# PROJECT DESIGN DOCUMENT (PDD) FORM FOR ARTICLE 6.4 PROJECTS

(Version 01.0)

| BASIC INFORMATION | | | |
|---|---|---|---|
| **Project title:** | Greenko AP01 Renewable Energy Storage Project | | |
| **UNFCCC project reference number:** | | | |
| **Host Party:** | India | | |
| **Other participating Parties:** | Choose a Party. | | |
| **Activity participant(s):** **(add rows if needed)** | **Type of Party** | **Name of activity participant(s)** | **Party that is to provide authorization** |
| | Host Party | Greenko AP01 IREP Pvt. Ltd | India |
| **PDD version number:** | V1.0 | | |
| **PDD completion date:** | 12/05/2024 | | |
| **Applied methodologies and standardised baselines, and their versions:** | Proposed new baseline and monitoring methodology (NM0XXX: "Storage and Supply of Renewable Electricity to the Grid through Pumped Hydro Storage") | | |
| **Sectoral scope(s):** | 01 - Energy Industries (renewable / non-renewable) | | |
| **Type of the project:** | ☒ Emission reductions activity<br>☐ Removals activity<br>☐ Combined emission reductions and removals activity | | |
| **Estimated annual emission reductions or net removals over the crediting period ($tCO_2e/year$):** | **2,178,384 ($tCO_2e/year$)** | | |

## SECTION A. Project description

### A.1. Project purpose and general description

Closed-loop renewable storage systems, when combined with grid-connected renewable energy (RE) generation projects, can deliver firm, schedulable, and dispatchable renewable power, supporting long-term energy and climate goals.

The Greenko AP01 Renewable Energy Storage Project is a greenfield development located in Kurnool District, Andhra Pradesh. As a stand-alone, off-stream, closed-loop storage facility connected to the grid, it offers long-duration energy storage suitable for a wide range of electricity use cases. This technology enables the reliable delivery of firm, schedulable, and dispatchable renewable power to end users.

Energy storage allows electricity to be stored at any desired time and for any duration, and when combined with solar, wind, or hydro power projects, it ensures a stable supply of renewable energy to the grid. By storing and shifting the delivery of renewable electricity, it displaces greenhouse gas-intensive power that would otherwise be used during those periods.

The project activity is currently designed to supply peak power between 19:00 and 24:00 by strategically integrating energy storage with solar and wind power generation.

The project activity will contribute to India’s sustainable development through the following:

- The project will deliver clean, carbon-neutral electricity to the Regional Load Dispatch Centre (RLDC) or National Load Dispatch Centre (NLDC), thereby displacing polluting and carbon-intensive fossil fuel-based electricity sources.
- Unlike conventional renewable energy (RE) generation plants, the proposed project integrates energy storage, allowing it to manage and schedule its electricity injections. Surplus RE generated during low-demand periods can be stored and supplied to the grid during peak demand, effectively enabling time-shifting of renewable energy generation.
- Increased deployment of such RE and storage technologies is essential for achieving national greenhouse gas (GHG) mitigation targets under the Paris Agreement. The proposed project will directly contribute to enhancing the country’s ability to meet its Nationally Determined Contributions (NDCs).
- The project will foster the development and dissemination of local technical expertise (“know-how”) in large-scale, environmentally sustainable electricity storage technologies. This knowledge transfer is expected to encourage other power producers to adopt similar technologies, accelerating their uptake across the country and amplifying associated environmental benefits.
- The implementation of this project is fully aligned with both national and international policies focused on accelerating the decarbonization of the economy.

### A.2. Confirmation that the project aligns with the A6.4 activity types indicated by the host Party

Yes, the project aligns with the A6.4 activity types as indicated by the host Party. Further details can be found in the official documentation provided by the Ministry of Environment, Forest and Climate Change (MoEFCC) at the following link:

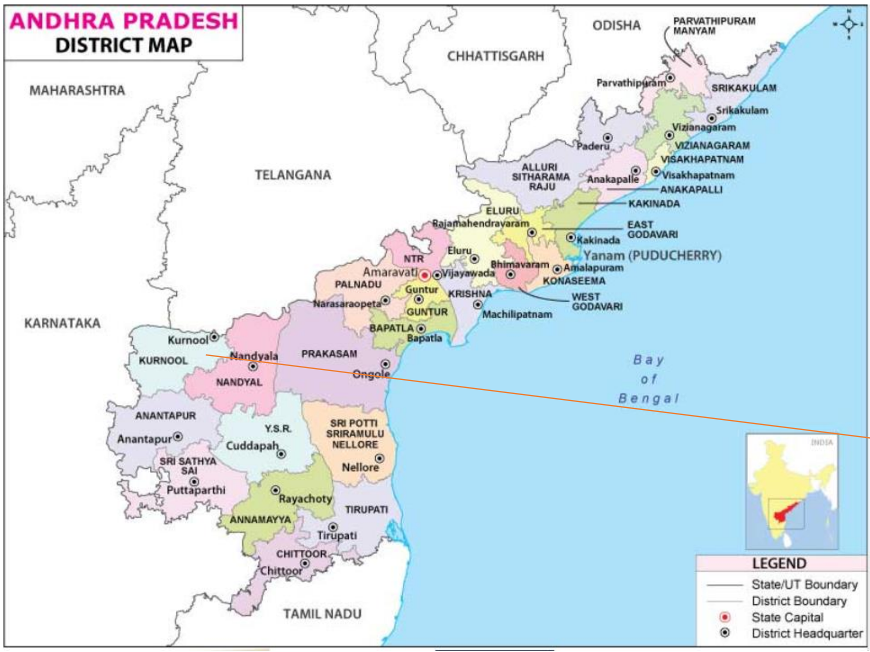
https://moef.gov.in/uploads/pdf/article_6.4.pdf

### A.3. Demonstration that the project, does not constrain, but aligns with the policies, options and implementation plans of the host Party

The project aligns with the policies, options and implementation plans of the host Party as given below: https://moef.gov.in/uploads/pdf/article_6.4.pdf

### A.4. Project location

| | |
|---|---|
| **Host Party** | India |
| **Region(s)/State(s)/Province(s)** | Andhra Pradesh (AP) |
| **Cities/towns/communities** | Pinnapuram, Kurnool |
| **Geographic coordinates** | Upper reservoir: longitude 78° 15' 13" E and latitude 15° 36' 26" N<br>Lower reservoir: longitude 78° 15' 30" E and latitude 15° 37' 26" N |
| **Map of project location** | |




Map depicting project location

## A.5. Technology/measures

### A.5.1. Existing technologies/measures prior to project implementation

The project is a greenfield initiative; therefore, there were no existing technologies or measures in place prior to its implementation.

### A.5.2. Technologies/measures implemented/deployed by the project

The greenfield Greenko AP01 Renewable Energy Storage Project consists of non-consumptive re-utilization of 1.30 TMC of water for recirculation among two reservoirs. Each reservoir (upper and lower) is of same capacity of 1.30 TMC.

Pinnapuram Renewable Energy Storage Project will thus comprise of two reservoirs being constructed in existing natural depressions with low height embankments of average height 12-14m (with maximum height 40m) to create the desired storage capacity.

This Project is standalone in nature and both the reservoirs are located away from all existing natural water systems and have no/negligible catchment area. Water will be lifted one time from existing Gorakallu Reservoir irrigation system and will be stored in the two reservoirs to be constructed and used cyclically for energy storage and discharge. Evaporation losses if any will be recouped periodically.

The Project consist of eight units and are powered by reversible turbines. The total project capacity is 1,680 MW. Based on the contractual obligation the turbines would be operated in pump mode or generator mode.

The project comprising of following components:

- Concrete lined Approach channel connecting to Intake Structure of upper reservoir.

- Rockfill embankments varying from 10m to 40m height for creation of Pinnapuram upper & lower reservoir with 1.30 TMC live storage capacity
- Intake Structure
    - Circular steel lined intake tunnel
    - Surface penstock
    - Circular steel lined Pressure Shaft each for unit
    - A surface Powerhouse having an installation of six nos. reversible Francis turbine each of 240 MW capacity (All units of variable speed turbines) and two nos. reversible Francis turbine each of 120 MW capacity (both units are variable speed turbines) operating under a rated head of 122.33 m in generating mode and 128.33 m in pumping mode.
    - Concrete lined tail race channel connecting Tail race channel to the lower reservoir.
    - Quad Moose Double Circuit Transmission Lines from PHS to Central Pooling Sub Station of PHS.
    - The ramping capability of the units is about 3% of unit size /min.

### A.5.3. Declaration related to the existence of a former project in the same geographical location

The project is a greenfield project activity and there is no former project existing in the same geographical location.

## A.6. Parties and activity participants

| Type of Party | Name of the Party | Activity participant(s) |
|---|---|---|
| Host Party | India | Greenko AP01 IREP Pvt.Ltd |

# SECTION B. Application of methodologies and standardized baselines

## B.1. References to methodologies and standardized baselines

1. Draft Methodology: Proposed new baseline and monitoring methodology (NM0XXX: “Storage and Supply of Renewable Electricity to the Grid through Pumped Hydro Storage”)
2. A6.4-MEP005-A01 - Draft Standard: Setting the baseline in mechanism methodologies (v.03.0)
3. A6.4-MEP005-A02 - Draft Standard: Addressing leakage in mechanism methodologies (v.02.0)

## B.2. Applicability of methodologies and standardized baselines

| Applicability condition in the methodological regulatory document or the methodological requirement specified by the host Party | Compliance of the project with the applicability condition in the methodological regulatory document or the methodological requirement specified by the host Party |
|---|---|
| 1. The system stores potential energy in the form of water in a reservoir (stored component) which is subsequently converted back into electricity and supplied to the grid (which may be the same grid or a different one). | The Greenko AP01 Renewable Energy Storage Project stores energy in the form of potential energy by pumping water into reservoirs. This stored water is later released to generate electricity, which is then supplied to different grids, thereby meeting the requirement. |
| 2. The generator, storage system owner/operator, and end-user of electricity may be the same entity or separate entities. | In the case of the Greenko AP01 Renewable Energy Storage Project, Greenko serves as the owner and operator of the storage facility, fulfilling the role of the storage system owner/operator as outlined in the requirement. |

| | |
|---|---|
| 3. The energy stored and subsequently supplied must be predominantly sourced from renewable generation sources. This methodology does not apply if non-renewable electricity accounts for 25% or more of the total energy stored and delivered. | The Greenko AP01 Renewable Energy Storage Project involves both renewable energy generation and storage. The energy stored and delivered by the project is entirely renewable, with less than 5% of the electricity used for pumping operations sourced from non-renewable electricity, well below the 25% threshold specified in the requirement. |
| 4. The methodology is applicable only where greenhouse gas (GHG) intensity data of the connected electricity grid is publicly available at hourly or finer time intervals for each day of the year, or where reliable annual average GHG intensity data is publicly released by the grid authority. In cases where such data is monitored in real time but released by the grid authority later (e.g., monthly or annually), the methodology remains applicable, if project verification is conducted only after the official release of the data, using the most recent publicly available figures for the relevant monitoring period. | The Greenko AP01 Renewable Energy Storage Project is connected to an electricity grid where GHG intensity data is made publicly available on a real-time basis. If such data is only released periodically (e.g., monthly or annually) by the grid authority, the project verification will be conducted only after the official release of the most recent GHG intensity data for the relevant monitoring period, in full compliance with the methodology's requirements. |
| 5. The renewable energy plant supplying electricity must have been operational for less than two years, to ensure that the project does not divert existing renewable energy and thereby avoids associated emissions. | The project activity sources electricity exclusively from renewable energy plants that have been operational for less than two years. This ensures that the electricity used is from new capacity and not diverted from existing renewable generation, thereby avoiding the risk of displacing renewable electricity that would have otherwise contributed to decarbonizing the grid. |
| 6. For pumped hydro storage plants (PHSPs) one of the following conditions must be satisfied:<br>o The project is implemented as a greenfield project involving multiple reservoirs, **with no alteration in the volume** of any reservoir; **or**<br>o The project involves the construction of new single or multiple reservoirs, and the **power density** calculated using Equation (7) is **greater than 4 W/m²**. | The project is being implemented as a greenfield project with two reservoirs (upper and lower). The power density will exceed 4 W/m², as demonstrated by the calculations, fulfilling the second condition of the requirement. |

## B.3. Project boundary, sources, sinks and greenhouse gases

1. The spatial extent of the project boundary includes the potential energy storage system and the associated generation/pumping facility.
2. It also encompasses all renewable power plants/units physically connected to the grid electricity system that the CDM project storage plant and RE generation plant are connected to.
3. Additionally, the boundary includes the grid that receives electricity generated by the project activity via wheeling or through a dedicated electricity transmission and distribution line.

### B.3.1. Baseline emissions/removals

| Source | GHG[1] | Justification/Explanation |
|---|---|---|

[1] Refer to Appendix 1 of A6.4-STAN-AC-002 and A6.4-STAN-AC-004.

| | | | |
|---|---|---|---|
| CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity | $CO_2$ | ☒ Included<br>☐ Not included | Major Emission Source |
| | $CH_4$ | ☐ Included<br>☒ Not included | Minor Emission Source |
| | $N_2O$ | ☐ Included<br>☒ Not included | Minor Emission Source |
| | ----- | ☐ Included<br>☒ Not included | Minor Emission Source |

### B.3.2. Project emissions/removals

| Source | GHG | | Justification/Explanation |
|---|---|---|---|
| Utilization of electricity from grid or from fossil fuel generators by PHS for pumped mode. | $CO_2$ | ☒ Included<br>☐ Not included | Major Emission Source |
| | $CH_4$ | ☐ Included<br>☒ Not included | Minor Emission Source |
| | $N_2O$ | ☐ Included<br>☒ Not included | Minor Emission Source |
| | ----- | ☐ Included<br>☒ Not included | Minor Emission Source |
| For PHS, emissions of CH4 from the reservoir | $CO_2$ | ☐ Included<br>☒ Not included | Minor Emission Source |
| | $CH_4$ | ☒ Included<br>☐ Not included | $CH_4$ Emissions from the reservoir |
| | $N_2O$ | ☐ Included<br>☒ Not included | Minor Emission Source |
| | ----- | ☐ Included<br>☒ Not included | Minor Emission Source |

## B.4. Establishment and description of baseline scenario

### B.4.1. Identification of the baseline scenario

1. **Baseline scenario description:**

The baseline scenario for the proposed energy storage project is based on the actual greenhouse gas (GHG) emissions from the grid during the monitoring period. It assumes that the electricity supplied to the grid by the project activity would otherwise have been generated by the operation of grid-connected power plants and the addition of new generation sources, in the absence of the project. Emissions are calculated using the hourly dispatch data analysis method to determine the emission factor, ensuring that the baseline accurately reflects the real-time behaviour of the grid.

- **Standardized Baseline:**

  No approved standardized baseline is applicable to this project. Therefore, the baseline scenario is determined using the applicable methodology and regulatory provisions.

- **Baseline Approach by Host Party:**

  The host Party (India) has not specified a baseline approach in accordance with paragraph 27(a) of the Rules, Modalities and Procedures (RMPs). Hence, the baseline has been developed using the default approach under the applied methodology.

2. **Information on Facilities, Systems, and Equipment**

   1. **Project Scenario:**

The project scenario involves a greenfield pumped hydro storage (PHS) facility that includes two newly constructed reservoirs (upper and lower), a reversible turbine system for pumping and generation, and integration with solar and wind-based renewable energy systems. The storage system enables time-shifting of renewable electricity to meet peak demand.

2. **Baseline Scenario:**

In the absence of the project, the electricity that would have been delivered during peak periods would instead be supplied by the grid. The Indian grid during these periods is primarily dominated by fossil fuel-based generation, particularly coal-fired power plants, leading to higher GHG emissions.

3. **Replacement of Existing Equipment:**

The project is a greenfield activity. Therefore, no existing equipment is being replaced, and the assessment of remaining equipment lifetime is not applicable.

3. **Step-by-Step Procedure for Baseline Emission Estimation**

**Step 1: Collection of Hourly Dispatch and Generation Data**

The project is currently in the commissioning phase and is scheduled to begin operations by June 2025. For the purpose of baseline emission calculation, the dispatch data from the previous year is used. During verification, the actual emissions data for each hour, corresponding to the time when electricity is generated and supplied to the grid, will be collected and validated by a third-party authority and used for the ex-post calculations.

**Step 2: Identification of Hourly Generation Mix**

The contribution of different generation sources to grid electricity will be determined for each hour. This includes:

- Renewable energy (solar, wind, hydro)
- Fossil fuel-based generation (coal, gas, diesel). Each source's hourly contribution will be recorded in terms of energy output and emissions.
- This data is sourced from the electricitymap platform, which utilizes official national electricity monitoring data from India for its analysis.

**Step 3: Determination of Hourly Emission Factors**

For the purpose of the ex-ante emission reduction calculation for the year 2025, dispatch data from the previous year (i.e., 2024) has been used as a reference. The relevant data set is available at the attached link.

**Step 4: Continuous Monitoring and Adjustment**

Hourly emission factors will be updated regularly over the monitoring period to reflect changes in grid generation mix. Adjustments will be made as necessary to ensure a conservative and accurate emissions estimate.

**Step 5: Calculation of Emission Factor ($EF_{DD,h,d,y}$)**

For each hour *h* on day *d* in year *y*, the Emission Factor will be calculated as outlined in Section 7.1.2 of this document. This represents the marginal emissions displaced by the project. All assumptions, data sources, and calculations will be transparently documented and made available for verification.

### B.4.2. Identification of the BAU scenario or reference benchmark

1. **BAU Scenario or Reference Benchmark Description**

The Business-As-Usual (BAU) scenario represents the most likely situation in the absence of the proposed pumped storage hydropower project. Under this scenario, the grid would continue to meet electricity demand through the existing generation mix, primarily dominated by fossil fuel-based thermal power plants. The grid's reliance on coal and gas plants for balancing and peaking needs would persist, particularly during periods of low renewable generation or high electricity demand. The BAU scenario assumes that no large-scale, long-duration energy storage solution, such as the proposed pumped hydro project, would be implemented during the project period.

This BAU scenario is identified in line with the methodological steps provided in the applied methodology and reflects current operational practices, regulatory frameworks, historical and projected emission trends in the energy sector.

**2. Step-by-Step Procedure BAU Identification**

**Step 1: Define the Project's Service or Output**

The proposed project delivers long-duration renewable energy storage that enables time-shifting of electricity generation. It allows energy (e.g., solar/wind) to be stored and dispatched to the grid when demand peaks, effectively displacing fossil-fuel generation and reducing the emissions.

**Step 2: Assess Current Practices and Trends**

Currently, the Indian electricity grid relies significantly on thermal power plants for meeting peak demand and balancing intermittent renewable generation. The project location is within a region primarily served by coal-based generation. Without the project, the grid would continue to dispatch fossil fuel-based electricity, leading to substantial GHG emissions during peak demand hours.

**Step 3: Identify Plausible Alternatives**

In the absence of the proposed pumped storage hydropower project, several plausible alternatives could be pursued to meet grid balancing and peak demand requirements:

**S1: Continuation of Existing Grid Practices without Storage Systems**

This scenario assumes no additional investment in energy storage technologies. Grid balancing is managed by continuing the current reliance on coal and natural gas power plants. This leads to potential inefficiencies during peak demand or times of surplus renewable generation due to curtailment.

**S2: Investment in Fossil Fuel-Based Power Plants**

To meet time-specific electricity demand, investments are made in the development of new fossil fuel-based generation capacity. This scenario is likely to result in increased greenhouse gas emissions and would maintain or increase the grid's reliance on non-renewable sources.

**S3: Investment in Renewable Energy with Storage Systems (BESS)**

This scenario involves the installation of solar and wind generation capacities paired with Energy Storage Systems (PHS or BESS). However, this alternative is limited by cost and scalability, which can restrict its widespread adoption. While the storage system may allow some flexibility, there is still the potential for inefficiencies or curtailment of excess renewable generation during periods of surplus power. This scenario would provide a more sustainable solution but would still face economic and operational challenges.

**S4: Investment in Small-Scale Battery Storage (BESS)**

In this scenario, there is a limited-scale installation of small battery storage systems to assist with grid balancing. However, this option is constrained by cost and scalability issues. It would only be effective for small-scale applications and would not address larger-scale grid balancing needs, leading to inefficiencies during peak demand or surplus renewable generation.

**S5: Investment in Renewable Energy without Storage**

This scenario involves the installation of renewable energy sources such as solar and wind without any energy storage systems (e.g., BESS or pumped hydro storage). The energy generated would be directly supplied to the grid, but without the capacity to store excess generation during periods of low demand. This could lead to curtailment during surplus generation times and result in inefficiencies in meeting peak demand periods, thus reducing the overall efficiency and utilization of renewable energy.

**S6: Reliance on Curtailment of Renewables during Surplus Generation Periods**

This scenario assumes that, due to the absence of large-scale storage or other balancing technologies, excess renewable generation is curtailed. This leads to inefficiencies and unnecessary emissions from renewable sources, which could have otherwise been utilized if proper storage or balancing mechanisms were in place.

**Step 4: Select the Most Likely BAU Scenario**

Among the identified alternatives, continued reliance on the current fossil-dominated generation mix is the most plausible scenario (S2). This is based on the operational and economic realities of the grid, historical reliance on fossil fuels, and the absence of grid-scale energy storage infrastructure. Therefore, in the absence of the proposed Pump Storage Project, the grid would continue to meet the electricity demand using carbon-intensive sources, resulting in significant GHG emissions.

3. **Steps for Business-as-Usual Estimation**

1. **Define the Project Output:**

The project activity involves the provision of 1,650 MW of electricity through a pumped hydro energy storage (PHES) system. This electricity is primarily dispatched during peak demand periods, effectively displacing more carbon-intensive sources that would otherwise meet this demand. The estimated average annual electricity generation is 33,19,140 MWh, and a detailed calculation of the electricity generation profile is provided in subsequent sections of this document.

2. **Historical Dispatch Data Analysis:**

To establish a robust business-as-Usual (BAU) scenario, historical hourly dispatch data from the past three years has been analysed. This data is obtained from the ElectricityMap platform, which derives its information from the Indian national grid monitoring system and provides transparent, reliable, and timestamped records of power sector emissions and dispatch patterns.

3. **Calculate Hourly Emission Trends:**

Using the hourly dispatch data, marginal emission trends have been derived by determining the emission intensity of the marginal (load-following) generating units at each hour. These trends highlight the fluctuation in emission intensity due to changes in grid mix, demand variation, and renewable energy contributions throughout the day and year.

4. **Establish Projected Margin Emission Factors:**

From the hourly emission data over the historical period, average emission factors for each hour and day are calculated to derive the projected margin emission factors. These projections represent what the emissions would likely be in the absence of the project, reflecting realistic and conservative expectations based on past grid behaviour

5. **Apply Projected Margins to Project Output:**

The hourly electricity generation expected from the project is multiplied by the corresponding projected margin emission factors to calculate the estimated BAU emissions.

## B.5. Demonstration of additionality

### B.5.1. Regulatory analysis

**1. Compliance Check**

The Greenko AP01 Renewable energy storage project ensures compliance with all applicable laws, regulations, and policies governing energy storage and supply. Key compliance measures include:

1. **Alignment with Nationally Determined Contributions (NDCs) and Long-Term Low Emission Development Strategies (LT-LEDS):** The project directly supports India's commitment to increasing renewable energy penetration and reducing reliance on fossil fuels as outlined in the NDCs and LT-LEDS.
2. **Grid Emission Reduction Targets:** The project adheres to emission reduction mandates set by the National Load Dispatch Centre (NLDC) and State Load Dispatch Centre (SLDC), facilitating enhanced grid stability and renewable energy utilization.

**2. Policy Integration**

1. The Greenko AP01 Renewable energy storage project is in alignment with India's broader energy transition policies, including the National Electricity Plan (NEP) and the National Energy Storage Mission (NESM), which promote the adoption of energy storage solutions for improved grid reliability.
2. The project leverages financial mechanisms available under the **Article 6.4 framework**, enabling it to generate carbon credits and support global climate change mitigation efforts beyond regulatory requirements.

**3. Demonstration that the Project is Beyond Regulatory Requirements**

1. **Exceeding Regulatory Mandates:** While India has supportive policies for energy storage, there are no mandatory requirements for pumped storage adoption at this scale. The project is initiated voluntarily and is not driven by compliance obligations.
2. **Overcoming Financial and Institutional Barriers:** The high capital investment and mature market for storage services  required for pumped storage projects presents a significant barrier. The project addresses this challenge through potential revenue streams from carbon credits, making it viable beyond standard regulatory incentives.
3. **Advancing Low-Carbon Technologies:** By providing large-scale energy storage, the Pinnapuram Pumped Hydro Storage Project (PHSP) plays a crucial role in reducing grid instability and renewable energy curtailment, supporting a cleaner and more efficient power system in India.
4. The Pinnapuram PHS complies with national and international regulatory frameworks while exceeding baseline regulatory requirements. By addressing key financial, technological, and institutional barriers, the project establishes additionality under Article 6.4, demonstrating its crucial role in India’s clean energy transition and decarbonization efforts.

### B.5.2. Avoidance of lock-in

A detailed analysis of the **project componentss** has been conducted to confirm the absence of lock-in risks:

| Component | Lock-In Risk Assessment | Mitigation Strategy |
|---|---|---|
| **Pumping Energy Source** | Dependency on non-renewable energy for pumping operations | The project activity avoids lock-in of the pumping energy source by sourcing electricity exclusively from renewable energy, ensured through contractual agreements. |
| **Generation Output** | PHS project may indirectly support fossil-based peak demand if not properly timed. | The project activity avoids lock-in of fossil-based generation support by synchronizing operations with periods of renewable surplus and grid demand using advanced forecasting and dispatch planning. |
| **Technology Selection for Storage and Generation** | Use of outdated or less-efficient technologies that limit future performance and emissions reductions. | Implementing modern, high-efficiency technologies and ensuring that the system can integrate with future upgrades or improvements. |
| **Project Lifetime** | Risk of technological obsolescence or degradation in system performance over time. | The system is designed to remain adaptable, allowing for the integration of future technological advancements and ensuring sustained efficiency throughout its lifetime. |

**Pumping Energy Source**:

The project avoids reliance on fossil fuels by ensuring that pumping energy is exclusively sourced from renewable energy, secured through long-term contracts or agreements. This guarantees that the environmental benefits of the hydropower project are not compromised using non-renewable electricity.

**Generation Output**:

To prevent the risk of indirectly supporting fossil-based peak demand, the project will strategically time discharges to coincide with renewable energy surpluses or periods of high demand, ensuring that fossil-fuel Peaker plants are displaced and renewable energy is prioritized for grid integration.

**Technology Selection for Storage and Generation**:

The project employs advanced, high-efficiency technologies to avoid performance limitations in the future. The system is also designed to accommodate future technological advancements, ensuring ongoing improvements in efficiency and emissions reductions.

**Project Lifetime**:

The project is designed with a long-term perspective, ensuring that the chosen technologies and infrastructure are durable and adaptable over the project's lifetime. Regular upgrades and maintenance are planned to keep the system efficient and aligned with evolving renewable energy standards, ensuring that the project continues to provide emissions reductions throughout its operational lifespan.

### B.5.3. Financial additionality or performance-based approach

☒ Financial additionality ☐ Performance-based approach

This section has been structured in accordance with the anticipated provisions of the forthcoming standard to be issued by the Article 6.4 Supervisory Body, ensuring consistency with the latest regulatory guidance and methodological expectations. It will be updated once the official standard is released.

### B.5.4. Common practice analysis

This section has been structured in accordance with the anticipated provisions of the forthcoming standard to be issued by the Article 6.4 Supervisory Body, ensuring consistency with the latest regulatory guidance and methodological expectations. It will be updated once the official standard is released.

## B.6. Addressing non-permanence and risks of reversals

### B.6.1. Identification of risk of reversal

Not applicable

### B.6.2. Reversals risk assessment

Not applicable

### B.6.3. Reversals risk mitigation plan

Not applicable

### B.6.4. Remediation of reversals

Not applicable

## B.7. Calculation of emission reductions or net removals

### B.7.1. Calculation of BAU emissions/removals and baseline emissions/removals

### B.7.1.1. Calculation of BAU emissions/removals

The BAU emissions are calculated by considering the emissions produced by the energy mix used to meet the grid demand.

$$\mathbf{BAU_y} = \sum_{d=1}^{365} \sum_{h=1}^{24} ((EG_{h,d,y}^{Delivered} * y_{\mathrm{h,d,y}}) - (EG_{h,d,y}^{Received} * x_{\mathrm{h,d,y}})) * EF_{PM,h,d,y} \quad \text{Equation (1)}$$

Where,

*$BAU_y$ = BAU emissions for year y, based on historical trends and projections of grid-connected power plants t CO2*

$EG_{h,d,y}^{Delivered}$ = Electricity delivered to grid at hour h, day d, in year y (MWh)

$EG_{h,d,y}^{Received}$ = Electricity used for pumping at hour h, day d, in year y (MWh)

$EF_{PM,h,d,y}$ = Projected Margin grid emission factor at hour h, day d, in year y ($tCO_2/MWh$)

$x_{h,d,y}$ = Fraction of received electricity that is renewable at hour h, day d, in year y (0 ≤ x ≤ 1)

$y_{h,d,y}$ = Fraction of delivered electricity that is renewable at hour h, day d, in year y (0 ≤ y ≤ 1)

Projected margin $CO_2$ emission factor at an hour 'h' on a day 'd' in year 'y' is calculated as follows ($EF_{PM,h,d,y}$)

$$\mathbf{EF_{PM,h,d,y} = EF_{h,d,N} + (\frac{1}{N-1})\sum_{y=2}^{N}(EF_{h,d,y} - EF_{h,d,y-1})} \quad \text{Equation (2)}$$

$EF_{h,d,y}$ = Average emission factor for hour h, day d, and year y (t CO2/MWh)
N = Number of years (typically 3 to 5 years)

In line with the approved methodology, this PDD applies the assumption that recent historical trends in marginal emission intensity (MEI) are indicative of future operational conditions. This forward-looking approach allows for a more accurate estimation of grid emissions that reflects the actual dispatch order of power plants and grid dynamics.

Accordingly, the marginal emission factors have been derived by analysing historical MEI data over the past 3 years. The trend observed in this dataset has been extrapolated to estimate the expected marginal emission intensity over the crediting period.

Detailed calculations, data sources, and assumptions are provided in the separate document titled "Illustrative Sample Calculation Sheet," submitted to the Methodology Expert Panel (MEP) as part of this submission package.

Hence, the Business-As-Usual (BAU) emissions, based on the trend analysis and calculations detailed in the "Illustrative Sample Calculation Sheet" submitted to the MEP, are estimated to be

$$\mathbf{BAU_y = 2,342,456\ tCO2/year}$$

### B.7.1.2. Calculation of baseline emissions/removals

The net baseline emission reductions at any hour of the day and year are as follows:

$$\mathbf{BER_y} = \sum_{d=1}^{365}\sum_{h=1}^{24}((\boldsymbol{EG_{h,d,y}^{Delivered}} * \boldsymbol{y}_{\mathbf{h,d,y}}) - (\boldsymbol{EG_{h,d,y}^{Received}} * (\boldsymbol{x}_{\mathbf{h,d,y}})) * \boldsymbol{EF_{DD,h,d,y}} \quad \text{Equation (3)}$$

$BER_{h,d,y}$ = Baseline Scenario emission reductions at an hour 'h' on a day 'd' in year 'y' (t CO2/hr)

$EG_{h,d,y}^{Delivered}$ = Electricity delivered to grid at hour h, day d in year y (MWh)

$EG_{h,d,y}^{Received}$ = Electricity used for pumping at hour h, day d, in year y (MWh)

$EF_{DD,h,d,y}$ = Dispatch Data Grid emission factor at hour h, day d, in year y ($tCO_2/MWh$)

$x_{\mathrm{h,d,y}}$ = Fraction of received electricity for pumping that is renewable at hour h, day d, in year y (0 ≤ $x$ ≤ 1)

$y_{\mathrm{h,d,y}}$ = Fraction of delivered electricity that is renewable at hour h, day d, in year y (0 ≤ y ≤ 1)

The $EF_{DD,h,d,y}$, is calculated based on the marginal emissions associated with electricity generation during the specific hours when electricity from the pumped storage project is supplied to the grid.

Given that project operations have not yet commenced, the calculations provided herein are ex-ante estimates, the hourly emission factors are estimated using historical data from the past one year (Carbon intensity data from year 2024).

This data is sourced from the Electricity Maps platform. During the monitoring period, the actual hourly emission intensity will be monitored for the hours in which electricity is supplied to the grid, and the data will be used for ex-post calculations and project verification.

The emission factor for grid-connected power generation at hour *h* on day *d* in year *y* ($tCO_2$/MWh), as detailed in the "Illustrative Sample Calculation Sheet" submitted to the MEP, is estimated to be

$$\mathbf{BER_y = 2,292,738\ tCO2/year}$$

### B.7.1.3. Calculation of the annual difference between baseline and BAU emissions/removals

Each year within the crediting period, the difference between Business-As-Usual (BAU) emissions and baseline emissions is calculated as:

$$\Delta E_y = \mathrm{BAU_y} - BER_y \qquad \text{Equation (4)}$$

Where,

$\Delta E_y$: Difference in emissions for year y ($tCO_2e$/yr)

$$\boldsymbol{\Delta E_y = 2,342,456 - 2,293,738}$$

$$\boldsymbol{\Delta E_y = 49{,}717\ \mathrm{tCO2/year}}$$

### B.7.1.4. Factors or quantitative methods for downward adjustment of baseline

In this methodology, the BaU and Baseline is not a number but a set of 7860 or more numbers i.e. emission intensity of the relevant grid at each hour (or a smaller duration) in a day during the 365 days. Accordingly, comparison of BAU and Baseline is not possible to determine downward adjustment. A conservative estimate of emission reductions can be arrived at by following the procedure below:

1. Compute the annual emission reductions attributable to the mitigation activity using BAU and Baseline emissions.
2. Chose lower amongst the two numbers representing a conservative value.

Therefore:

$$\mathbf{BE_y = min\ (BAU_y, BER_y)} \qquad \text{Equation (5)}$$

The corresponding equation is:

$$BE_y = BER_y$$

$$\boldsymbol{BE_y = 2,292,738\ \mathrm{tCO2/year}}$$

### B.7.2. Calculation of project emissions/removals

**Project emissions are calculated as follows:**

$$PE_y = PE_{FF,y} + PE_{HP,y} + PE_{grid,y} + PE_{mw,y} \qquad \text{Equation (6)}$$

Where:

| | | |
|---|---|---|
| $PE_y$ | = | Project emissions in year *y* (t $CO_2e$/yr) |
| $PE_{FF,y}$ | = | Project emissions from fossil fuel consumption in year y (t $CO_2e$/yr). |
| $PE_{HP,y}$ | = | Project emissions from water reservoirs of pumped storage plants in year *y* (t $CO_2e$/yr). |

$PE_{grid,y}$ = Emissions from charging the storage using the power from the grid or from fossil fuel electricity generators

$PE_{mw,y}$ = Project emissions due to makeup water pumped to the reservoir due to evaporation.

**1. Emissions from fossil fuel consumption at project site ($PE_{FF,y}$)**

$$PE_{FF,y} = \sum_f (Q_{f,y} * EF_{f,y} * NCV_f) \quad \text{Equation (7)}$$

Where:

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (t $CO_2$e/yr)

$Q_{f,y}$ = Quantity of fuel 'f' consumed during year 'y' (Gg/yr)

$NCV_f$ = Net Calorific Value of fuel 'f' (TJ/Gg)

$EF_{f,y}$ = Emission factor for fuel 'f'(t $CO_2$e/TJ)

The project activity is a greenfield development that operates with 100% renewable energy and does not involve any fossil fuel use at the project site. Therefore, the emissions associated with on-site fossil fuel consumption are zero.

$$\boldsymbol{PE_{FF,y} = 0}$$

**2. Emissions from water reservoirs of pumped storage projects (PEHP,y)**

The power density (*PD*) of the project activity is calculated as follows:

For pumped storage project activities that result in new single or multiple reservoirs and activities that result in the increase of single or multiple existing reservoirs, project participants shall account for $CH_4$ and $CO_2$ emissions from the reservoirs, estimated as follows:

$$PD = \frac{\sum Cap_{PJ,i}}{\sum A_{PJ,j}} \quad \text{Equation (8)}$$

$PD$ = Power density of the project activity (W/$m^2$)

$Cap_{PJ}$ = Installed capacity of the pumped storage project after the implementation of the project activity (W)

$A_{PJ}$ = Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m2)

$$PD = \frac{1680000000}{6400000}$$

$$\mathbf{PD = 262.5\ W/m2}$$

The power density of the PS project activity is 262.5 W/$m^2$ greater than 10 W/$m^2$, hence

$$\boldsymbol{PE_{HP,y} = 0}$$

**3. Emissions from charging the storage using the power from the grid ($PE_{grid,y}$)**

$$\mathbf{PEgrid_{,y}} = \sum_{d=1}^{365} \sum_{h=1}^{24} ((EG_{h,d,y}^{Delivered} * (1 - y_{h,d,y})) - (EG_{h,d,y}^{Received} * (1 - x_{h,d,y}))) * EF_{DD,h,d} \quad \text{Equation (9)}$$

Where:
$PE_{grid,y}$ = Project emissions due to electricity used for charging the storage system from the electricity grid in year 'y'(t $CO_2$e/yr)
$EG_{h,d,y}^{Delivered}$ = Electricity delivered to grid at hour h, day d, in a year y (MWh)
$EG_{h,d,y}^{Received}$ = Electricity used for pumping at hour *h*, day *d*, in a year y (MWh)
$EF_{DD,h,d,y}$ = Dispatch Data Grid emission factor at hour h, day d, in a year y ($tCO_2$/MWh)
$x_{h,d,y}$ = Fraction of received electricity for pumping that is renewable, in a year y ($0 \leq x \leq 1$)
$y_{h,d,y}$= Fraction of delivered electricity that is renewable, in a year y ($0 \leq y \leq 1$)

The project operates with **85%** of electricity sourced from the renewable and **15%** is sourced from the non-renewable use at the project site for charging the storage. The emissions associated with the usage of grid electricity for charging the storage is explained in the Illustrative Sample Calculation Sheet" submitted to the MEP, is estimated to be

$$PE_{grid,y} = 142,943 \ tCO2/year$$

**4. Emissions due to makeup water pumped to the reservoir due to evaporation ($PE_{mw,y}$)**
Consider the project emissions due to make up water only if non-RE power is being used in pumping to the reservoir. And is calculated as follows

$$PE_{mw,y} = V_{evap,y} * SEC_{pump} * EF_{DD,h,d,y} \quad \text{Equation (10)}$$

Where:

| | | |
|---|---|---|
| $PE_{mw,y}$ | = | Project emissions due to makeup water pumped to the reservoir due to evaporation(tCO2/year) |
| $V_{evap,y}$ | = | Volume of water lost through evaporation over the year (m3/year) |
| $SEC_{pump}$ | = | Specific Energy Consumption for Pumping (MWh/m3) |
| $EF_{grid,y}$ | = | Emission factor of electricity (tCO2/MWh) |

The project operates entirely on renewable energy, without relying on or using electricity from fossil-based sources or the grid. As a result, the emissions associated with pumping makeup water to the reservoir due to evaporation are zero.

$$PE_{mw,y} = 0$$

**Project Emissions**

$$PE_y = 0$$

### B.7.3. Addressing of leakage

#### B.7.3.1. Sources of leakage

The sources of leakage include the following:

**1. Transfer of Baseline Equipment**

If project implementation involves the relocation or repurposing of low-emission infrastructure (e.g., hydro turbines) from existing applications where they were displacing fossil-based energy, the resulting emissions increase at the original location shall be considered as leakage.

**2. Competition for Resource Use**

Where project activities lead to the diversion or constrained availability of shared resources—such as land/water for reservoir construction—resulting in indirect emissions or environmental impacts, these shall be accounted as leakage.

**3. Diversion of Existing Production or Outputs**

If renewable energy used to charge storage systems would otherwise displace fossil fuel generation in another context (e.g., grid exports), and is instead diverted to the project, then the increased fossil-based generation elsewhere shall be treated as leakage.

**4. Environmental GHG Releases**

Environmental emissions resulting from storage infrastructure construction, operation, or disposal that fall outside the direct project boundary but are causally linked to the project are considered leakage. This includes:

- Methane emissions from flooded biomass in new PSH reservoirs.

#### B.7.3.2. Description of how leakage is avoided, minimized or addressed

1. **Transfer of Baseline Equipment (Applicable to Brownfield Projects)**

   The project is a greenfield activity; hence, there is no diversion or transfer of any baseline equipment from existing facilities. Therefore, this source of leakage is not applicable.

2. **Competing Resource Use**

   As a greenfield project, the activity does not utilize resources that would otherwise be employed in alternative uses. There is no competition for renewable or other critical resources, and therefore, leakage emissions due to competing resource use are considered negligible.

3. **Diversion of Existing Production or Outputs**

   Since the project is a new installation, it does not redirect existing renewable electricity or fossil-based generation from other applications. Thus, no leakage is expected from the diversion of electricity. To further ensure integrity, the project will source electricity either from newly added renewable capacity or from surplus renewable energy available during off-peak hours. If grid electricity is used, the associated emissions will be accounted for under project emissions.

4. **Environmental GHG Release**

   The project operates entirely within its defined boundary and includes design measures to monitor and control GHG emissions. There is no transportation or activity outside the boundary that could cause unintended GHG leakage. A Life Cycle Assessment (LCA) has been conducted, and all identifiable emissions are transparently accounted for during project verification, confirming that environmental GHG leakage risks are effectively minimized.

| Leakage Source | Assessment |
|---|---|
| **Transfer of Baseline Equipment** | Not applicable. The project is a greenfield development with no diversion or transfer of baseline equipment from existing facilities. |
| **Competing Resource Use** | No significant leakage. The project does not utilize resources that would otherwise be used in alternative activities; hence, resource competition is negligible. |

| | |
|---|---|
| **Diversion of Existing Production or Outputs** | No diversion occurs. The project does not redirect existing renewable or fossil-based electricity. Electricity will be sourced from new or surplus renewable capacity; grid emissions, if any, are accounted for. |
| **Environmental GHG Release** | Leakage is minimized. The project is confined within its boundary, with no off-site transport. Environmental safeguards and a Life Cycle Assessment (LCA) ensure all emissions are managed and transparently reported. |

### B.7.3.3. Calculation of leakage emissions

The project poses minimal leakage risks as it is a **greenfield activity** with no transfer of baseline equipment, diversion of existing production, or significant competition for resources. These aspects are reinforced by the applicability conditions, which require 100% renewable electricity (with up to 25% from the grid, whose emissions are accounted for). The project also includes safeguards to manage GHG emissions, ensuring alignment with environmental integrity and leakage prevention principles.

Therefore,

$$\mathrm{LE_y} = 0$$

### B.7.4. Calculation of emission reductions or net removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

| | | |
|---|---|---|
| $PE_y$ | = | Project Emissions in year y (t CO2e/yr) |
| $LE_y$ | = | Leakage Emissions in year y (t CO2e/yr) |
| $ER_y$ | = | Net Emission Reduction’s due to storage in year ‘y’ (t CO2e/yr) |

$$ER_y = BE_y - PE_y - LE_y$$

$$\boldsymbol{ER_y = 2,292,738 - 142,943 - 0}$$

$$\boldsymbol{ER_y = 2,149,795\ tCO2/year}$$

### B.7.5. Data and parameters fixed ex ante

| | |
|---|---|
| **Data/parameter** | $EF_{h,d,N}$ |
| Description | Average emission factor for hour h, day d, and year y |
| Data unit | tCO2/MWh |
| Equations referred | Equation 2 |
| Purpose of data | ☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* |
| Value(s) applied | 0.658 |
| Source of data | ☐ Measured ☒ Other sources<br>*Tick the applicable box. ‘Other sources’ include official statistics, expert judgment, proprietary data, IPCC, commercial and scientific literature, etc.* |
| Choice of data or measurement methods and procedures | The emission factor is estimated from historical hourly grid dispatch and emissions data. The calculation involves averaging hourly marginal emission factors over a baseline period (typically 3–5 years). |

| | |
|---|---|
| Additional comments | The projected margin is used to represent expected marginal emissions from fossil-based generation displaced by the project. This value must be updated periodically (e.g., every crediting period) using the most recent 3–5 years of data. |

| Data/parameter | N |
|---|---|
| Description | Number of historic years considered for the calculation of BAU |
| Data unit | tCO2/MWh |
| Equations referred | Equation 2 |
| Purpose of data | ☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* |
| Value(s) applied | *2* |
| Source of data | ☐ Measured ☒ Other sources<br>*Tick the applicable box. 'Other sources' include official statistics, expert judgment, proprietary data, IPCC, commercial and scientific literature, etc.* |
| Choice of data or measurement methods and procedures | Typically, 3–5 years. |
| Additional comments | This value must be updated periodically (e.g., every crediting period) using the most recent 3–5 years of data. |

| Data/parameter | $Cap_{PJ}$ |
|---|---|
| Description | Installed capacity of the pumped storage project after the implementation of the project activity |
| Data unit | Watt |
| Equations referred | Equation 8 |
| Purpose of data | ☐ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* |
| Value(s) applied | 1680000000 |
| Source of data | ☐ Measured ☒ Other sources<br>*Tick the applicable box. 'Other sources' include official statistics, expert judgment, proprietary data, IPCC, commercial and scientific literature, etc.* |
| Choice of data or measurement methods and procedures | Installed capacity based on manufacturer's specifications or recognized standards |
| Additional comments | No comments |

| Data/parameter | $A_{PJ}$ |
|---|---|
| Description | Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full |
| Data unit | $m^2$ |
| Equations referred | Equation 8 |

| | |
|---|---|
| Purpose of data | ☐ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* |
| Value(s) applied | 6400,000 |
| Source of data | ☐ Measured ☒ Other sources<br>*Tick the applicable box. 'Other sources' include official statistics, expert judgment, proprietary data, IPCC, commercial and scientific literature, etc.* |
| Choice of data or measurement methods and procedures | Value based on manufacturer's specifications or recognized standards |
| Additional comments | No comments |

### B.7.6. Summary of ex ante estimates of emission reductions/net removals

| Year | Baseline emissions/removals ($tCO_2e$) | Project emissions/removals ($tCO_2e$) | Leakage emissions ($tCO_2e$) | Emission reductions/Net removals ($tCO_2e$) |
|---|---|---|---|---|
| Year 1 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 2 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 3 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 4 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 5 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 6 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 7 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 8 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 9 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| Year 10 | 2,292,738 | 142,943 | 0 | 2,149,795 |
| **Total** | 22,927,380 | 1,429,430 | 0 | 21,497,950 |
| **Total number of years in the crediting period** | 10 | | | |
| **Annual average over the crediting period** | 2,292,738 | 0 | 0 | 2,149,795 |

## B.8. Monitoring Plan

### B.8.1. Data and parameters to be monitored

| | |
|---|---|
| **Data/parameter** | $EG_{h,d,y}^{Delivered}$ |
| Description | Amount of electricity delivered to grid at hour *h*, day d, in a year y |
| Data unit | MWh/hr |
| Equations referred | Equation 1, Equation 3 and Equation 9 |

| | | |
|---|---|---|
| Purpose of data | ☒ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions | |
| Measurement methods and procedures | Measured using calibrated electricity meters installed at the grid interconnection point. Readings must be recorded continuously with at least hourly resolution. | |
| Entity/person responsible for the measurement | Project proponent/plant operator (as applicable) | |
| Measuring instrument(s) | *Type of instrument* | Digital energy meter (grid-compliant) |
| | *Accuracy class* | Class 0.5s or better (as per IEC 62053-22 or equivalent) |
| | *Calibration requirements* | Calibrated annually or as per manufacturer/grid code |
| | *Location* | At the grid export metering point (typically at the substation or plant interconnection) |
| Measurement intervals | Continuous measurement, with automated hourly recording and data logging | |
| QA/QC procedures | Regular calibration and maintenance of meters; comparison with SCADA/utility data; backup logging system in case of data loss. Anomalies flagged and corrected in accordance with approved data handling protocol | |
| Additional comment | No comments | |

| **Data/parameter** | $EG_{h,d,y}^{Received}$ | |
|---|---|---|
| Description | Amount of electricity used for pumping at hour h, day d, in year y | |
| Data unit | MWh/hr | |
| Equations referred | Equation 1, Equation 3 and Equation 9 | |
| Purpose of data | ☒ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions | |
| Measurement methods and procedures | Measured using calibrated electricity meters installed at the grid interconnection point. Readings must be recorded continuously with at least hourly resolution. | |
| Entity/person responsible for the measurement | Project proponent/plant operator (as applicable) | |
| Measuring instrument(s) | *Type of instrument* | Digital energy meter (grid-compliant) |
| | *Accuracy class* | Class 0.5s or better (as per IEC 62053-22 or equivalent) |
| | *Calibration requirements* | Calibrated annually or as per manufacturer/grid code |
| | *Location* | At the grid export metering point (typically at the substation or plant interconnection) |
| Measurement intervals | Continuous measurement, with automated hourly recording and data logging | |
| QA/QC procedures | Regular calibration and maintenance of meters; comparison with SCADA/utility data; backup logging system in case of data loss. Anomalies flagged and corrected in accordance with approved data handling protocol | |
| Additional comment | No comments | |

| **Data/parameter** | $y_{\mathrm{h,d,y}}$ | |
|---|---|---|
| Description | Fraction of delivered electricity that is renewable at hour h, day d, in year y | |
| Data unit | % | |
| Equations referred | Equation 1, Equation 3 and Equation 9 | |
| Purpose of data | ☒ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* | |
| Measurement methods and procedures | | |
| Entity/person responsible for the measurement | Project proponent/plant operator (as applicable) | |
| Measuring instrument(s) | *Type of instrument* | Digital energy meter (grid-compliant) |
| | *Accuracy class* | |
| | *Calibration requirements* | Calibrated annually or as per manufacturer/grid code |
| | *Location* | At the grid export metering point (typically at the substation or plant interconnection) |
| Measurement intervals | Continuous measurement, with automated hourly recording and data logging | |
| QA/QC procedures | Regular calibration and maintenance of meters; comparison with SCADA/utility data; backup logging system in case of data loss. Anomalies flagged and corrected in accordance with approved data handling protocol | |
| Additional comment | No comments | |

| **Data/parameter** | $x_{\mathrm{h,d,y}}$ | |
|---|---|---|
| Description | Fraction of received electricity that is renewable at hour h, day d, in year y | |
| Data unit | % | |
| Equations referred | Equation 1, Equation 3 and Equation 9 | |
| Purpose of data | ☒ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* | |
| Measurement methods and procedures | | |
| Entity/person responsible for the measurement | Project proponent/plant operator (as applicable) | |
| Measuring instrument(s) | *Type of instrument* | Digital energy meter (grid-compliant) |
| | *Accuracy class* | |
| | *Calibration requirements* | |

| | | |
|---|---|---|
| | *Location* | At the grid export metering point (typically at the substation or plant interconnection) |
| Measurement intervals | Continuous measurement, with automated hourly recording and data logging | |
| QA/QC procedures | Regular calibration and maintenance of meters; comparison with SCADA/utility data; backup logging system in case of data loss. Anomalies flagged and corrected in accordance with approved data handling protocol | |
| Additional comment | No comments | |

| | | |
|---|---|---|
| **Data/parameter** | $EF_{DD,h,d,y}$ | |
| Description | Dispatch Data Grid emission factor at hour h, day d, in year y | |
| Data unit | t CO2/hr | |
| Equations referred | Equation 3, Equation 9 and Equation 10 | |
| Purpose of data | ☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions<br>*Tick the applicable box(es).* | |
| Measurement methods and procedures | Emission factor is determined using actual hourly data on electricity generation and fuel-specific $CO_2$ emissions from grid-connected power plants that are on the margin at each hour. It reflects the emissions from real-time dispatch decisions. | |
| Entity/person responsible for the measurement | Grid operator or designated national/regional authority (e.g., system operator or energy regulator) | |
| Measuring instrument(s) | *Type of instrument* | Historical generation and emissions data from grid dispatch logs, emission monitoring systems, or national GHG inventory systems |
| | *Accuracy class* | Based on real-time monitored dispatch and emissions data; emission factors aligned with IPCC or country-specific sources |
| | *Calibration requirements* | - |
| | *Location* | Grid-wide, for the interconnected system where the project operates |
| Measurement intervals | Continuous measurement with hourly data recording and aggregation | |
| QA/QC procedures | - | |
| Additional comment | - | |

### B.8.2. Sampling plan

At this stage, the project is not yet commissioned. However, the project proponent will develop a detailed sampling plan before the start of monitoring, in accordance with the approved methodology and applicable guidance under the Article 6.4 mechanism

### B.8.3. Monitoring management system

>>

#### B.8.4. Post-crediting period monitoring plan

>>

## SECTION C. Start date, crediting period type and duration

### C.1. Project start date

The project is expected to begin generating electricity by July 2025. This marks the anticipated operational start of the pumped hydro storage facility, at which point it will begin contributing to emissions reductions and integrating into the grid.

### C.2. Expected operational lifetime of the project

**Expected Operational Lifetime of the Project:**

The expected operational lifetime of the Pumped Hydro Storage (PHS) project is 50 **years**.

**Justification:**

Pumped hydro storage projects are characterized by robust civil infrastructure, including reservoirs, tunnels, and penstocks, which are designed for extended use and minimal degradation over time. Globally, several PHS plants commissioned in the mid-20th century continue to operate reliably. With proper maintenance and periodic refurbishments of electromechanical components such as turbines and generators (which typically require major overhauls every 25–30 years), the full facility can remain functional for **50 years**

Considering best practices in engineering design, quality of materials, and operation and maintenance plans, an 50 ssyear lifetime is a reasonable and conservative estimate for this project.

### C.3. Project crediting period

#### C.3.1. Type of crediting period approved by the host Party

☐ Renewable ☒ Fixed

#### C.3.2. Start date of the crediting period

July 2025

#### C.3.3. Duration of the crediting period

10 Years (Fixed Crediting Period)

## SECTION D. Environmental impacts, social impacts and sustainable development impacts

### D.1. Environmental and social impacts and sustainable development impacts as per the Article 6.4 sustainable development tool

#### D.1.1. Summary of the environmental and social risk assessment and applicable mitigation measures

>>

#### D.1.2. Summary of the sustainable development impacts assessment

>>

#### D.1.3. Monitoring plan of activity-level environmental and social indicators and activity-level SD indicators

>>

### D.2. Environmental and social impacts as per the host Party regulations

#### D.2.1. Summary of host Party requirements

>>

#### D.2.2. Summary and conclusion of the assessment

>>

## SECTION E. Local stakeholder consultation

### E.1. Scope of the consultation

>>

### E.2. Stakeholders invited

>>

### E.3. Modalities for the consultation

>>

### E.4. Summary of comments received

>>

### E.5. Consideration of comments received

>>

## SECTION F. Confirmation of avoidance of double or revived registration

| | | |
|---|---|---|
| **A 6.4 mechanism** | ☒ | **The proposed A6.4 project has not been already registered as an A6.4 project.** |
| | ☒ | **The proposed A6.4 project has not been already included as a component project (CP) in a registered Article 6.4 mechanism programme of activities (A6.4 PoA).** |
| | ☒ | **The proposed A6.4 project has not been previously deregistered from the Article 6.4 mechanism.**<br>>> *Tick all the three boxes above as a confirmation of compliance with mandatory requirements.* |
| | ☒ | **The proposed A6.4 project has not been excluded from a registered A6.4 PoA.** |

| | |
|---|---|
| | *>>Tick the box if applicable.* |
| **Other** | ☒ **The proposed A6.4 project is not currently registered or being pursued for registration, or covered by a programme, under any other international, regional, national, subnational or sector-wide GHG mitigation crediting scheme.**<br>☐ **The proposed A6.4 project was previously registered under or covered by a programme under any other international, regional, national, or subnational or sector-wide GHG mitigation crediting scheme but deregistered or excluded from the other crediting scheme before fully consuming the crediting period under the other crediting scheme.**<br>☐ **The proposed A6.4 project is currently registered or covered by other international, regional, national, subnational or sector-wide GHG mitigation crediting scheme.**<br>*>> Tick only one applicable box.* |

## Appendix 1. Contact information of activity participants

*(Copy this table for each activity participant)*

| | |
|---|---|
| **Organization name** | Greenko AP01 IREP Pvt.Ltd |
| **Country** | Choose an item. |
| **Address** | Plot No.12, Hitech City, Madhapur,<br>Hyderabad – 500081, Telangana, INDIA |
| **Telephone** | 04040303280 |
| **Mobile** | 9820135929 |
| **E-mail** | mailto:rambabu.p@greenkogroup.com |
| **Website** | https://www.greenkogroup.com/ |
| **Contact person** | Dr. Rambabu Paravastu |

## Appendix 2. Applicability of methodologies and standardized baselines

1. Draft Methodology: Proposed new baseline and monitoring methodology (NM0XXX: Renewable energy storage and supply to the electricity grid)
2. A6.4-MEP005-A01 - Draft Standard: Setting the baseline in mechanism methodologies (v.03.0)
3. A6.4-MEP005-A02 - Draft Standard: Addressing leakage in mechanism methodologies (v.02.0)

## Appendix 3. Further background information on ex ante calculation of emission reductions or net removals

>>

## Appendix 4. Summary of post-registration changes

>>

## Appendix 5. Further background information on monitoring plan

>>

## Appendix 6. A6.4 Environmental and Social Safeguards Risk Assessment Form (A6.4-FORM-AC-015)

>>

## Appendix 7. A6.4 Environmental and Social Management Plan Form (A6.4-FORM-AC-016)

>>

## Appendix 8. A6.4 Sustainable Development Impact Form (A6.4-FORM-AC-017)

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# ATTACHMENT. Instructions for completing this form

# 1. General instructions

## 1. Compliance of project design with requirements

1.1 When completing this form for a proposed Article 6.4 project (hereinafter referred as proposed project), demonstrate the compliance with relevant requirements in: [2]

(a) The "Article 6.4 activity standard for projects";

(b) The Tool: "Article 6.4 sustainable development tool";

(c) The applied methodologies;

(d) The applied standardized baselines, where applicable; and

(e) Any other standards, methodologies, methodological tools and guidelines applied in accordance with the applied methodologies (hereinafter "any other standards, methodologies, methodological tools and guidelines to be applied in accordance with the applied (selected) methodologies" are collectively referred to as the other (applied) methodological regulatory documents);

(f) Methodological requirements that may be specified by the host Party in accordance with paragraph 27(a) of the rules, modalities and procedures (RMPs) for the Article 6.4 mechanism.[3]

## 2. Documenting post-registration changes

2.1 When documenting the changes that occurred to the project in accordance with the applicable provisions relating to post-registration changes:

(a) Prepare two versions of the PDD using this form, one in clean version and the other version indicating the changes to the previously approved PDD (i.e. the PDD at registration, renewal of the crediting period or the last post-registration change, whichever the latest) in track-change;

(b) Provide a summary of the changes in Appendix 4 below.

## 3. Confidential information

3.1 Where a PDD contains information that the activity participants wish to be treated as confidential/proprietary, submit the PDD in two versions:

(a) One version where all parts containing confidential/proprietary information are made illegible (e.g. by covering those parts with black ink) to be made publicly available without displaying confidential/proprietary information;

(b) Other version containing all information that is to be treated as confidential/proprietary by all parties handling this documentation (designated operational entities (DOEs), Supervisory Body members and alternate members, panel members, external experts requested to consider such documents in support of work for the Supervisory Body, and the secretariat).

3.2 Information is not considered proprietary or confidential if it is used to:

(a) Demonstrate additionality;

(b) Describe the application of the selected methodologies, standardized baselines and the other methodological regulatory documents; and

(c) Support the social, environment and sustainable development impact assessments.

(d) Make any data, values and formulae included in spreadsheets accessible and verifiable.

## 4. Working language

(a) Complete this form in English;

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[2] The "Rules and Regulations" section of the UNFCCC Article 6.4 mechanism website (https://unfccc.int/process-and-meetings/bodies/constituted-bodies/article-64-supervisory-body/rules-and-regulations) contains all regulatory documents for the Article 6.4 mechanism, such as standards (including methodologies and standardized baselines), procedures, methodological tools, guidelines, clarifications and forms that are applicable to the A6.4 activities.

[3] Annex to decision 3/CMA.3.

(b) Prepare all attached documents in English, or provide full translation to English of relevant sections of documents if their originals were prepared in other language.

## 5. Format and lay-out of the form

(a) Complete this form using the same format without modifying its font, headings or logo, and without any other alteration to the form;

(b) Do not modify or delete tables and their columns in this form. Add rows of the tables as needed;

(c) Add additional appendices as needed.

## 6. Sections not applicable

6.1 If a section of this form is not applicable, explicitly state that the section is left blank intentionally.

## 7. Other instructions

7.1 Use an internationally recognized format for presentation of values. For example, use digits grouping in thousands and mark a decimal point with a dot (.), not with a comma (,).

7.2 Complete this form removing this Attachment.

## 8. Acronyms

8.1 The following acronyms are referred to in this form:

(a) PDD: project design document;

(b) Activity standard: Article 6.4 activity standard for projects;

(c) Sustainable development tool: Tool: Article 6.4 sustainable development tool.

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### Document information

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