

11– 09 – 2024

News: Nuclear Power Trains

- Indian Railways (IR) is exploring the use of nuclear power through captive units as it seeks to increase reliance on non-fossil fuel sources and renewable ones.

Nuclear Powered Trains

- Nuclear Powered Trains uses heat generated from a nuclear reaction to produce high-pressure steam.
- This steam drives two turbines, one turbine powers the train, while the other generates electricity for equipment like air conditioners and lights.
- The concept of nuclear-powered trains was first seriously considered in the 1950s, when it became an official goal of the USSR's Ministry of Transport.
- **Functioning of Nuclear-Powered Trains:** The proposed design involves a portable nuclear reactor that heats fluid to produce steam. This steam drives electric turbines, generating power for the train.

- **Safety Considerations:** The use of thorium reactors is considered due to their relatively low radiation risk compared to other nuclear materials. The reactor's design includes safety features to minimise risks and prevent misuse.

Potential Benefits

- **Reduced Carbon Emissions:** Nuclear power can significantly reduce CO₂ emissions compared to fossil fuels, aligning with global efforts to combat climate change.
- **Energy Efficiency:** Nuclear reactors provide a high energy output with minimal fuel. This could potentially reduce the operational costs and environmental impact of rail transport over long distances.
- **Low Infrastructure Requirements:** Nuclear-powered trains could operate independently of overhead electric lines, reducing infrastructure costs and providing greater flexibility in operations.
- **Extended Range:** Nuclear-powered trains could operate over long distances without the need for frequent refuelling. This would be advantageous for freight and passenger services on extensive rail networks.

- **High Efficiency:** The potential for high operational efficiency is a major advantage. Nuclear reactors could provide continuous power, optimising rail transport performance.

Challenges of Nuclear-Powered Trains

- **Radiation Risks:** Handling nuclear materials and ensuring safety against radiation leaks are significant challenges. Adequate shielding and safety measures are essential to protect passengers and crew.
- **High Costs:** The initial costs for developing and implementing nuclear-powered trains are high. This includes the expense of developing small, safe reactors and integrating them into locomotives.
- **Technical Complexity:** Designing and maintaining nuclear reactors for moving trains involves complex engineering challenges.
- Apart from nuclear power, the Railways are already in the process of commissioning solar power units and wind-based power plants.

Reasons why Indian Railways are searching for alternative source of energy

- **High Energy Consumption:** The Indian Railways consumes over 20 billion kWh of electricity annually, which is around 2% of the country's total power consumption.

- This high level of consumption underscores the need for more sustainable energy solutions.
- **Increasing Power Demand:** Power requirements are projected to grow from 4,000 MW in 2012 to approximately 15,000 MW by 2032 due to ongoing electrification efforts.
- This substantial increase highlights the need for diversified energy sources.
- **Electrification Targets:** Indian Railways aims to electrify 100% of its broad-gauge network by 2030. This ambitious goal will significantly increase the demand for electricity, necessitating alternative energy sources to meet this need sustainably.
- **Environmental Impact:** The railway's reliance on diesel and electricity results in high CO₂ emissions.
- As a part of its low-carbon strategy, the Indian railways has envisaged a target of 33% reduction in its emissions intensity below 2005 levels by 2030.
- **Diminishing Revenue Surplus:** Railways' revenue earnings have barely been able to keep up with its revenue expenditure.
- Between 2013-14 and 2023-24, Railways' revenue expenditure is estimated to grow at an annualised rate of 7.2%, faster than its revenue receipts (annual growth of 6.3%).

- Indian Railways aims to generate its own energy to reduce its expenditure on outside energy sources.
- **Cost Optimisation:** Indian Railways is the largest consumer of electricity and spends close to Rs 20,000 crore annually to run their trains and offices.
- The organisation is looking to reduce costs through renewable energy procurement and lower-cost models for power generation.

National Rail Plan (NRP)

- The National Rail Plan (NRP) aims at providing a long term perspective planning for augmenting the Railway Network.

Objectives of the plan

- To create capacity ahead of demand by 2030, which in turn would cater to growth in demand right up to 2050?
- To increase the modal share of Railways from 27% currently to 45% in freight by 2030 as part of a national commitment to reduce Carbon emission and to continue to sustain it.

- To assess the actual demand in freight and passenger sectors, a yearlong survey was conducted over hundred representative locations by survey teams spread all over the country.
- Forecast growth of traffic in both freight and passenger year on year up to 2030 and on a decadal basis up to 2050.
- Formulate strategies based on both operational capacities and commercial policy initiatives to increase modal share of the Railways in freight from 35% in 2015 to 45% by 2030.
- Reduce transit time of freight substantially by increasing average speed of freight trains from present 22 Kmph to 50 Kmph.
- Reduce overall cost of Rail transportation by nearly 30% and pass on the benefits to the customers.
- Railways will be using solar power in a big way to achieve Net Zero Carbon Emissions by 2030.

As part of the National Rail Plan, Vision 2024 has been launched for accelerated implementation of certain critical projects by 2024 such as:

- 100% electrification. It will be the first 100% electrified rail transportation system by then.
- Multitracking of congested routes.

- Upgradation of speed to 160 kmph on Delhi-Howrah and Delhi-Mumbai routes.
- Upgradation of speed to 130kmph on all other Golden Quadrilateral-Golden Diagonal (GQ/GD) routes.
- Elimination of all Level Crossings on all GQ/GD route.
- Indian Railways plans to install 20 GigaWatts (GW) of solar for both traction loads and non-traction loads.
- The Railways built a 1.7-MW solar power plant in Bina, Madhya Pradesh, in July 2020. It is the first solar energy plant in the world to directly power railway overhead lines, from which locomotives draw traction power.
- The government **will engage with the private sector in areas like operations and ownership** of rolling stock, development of freight and passenger terminals, development/operations of track infrastructure, etc.

Key Statistics

- Indian Railways is the **world's fourth largest railway network in terms of size**. It is **one of the largest electricity consumers** in the country.
- Indian Railways **transports 24 million passengers every day across the subcontinent on 13,000 trains covering approximately 67,956 km**.

- Indian Railways transports 3.3 million tonnes of freight per day, and thus the fuel requirements are massive.
- India's transport sector contributes to 12% of the country's greenhouse gas emissions with the railways accounting for about 4% of these emissions.
- The Indian Railways can raise the official target of 50% freight share by 2030, up from its current share of 33%.
- By shifting freight to rail and optimising truck use, India can reduce logistics costs from 14-10% of Gross Domestic Product and carbon dioxide emissions by 70% by 2050 compared to a business-as-usual scenario.

News: Horseshoe Crabs

- Recently, the Zoological Survey of India (ZSI) and Odisha Forest Department have started the exercise to tag Horseshoe Crabs to conserve this ancient species.

Horseshoe Crabs

- Horseshoe Crabs are marine and brackish water arthropods of the family Limulidae and the only living members of the order Xiphosura.
- These are one of the oldest living creatures on Earth (emerged 250 million years ago), also called living fossils.

- **Species and Location:** There are 4 existing species of horseshoe crabs.
- India has 2 species of horseshoe crabs: *Tachypleus Gigas* (found in Odisha and West Bengal) and *Carcinoscorpius rotundicauda* (found in Sundarbans mangroves of West Bengal).
- American horseshoe crab (*Limulus polyphemus*): Found along the eastern coast of the USA and in the Gulf of Mexico.
- Tri-spine horseshoe crab (*Tachypleus Tridentatus*): Found in the Indo-Pacific region.

Threat

- Destructive fishing practices and illegal smuggling.

Conservation Status

- **Wildlife Protection Act (WPA), 1972:** Indian species are protected under **Schedule II** of WPA 1972.

IUCN Status

- American horseshoe crab: Vulnerable.
- Tri-spine horseshoe crab: Endangered.
- The two other species are not listed yet.

Medicinal Uses

- Its carapace (hard upper shell) is applied onto scars.
- Horseshoe crab blood is bright blue and contains immune cells that are sensitive to toxic bacteria.
- These cells clot around invading bacteria, protecting the horseshoe crab's body.
- Scientists used these cells to develop a test called Limulus Amebocyte Lysate (LAL), which checks new vaccines for contamination, preventing the distribution of vaccines with harmful bacteria.
- International Horseshoe Crab Day is celebrated on 20th June every year to showcase the collective conservation efforts for horseshoe crabs.
- Recently, the Zoological Survey of India (ZSI) and Odisha Forest Department have started the exercise to tag Horseshoe Crabs to conserve this ancient species.