Floating Solar

Mains: *GS III – Energy*

Why in News?

The recent approval of the Pradhan Mantri Surya Sarovar Yojana (PM-SSY), with an emphasis on floating solar and co-located energy storage, could provide the policy impetus required to transform floating solar from a niche technology into an important component of India's renewable-energy portfolio.

What is Floating Solar?

- **Floating solar** – It refers to solar photovoltaic modules installed on floating platforms placed on water bodies such as reservoirs, lakes, industrial ponds and other suitable inland water bodies.
- The platforms are generally secured using anchoring systems connected to the reservoir bed or banks.
- Electricity generated by the panels is transmitted to shore through underwater or floating electrical cables and subsequently integrated into the grid.
- Unlike conventional solar parks, floating solar requires little or no additional land acquisition.
- It is therefore particularly relevant for a land-constrained country such as India.

Why is floating solar important for India?

- **Conservation of Land –** The foremost advantage of floating solar is its ability to generate electricity without competing directly with agricultural, residential or industrial land.
- This is especially valuable in densely populated regions where acquiring large contiguous parcels of land for solar parks can create social and environmental conflicts.
- **Better Utilisation of Existing Water Bodies –** India possesses numerous large reservoirs associated with irrigation, hydropower and water-supply projects.
- Using a carefully selected portion of their surface area for solar generation can create an additional productive use of existing infrastructure.
- The National Institute of Solar Energy has assessed India's floating-solar potential at about **102 GW**, based on utilisation of only 20% of suitable reservoir areas.
- Compared with the country's present floating-solar capacity of roughly 700 MW, this indicates a substantial untapped opportunity.
- **Reduction in Water Evaporation –** Floating solar can reduce evaporation from the

portions of water bodies covered by solar modules by providing shade and limiting direct exposure to sunlight and wind.
- This could be particularly useful in water-stressed regions.
- However, the magnitude of water savings would vary according to climatic conditions, reservoir characteristics and the percentage of surface area covered.
- **Improved Solar-Panel Performance –** Water beneath the floating platforms can have a cooling effect on solar modules.
- Since photovoltaic efficiency generally declines as module temperature rises, this cooling can improve the operational performance of panels, particularly during hot summer conditions.
- **Synergy with Hydropower –** Floating solar can complement hydropower generation.
- Solar power is generated mainly during daylight hours, while reservoirs can provide flexibility for electricity generation at other times.
- When combined with energy storage, this can strengthen the reliability and flexibility of renewable-energy systems.
- **India's Emerging Experience –** India has already demonstrated the technical feasibility of floating solar at the utility scale.
- **100 MW floating solar project at Ramagundam in Telangana** and a **92 MW project at Kayamkulam in Kerala** in 2022.
- The **Omkareshwar Floating Solar Park in Madhya Pradesh**, planned for about 600 MW, represents another major milestone.
- Around 278 MW is currently operational, and the fully commissioned project is expected to generate substantial clean electricity over its operational life.
- These projects demonstrate that India possesses the technical capacity and institutional experience necessary to develop floating solar at scale. However, deployment remains limited compared with the country's enormous assessed potential.

PM-SSY: A Policy Push

• The **Pradhan Mantri Surya Sarovar Yojana** can potentially address several barriers that have prevented floating solar from achieving widespread adoption.
• The scheme targets **5,000 MW of floating-solar capacity** with a total financial outlay of **Rs.5,070 crore**.
• It also provides for co-located energy-storage systems with a minimum storage duration of two hours, amounting to **10,000 MWh of cumulative storage capacity**.
• A key feature is **Central Financial Assistance (CFA) of Rs.1 crore per MW** for eligible projects upon commissioning.
• In addition, up to **Rs.0.5 crore per project** can be provided for preparatory activities such as feasibility studies, hydrographic surveys and environmental assessments.
• This is important because floating-solar projects require detailed assessment of water depth, reservoir-bed characteristics, anchoring requirements, water-level fluctuations, wind and wave conditions, aquatic ecology and electrical infrastructure before construction can begin.
• The scheme also has the potential to stimulate domestic manufacturing, create employment across the floating-solar value chain and encourage wider participation beyond a few large public-sector projects.

What are the challenges to large-scale deployment?

- **Environmental Concerns –** Large-scale coverage of water surfaces may affect

aquatic ecosystems, water quality, fisheries and biodiversity.

- Reservoirs that support important bird habitats, fisheries or ecologically sensitive ecosystems require particular caution.
- Environmental impact assessments must therefore form an integral part of project selection.
- **Climate and Technical Risks –** Floating platforms are exposed to strong winds, waves, storms and fluctuating water levels.
- Anchoring and mooring systems must consequently be designed according to local hydrological and climatic conditions.
- Climate-resilient engineering will become increasingly important as extreme weather events intensify.
- **Higher Capital Costs –** Floating solar is generally more expensive than conventional ground-mounted solar because it requires specialised floating platforms, anchoring systems, electrical equipment and installation techniques.
- The addition of battery storage further increases capital requirements.
- Therefore, government support alone may not be sufficient.
- Developers will need access to affordable finance, predictable tariffs and long-term power-purchase agreements to make projects bankable.
- **Institutional Coordination –** A floating-solar project can involve state governments, electricity distribution companies, water-resource and irrigation departments, municipal authorities, environmental agencies and other stakeholders.
- The absence of clearly defined responsibilities can result in delays in approvals and project implementation.
- India therefore needs transparent frameworks for identifying suitable water bodies, allocating them for renewable-energy development and establishing responsibility among different institutions.

What could be done?

- **Mapping** – A national and state-level mapping exercise should identify suitable reservoirs based on technical, economic and ecological parameters.
- **Guidelines** – Standardised guidelines should define permissible surface-area coverage, anchoring norms, environmental safeguards and safety requirements.
- **Approval** – Single-window approval mechanisms can reduce delays caused by fragmented institutional responsibilities.
- **Integration** – Floating solar should increasingly be integrated with **battery storage and hydropower**, enabling more reliable renewable-energy supply.
- **R&D** – Research and development should focus on durable floating platforms, climate-resilient anchoring systems, recyclable materials and lower-cost storage technologies.
- **Environmental monitoring** – Project developers must adopt robust environmental monitoring to ensure that renewable-energy expansion does not undermine aquatic ecosystems.

*To realise the potential of floating solar, India should adopt a **"right project, right water body"** approach rather than pursuing capacity addition alone.*

What lies ahead?

- If implemented responsibly, floating solar can evolve from a handful of demonstration-scale and utility-scale projects into a significant pillar of India's clean-energy transition.
- It can simultaneously contribute to **energy security, land conservation, water management, employment generation and climate goals**, making it a promising candidate for India's next renewable-energy success story.

Reference

[The Indian Express| Floating Solar]