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Q16

Describe the benefits of deriving electric energy from sunlight in contrast to the conventional energy generation. What are the initiatives offered by our Government for this purpose?

UPSC Civil Services Mains 2020 · GS III · 15 marks · Infrastructure

Infrastructure: Energy, Ports, Roads, Airports, Railways etc.

Core demand of the question

- Describe the benefits of deriving electric energy from sunlight in contrast to the conventional energy generation. What are the initiatives offered by our Government for this purpose?
- Keep the explanation within a 15-mark length

Revision summary

Solar PV has no plant fuel, low operational water, and modular scale versus coal thermal.

It cuts operating emissions and can generate near load on rooftops.

- **It is variable:** nights and clouds still need storage or conventional firm power.

JNNSM, SECI parks, KUSUM, rooftop schemes, and RPOs are the main domestic initiatives.

ISA is the international arm; 175 GW by 2022 was the target frame of that period.

Introduction

Solar electricity turns irradiance into current through photovoltaic cells or, less often in India, concentrated solar heat. Conventional generation here means mainly **coal thermal**, plus gas, large hydro, and nuclear. Solar's benefits are fuel-free kilowatt-hours and modular scale. Its limits are night, clouds, land, and a grid that still needs firm power. Policy since the National Solar Mission has tried to buy down that gap.

Body

Benefits versus conventional generation

- **No fuel cycle at the plant:** no coal rakes, no imported gas price spike, no mine-to-ash chain. Operating emissions at the panel are effectively zero (manufacturing and land still have a footprint).
- **Modular and quick:** a megawatt of solar can be added in months; a pit-head thermal plant is years of clearances and boilers.
- **Distributed option:** rooftop and agricultural pumps can generate at the load, cutting some T&D loss that conventional central stations pay.
- **Water:** PV uses little operational water compared with thermal cooling towers - material in stressed basins.
- **Energy security:** sunlight is domestic; coal is largely domestic too, but solar diversifies away from a single dirty stock and from imported thermal coal in some plants.

- **Health and climate:** displacing coal reduces local air pollution and CO₂ per kWh, which is the public-health case, not only a climate pledge.

Honest contrast - what conventional still does better

- **Firm, dispatchable power:** coal, hydro, and nuclear follow load; solar is **variable**. Without storage, gas, hydro, or demand response, the grid still leans on conventional capacity after sunset.
- **Land and materials:** utility solar needs acres and imported cells/modules in many years; thermal is compact at the plant but huge if mines and ash ponds are counted.
- **Inertia and system stability:** synchronous machines help the grid; inverters need ancillary-market design.
- So the benefit is real on energy and emissions; it is not a complete substitute on reliability unless storage and transmission are built.

Government initiatives

- **Jawaharlal Nehru National Solar Mission (2010)** under NAPCC: the original reverse-auction, RPPO, and park architecture.
- **SECI** tenders, **solar parks**, and interstate transmission support that crashed tariffs through competition.
- **KUSUM:** solarise pumps, grid-connected agro-feeders, and farmer as producer - the rural initiative.
- **Rooftop solar** schemes (residential incentives, later phase changes), **CPSU** programmes, and **defence/railway** solarisation.
- **Renewable Purchase Obligations, waiver of ISTS charges** for solar/wind in specified windows, and **green energy corridors**.
- **International Solar Alliance** (co-founded by India): diplomacy and standardisation, not a domestic kWh.
- At the 2020 horizon, India was pursuing a **175 GW renewable** target by 2022 (100 GW solar in that package) and signalling a larger **450 GW** non-fossil path - targets, not already-installed facts.
- **Complementary: PLI for high-efficiency modules** (announced around this industrial-policy wave) to cut import dependence - name it as industry policy, not as a 2010 Mission clause.

To make the benefit stick

- Pair solar with **storage, flexible coal/hydro, and market reforms** (ramping, ancillary services).
- Do not count diesel-backup rooftop as a clean win.

Flow diagram

Sunlight -> PV electricity

PV electricity -> No fuel low water modular

Coal thermal -> Firm power fuel ash

JNNSM SECI KUSUM RPO -> PV electricity

Storage transmission -> Grid-worthy solar

Conclusion

Solar electricity beats conventional thermal on fuel, water, modularity, and operating emissions. It loses on night-time firmness unless storage and the grid catch up. Government initiatives run from the National Solar Mission and **SECI** parks through KUSUM, rooftop programmes, RPOs, and the International Solar Alliance. The benefit is a cleaner kWh; the system still needs conventional or stored power when the sun is down.

Facts & figures

JNNSM

National Solar Mission launched 2010 under the National Action Plan on Climate Change.

SECI

Solar Energy Corporation of India: central offtaker and tendering agency that drove tariff discovery.

PM-KUSUM

Farmer-centric solar pumps and agro-feeders, intended to cut diesel and some grid strain.

RPO

Renewable Purchase Obligation on discoms: the demand-side legal push for solar kWh.

ISA

International Solar Alliance, India-initiated platform for solar-rich countries.

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