GOVERNMENT OF INDIA
MINISTRY OF POWER

RAJYA SABHA
UNSTARRED QUESTION NO.4153
ANSWERED ON 30.03.2026

IMPACT OF INCREASING RENEWABLE ENERGY PENETRATION ON GRID STABILITY

4153 DR. KAVITA PATIDAR:
SHRI UJJWAL DEORAO NIKAM:
SHRI DEEPAK PRAKASH:
SHRI ASHOKRAO SHANKARRAO CHAVAN:

Will the Minister of **POWER** be pleased to state:

(a) whether Government has assessed the impact of increasing renewable energy penetration on grid stability, and;

(b) if so, the details thereof;

(c) the steps taken to expand transmission infrastructure for renewable energy evacuation;

(d) the number of renewable energy projects facing delays due to grid connectivity constraints;

(e) whether energy storage systems are being integrated with renewable energy projects;

(f) if so, the extent of integration thereof;

(g) whether Government is implementing large-scale renewable energy corridors under the Green Energy Corridor initiative; and

(h) if so, the details thereof?

A N S W E R

THE MINISTER OF STATE IN THE MINISTRY OF POWER

(SHRI SHRIPAD NAIK)

(a) & (b) : The Government has comprehensively assessed the impact of increasing Renewable Energy (RE) penetration on grid stability, particularly in view of the variability and intermittency associated with solar and wind power. With the rapid scale-up of RE generation, there is focus on ensuring grid readiness, flexibility, and reliability through a combination of transmission strengthening, RE forecasting, grid operation reforms and energy storage integration.

In this regard, the following measures have been undertaken:

(i) Establishment of Regional Energy Management Centres (REMCs) for renewable forecasting and real-time grid management.

(ii) Implementation of Automatic Generation Control (AGC) and Ancillary Services (SRAS/TRAS) for frequency regulation and balancing.

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(iii) Advanced grid support technologies such as STATCOMs and synchronous condensers for voltage stability and dynamic response have been considered in the transmission planning and are at various stages of implementation.

(iv) Under the Revamped Distribution Sector Scheme (RDSS), Supervisory Control and Data Acquisition (SCADA) works have been sanctioned for 455 towns.

(v) Advanced weather forecasting by National Centre for Medium Range Weather Forecasting (NCMRWF) in coordination with the Indian Space Research Organisation (ISRO) for better RE generation and demand forecasting, thereby supporting effective management of variability in renewable energy generation.

(vi) Central Electricity Authority (CEA) (Technical Standards for Connectivity to the Grid) Regulations lay down the minimum technical requirements for the RE generating plants to ensure the safe, secure and reliable operation of the grid. The compliances to the said regulations by RE plants are verified jointly by Central Transmission Utility (CTUIL) and Grid-India/ Regional Load Dispatch Centres (RLDC) based on relevant system studies before granting connectivity/interconnection to the national grid.

(vii) Indian Electricity Grid Code mandates RE plants to participate in the primary and secondary frequency control in case of contingencies. Hybrid RE power plants, Energy Storage Systems such as BESS and PSP are promoted for mitigating variability in RE generation and provide adequate frequency support to the grid.

(viii) The grid stability in case of voltage fluctuations is dependent on the adequate reactive power support from generators. The requirements of dynamic reactive power support from the generators is covered in the CEA (Technical Standards for connectivity to the Grid) Regulations.

(ix) Flexibilization of thermal generation is mandated to address the variability of RE generation.

(c), (g) & (h): The Government has taken following measures to expand transmission infrastructure for evacuation of renewable energy:

(i) Government of India has published National Electricity Plan (Volume-II Transmission) in 2024, which outlines the transmission system requirements for the period 2023 to 2032, commensurate with projected generation capacity additions to meet the projected electricity demand.

(ii) Transmission system has been planned for integration of over 500 GW non-fossil generation capacity by the year 2030. Further, the Central Electricity Authority (CEA) has brought out a comprehensive transmission plan in March 2026 for integration of over 900 GW of non-fossil fuel capacity by 2035-36.

(iii) Ministry of New and Renewable Energy (MNRE) is implementing Green Energy Corridor (GEC) scheme in ten states viz., Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttar Pradesh. Out of sanctioned 17,686 ckm transmission lines and 47,177 MVA substations for evacuation of 44 GW RE capacity, a total of 9856 ckm transmission lines and 24,300 MVA substations for evacuation of 24 GW RE capacity has been commissioned under GEC scheme.

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(d): The transmission schemes associated with RE generation projects are taken up for implementation in a phased manner commensurate with the RE Capacity addition. Towards achievement of 500 GW non-fossil generation by 2030, transmission system for 230 GW was envisaged to be developed under Inter-State Transmission System (ISTS). For this, action for transmission system of about 260 GW under ISTS has already been taken, 54 GW transmission system is already commissioned, 173 GW transmission capacity is under construction and 33 GW transmission projects are under bidding.

Further, CTUIL has received large number of applications of RE projects beyond 500 GW. However, grant of connectivity for such applications are under consideration taking into account the load-generation balance, identification of load centers and Resource Adequacy Studies carried out by CEA with respective States/UTs.

(e) & (f): The Government is promoting integration of Energy Storage Systems (ESS) with renewable energy to address intermittency and ensure reliable power supply. The following measures have been taken:

(i) Ministry of Power is administering two Viability Gap Funding (VGF) schemes, launched in March 2024 and June 2025, to support development of approximately 43.8 GWh of Battery Energy Storage Systems (BESS). The objective of the scheme is to deploy BESS for the integration of larger amount of RE.

(ii) Central Electricity Regulatory Commission (Third Amendment) Regulations, 2025 have introduced Solar Hour and Non-Solar Hour access, under which solar projects are aligned with Solar Hours, while wind and Energy Storage Systems are permitted round-the-clock access. This framework promotes optimal utilisation of transmission capacity and encourages hybrid project with different combination of solar, wind and BESS to ensure more reliable renewable power supply.

(iii) Planning of transmission systems to support development of up to 100 GW of Pumped Storage Projects (PSPs) during 2025-26 to 2035-36.

(iv) Providing budgetary support for enabling infrastructure (Roads, Transmission lines etc.) for development of Hydro PSP.

(v) Waiver of Inter-State Transmission System (ISTS) charges has been extended, for co-located BESS projects commissioned up to June 2028 and for Pumped Storage Projects (PSPs) where construction work is awarded by June 2028, to improve overall project viability.

(vi) Production Linked Incentive (PLI) scheme with an outlay of ₹18,100 crore supports establishment of 50 GWh Advanced Chemistry Cell manufacturing capacity, including grid-scale storage.

(vii) Guidelines have been issued for procurement of renewable energy with storage to enable firm and dispatchable power supply.

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