RENEWABLE ENERGY PROJECT DEVELOPMENT PLAN

Green Energy Acceleration Targets 2025-2030
GREAT 2025-2030

December 2024

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1. INTRODUCTION

This report was compiled by a committee comprising members of the Ceylon Electricity Board (CEB) and the Sri Lanka Sustainable Energy Authority (SLSEA), appointed by the Secretary of the Ministry of Energy, to develop a renewable energy project implementation strategy and action plan for the period 2025-2030. The primary objective of this initiative was to identify possible renewable energy projects that could be implemented within the specified timeframe of 2025-2030. The goal was to increase the share of renewable energy in electricity generation while reducing overall electricity costs. This perspective ensures a more actionable and result-oriented methodology. Accordingly, the committee refined the objective to emphasize the identification and facilitation of implementable renewable energy projects within the stipulated period, tailored to the overarching goals of sustainability and cost-efficiency.

This comprehensive action plan serves as a platform and working document to achieve the objectives of the National Energy Policy, designed to support national development goals while accelerating renewable energy targets efficiently. As Sri Lanka navigates its energy transition, this action plan provides a structured pathway to meet energy demands sustainably, ensuring that development aligns with the country's clean energy ambitions.

The National Energy Policy has been strategically reorganized into three primary focus areas:

01 **Affordable and Secure, Cleaner Energy Supply:**
Ensuring the energy supply remains cost-effective, secure, and increasingly clean through diversified renewable energy sources.

02 **Smart and Sensible, People-Centric Energy:**
Promoting energy solutions that are technologically advanced yet practical, putting people's needs and accessibility at the core.

03 **Strategic Global Integration in the Energy Sector:**
Strengthening international collaborations, attracting foreign investments, and aligning Sri Lanka's energy sector with global best practices.

This action plan plays a pivotal role in achieving these objectives by providing a clear roadmap that outlines project timelines, resource allocations, and policy measures necessary for successful implementation. The plan identifies critical projects focusing on solar, wind, hydro, and emerging energy technologies while emphasizing grid readiness, digitalization, and energy storage solutions. Additionally, it addresses the need for infrastructure upgrades, transmission strategies, and stakeholder engagement to ensure the seamless integration of large-scale renewable energy projects. Together, these efforts will enable Sri Lanka to meet its energy needs sustainably, ensuring energy security, affordability, and resilience while contributing to global climate goals.

2.OBJECTIVE

The primary objective is to drive the National Energy Policy toward achieving its expected targets by identifying and implementing viable renewable energy projects. This includes formulating a comprehensive five-year action plan (2025-2030) focused on executing renewable energy development initiatives that can be seamlessly integrated into the national electricity grid. The plan aims to accelerate Sri Lanka's transition to a cleaner, sustainable energy future, aligning with the vision of a "Clean Sri Lanka with Clean Energy."

3. CAPTION FOR THE PROJECT

The committee was of the view that securing attractive financing from international donor agencies and lending institutions is crucial for the rapid implementation of projects aimed at increasing renewable energy-based electricity generation and reducing electricity costs. In this context, the Committee recognized the importance of emphasizing the climate change mitigation aspect of these projects, which should ideally be reflected in the project title to enhance its appeal to potential financiers.

Accordingly, the Committee proposes the title for this action plan as the **'Green Energy Acceleration Targets 2025–2030'** (GREAT 2025–2030) Project. This revised title effectively underscores the dual focus on renewable energy advancement and climate action, ensuring a compelling and memorable representation for stakeholders and funding channels.

RENEWABLE ENERGY PROJECT DEVELOPMENT CONTEXT

As far as the context related to renewable energy project development is concerned, SLSEA is involved in the identification of renewable energy resources and renewable energy project approval process, and CEB is involved in the matters related to grid connectivity and procuring of energy. In addition to these interventions, SLSEA is involved in the studies related to large-scale projects and land matters pertaining to such projects. Accordingly, the projects that are in the renewable energy project approval process are the primary category of projects considered for development in the stipulated period.

Additionally, large-scale projects that are in the study process were also considered. In addition to these, rooftop solar PV systems are the other category of projects for meeting the renewable energy targets. A brief account on the projects of these categories is given below.

(a). Large-scale projects

Large-scale projects are the projects greater than 10 MW capacity (generally in the capacity range of 100 MW and above), and such projects are connected to the transmission system; the existing transmission system has transmission infrastructure at 132 kV and 220 kV voltages, and there is a proposed transmission infrastructure development of 400 kV in the Northern backbone line. Large-scale projects are implemented through Power Purchase Agreements (PPAs) specific to each project.

In this report large-scale projects are referred to on individual basis in context of aligning projects for the upcoming period.

(b). Small-scale projects

Small-scale projects are generally in the capacity range of 10 MW, and such projects are connected to the distribution system at 33 kV. There is an announced Feed-in Tariff for these projects, whereby such projects are implemented through Standardized Power Purchase Agreements (SPPAs). Accordingly, the projects of this category are generally referred to as 'SPPA Projects'. Meanwhile, there have been past tenders for small-scale projects as well, where tenders were floated calling projects for different grid sub-stations. Projects of this category are referred to as 'Tender Projects' in this report. Small-scale projects (both SPPA Projects and Tender Projects) are considered on cumulative basis in this report rather than specific projects on individual basis.

(c). Rooftop solar PV/ Distributed solar PV

Rooftop solar PV projects are operated from around 1 kW to several MWs, and most of them are connected to the low voltage (230/400 V) distribution system and projects in the capacity range of 1 MW are connected to the medium-voltage (33 kV) distribution system. As rooftop solar PV systems are not connected to the transmission infrastructure, those projects are not going to be specifically included in the upcoming capacity addition in this report. Nevertheless, it is expected to go for a maximum feasible capacity addition of rooftop solar projects subject to addressing the specific constraints in that regard detailed towards the end of this report.

While solar capacities share similarities in energy generation patterns, their unique procurement methods and operational capabilities necessitate differentiated consideration as explained in Table 1. These solar categories cannot be substituted one another without implementing specific interventions tailored to their unique characteristics. Such interventions include improved grid integration strategies, enhanced visibility, and operational mandates to ensure system reliability. This distinction is crucial to optimize solar energy integration into the grid and leverage the full potential of each category.

Table 1: Solar Power Categories

	Category	Procurement	Operational Capability
01	Large scale solar projects (> 10 MW)	Ground-based or floating systems procured through tender projects	Visible and dispatchable; provides limited ancillary services support
02	Small scale solar projects (1- 10 MW)	Ground-based or floating systems procured via feed-in tariff or tender projects	Partially-visible with low dispatchability; lacks ancillary services support.
03	Rooftop solar PV/ Distributed solar PV	Rooftop systems utilizing Net Metering, Net Accounting, Net Plus, and Net Plus Plus schemes	No visibility with no dispatchability; lacks ancillary services support.

4. RENEWABLE ENERGY RESOURCE POTENTIAL

SLSEA has published Renewable Energy Resource Development Plan (RERDP) – 2024-2027. RERDP provides details of the renewable energy resources available in the country. RERDP is the guideline document for SLSEA to identify renewable energy project sites especially for large-scale projects, and also for the investors to identify projects through their own interventions especially when it comes to the small-scale projects. So, in accordance with this, the Committee considered the projects in the renewable energy project approval process of SLSEA. As that contains ample of projects to be considered for the 2025-2030 period, it necessitated no further review of RERDP in the process.

5. TRANSMISSION INTEGRATION FOR RE PROJECTS

The successful implementation of renewable energy projects requires careful planning and coordination on critical transmission infrastructure to ensure the efficient evacuation of power generated from the power plants. For each project, it is mandatory to identify and develop the necessary transmission infrastructure in parallel with the power generation facilities. This ensures that electricity generated by renewable energy projects can be reliably transported to the grid and distributed to consumers. Securing funding for these transmission infrastructure projects and ensuring their timely completion are crucial for the successful commissioning of power plants. Without reliable transmission infrastructure, even the best-designed power plants could face delays in starting operations or struggles with delivering power to the grid.

Ensuring that the necessary transmission infrastructure is developed in parallel with renewable energy projects will not only facilitate the efficient evacuation of power but also ensure that these projects can deliver reliable, sustainable energy to meet the growing demand.

In connection to the identification of transmission infrastructure development for future renewable energy projects, based on the renewable energy resources available in the country, and the identification projects in accordance with the RERDP, CEB identifies the transmission infrastructure development needs, and transmission infrastructure projects are initiated, in alignment with the Renewable Energy Development Master Action Plan (REDMAP) that has been published by the CEB.

In this process, geographical positioning of the future renewable energy project sites is considered on cluster basis. The renewable energy project clusters were revisited in this exercise in order to ensure the optimal capacity addition in the upcoming period, particularly due to the observation of the Committee that transmission infrastructure development would be one of the most critical constraints for the renewable energy capacity addition in the period 2025-2030. The clusters considered for this task are depicted in Figure 1 and their resource potential is depicted in Table 2.

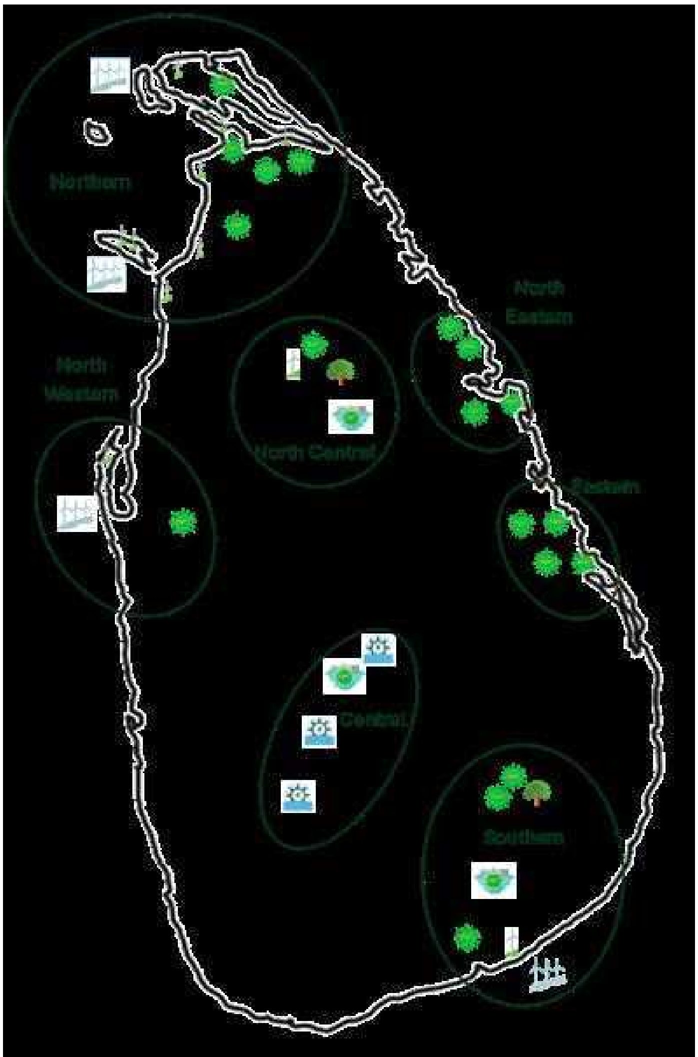


Figure 1: Renewable Energy Zones

Table 2: Zone-wise Renewable Energy Potentials considered in Transmission Capacity Projections

Renewable Energy Zone	Potential Absorption Capacity (MW)						
	Solar		Wind		Mini Hydro	Biomass	Total
	Ground Mounted	Floating	On Shore	Off Shore			
Northern	1,700	10	1,400	2,500	-	15	5,565
Northeastern	1,800	40	10	-	-	25	1,875
Northwestern	50	-	200	500	-	10	760
North Central	50	620	200	-	-	45	910
Eastern	1,200	30	-	-	-	30	1,260
Southern	400	100	50	1,000	-	60	1,5 60
Central	-	700	-	-	300	15	1,090
Total	5,200	1,500	1,860	4000	300	200	13,000

6. TRANSMISSION INFRASTRUCTURE FOR RE PROJECTS

The major transmission infrastructure developments identified for evacuating power from renewable energy projects in Sri Lanka are summarized below, with specific focus on three critical zones:

- Northeastern Zone Development
- Northern Zone (Mannar Sub-region) Development
- Northern Zone (Kilinochchi Sub-region) Development

The detailed description related to resource potential and respective transmission infrastructure development to the zone is given in Annex 1.

The major transmission lines required to absorb renewable energy projects from their RE zones are illustrated in Figure 2 and their present status and expected year of completion is presented in Table 3.

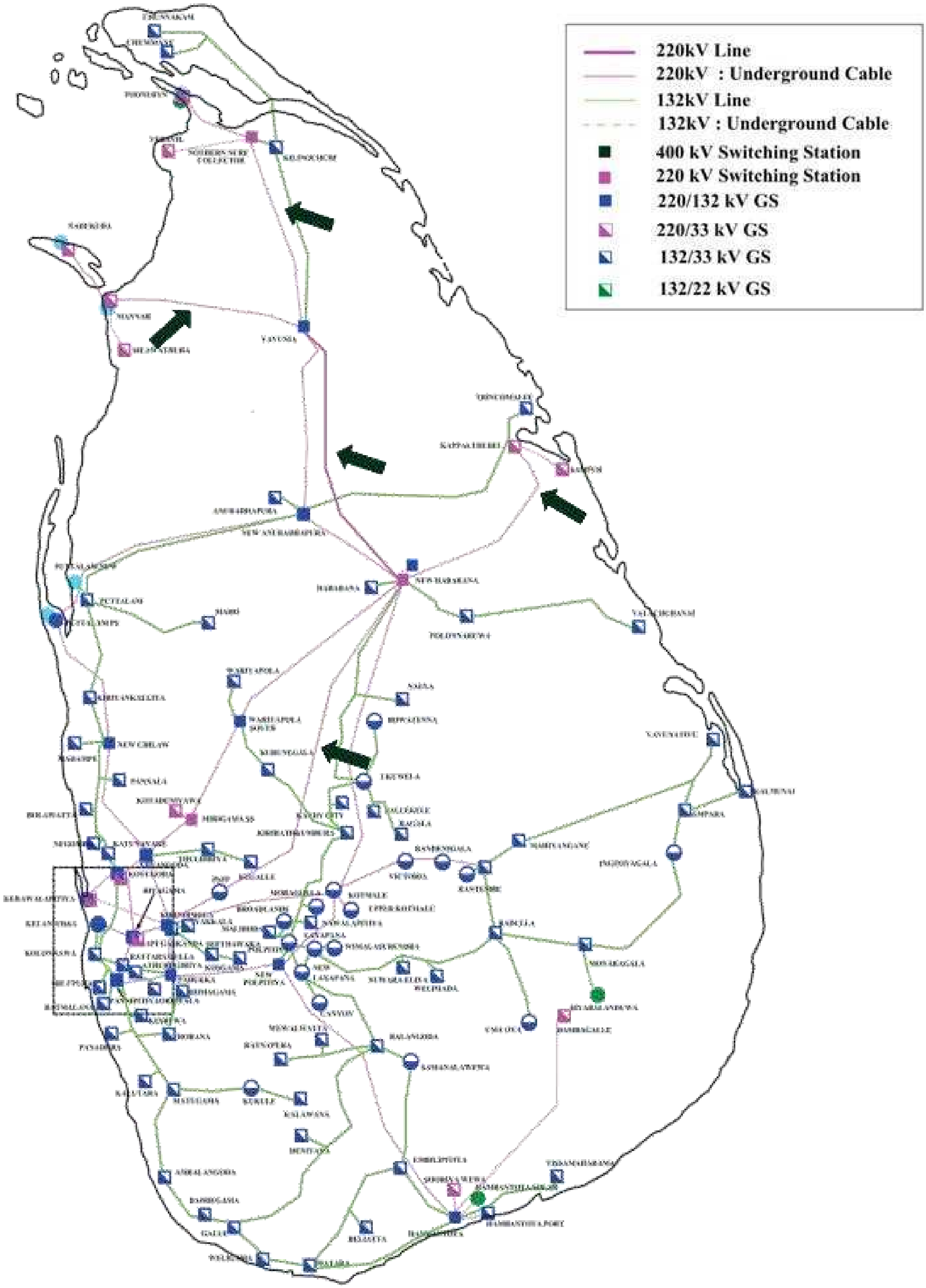


Figure 2: Expected Major Transmission Developments for RE Integration 2025-2030

Table 3: Earmarked Transmission Line Projects

Description	Proposed Intervention	Present Status	Year of Contract Award	Expected Year of Completion
220 kV New Habarana to Kappalthurei transmission line	A loan from Asian Infrastructure Investment Bank (AIIB) has been proposed	Loan is under dialogue with AIIB	2025	2028
220 kV Sampur-Kappalthurei transmission line and Sampur collector substation	A loan from Asian Infrastructure Investment Bank (AIIB) has been proposed	Loan is under dialogue with AIIB	2025	2028
Re-conductoring 220 kV Mannar-Vavuniya transmission line	Ongoing Project done by CEB	Materials Received, final stages of procurement for construction	2025	2026
220 kV Mannar to Mullikulama transmission line	Planned Project by CEB	Required to initiate Tende	2026	2028
Northen Collector-New Habarana via Vavuniya 400 kV backbone transmission line	Financial arrangements to be arranged	Required to initiate surveys, Securing of Land and Transmission Line Corridors and Seeking Financing	2027	2030
New Habarana - Maha - Kirindiwela 400 kV transmission line	Financial arrangements to be arranged	Required to initiate surveys, Securing of Land and Transmission Line Corridors and Seeking Financing	2028	2033

7. ZONE-BASED RE CAPACITY ADDITION

In view of the transmission infrastructure development being a critical factor for the upcoming renewable energy capacity addition, RE connection feasibility of each zone with the existing transmission infrastructure and additional capacity once the required upgrading is completed, are given in Table 4.

Table 4: Zone based RE Capacity Additions in next five years for Major RE Zones after upgradation of transmission facilities

Zone	Proposed Intervention		Proposed Intervention		
	Allocated for Development	Remaining Available	Additional Capacity (after upgradation)	Expected Commissioning Year	Present Status
Northern (Kilinochchi Sub Region)	12 MW (SPPA)	0 MW	900 MW (Vuvuniya 220 kV Development Northen Collector-New Habaran via Vavuniya 400 kV transmission line, Initial 220 kV operation)	2030	Financial arrangements to be arranged
Northern (Mannar Sub Region)	70 MW (50 and 20 MW Wind Tenders)	45 MW	270 MW (Reconductoring of 220 kV Mannar-Vavuniya transmission line)	2027	Ongoing
Northeastern	100 MW (SPPA, Tenders and Sampur Project)	0 MW	1000 MW (New Habarana to Kappalthurei 220 kV transmission line	2028	Funds almost committed from AIIB
Eastern	95 MW (SPPA and Tenders)	100 MW	-	-	-
Southern	350 MW (SPPA and Tenders)	0 MW	100 MW (100 MW/400 MW BESS Development)	2028	Financial arrangements to be arranged

8. ALIGNMENT OF UPCOMING PROJECTS FOR REQUIRED CAPACITY

The details of solar capacity additions of major renewable energy zones with their respective projects and expected commissioning years are shown in Table 5 and their zonal distribution is illustrated in Figure 3. The zonal variation is essential in order to reduce the impacts created through intermittency and resource adequacy during wet periods.

Table 5: Details of Capacity Additions Expected from Solar Power Projects

Zone	Project Name/ Project Category	Capacity/ Cumulative Capacity (MW)	Expected year
Northern (Kilinochchi Sub Region)	SPPA (< 10 MW)	12	2025 - 2026
	Tender (< 10 MW)	-	2025 - 2026
	Kilinochchi I	50	2029
	Kilinochchi II	100	2031
Northeastern	SPPA (< 10 MW)	20	2025 - 2026
	Tender (< 10 MW)	30	2025 - 2026
	Sampur Phase I	50	2028
	Sampur Phase II	70	2029 - 2030
	Trincomalee I	100	2029 - 2030
	Trincomalee II	100	2029 - 2030
Eastern	SPPA (< 10 MW)	50	2025 - 2026
	Tender (< 10 MW)	50	2025 - 2026
	Valaichenai	100	2027 - 2028
Southern	SPPA (< 10 MW)	260	2025 - 2026
	Tender (< 10 MW)	79	2025 - 2026
	Siyambalanduwa	100	2026
	Ridiyagama solar (Floating/Ground)	100	2029
Other Areas (Scattered)	SPPA (< 10 MW)	60	2025 - 2027
	Tender (< 10 MW)	240	2025 - 2028
Total	1,571		

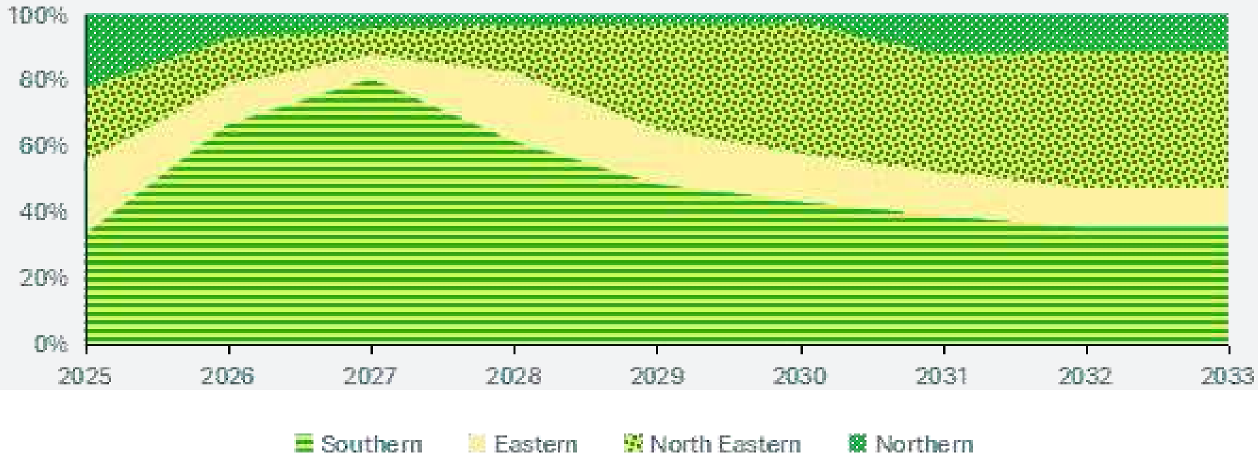


Figure 3: Zonal Distribution of Dispatchable Solar

The details of wind capacity additions of major renewable energy zones with their respective projects and expected commissioning years are shown in Table 6 and their zonal distribution is illustrated in Figure 4.

Table 6: Details of Capacity Addition expected from Wind Power Projects

Zone	Project Name / Project Category	Capacity/ Cumulative Capacity (MW)	Expected year
Northern (Kilinochchi Sub Region)	SPPA (< 10 MW)	-	2025 - 2026
	Tender (< 10 MW)	-	2025 - 2026
	Poonaryn	234	2030
	Veravil	200	2031
	Karachchi	120	2032
Northern (Mannar Sub Region)	SPPA (< 10 MW)	-	2025 - 2026
	Tender (< 10 MW)	20	2025 - 2026
	Mannar Extension	50	2026
	Mannar Phase II	250	2027
	Mullikulam	100	2028
Northwestern	SPPA (< 10 MW)	20	2025 - 2026
	Tender (< 10 MW)	10	2025 - 2026
	Kalpitiya	120	2028
Total	1,124		

The Wind power energy production is highly seasonal and majority of the annual wind energy is delivered during the high wind season from May to September. The Mannar sub region has the highest plant factor followed by the Kilinochchi region and then the Puttalam region. However, the seasonality remains the same for all available sites in Sri Lanka.

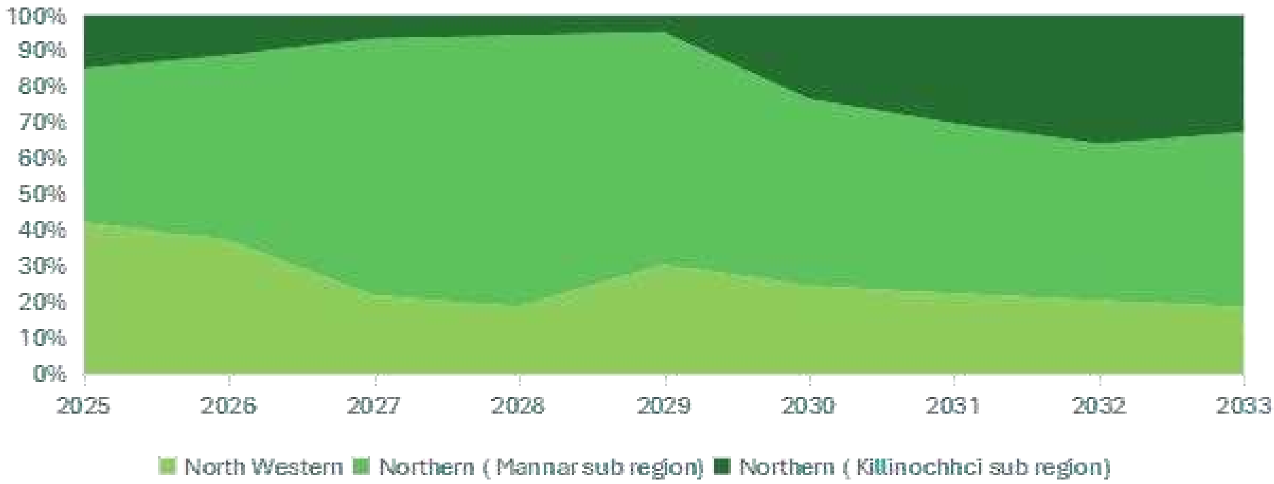


Figure 4: Zonal Distribution of Wind

Furthermore, currently a capacity of 51 MW from Mini hydro in Central Zone and 38 MW of Biomass based power plants scattered around the island is at various stages of development. Additional capacity shall be procured based on proposals received though feed in tariff schemes.

9. MAJOR INTERVENTIONS TO ENABLE RENEWABLE ENERGY GROWTH

To enable the growth of renewable energy, the integration of key grid-scale interventions such as battery energy storage systems (BESS), pumped hydro storage systems and synchronous condensers is essential. BESS will play a vital role in addressing the intermittency of renewable energy, reducing curtailments, and providing grid stability. The expected service from BESS shall include primary frequency regulation, fast frequency response, energy shifting and assisting in system restoration in the occurrence of any blackouts.

Additionally, pumped storage systems are critical for large-scale energy storage, offering grid flexibility and serving as a reliable mechanism for balancing supply and demand during peak periods. They also supply much needed inertia to the system even during pumping mode which is essential when operating the grid in high inverter based penetrations. Furthermore, synchronous condensers will be deployed to enhance grid stability by providing inertia, voltage control, and reactive power support, which are vital as the grid transitions to higher levels of renewable energy penetration. Together, these interventions form the backbone of a resilient and adaptable grid capable of absorbing significant renewable energy contributions.

A summary of these interventions which are planned as projects with the expected years of award and competition are summarized in Table 7.

Table 7: Details of Major Grid Scale Interventions

Zone	Project Name	Year of Contract Award	Expected year of Completion
Battery Energy Storage Systems	100 MW / 100 MWh BESS at Kollonawa	2025	Dec - 2025
	100 MW / 400 MWh BESS at Southern Region	2026	Jan - 2028
	100 MW / 400 MWh BESS	2027	Jan - 2029
	50 MW / 50 MWh BESS	2028	Jan - 2030
	100 MW / 400 MWh BESS	2029	Jan - 2031
	200 MW / 800 MWh BESS	2030	Jan - 2032
Pumped Hydro Storage System	600 MW PSPP at Maha Oya	2028	Jan - 2034
Synchronous Condensers	70 MVA Synchronous Condensers at Mannar	2026	Jan - 2028
	70 MVA Synchronous Condensers at New Habarana	2026	Jan - 2028
	Kelanithissa GT 7 conversion	2025	Jan - 2027

ADB financing has been received for the first utility scale BESS of 100 MW / 100 MWh at Kollonawa. Financial arrangements are required to be arranged for all other projects.

10. TIMELINES OF MAJOR PROJECTS

Aligning the development of solar and wind projects with the corresponding transmission line infrastructure is crucial to ensure the efficient evacuation of power. To achieve this, clear and well-defined project timelines are essential.

The timelines for these projects are based on key milestones, securing of land, including Cabinet Approvals, TEC Appointment, Tendering, Awarding and PPA Signing, Pre-construction Activities, Approvals and Financial Closure, Power Plant Construction, and Commissioning.

The detailed project timelines for each type of project are outlined in the following annexures

- Annex 02: Wind Projects Timelines
- Annex 03: Battery Energy Storage Timelines
- Annex 04: Pumped Hydro Storage Timelines
- Annex 05: Key Grid Interventions

These detailed timelines are designed to ensure that the development of renewable energy projects and the necessary transmission infrastructure proceed in parallel, ensuring timely and effective delivery of power to the grid.

11. LEVERAGING DIGITALIZATION FOR OVERCOMING CHALLENGES

While it is well recognized that increase of renewable energy based electricity generation capacity is essentially important for the country, it will be very important to draw attention on the limitations faced by the grid, in order to take appropriate measures for resolving the constraints.

Effects of Reduction in Demand Growth

By the end of 2023, the total installed generating capacity, including rooftop solar systems, was approximately 5,194 MW. Out of this, renewable energy sources accounted for 3,107 MW, and thermal energy contributed 2,088 MW. The peak electricity demand reached 2,415 MW in March 2023, while total net electricity generation for the year stood at 15,728 GWh. Sri Lanka's electricity market is primarily driven by the domestic sector, which accounts for 36% of the total market share. The industrial and commercial sectors share fairly equal portions of the market, with 32% and 30%, respectively. The electricity demand in Sri Lanka has shown significant fluctuations over recent years due to various external factors. The average electricity demand growth rate during past 5 years (2019-2023) is -0.6% which indicates a reduction in the demand. This negative trend reflects the impact of the COVID-19 pandemic, economic recession, and subsequent planned load shedding in 2022. These events disrupted the otherwise continuous growth in electricity demand observed over the previous two decades. Figure 5 and 6 present comparisons between the peak and energy demand forecasts of Long Term Generation Expansion Plan (LTGEP) 2023-2042 & LTGEP 2025-2044. Since LTGEP 2023-2042 was prepared prior to the economic contraction that hit Sri Lanka in 2022, there is approximately a 4 year lag in the demand between the two LTGEPs reflecting the effect of the economic recession on electricity demand.

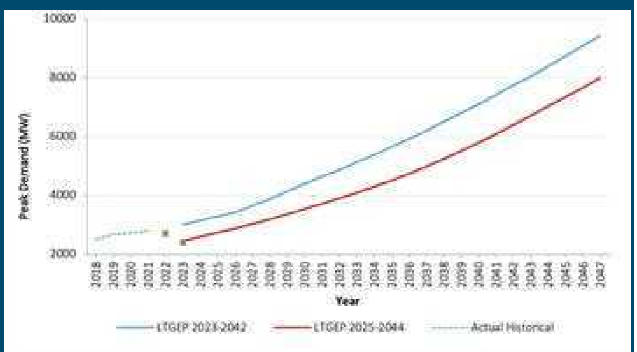


Figure 5: Growth of Peak Electricity Demand (MW)

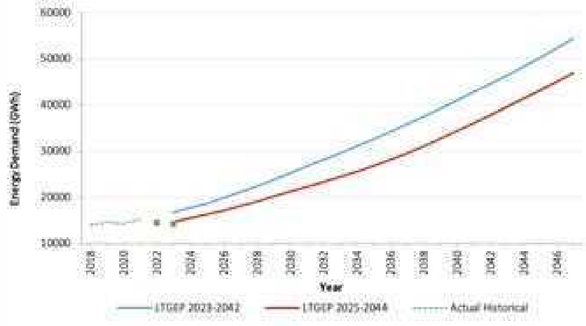


Figure 6: Growth of Energy Demand (GWh)

Further, the reduction in the renewable energy requirement due to the considerable demand reduction in the LTGEP 2025-2044 in comparison to LTGEP 2023-2042, is shown in figure 7. As exploitable hydro capacity is almost exhausted in Sri Lanka, solar and wind are the prominent renewable sources in future years. Hence it can be noted that there are significant reductions in expected solar and wind capacity additions in coming years due to diminished demand. For instance, there has been a 1,227 MW reduction in solar capacity expected in 2030 while expected reduction in wind capacity is 596 MW.

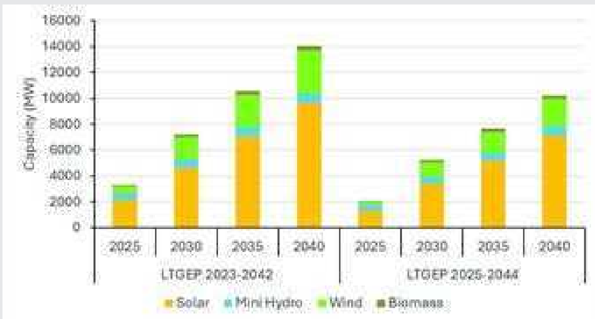


Figure 7: Renewable Energy Capacities

Additionally, the requirement for energy storage also has seen a dramatic decrease, specifically BESS. The slower rate of renewable energy penetration into the grid also delays the urgency for large-scale storage solutions to manage variability and intermittency. Hence most of the BESS proposed in LTGEP 2023-2042 has been delayed and BESS capacities also reduced as shown in Figure 8. Furthermore, the need for pump storage power plant (PSPP) has been postponed to post-2030.

This shift aligns with the revised energy strategy that prioritizes cost-effective and immediate solutions while accommodating the current economic constraints.

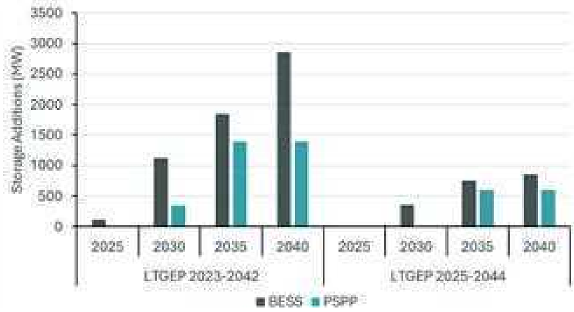


Figure 8: Storage Capacities

Figures 9 and 10 illustrate the cumulative solar and wind energy requirements outlined in the LTGEP and the availability of prospective projects up to 2032.

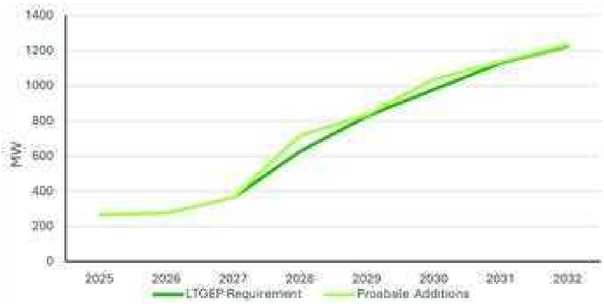


Figure 9: Cumulative Wind Capacities

The data highlights that the integration of wind energy is on target with the values projected by the LTGEP. However, while the current capacity slightly surpasses the planned targets, it is important to note that future wind energy projects will be carefully aligned with energy demands and generation requirements. This alignment will ensure that wind energy integration is optimized limiting curtailments or causing inefficiencies in system operations.

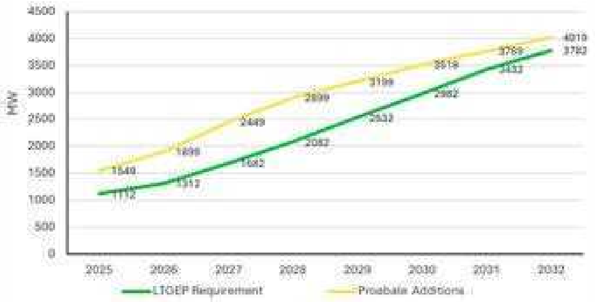


Figure 10: Cumulative Solar Capacities

The data reveals that solar energy integration has significantly exceeded the projected requirements, underscoring the rapid deployment and adoption of solar energy projects in Sri Lanka. This trend demonstrates the growing emphasis on harnessing solar power as a key contributor to the renewable energy mix. This has mainly been driven through rapid deployment of rooftop solar PV schemes which were promoted through attractive tariff rates. However, due to the surplus capacity deployed through rooftop solar installations, it has been difficult to align the other small scale and large scale solar projects as the capacity requirement under current demand projection has already been exceeded.

While the higher-than-required solar energy capacity highlights the success of past initiatives, it also signals the need for adjustments to the power system to accommodate this upward trend. Future projects must focus on integrating solar energy efficiently without compromising grid stability. This includes upgrading grid infrastructure, implementing advanced energy management systems, and incorporating storage solutions like Battery Energy Storage Systems (BESS) to mitigate the variability and intermittency of solar power generation.

Effects of Dispatch on Sundays or Holidays

The daily generation curve indicates a significant challenge arising on Sundays due to a substantial reduction in daytime peak demand. This issue is primarily attributed to the integration of over 1,350 MW of rooftop solar capacity into the system network. Unlike centralized generation sources, rooftop solar power is distributed and largely invisible and uncontrollable by the System Control Center, creating operational difficulties in maintaining grid stability. The demand reduction during the daytime peaks has caused a mismatch between generation and consumption, as evidenced by the data.

As an example, Figure 11 highlights the daily generation curve on December 15, 2024, with a daytime net demand of approximately 600 MW. These reduced demand levels pose challenges in meeting the minimum operating requirements of spinning reserves, frequency regulation and operation of base-load power plants, which are essential for grid stability. Such conditions lead to increased difficulty in balancing the grid, as excess generation from rooftop solar during low demand periods can result in frequency fluctuations, overloading, and eventually lead to black outs.

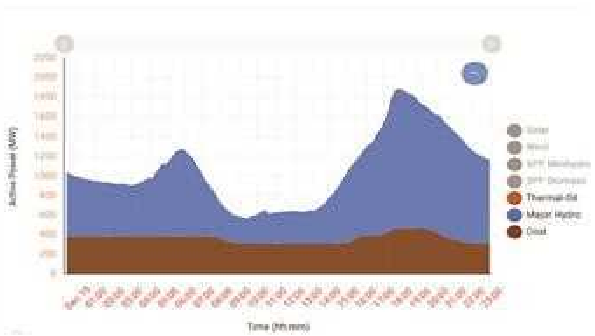


Figure 11: Net Generation on 15th December 2024

Projection of Day Time Operational Demand

According to the LTGEP and projections for probable solar integration up to 2030, it is evident that the system's minimum daytime demand requirements will fall below the anticipated solar generation capacities after 2025. The integrated solar capacity is categorized into three types: non-visible non-dispatchable solar (such as rooftop solar installations), semi-visible low-dispatchable solar, and visible dispatchable solar. Among these, non-visible non-dispatchable solar is expected to see a significant rise in penetration, as illustrated in Figure 12.

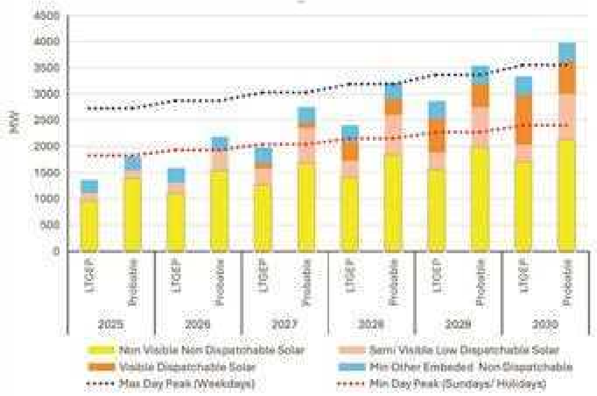


Figure 12: Comparison of LTGEP Requirements vs Probable Solar Addition Projections

The high penetration of non-visible non-dispatchable solar poses a critical challenge for the grid, as this type of generation is inherently decentralized, uncontrollable, and largely unpredictable from the perspective of the System Control Center. This issue becomes particularly pronounced on weekends, especially Sundays, when overall demand is already reduced. The resulting mismatch between high solar generation and low system demand can exacerbate grid instability by pushing the system below its minimum operational thresholds.

If the grid connected solar development is to be replaced with distribution embedded solar projects, they are required to provide grid support services with capabilities of remote managements. This requirement has largely been overlooked for rooftop solar installations, which continue to expand rapidly without any interventions. This situation poses risks to grid stability and emphasizes the need for stricter enforcement of grid support standards in future renewable energy developments.

Completion of Projects of Digitalization

01 The early introduction of a "Renewable Energy Control Desk" to the National System Control Centre

A Renewable Energy Control Desk is essential to separately manage renewable energy capacities that are going to be integrated in large proportions. The funding for the project has been secured, however considering the time requirement for procurement and implementation the earliest availability of the facility shall be in June 2026.

The Renewable Energy Control Desk shall maintain an accurate renewable energy generation forecast for the national grid. This shall include analysis of weather patterns and historical generation data and preparing regular updates to the forecast. Renewable energy forecasting requires to be done for each project site or project zone. For this purpose, a National Forecasting module is required to be integrated and automatically forecast all the necessary weather dependent input parameters (wind speed, wind direction, solar irradiance, temperature, humidity, rainfall, etc.) and derive the Active Power output of each station/zone accurately.

The renewable energy forecasting is required to have forecasting done on each potential site/zone with day ahead, intraday an intra hour resolution.

In addition, monitoring and controlling renewable energy resources shall be done through Renewable Energy Control Desk. Renewable energy scheduling with transparently allocating generation and management among different power projects is also identified as an essential requirement.

The Renewable Energy Control Desk facility shall have only visibility and certain controllability of small scale projects (1- 10 MW) and full dispatchability of only large scale solar and wind projects (> 10 MW). However, if a significant portion of solar energy is integrated through rooftop solar installations, these systems will remain neither visible nor controllable by the RE Desk facility. Addressing this limitation would require the establishment of communication channels between distributed generators and distribution control centers.

Digitalization of distributed generation through Distribution Control Centers

02

It is required to establish Distribution Control Centers (DCCs) for high density rooftop solar regions and enable digitalized communication between rooftop solar PV systems and Distribution Control Centers. This will enable accurate tracking and coordination of distributed generation output and allow real time visibility of the distributed generation as an aggregated value for the National System Control Centre. This will support centralized management and improve decision-making.

Incorporate systems within the DCC to allow selective disconnection of portions of distributed generation only during emergencies. This will ensure grid stability and mitigate risks during critical events.

Smart Meters for Distributed Generation

03 The replacement of meters or inverters which can interact with the grid and respond to signals from the operator are necessary for large scale deployment of distributed generation. It is required to assess the capabilities of existing infrastructure at distribution level and propose mandatory interventions to improve visibility and controllability of roof top solar systems.

Additionally, it is critical to ensure that all distributed generators comply with frequency ride-through requirements outlined in the grid code during commissioning. Periodic reviews should also be conducted to confirm that consumer settings remain in alignment with these standards.

The basic layout of digitalized national infrastructure for renewable energy integration is illustrated in Figure 15.

Critical Policy level Interventions

01 Allow Time of week tariff for industrial/ commercial consumers with reductions for Sundays and Holidays to incentivize.

Introduce a time-of-week tariff structure specifically for industrial and commercial consumers. This should include reduced tariffs during Sundays and holidays to incentivize day time energy usage and enhance operational flexibility.

02 Compulsory Time of Use Tariff for future Distributed Generation

Mandate a time-of-use tariff system for all future distributed generation systems. This will ensure optimal energy distribution and demand-side management. Additionally, restrict feed-in to the grid during daytime hours and encourage energy supply during alternate hours. It is important to establish a proper tariff with time of use.

03 Promote EVs with attractive rates for daytime charging

Develop initiatives to promote Electric Vehicle (EV) adoption, allowing attractive daytime charging rates to encourage EV usage. Implementing reduced tax rates for EVs and establish public EV charging infrastructure with affordable, time based tariffs for daytime charging.

04 Promote Day time Industry Operations that contribute to national growth

The planned renewable energy and firm energy projects are sufficient to meet the projected electricity demand until 2030. In order to integrate more renewable energy into the grid, it is necessary to further increase electricity demand. This can be optimally achieved by encouraging the development of new industries that operate primarily during the daytime, aligning their energy usage with peak renewable energy production. The industrial expansion will in return drive the economy through GDP growth.

05 Create Task force for Immediate implementation of identified projects in Digitalization

Establish a task force which allows the immediate implementation of Digitalization projects related to Renewable Energy Desk, Distribution Control Centers and Smart Grids in high rooftop penetration areas.

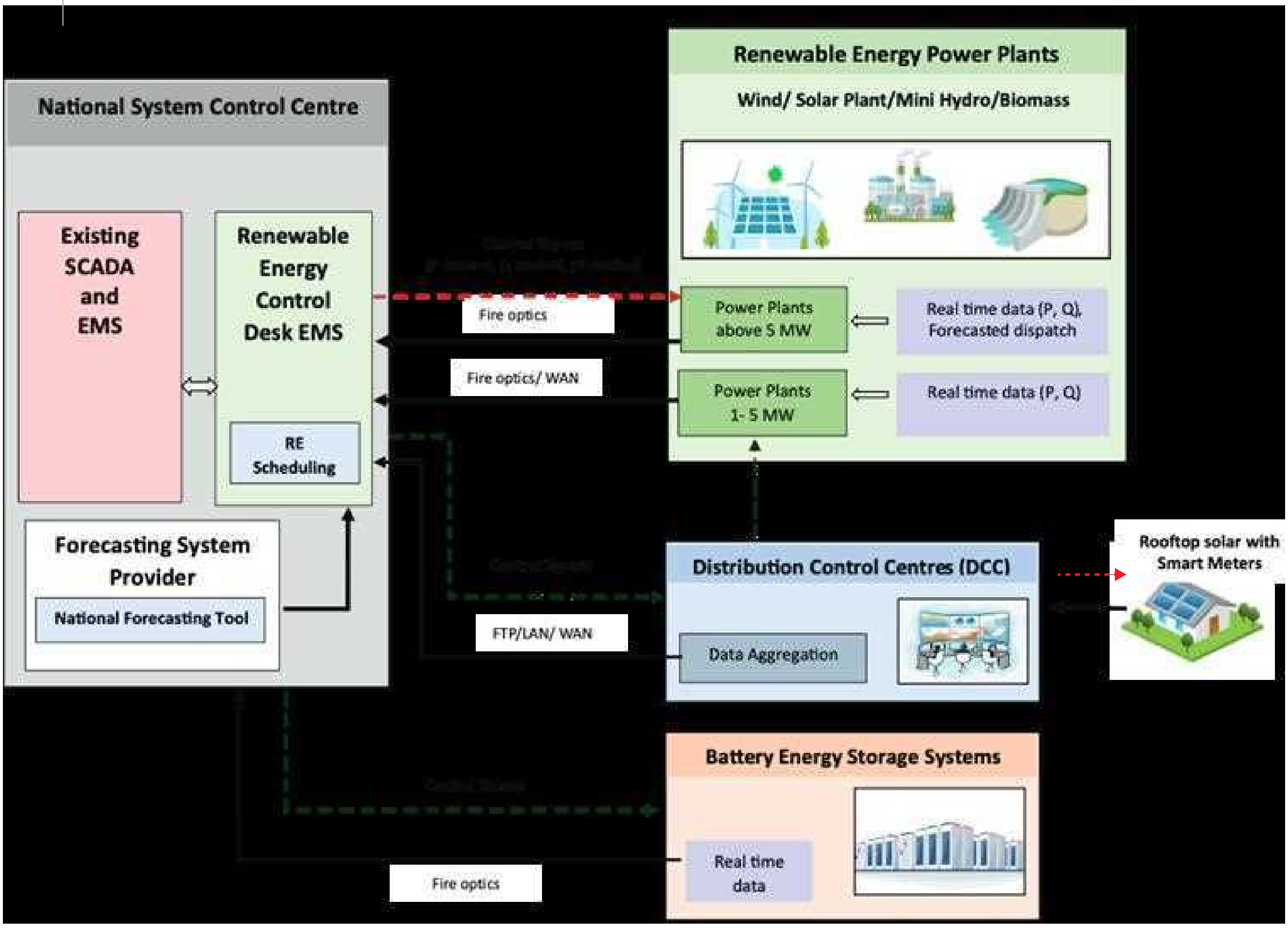


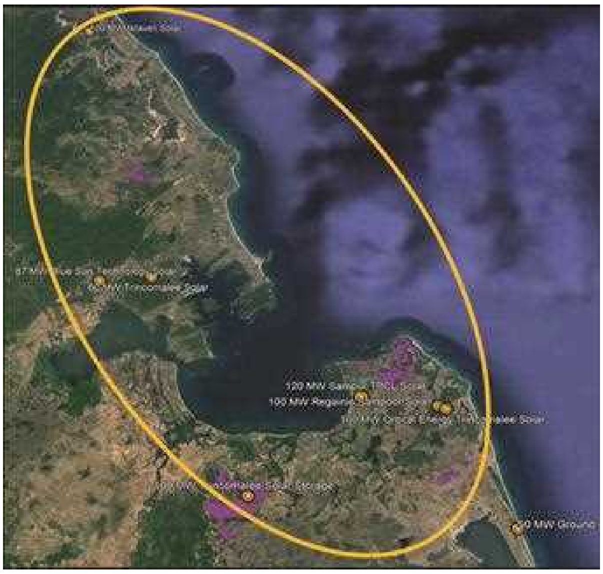
Figure 15 : Layout of Digitalized Infrastructure for RE Integration

ANNEX 1

DETAILS OF RENEWABLE ENERGY ZONES

NORTH EASTERN ZONE DEVELOPMENT

The Northeastern Zone has been identified as an area with high potential for solar energy generation, particularly for ground-mounted solar projects as shown below.



Estimated Potential

- Solar 1000+ MW

Transmission Capacity

- Present Additional Capacity Not Available
- 220 kV Development < 1000 MW

Required Transmission Developments

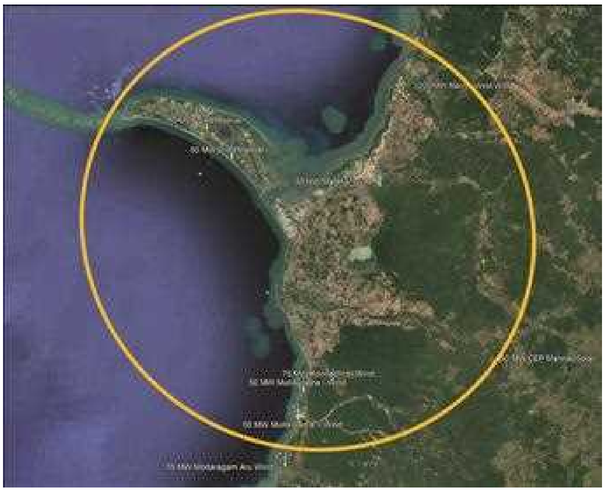
- Phase I
  - New Habarana – Kappalthurei 220kV Development
  - 220 KV Lines and Collector Substations to Large Scale Projects (✓2027/ 2028)

Prospective Projects

- Sampur Phase I - 50 MW (220 kV Sampur Kappaluturei Line ✓)
- Sampur Phase II – 70 MW
- Four Identified Potential Projects – 437 MW

NORTHERN ZONE (MANNAR SUB REGION) DEVELOPMENT

The Northern Zone, specifically the Mannar Sub-region, has been identified as another key area for renewable energy development, particularly for large-scale wind energy projects as shown in below.



Estimated Potential

- Onshore Wind 1000+ MW, Offshore Wind 1000+ MW , Solar 200+ MW

Transmission Capacity

- 220 kV Upgradation Development < 500 MW
- 400 kV Development < (1600 + 500) MW

Required Transmission Developments

- Phase I
  - Reconductoring of 220 kV Mannar-Vavuniya Line (✓2026)
  - 220 KV Lines and Collector Substations to Large Scale Projects (✓2027/ 2028)
- Phase II
  - Mannar (Thiruketheeswaran) to Vavuniya 400 kV Line

Prospective Projects

- Mannar Extension Wind 50 MW
- Mannar Phase II Wind - 250 MW
- Mannar Phase III Wind – 220 MW (Mullikulama 2 x 50 MW, Kondachchi 75 MW, Modaragam Aru 35 MW
- Manthai West 200 MW+
- Identified Potential Projects – 50 MW
- Raw Resources (1000 MW Wind, 1000 MW + offshore Wind, 200 MW Solar)

NORTHERN ZONE (KILINOCHCHI SUB REGION) DEVELOPMENT

Group 5, Grouped objectThe Kilinochchi Sub-region in the Northern Zone also presents significant opportunities for renewable energy development, including both wind and solar energy projects as shown in below

Estimated Potential

- Wind 1000 MW+
- Solar 1000 MW+

Transmission Capacity

- Present – Additional Capacity Not Available
- 220 kV Development < 900 MW
- 400 kV Development < 1600 MW

Required Transmission Developments

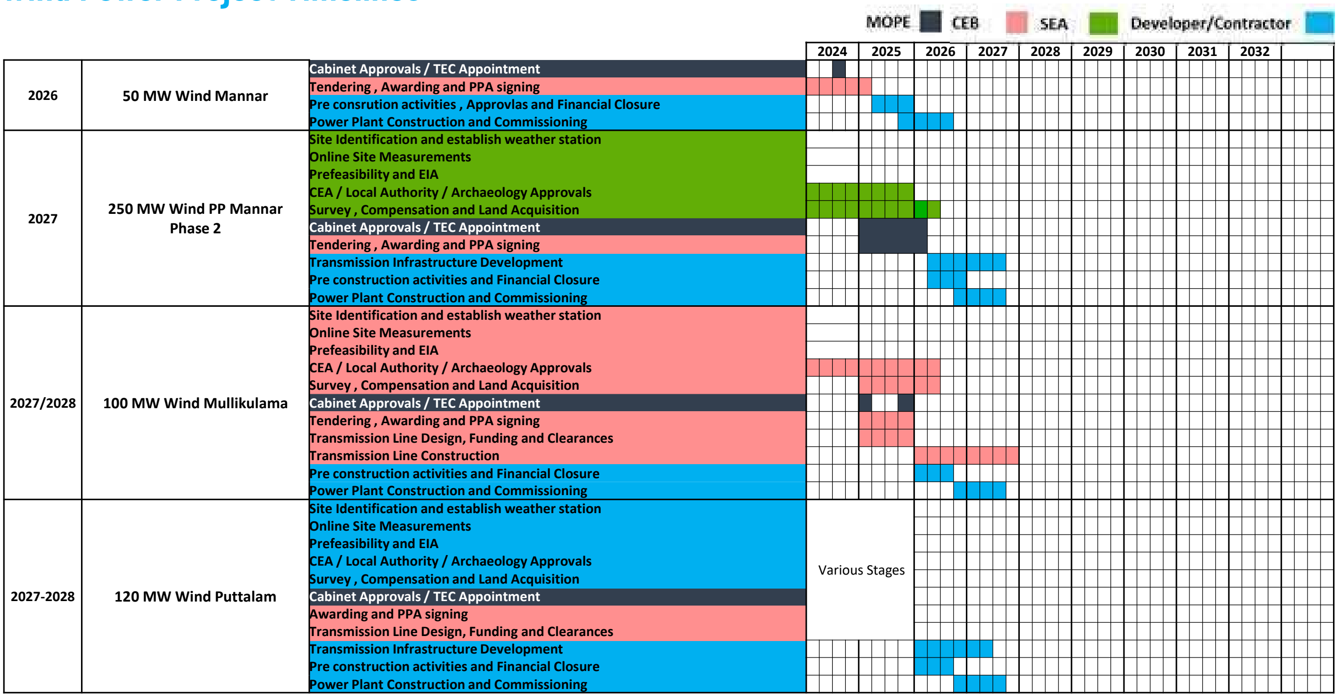
- Phase I
  - Vauniya 220kV development
  - Habarana- Vauniya- N Collector 400 kV transmission line (220kV operation) (✓2030)
  - 220 KV Lines and Collector Substations to Large Scale Projects
- Phase II
  - Construction of New Habarana – Maha – Kirindiwela 400 kV transmission Line and Construction of Maha 400 kV Switching station.
  - Construction of N Collector, Vauniya and New Habarana 400 kV switching station.

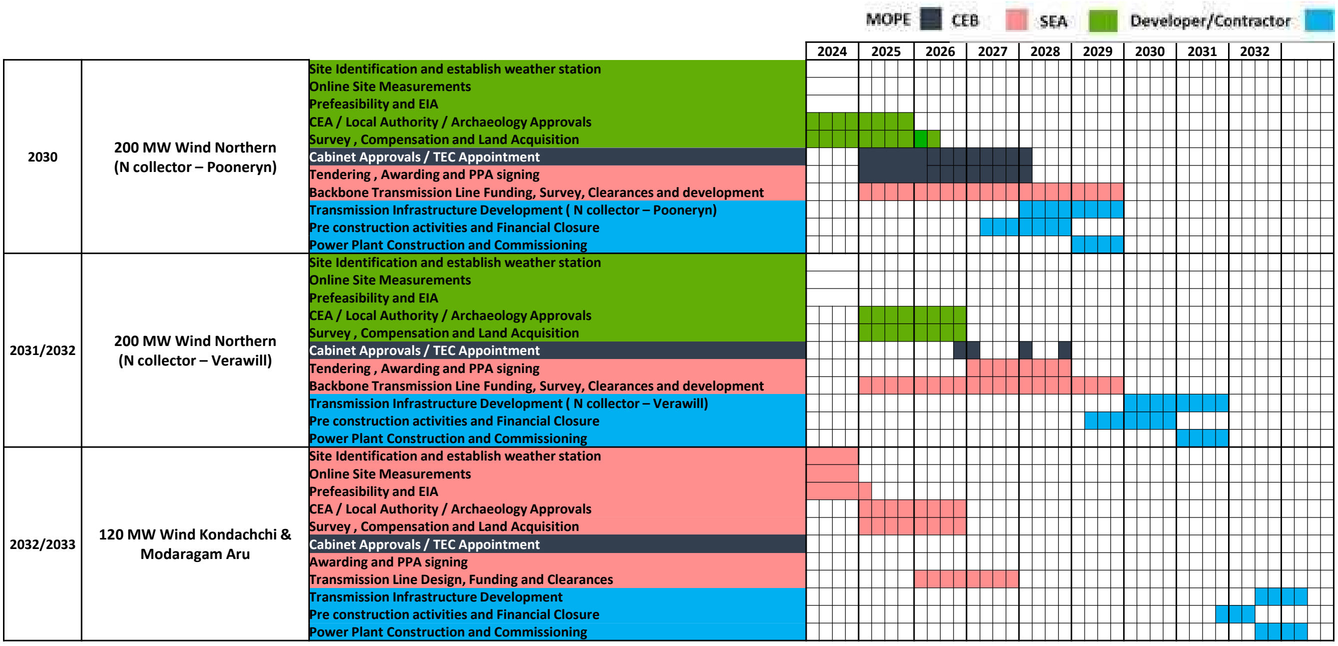
Prospective Projects

- Pooneryn Wind - 234 MW (220 kV Pooneryn to N Collector Tr line)
- Verawil Wind – 200 MW + 100 MW (220 kV Verawil to N Collector Tr line)
- Karachchi Wind – 100 MW
- Two Identified Potential Projects – 200 MW
- Raw Resources – 400 MW Wind, 1000 MW Solar

ANNEX 2

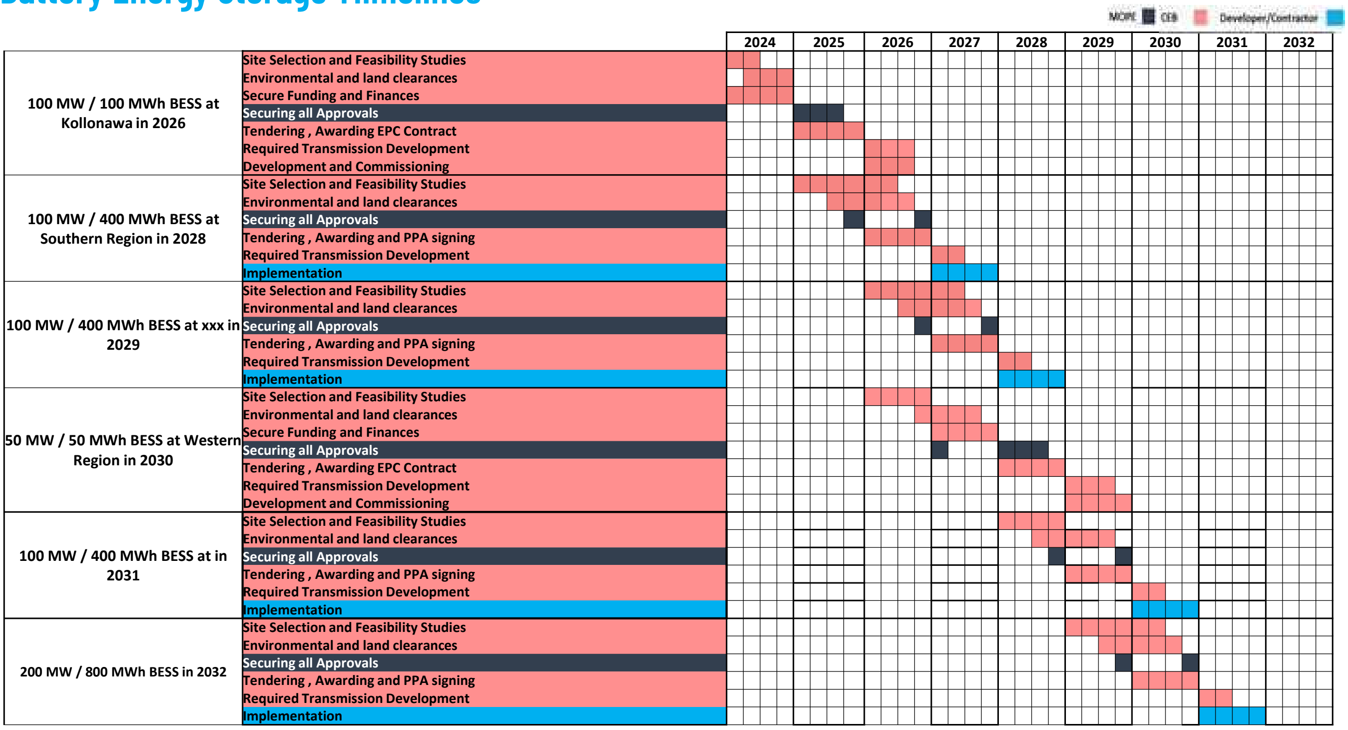
Wind Power Project Timelines





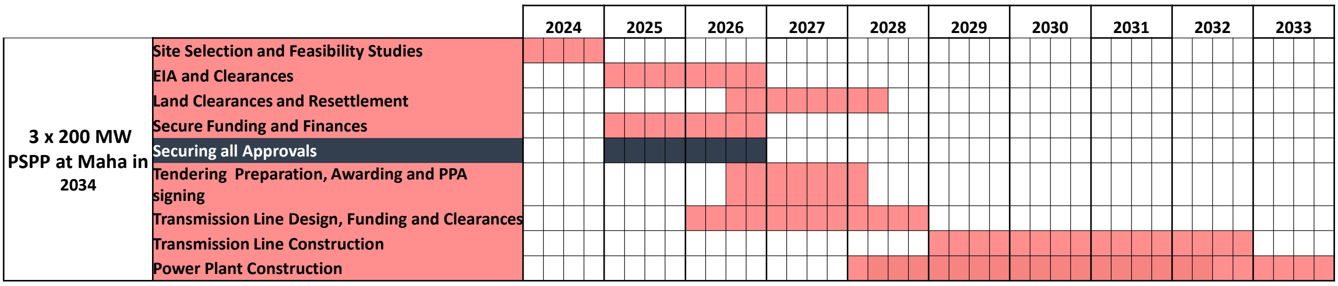
ANNEX 3

Battery Energy Storage Tiimelines



ANNEX 4

Pumped Hydro Storage Timeline



NPD Approval & Funding request	**Request has been submitted to NPD through MOE**
EIA Process	Application has been submitted to CEA

ANNEX 5

Key Grid Integration Measures

Measure	Activity	2023	2024	2025	2026	2027	2028	2029	2030
Renewable Energy Monitoring Control and Scheduling System at National System Control Centre	Feasibility Studies	■■■■	■■■■	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□
	Secure Funding and Finances	□□□□	■■■■	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□
	Securing all Approvals	□□□□	■■□□	■□■□	□□□□	□□□□	□□□□	□□□□	□□□□
	Tender Preparation, Procurement and Awarding	□□□□	□□□□	■■■■	□□□□	□□□□	□□□□	□□□□	□□□□
	Implementation	□□□□	□□□□	□□□■	■■□□	□□□□	□□□□	□□□□	□□□□
Establish Distribution Control Centres at Main Distributed Generation Zones with Smart Grid Infrastructure	Feasibility Studies	□□□□	□□□□	■■■■	□□□□	□□□□	□□□□	□□□□	□□□□
	Secure Funding and Finances	□□□□	□□□□	□□■■	■■□□	□□□□	□□□□	□□□□	□□□□
	Securing all Approvals	□□□□	□□□□	□□■■	■■□□	□□□□	□□□□	□□□□	□□□□
	Tender Preparation, Procurement and Awarding	□□□□	□□□□	□□□■	■■□□	□□□□	□□□□	□□□□	□□□□
	Implementation	□□□□	□□□□	□□□□	□□■■	■■■■	□□□□	□□□□	□□□□
Installation of Synchronous Condensers	Initial Studies. Site allocation. Etc	□□□□	□□□□	■■■■	□□□□	□□□□	□□□□	□□□□	□□□□
	Secure Funding and Finances	□□□□	□□□□	□□■■	■■□□	□□□□	□□□□	□□□□	□□□□
	Securing all Approvals	□□□□	□□□□	□□□■	□□□■	□□□□	□□□□	□□□□	□□□□
	Tender Preparation, Procurement and Awarding	□□□□	□□□□	□□□□	■■■■	□□□□	□□□□	□□□□	□□□□
	Implementation	□□□□	□□□□	□□□□	□□□□	■■■■	□□□□	□□□□	□□□□