Round-The-Clock (RTC) Clean Electricity

Mains: *GS3 - Science and Technology- developments and their applications and effects in everyday life | Infrastructure - Energy*

Why in News?

The recently released Transition Zero report highlighted that India can deliver 70% round-the-clock (RTC) clean electricity by 2030 at lower cost.

What is RTC Energy?

- **RTC (Round-the-Clock) clean energy** – It refers to a system where every hour of electricity use is matched with supply from zero-carbon sources like solar, wind, and battery storage.
- It is also referred to as "***24/7 carbon-free energy (CFE)"*** means matching every hour of electricity use with electricity from carbon-free sources.
- It ensures clean power is actually available when it is needed, all day, every day, instead of buying annual clean energy certificates.
- **Power generation** – Solar generates power during the day and wind production is variable, so neither can independently guarantee supply at all hours unless integrated with energy storage or other sources.
- **Need** – Industrial and Commercial Demand i.e. Heavy industries, manufacturing, and data centres require constant, uninterrupted electricity to function effectively.
- RTC *enables decarbonization* (reducing or eliminating CO2 emission by human activities) in situations where clean energy delivered in practice, especially during peak demand or nighttime hours.

C. **Fossil vs Non-Fossil Energy Share in Installed Capacity as on 30.06.2025**

Sector	Capacity (in GW)	Percentage
Thermal	242.04 GW	(49.92%)
Non-Fossil Fuel (RE+ LH+Nuclear	242.78 GW	(50.08%)
Total	**484.82 GW**	**(100%)**

- **Significance –** RTC Supports national renewables goals by enabling India to reach its target of 500 GW of non-fossil fuel capacity by 2030.
    - The report shows RTC clean energy could cut emissions by 2.4% under the 70% matching scenario and When it scaled to 100% RTC matching, the potential emissions reduction rises to 7%.

- RTC approach especially important for heavy industries and data centers, whose electricity demand is typically flat around the clock.

What are the advantages of RTC?

- **Cost efficiency** – The reports analysis indicates that achieving 70% RTC clean energy can save grid operators Rs.9,000 crore ($1 billion) per year by 2030.
- **Reduction in system cost** – It is estimated that capital and operational savings could lead to net system cost reductions of up to 35% compared to the annual matching model.
- **System flexibility and reliability** – Integrating renewables with energy storage or complementary sources smooths out the variability, providing steady and dependable power.
- **Competitive advantage for industries** – RTC power solutions with fixed pricing help commercial users shield themselves from price volatility.
- **Market and grid transformation** – RTC procurement pushes the energy market towards robust, advanced Power Purchase Agreements and supports the evolution of a resilient, sustainable electricity system.
- **Socio-economic benefits –** Green energy expansion through RTC increases energy access, creates jobs, boosts local economies, and enhances India's energy independence.
- **carbon abatement** – Carbon reduction under the RTC model is significantly lower.
    - The analysis reveals that achieving carbon reductions through 70% RTC clean electricity costs nearly 3 times less than doing so via annual matching.

What are the challenges in deploying RTC electricity systems?

- **Supply disruption** – Solar and wind are variable and unpredictable, making it tough to provide uninterrupted RTC supply without substantial energy storage or backup sources.
- **Batter storage drawbacks** – Long-duration energy storage (LDES) currently plays a minor role because its high upfront costs make it less economically attractive.
    - In contrast, 4-hour lithium-ion batteries are more competitive, widely available, and rapidly becoming cheaper.
- **Transmission bottlenecks** – Corridor congestion and delays in inter-regional grid upgrades hamper reliable power delivery to load centers, affecting RTC consistency.
- **High project costs** – Integrating storage, oversizing assets, and technical sophistication significantly raise capital and operational expenditures for RTC projects.
- **Regulatory hurdles** – Evolving and often ambiguous regulatory frameworks for RTC tenders can stall implementation and deter private sector confidence.
- **Operational delays** – Lengthy project approval, tender micromanagement, and lack of experience among developers slow the commissioning of RTC systems.

What are the measures can be taken?

- **Regulatory incentives** – Policy support and incentives for procuring RTC power rather than for generic or annual clean energy should be prioritized.
    - This can include targeted subsidies, flexibility credits, and mandates for hourly

matching.

- **Integration of infrastructure** – The required 70% RTC energy can be deployed using a combination of solar, onshore wind, and battery storage.
    - Solar and batteries, in particular, show high synergy, with each MW of solar requiring approximately 2 MWh of battery storage to ensure a stable and reliable power supply.
- **Support for battery and storage solution** – Scaling battery manufacture and deployment will be critical.
    - Incentivizing investment in both short-duration (like lithium-ion) and long-duration storage will ensure flexibility.
- **Grid modernization and planning** – Advance grid upgrades to integrate variable renewables, expand transmission infrastructure, and invest in digital solutions to monitor and manage real-time supply-demand.
- **Market mechanisms** – Introduction of flexible, real-time power purchase agreements (PPAs) and demand response programs to encourage customers and suppliers to align consumption.
- **Learning from global examples** – India must avoid pitfalls faced in Europe**,** where renewable market saturation led to a decline in the financial attractiveness of PPAs.
    - **For example –** In Spain due to cannibalization**,** the increased supply drives down wholesale electricity prices, impacting the per-unit revenue of renewable energy generators**.**

Cannibalization *refers to the rapid increase in renewable energy sources, particularly solar and wind, has led to an oversupply of electricity, which in turn has reduces the revenue of renewable energy producers.*

- **Building awareness** – Engage industries, utilities, and stakeholders through education, pilot projects, and partnerships to demonstrate the practical benefits and economic viability of RTC solutions.

What lies ahead?

- India is poised to set a global precedent with its transition to RTC clean energy. If the current policy momentum, market reforms, and technological adoption are sustained.
- As hourly emissions accounting becomes a global norm, India's early experience with RTC implementation will influence energy transition strategies in other emerging economies.
- Proactive adoption of RTC strategies will propel India to the forefront of the global clean energy movement, making the nation a model for round-the-clock, sustainable growth.

Quick facts

• The report arrives at a critical time, as the **Greenhouse Gas Protocol (GHGP)** the global standard for corporate emissions reporting is reviewing its Scope 2 guidance.
• The Greenhouse Gas Protocol (GHG Protocol) was released by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD)
• It is *expected to move toward hourly emissions* accounting, making RTC clean energy procurement increasingly relevant for ESG (Environmental, Social, and Governance) compliant companies.
• While hourly emissions accounting is emerging as the preferred method, the GHGP does not set targets or grade performance.
• A central focus of this review is the update to the Scope 2 guidance the rules governing how companies account for emissions from purchased electricity.

References

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