7	64	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	1	1	0	1	0	0	0	1	0	1	1	1	9

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
314	Upper	1,038	3.7	28	68	150	1	1	1	0	0	0	0	0	0	0	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	0	0	0	0	1	1	1	5
315	Upper	1,295	21.7	6	56	150	1	1	0	0	0	0	0	0	0	0	0	1	1	1	5
	Lower						0	1	0	0	0	1	0	0	0	0	0	1	1	1	5
316	Upper	620	8.7	7	113	150	0	1	0	1	0	0			1	1	0	1		1	
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
317	Upper	1,402	26.3	5	50	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
318	Upper	560	6.9	8	126	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	1	1	1	1	0	0	0	1	0	1	1	1	10
319	Upper	1,400	27.4	5	49	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
320	Upper	410	7	6	173	150	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	0	0	1	1	0	0	0	1	0	1	0	1	6
321	Upper	529	10.4	5	134	150	1	1	0	0	0	0	0		0	1	0	1	1	1	
	Lower						1	1	0	0	0	0	0	0	0	0	0	1	1	1	5
322	Upper	380	2.1	18	188	150	0	1	0	1	0	0			1	1	0	1		0	
	Lower						0	1	0	1	1	0	0	0	0	1	0	1	1	1	7
323	Upper	661	13.4	5	105	150	1	1	0	0	0	0	0	0	0	1	0	0	1	1	5
	Lower						0	1	1	1	1	1	0	0	0	1	0	1	1	1	9
324	Upper	561	11.1	5	126	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	0	1	1	0	0	0	0	0	0	0	1	1	5
325	Upper	570	10.7	5	125	150	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	1	1	1	0	0	0	1	0	1	1	1	9
326	Upper	510	9.6	5	140	150	1	1	0	0	0	0	0	0	0	1	0	1	1	1	
	Lower						0	1	1	0	1	1	0	0	0	1	0	0	1	1	7
327	Upper	1,146	4.2	27	63	150	1	1	1	1	0	0	0	1	0	1	0	1	1	1	9
	Lower						0	1	1	1	0	0	0	1	0	0	0	1	1	1	7
328	Upper	1,287	10.7	12	55	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	1	1	0	0	0	1	0	1	0	1	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
329	Upper	1,509	14.6	10	47	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	1	1	0	1	0	1	0	1	0	1	1	1	10
330	Upper	813	4	20	86	150	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	1	1	1	1	0	1	0	1	1	1	1	1	12
331	Upper	320	2.4	13	225	150	1	1	0	0	0	0	0		1	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	0	0	0		1	
332	Upper	310	5.6	6	74	50	0	0	1	0	0	0	0	1	1	1	0	1	0	1	
	Lower						1	0	1	0	1	1	0	1	0	1	0	1	0	1	8
333	Upper	241	3.3	7	99	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	1	0	0	0	0	1	0	1	0	1	0	1	
334	Upper	220	3.4	6	105	50	0	1	0	0	0	0	0	1	0	1	0	1	0	1	
	Lower						1	1	1	1	0	1	0	1	0	1	0	1	0	1	9
335	Upper	463	9.1	5	51	50	0	0	0	0	1	0	0	1	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	1	0	1	0	1	0	1	8
336	Upper	501	4.4	11	46	50	0	1	0	0	1	1	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	0	1	0	1	0	1	0	1	8
337	Upper	300	3.8	8	77	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	0	1	0	0	1	0	1	0	1	0	1	0	1	
338	Upper	622	7.3	9	38	50	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	1	1	0	0	0	1	0	1	8
339	Upper	330	4.7	7	70	50	1	0	0	0	1	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	1	0	0	1	1	1	0	0	0	1	0	1	8
340	Upper	590	3.8	16	41	50	1	1	0	0	0	1	0	1	0	1	0	1	0	1	7
	Lower						0	1	0	0	1	1	0	1	0	1	0	1	0	1	7
341	Upper	560	11.1	5	42	50	1	1	0	0	0	0	0	1	1	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	1	1	0	0	0	0	0	1	7
342	Upper	612	8.8	7	37	50	1	1	0	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
343	Upper	361	2.3	15	65	50	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	0	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
344	Upper	641	12.5	5	38	50	0	1	0	0	1	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	1	1	0	0	0	1	0	1	9
345	Upper	523	9.9	5	44	50	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	0	1	1	0	1	1	1	0	0	0	1	0	1	8
346	Upper	510	8.4	6	45	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	1	1	1	1	1	1	0	1	0	1	0	1	11
347	Upper	435	6.2	7	55	50	1	1	0	0	0	0	0	1	1	1	0	1	0	1	7
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	0	1	7
348	Upper	563	11	5	41	50	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	1	0	0	0	0	0	1	7
349	Upper	461	9.1	5	52	50	1	1	0	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	1	1	0	0	0	1	0	1	8
350	Upper	350	6.2	6	67	50	1	1	0	0	0	1	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	0	1	6
351	Upper	520	6.7	8	45	50	0	1	1	1	1	0	0	0	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	0	0	1	0	1	0	1	9
352	Upper	542	8.2	7	44	50	1	0	0	1	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	0	1	1	0	0	1	0	1	1	0	1	0	1	7
353	Upper	441	7.4	6	54	50	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	1	1	0	1	0	0	0	1	0	1	0	1	7
354	Upper	592	10.7	6	41	50	0	0	0	1	1	0	0	0	0	1	0	1	0	1	5
	Lower						1	0	0	1	0	0	1	0	1	1	0	1	0	1	7
355	Upper	592	8.7	7	40	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	0	1	0	0	1	0	1	0	1	8
356	Upper	169	1.6	11	141	50	0	0	1	1	1	1	0	0	0	1	0	1	0	1	7
	Lower						1	0	0	1	1	0	0	0	0	1	0	1	0	1	
357	Upper	290	5.6	5	82	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	
	Lower						0	1	0	1	0	0			1	1	0	1		0	
358	Upper	458	9.1	5	52	50	1	1	0	1	0	1	0	0	0	1	0	1	0	1	7
	Lower						0	0	0	1	0	0	1	0	0	1	0	1	0	1	5

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
359	Upper	991	9.2	11	24	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	0	1	6
360	Upper	359	1.7	21	66	50	0	1	0	1	1	1	0	0	0	1	0	0	0	1	6
	Lower						1	1	0	1	1	0	1	0	0	1	0	1	0	1	8
361	Upper	800	3	27	30	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
362	Upper	643	5.9	11	37	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	1	1	0	0	0	0	0	0	0	1	0	1	6
363	Upper	691	9.5	7	35	50	1	1	1	1	0	0	0	1	0	1	0	1	0	1	8
	Lower						0	1	1	0	1	1	1	1	0	0	0	1	0	1	8
364	Upper	490	6.9	7	48	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	0	1	1	0	0	0	0	0	1	0	1	5
365	Upper	400	7.4	5	59	50	1	1	0	0	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	0	1	1	0	0	0	0	0	1	0	1	5
366	Upper	231	0.6	42	103	50	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						1	1	1	1	0	1	0	1	0	1	0	1	0	1	9
367	Upper	750	14.8	5	32	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	1	1	1	0	0	0	0	0	0	0	1	5
368	Upper	501	7.9	6	47	50	1	1	0	0	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	0	1	6
369	Upper	623	7.8	8	37	50	1	1	0	1	0	0	0	0	0	1	0	0	0	1	5
	Lower						0	1	1	1	1	1	1	0	0	0	0	1	0	1	8
370	Upper	564	7.7	7	41	50	1	1	0	0	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	1	0	0	0	0	0	0	1	6
371	Upper	640	8.1	8	36	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						1	1	0	1	1	1	0	0	0	0	0	1	0	1	7
372	Upper	370	5.8	6	63	50	1	1	1	1	1	1	0	0	0	1	0	0	0	1	8
	Lower						0	1	0	1	1	1	1	0	0	1	0	1	0	1	8
373	Upper	531	9	6	44	50	1	1	1	0	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
374	Upper	460	3.4	13	52	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						1	1	0	0	1	0	0	0	0	1	0	1	0	1	6
375	Upper	443	5.5	8	52	50	1	1	0	1	0	0	0	0	0	1	0	0	0	1	5
	Lower						0	1	0	1	1	1	1	0	0	1	0	1	0	1	8
376	Upper	580	9	6	41	50	1	1	0	1	1	0	0	0	0	1	0	0	0	1	6
	Lower						1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
377	Upper	491	9.9	5	46	50	1	1	0	1	1	0	0	0	0	1	0	0	0	1	6
	Lower						1	1	0	0	1	1	1	0	0	1	0	0	0	1	7
378	Upper	270	4.1	7	85	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	0	1	6
379	Upper	360	4	9	67	50	1	1	1	0	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	1	0	0	0	0	0	0	1	0	1	0	1	6
380	Upper	441	4.1	11	54	50	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	0	1	0	0	0	1	0	1	7
381	Upper	444	3.3	13	54	50	1	0	0	1	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
382	Upper	432	7.3	6	53	50	1	1	0	1	0	0	0	0	0	1	0	0	0	1	5
	Lower						0	1	1	1	1	1	1	0	0	0	0	1	0	1	8
383	Upper	790	9.7	8	30	50	1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
	Lower						0	0	0	1	0	0	0	0	1	1	0	1	1	1	6
384	Upper	920	14.5	6	26	50	1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
	Lower						0	0	0	0	1	1	0	0	0	1	0	1	1	1	6
385	Upper	761	12.8	6	31	50	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						1	1	1	1	0	0	0	0	1	1	0	1	1	1	9
386	Upper	480	6.8	7	49	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						1	1	1	1	1	0	1	0	0	1	0	1	0	1	9
387	Upper	642	10.7	6	37	50	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
388	Upper	661	12.3	5	35	50	1	1	0	1	0	0	1	0	1	1	0	1	0	1	8
	Lower						0	1	0	1	1	1	1	0	0	0	0	0	0	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
389	Upper	450	7.8	6	52	50	1	1	0	1	0	0	1	0	1	1	0	1	0	1	8
	Lower						0	1	0	1	1	1	1	0	0	0	0	1	0	1	7
390	Upper	461	7.7	6	51	50	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
391	Upper	465	3.9	12	52	50	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						1	1	0	1	0	0	1	0	1	1	0	1	0	1	8
392	Upper	1,598	12	13	15	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
393	Upper	1,311	9.2	14	18	50	1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
	Lower						1	1	0	0	0	0	0	1	0	0	0	1	1	1	6
394	Upper	1,368	14.9	9	17	50	0	1	1	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	0	0	0	0	1	1	1	0	0	1	1	7
395	Upper	1,360	10.3	13	17	50	0	1	0	0	1	1	0	1	0	0	0	1	1	1	7
	Lower						0	0	0	1	0	0	0	1	0	1	0	1	1	1	6
396	Upper	751	13	6	32	50	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
397	Upper	1,511	14.4	10	15	50	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	0	0	0	0	1	0	1	0	0	0	0	1	1	4
398	Upper	1,582	12.8	12	15	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	0	1	0	0	1	1	6
399	Upper	1,070	16	7	21	50	1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	0	0	1	0	1	0	0	0	1	1	1	6
400	Upper	1,210	13.8	9	19	50	1	1	0	0	0	0	0	1	1	0	0	1	1	1	7
	Lower						0	1	0	1	0	0	0	1	0	1	0	1	0	0	
401	Upper	1,527	15.2	10	15	50	1	1	0	0	0	1	0	1	0	1	0	0	1	1	7
	Lower						0	0	0	0	0	0	0	1	1	0	0	1	1	1	5
402	Upper	1,560	21.2	7	15	50	0	1	1	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
403	Upper	1,181	13.4	9	20	50	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	0	0	0	1	1	0	1	0	0	0	1	1	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
404	Upper	1,592	28.8	6	15	50	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	0	1	1	0	1	0	0	0	0	1	1	6
405	Upper	971	9.5	10	25	50	1	1	0	0	1	1	0	1	1	1	0	1	1	1	10
	Lower						1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
406	Upper	910	18	5	26	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
407	Upper	371	6.9	5	64	50	1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	0	0	1	0	1	0	0	0	1	1	1	6
408	Upper	490	9.2	5	49	50	1	1	0	0	0	0	0	0	1	1	0	1	0	0	5
	Lower						1	1	1	1	0	1	0	0	0	0	0	1	0	0	6
409	Upper	482	4.5	11	51	50	1	1	0	0	0	0	0	0	1	1	0	1	1	0	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	0	6
410	Upper	351	6.2	6	66	50	1	1	0	0	0	0	0	0	1	1	0	1	1	0	6
	Lower						1	1	0	0	0	1	0	0	0	1	0	1	0	0	5
411	Upper	340	6.6	5	70	50	1	1	0	0	0	0	0	0	0	1	0	1	0	0	4
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	0	0	7
412	Upper	1,563	13.3	12	15	50	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
413	Upper	1,531	18	9	15	50	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	1	1	1	0	0	0	1	0	1	1	1	8
414	Upper	1,031	14.2	7	23	50	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						1	1	1	1	0	1	0	0	0	0	0	1	1	1	8
415	Upper	781	2.1	37	30	50	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						1	1	1	1	0	0	0	0	0	1	0	1	1	1	8
416	Upper	1,599	17	9	15	50	0	1	0	0	0	0	0	0	1	1	0	1	1	1	6
	Lower						0	1	0	1	0	0	0	1	1	1	0	1	1	1	8
417	Upper	1,600	20.8	8	15	50	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
418	Upper	1,582	21	8	15	50	0	1	1	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	1	0	0	0	1	1	1	0	1	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
419	Upper	1,471	19.2	8	16	50	1	1	0	0	0	1	0	0	0	1	0	0	1	1	6
	Lower						0	1	0	1	0	0	0	0	0	1	0	1	1	1	6
420	Upper	990	19.6	5	24	50	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						1	1	1	1	1	1	0	0	0	0	0	1	1	1	9
421	Upper	1,490	19	8	17	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	1	0	1	0	0	0	0	1	1	6
422	Upper	1,551	21.1	7	16	50	1	1	0	0	1	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	1	1	0	0	0	1	0	0	1	1	7
423	Upper	1,580	27.3	6	15	50	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
424	Upper	1,261	14.8	8	18	50	0	1	0	0	0	0	0	0	1	1	0	1	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
425	Upper	1,100	18.3	6	21	50	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
426	Upper	1,229	22.3	6	19	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	0	0	0	1	0	1	0	1	0	1	1	1	7
427	Upper	1,590	30.6	5	15	50	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	1	1	1	0	1	0	0	0	0	1	1	7
428	Upper	1,387	24.6	6	17	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	1	1	1	0	1	0	1	0	1	1	1	10
429	Upper	762	8.3	9	32	50	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						1	1	0	1	0	0	1	0	1	1	0	1	1	1	9
430	Upper	981	13.9	7	24	50	1	1	0	1	0	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
431	Upper	863	13.3	6	28	50	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
432	Upper	1,102	21.7	5	21	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	0	1	1	0	0	1	0	1	0	1	1	1	9
433	Upper	930	14.9	6	25	50	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	1	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
434	Upper	954	15.2	6	25	50	1	1	1	0	0	1	0	0	0	1	0	1	1	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
435	Upper	971	19.3	5	25	50	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
436	Upper	761	10.5	7	31	50	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	0	0	1	1	1	0	0	0	1	0	1	1	1	7
437	Upper	960	16.8	6	25	50	1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	1	1	6
438	Upper	610	4.6	13	38	50	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	0	1	6
439	Upper	636	9.4	7	36	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	1	1	0	1	0	0	0	0	1	1	7
440	Upper	395	7.6	5	61	50	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	1	1	1	1	0	0	0	1	0	0	1	1	8
441	Upper	380	6.1	6	62	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	0	0	0	1	0	1	0	0	0	0	1	1	
442	Upper	1,453	22.8	6	16	50	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
443	Upper	1,151	22.1	5	21	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	1	0	1	0	0	1	1	9
444	Upper	901	10.7	8	26	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	0	1	0	0	1	1	6
445	Upper	492	6.9	7	47	50	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	1	1	0	1	0	1	0	1	0	0	1	1	
446	Upper	412	5.8	7	57	50	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
447	Upper	391	3.2	12	59	50	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
448	Upper	680	13.4	5	34	50	0	1	0	1	0	0			1	1	0	0		1	
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	1	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
449	Upper	601	11.4	5	39	50	0	1	0	1	0	0			1	1	0	1		1	
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
450	Upper	571	9.6	6	42	50	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	0	0	0	1	0	0	0	0	0	0	1	1	4
451	Upper	850	16.9	5	27	50	1	1	0	0	0	0	0	0	1	1	0	0	1	1	6
	Lower						0	1	1	1	0	1	0	0	0	1	0	1	1	1	8
452	Upper	333	2.1	16	70	50	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	0	1	6
453	Upper	442	4.8	9	53	50	1	1	0	1	0	0			1	1	0	1		1	
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	1	1	9
454	Upper	552	9	6	41	50	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
455	Upper	174	3.1	6	40	15	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	0	1	6
456	Upper	610	4.1	15	12	15	1	1	0	0	0	1	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	0	1	6
457	Upper	501	7.4	7	14	15	1	1	0	0	0	0	0	1	1	1	0	1	0	1	7
	Lower						0	1	1	0	1	1	1	1	0	0	0	0	0	1	7
458	Upper	230	2.7	9	31	15	0	1	1	0	1	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	0	0	1	0	1	0	1	0	1	0	1	7
459	Upper	420	3.8	11	17	15	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	0	0	1	1	0	1	0	1	0	1	0	1	7
460	Upper	350	5.9	6	20	15	1	0	0	0	0	0	0	1	0	1	0	1	0	1	5
	Lower						0	1	0	0	1	1	0	1	0	0	0	1	0	1	6
461	Upper	540	7.7	7	13	15	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	0	0	0	0	1	1	1	1	0	1	0	1	8
462	Upper	543	9.9	5	13	15	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	1	0	0	0	0	0	1	6
463	Upper	511	8.1	6	14	15	0	1	0	0	1	0	0	1	1	1	0	1	0	1	7
	Lower						0	1	0	0	1	1	1	1	0	1	0	1	0	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
464	Upper	360	6.7	5	20	15	1	1	0	0	0	1	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	1	0	1	0	0	0	1	8
465	Upper	991	12	8	7	15	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	0	0	0	0	0	0	0	1	5
466	Upper	790	10.9	7	9	15	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	1	1	0	1	0	1	0	1	9
467	Upper	760	12.9	6	10	15	1	0	0	1	1	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	0	0	0	0	0	0	0	1	5
468	Upper	611	3.9	16	12	15	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	1	1	1	0	0	0	1	0	1	0	1	7
469	Upper	480	7.7	6	15	15	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
470	Upper	432	6.4	7	17	15	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	0	1	1	0	0	0	1	0	1	0	1	7
471	Upper	274	5.2	5	26	15	1	1	0	1	1	1	0	0	0	1	0	1	0	1	8
	Lower						1	0	0	1	0	0	0	1	0	1	0	1	0	1	6
472	Upper	700	12.7	6	10	15	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	1	1	1	0	0	0	0	0	0	0	1	5
473	Upper	601	9.2	7	11	15	0	1	0	1	1	0	0	0	0	1	0	0	0	1	5
	Lower						0	1	1	1	1	1	1	0	0	1	0	0	0	1	8
474	Upper	492	8.7	6	15	15	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	1	1	0	1	0	1	0	1	10
475	Upper	320	4.8	7	22	15	0	1	0	0	1	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	0	1	7
476	Upper	550	8.8	6	13	15	1	1	0	0	0	0	0	0	0	1	0	0	0	1	4
	Lower						0	1	1	1	1	1	1	0	0	0	0	1	0	1	8
477	Upper	390	1.8	21	18	15	1	1	0	1	0	0	0	1	0	1	0	1	0	1	7
	Lower						1	1	0	1	0	1	1	1	0	0	0	1	0	1	8
478	Upper	500	8.4	6	14	15	1	1	0	1	1	0	0	1	0	1	0	1	0	1	8
	Lower						1	0	0	1	0	0	0	1	0	1	0	1	0	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	**Type**	**Metres**	**Kilometres**	**%**	**Gigalitres**	**GWh**	**Treecover**	**Unused land**	**Surface waterbodies**	**Run-off**	**Agricultural land**	**Human settlement**	**Air quality**	**Seismic activity**	**Road and railway**	**Power infrastructure**	**Heritage sites**	**Protected areas**	**Endangered flora**	**Endangered fauna**	**Total**
479	Upper	501	9.9	5	14	15	1	1	0	0	1	0	0	0	0	1	0	0	0	1	5
	Lower						0	1	1	1	1	1	0	0	0	1	0	1	0	1	8
480	Upper	481	8.7	6	15	15	1	0	0	0	0	0	0	0	0	1	0	1	0	1	4
	Lower						0	1	1	0	1	1	0	0	0	1	0	0	0	1	6
481	Upper	440	8.4	5	16	15	0	1	0	1	1	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	0	0	0	0	0	1	0	1	6
482	Upper	780	4.5	17	9	15	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	0	0	1	0	0	0	0	1	1	0	1	1	1	6
483	Upper	1,015	10.1	10	7	15	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	0	1	1	1	1	0	0	1	0	0	0	1	7
484	Upper	750	3.8	20	10	15	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						1	1	0	1	0	0	1	0	1	1	0	1	0	1	8
485	Upper	667	11.7	6	11	15	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	1	0	0	1	0	1	0	1	8
486	Upper	611	11.9	5	12	15	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						1	1	1	0	1	1	0	0	0	1	0	0	0	1	7
487	Upper	758	10.5	7	9	15	1	1	0	0	0	0	0	1	0	1	0	0	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
488	Upper	1,593	19.1	8	5	15	1	1	0	0	0	1	0	1	0	0	0	1	1	1	7
	Lower						1	1	0	0	0	1	0	1	0	0	0	0	1	1	6
489	Upper	1,470	14.8	10	5	15	0	1	0	0	0	0	0	1	1	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
490	Upper	1,387	6	23	5	15	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	1	1	1	0	0	1	1	7
491	Upper	1,209	14.4	8	6	15	1	1	0	0	0	0	0	1	1	0	0	1	1	1	7
	Lower						0	1	0	1	0	0	0	1	1	1	0	1	1	1	8
492	Upper	1,550	24.5	6	5	15	1	0	0	0	0	1	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
493	Upper	1,540	15.7	10	5	15	1	1	0	0	1	1	0	1	0	1	0	1	1	1	9
	Lower						1	1	0	0	0	0	0	1	0	0	0	1	1	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
494	Upper	1,588	18.2	9	5	15	1	1	0	0	0	1	0	1	1	1	0	1	1	1	9
	Lower						0	1	0	1	0	0			1	1	0	0		0	
495	Upper	1,332	14.2	9	5	15	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
496	Upper	1,583	20.3	8	5	15	1	1	1	1	0	1	0	1	1	1	0	1	1	1	11
	Lower						0	1	0	1	0	0	0	1	1	0	0	1	1	1	7
497	Upper	800	3	27	9	15	1	1	0	0	0	1	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
498	Upper	1,448	28.4	5	5	15	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
499	Upper	1,014	20.4	5	7	15	1	1	0	0	0	0	0	1	1	1	0	0	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
500	Upper	975	16.5	6	7	15	1	1	1	1	0	1	0	1	0	1	0	1	1	1	10
	Lower						0	1	0	1	0	0	0	1	0	1	0	1	1	1	7
501	Upper	1,570	17.8	9	5	15	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
502	Upper	1,600	17	9	5	15	0	1	0	1	0	1	0	0	1	1	0	1	1	1	8
	Lower						1	0	0	0	0	0	0	0	1	1	0	1	1	1	6
503	Upper	1,590	22.3	7	5	15	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
504	Upper	1,333	11.9	11	6	15	0	1	0	0	0	0	0	0	1	1	0	1	1	1	6
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
505	Upper	1,190	8.8	14	6	15	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	0	1	1	1	0	0	0	0	0	0	1	1	6
506	Upper	1,350	20.3	7	5	15	0	1	0	1	0	0	0	0	0	1	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
507	Upper	1,105	19.9	6	6	15	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	1	1	0	1	0	1	0	0	0	0	1	1	8
508	Upper	1,581	29.6	5	5	15	0	1	0	0	0	0	0	0	0	1	0	1	1	1	5
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
509	Upper	1,121	17.8	6	6	15	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	0	0	0	0	0	1	0	0	0	1	1	1	6
510	Upper	973	13.2	7	7	15	1	1	0	0	0	0	0	0	0	1	0	1	1	1	6
	Lower						0	1	0	0	1	1	0	0	0	0	0	1	1	1	6
511	Upper	600	7.3	8	12	15	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
512	Upper	1,149	22.6	5	6	15	0	1	0	1	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
513	Upper	1,004	18.8	5	7	15	1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	0	1	1	7
514	Upper	324	5.9	5	22	15	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	1	0	1	1	0	0	0	0	0	1	1	1	7
515	Upper	1,240	15.2	8	6	15	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	1	1	0	1	0	1	0	0	0	0	1	1	8
516	Upper	799	6.7	12	9	15	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	1	1	0	1	0	1	0	1	0	1	1	1	
517	Upper	738	11.8	6	10	15	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
518	Upper	1,141	20.2	6	7	15	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	1	0	1	0	0	0	0	1	1	6
519	Upper	702	11.3	6	10	15	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
520	Upper	752	15	5	10	15	1	1	0	0	0	0	0	1	0	1	0	0	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
521	Upper	373	3.1	12	19	15	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						1	1	1	1	0	1	0	0	0	0	0	1	1	1	8
522	Upper	630	11.9	5	11	15	1	1	0	1	0	0		0	0	1	0	1		0	
	Lower						0	1	0	0	1	1	0	0	0	1	0	0	1	1	6
523	Upper	622	12.1	5	11	15	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	0	0	1	1	0	0	0	1	0	1	0	1	6

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
524	Upper	311	2.6	12	22	15	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						0	1	0	0	1	0	0	0	0	1	0	1	0	1	5
525	Upper	610	12	5	12	15	1	1	0	0	0	0	0	0	0	0	0	0	1	1	4
	Lower						0	1	0	0	1	0	0	0	0	1	0	1	1	1	6
526	Upper	1,167	5.4	22	6	15	1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
	Lower						1	1	1	1	0	0	0	1	0	1	0	1	1	1	9
527	Upper	1,478	16.2	9	5	15	1	1	0	1	0	0	0	1	1	1	0	1	1	1	
	Lower						0	1	0	1	0	0			1	1	0	0		0	
528	Upper	1,431	9.8	15	5	15	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
529	Upper	1,120	3.7	30	6	15	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
530	Upper	1,299	14.3	9	5	15	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
531	Upper	1,391	15.4	9	5	15	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
532	Upper	680	7	10	4	5	1	1	0	0	0	0	0	1	0	1	0	1	0	1	6
	Lower						1	1	0	0	0	0	1	1	1	1	0	1	0	1	8
533	Upper	720	8.8	8	3	5	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	1	0	1	1	1	0	0	0	1	0	1	0	1	7
534	Upper	991	4.2	23	2	5	1	1	0	0	0	1	0	1	0	1	0	1	0	1	7
	Lower						1	1	0	1	0	0	1	1	0	1	0	1	0	1	8
535	Upper	720	8.5	8	3	5	1	1	0	0	0	0	0	1	0	1	0	0	0	1	5
	Lower						1	1	0	1	0	0	1	1	1	1	0	1	0	1	9
536	Upper	360	3.7	10	7	5	0	1	0	1	0	0	0	1	1	1	0	1	0	1	7
	Lower						1	1	0	1	1	0	1	1	0	1	0	1	0	1	9
537	Upper	790	8.1	10	3	5	1	1	0	1	0	0	0	0	1	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	0	0	1	0	1	1	1	9
538	Upper	721	13.3	5	3	5	1	1	0	1	0	0	0	0	0	1	0	1	0	1	6
	Lower						0	0	0	1	0	0	0	0	0	1	0	1	0	1	4

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
539	Upper	1,600	16.2	10	2	5	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
540	Upper	1,592	18.7	9	2	5	0	0	0	0	0	0	0	1	1	1	0	1	1	1	6
	Lower						1	1	0	0	0	0	0	1	1	1	0	0	1	1	7
541	Upper	1,413	14.9	9	2	5	1	1	0	0	0	1	0	1	0	1	0	1	1	1	8
	Lower						0	0	0	0	0	0	0	0	1	1	0	1	1	1	5
542	Upper	800	11.4	7	3	5	1	1	0	0	0	0	0	1	0	1	0	0	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
543	Upper	1,389	22.2	6	2	5	0	1	0	0	0	1	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0	0	1	1	0	0	1	1	1	7
544	Upper	1,431	23.9	6	2	5	1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
545	Upper	1,531	27.4	6	2	5	1	1	0	1	1	1	0	1	0	1	0	1	1	1	10
	Lower						0	0	0	1	0	0	0	0	1	0	0	1	1	1	5
546	Upper	831	15.4	5	3	5	1	1	0	0	0	0	0	1	1	1	0	0	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
547	Upper	370	3.7	10	6	5	1	1	0	0	0	0	0	0	0	1	0	1	0	0	4
	Lower						1	1	1	1	0	1	0	0	0	0	0	1	1	0	7
548	Upper	1,465	14.1	10	2	5	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						1	1	0	1	1	0	0	0	0	1	0	1	1	1	8
549	Upper	1,585	21.2	7	2	5	1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
	Lower						0	1	0	1	1	1	0	0	0	1	0	1	1	1	8
550	Upper	790	10.5	8	3	5	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	0	1	1	1	0	0	0	1	0	0	1	1	7
551	Upper	1,394	18.3	8	2	5	1	1	0	1	0	0	0	0	0	1	0	1	1	1	7
	Lower						0	1	1	1	1	1	0	0	0	1	0	0	1	1	8
552	Upper	763	10.2	7	3	5	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	0	1	1	1	0	1	0	0	0	0	1	1	8
553	Upper	1,538	27.7	6	2	5	0	1	0	0	1	0	0	0	0	1	0	1	1	1	6
	Lower						0	0	0	0	0	0	0	1	1	1	0	0	1	1	5

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
554	Upper	1,093	17.6	6	2	5	1	1	0	1	0	0	0	0	1	1	0	1	1	1	8
	Lower						0	1	1	1	1	1	0	0	0	0	0	1	1	1	8
555	Upper	795	15	5	3	5	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						0	1	0	1	0	0			1	1	0	0		0	
556	Upper	715	9.3	8	3	5	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						0	1	0	1	0	0			1	1	0	0		0	
557	Upper	471	7.2	7	5	5	1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
558	Upper	628	12.1	5	4	5	1	1	0	0	0	0	0	1	0	1	0	1	1	1	7
	Lower						1	1	0	0	0	0	0	1	1	1	0	1	1	1	8
559	Upper	1,161	13.2	9	2	5	1	1	0	0	0	0	0	0	1	1	0	1	1	1	7
	Lower						1	1	0	0	1	0	0	0	0	1	0	0	1	1	6
560	Upper	471	8.5	6	5	5	1	1	0	0	0	0	0	0	1	1	0	1	0	1	6
	Lower						0	1	1	0	1	1	0	0	0	0	0	0	0	1	5
561	Upper	1,228	19.8	6	2	5	1	1	0	0	0	0	0	0	1	1	0	0	1	1	6
	Lower						1	1	1	1	0	1	0	0	0	1	0	0	1	1	8
562	Upper	691	13.6	5	3	5	0	1	0	1	0	0			1	1	0	0		0	
	Lower						0	1	1	0	1	1	0	0	0	1	0	0	1	1	7
563	Upper	1,374	9	15	2	5	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
564	Upper	494	5.2	9	5	5	1	1	0	1	0	0			1	1	0	1		1	
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	1	1	9
565	Upper	600	2.7	23	2	2	0	1	0	0	1	1	0	1	0	1	0	1	0	1	7
	Lower						0	1	1	1	1	1	0	1	0	0	0	1	0	1	8
566	Upper	471	1.9	25	2	2	1	1	0	0	0	0	0	0	0	1	0	1	0	1	5
	Lower						0	1	0	0	1	0	0	0	0	1	0	1	0	1	5
567	Upper	430	1.9	23	2	2	0	0	0	1	0	0	0	0	0	1	0	0	0	1	3
	Lower						1	1	1	1	0	0	0	0	0	1	0	0	0	1	6
568	Upper	420	2.2	19	2	2	0	0	0	1	0	0	0	0	0	1	0	1	0	1	4
	Lower						1	1	0	1	0	0	1	0	0	1	0	1	0	1	7

Pairing	Reservoirs	Head	Separation	Slope	Volume	Energy	Landuse and landcover*		Water resources*		Socioeconomic context*		Environmental quality*		Infrastructure proximity*		Cultural and legal protection		Biodiversity and ecology*		EIA*
No	Type	Metres	Kilometres	%	Gigalitres	GWh	Treecover	Unused land	Surface waterbodies	Run-off	Agricultural land	Human settlement	Air quality	Seismic activity	Road and railway	Power infrastructure	Heritage sites	Protected areas	Endangered flora	Endangered fauna	Total
569	Upper	631	7.1	9	2	2	0	1	0	1	0	0			1	1	0	0		0	
	Lower						1	1	0	1	0	0	0	1	0	1	0	1	1	1	8
570	Upper	777	5.6	14	1	2	1	1	0	1	0	0	0	1	1	1	0	1	1	1	9
	Lower						0	1	0	1	0	0	0	1	0	1	0	1	1	1	
571	Upper	789	10.9	7	1	2	1	1	0	0	0	0	0	1	0	1	0	0	1	1	6
	Lower						0	1	0	1	0	0			1	1	0	0		0	
572	Upper	1,228	6	20	1	2	1	1	1	1	0	0	0	1	1	1	0	1	1	1	10
	Lower						1	1	0	1	0	0	0	1	1	1	0	1	1	1	9

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