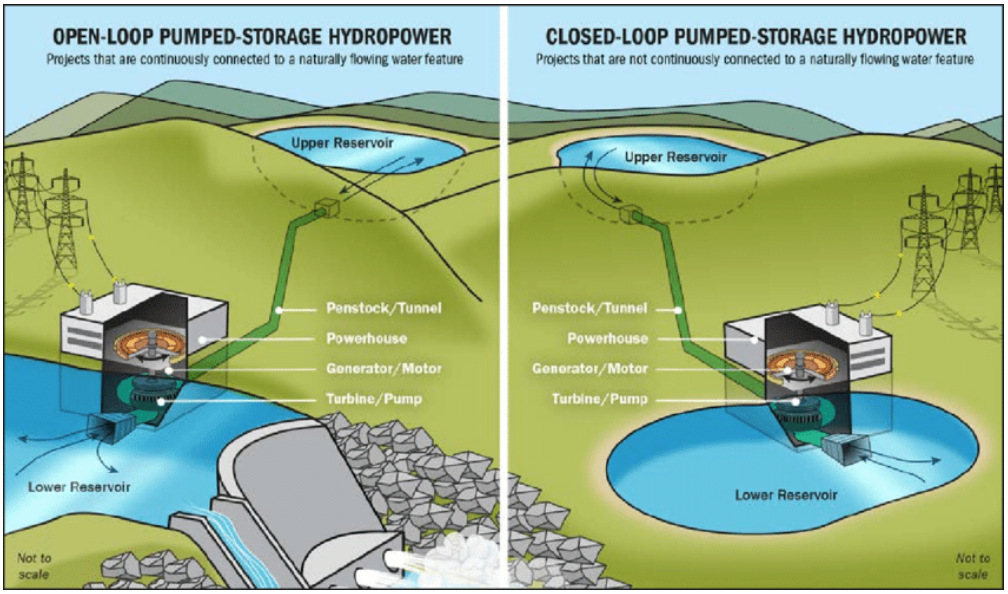
Pumped Storage Projects

Why in news?

Union Budget 2024-25 stated that a policy for promoting pumped storage projects will be brought out for electricity storage.

What are the Pumped Storage Projects?

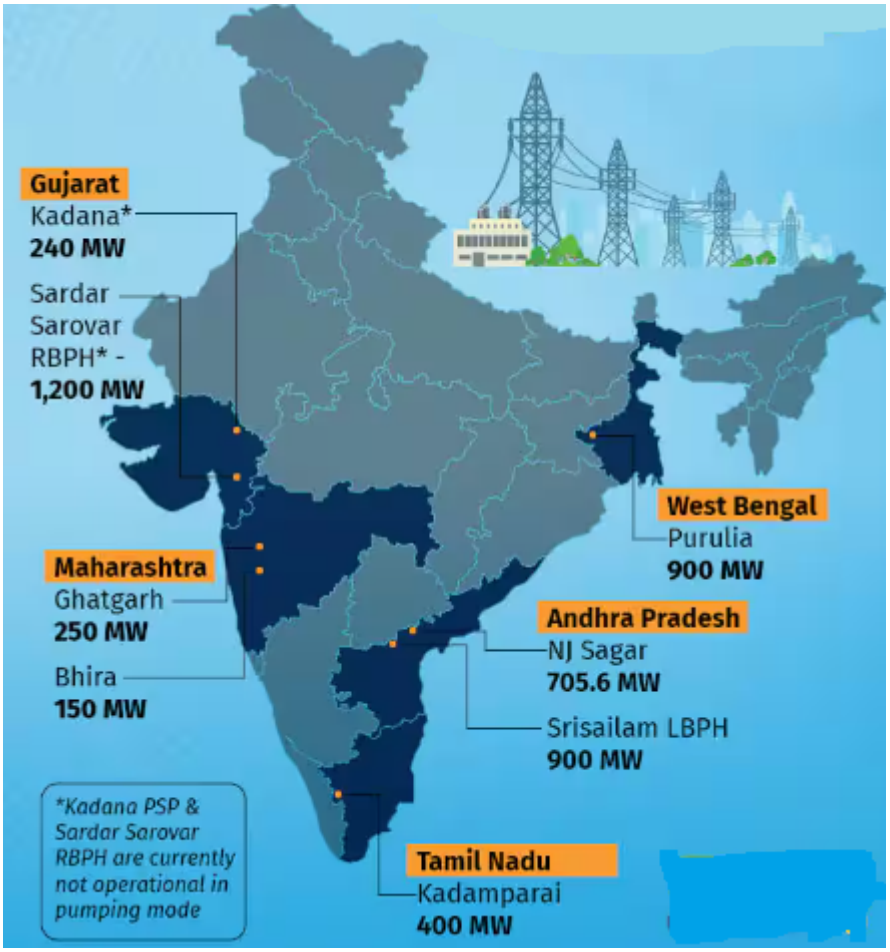
- It is also known as pumped storage hydropower.
- **Pumped storage hydropower (PSH)** – A type of energy storage that *uses the pumping and release of water* between *two reservoirs at different elevations* to store water and generate electricity.
- These are like super large batteries but natural and use water and thus called as ***Water Battery.***
- **Working principle**
    - **When demand for electricity is low** - A PSH project can use low cost energy to pump water from the lower reservoir to the upper reservoir for storage.
    - **When demand for electricity is high - A** PSH project can release water from the upper reservoir through a powerhouse to generate electricity.
- Traditionally, PSH plants *generated power during the day* and *pumped at night*, with modest diurnal or seasonal variation.
- **Working –** Take for example, *Kadamparai plant* near Valparai in Coimbatore district, Tamilnadu.
- The plant has a higher reservoir that is at a height of around 380 m above a lower reservoir.
- It acts as a *turbine generator* set producing electric power when the water flows from the upper reservoir to the lower.
- The same unit *can function as a pump consuming electric power* when it pumps water from lower to higher reservoir.
- **Types** – It is of 2 types
    - On-river type
    - Off-river type
- **On-river Type** – It is an *open loop system* connected with already *existing hydroelectric project* supplied by a river and thus existing hydro projects could become pumped storage.
- **Off-river type** – It has two reservoirs at two different levels to which the water is pumped up or falls down to under gravity.
- They are not connected with any natural flow of rivers or streams.
- It has wider choice for sites, lower cost, shorter construction period (2-4 years) and minimal environmental impact.



What is the status of pumped storage projects in India?

- **Potential** - As per Central Electricity Authority, the current potential of 'on-river pumped storage' in India is ***103 GW***.
- **Current capacity** - India has ***4.7 GW*** of pumped storage with *8 plants operating* currently.

No	Plant	State
1	Nagarjuna Sagar	Telangana
2	Srisailam LBPH	
3	Kadamparai	Tamil Nadu
4	Bhira	Maharashtra
5	Ghatgar	
6	Purulia	West Bengal
7	Kadana	Gujarat
8	Sardar Sarovar Project	



- **Upcoming projects**
  - 600 MW Upper *Indravati in Odisha*
  - 2,000 MW *Sharavathy in Karnataka* .
  - *Koyna* Left Bank Pumped Storage Project in Maharashtra
  - *Kundah* (Stage-I, II, III & IV) Project in Tamil Nadu
  - *Tehri* St-II Pumped Storage Project in Uttarakhand
- **Projections** - As per the National Electricity Plan (Generation), the installed capacity of energy storage systems including BESS is projected at 74 GW by 2031-32.

China leads the world with 44 GW of pumped storage supporting 1,300 GW of wind and solar followed by Japan and USA.

What are its benefits?

- **Efficient energy generation** – *Energy recovery of 70–80%* or more can be achieved after conversion losses and evaporation losses from the exposed water surface.
- **Ensures energy security** – It meets both the Base Load & Peaking Power demands efficiently and are integrated with the main grid from other energy sources.
- **Durability** – They have a *service life of more than 40-50 years*, larger than any other existing energy storage technology available.
- **Cost effective** – It is currently the *most cost-effective means of storing* large amounts of electrical energy.
- Increased life span results in a *low cost of delivered energy* over the life of the

projects.

- **Environment friendly** – They don't produce harmful by-products or pose problems of disposal as in case of battery storage.
- **Stabilizes renewable energy supply** – Renewable sources like wind and solar energy fluctuates on basis of day, seasons & weather and so PSPs can help in balancing this fluctuation.
- **Support green energy transition** – It can help India achieve its Nationally Determined Contribution (NDC) targets
  - 500 GW of non-fossil power by 2030
  - 50% of installed capacity from non-fossil fuel sources by 2030
  - Achieve net zero carbon emissions by 2070
- **Move towards Atmanirbhar Bharat** - It primarily use indigenous technologies and domestically produced materials.
- **Develops Indian economy** – As it is highly capital intensive and involves local *transport infrastructure* for the mobilization of men and materials, local *industries such as cement and steel* also get impetus and *drive job creation* in the economy.

What are the challenges in developing PSPs?

- **High capital costs** – It requires huge investment to construct or alter an existing power plants into a pumped storage.
- **Higher cost of pumping power** - One of the prerequisites to ensure the commercial viability of a PSP unit is availability of input power at affordable tariff.
- **Geographical limitation** - Necessity of appropriate geography, terrain is a limiting factor the project.
- **Clearances delays** - Environmental clearance and forest clearance process of PSPs is very cumbersome, since these projects are treated at par with the conventional hydro projects.
- **Environmental impacts** – Large capacity secondary storage requires further altering the already strained mountain, valley ecosystem.

What lies ahead?

- Discarded mines including coal mines could be used as hydro storage and thereby become natural enablers for development of PSPs.
- All existing hydro projects may be examined to assess the feasibility for creating storage.
- Competitive bidding would accelerate development of grid-scale storage projects and discovery of price based on the learning.
- Supporting PSPs through concessional climate finances.
- Making them eligible for sovereign green bonds.
- Creation of a revolving fund for project preparation through project specific SPV.
- State governments and central PSUs may take up a few projects through their Undertakings.

References

1. The Hindu | Union Budget 2024 promised policy on pumped storage

2. Power Ministry | Guidelines on PSPs
3. TERI | Discussion paper on PSPs

