India’s First Small-Scale LNG Unit in Madhya Pradesh

For Prelims: First Small-scale Liquefied Natural Gas Unit in India, Composition of Natural Gas, LNG And CNG, **BioCNG**, Major Applications of LNG.

For Mains: Challenges Related to LNG, Need for Small-Scale LNG.

Source: IE

Why in News?

The **Union Minister for Petroleum and Natural Gas** recently inaugurated India’s first **small-scale liquefied natural gas (SSLNG)** unit at GAIL (India) Ltd’s Vijaipur complex in Madhya Pradesh.

- This development is part of the government's broader initiative to promote the **use of** natural gas in various sectors and increase its share in the country's primary energy mix to **15% by 2030.**

What is LNG and SSLNG?

- **About:** Liquefied natural gas (LNG) is natural gas that has been cooled to a liquid state, about **-260°F (-162°C),** to make it easier and safer to store and transport.
  - Natural gas is a cleaner and more economical alternative to conventional hydrocarbons like coal **and oil,** making it crucial in India's transition towards greener energy sources.
    - The primary component of natural gas is **methane**, comprising 70-90% of its composition.
  - According to the IEA, Natural gas accounts for about a quarter of global electricity generation.
    - Presently in India the share of natural gas in the energy basket is **6.7%.**
  - The top natural gas producing countries are the **United States, Russia and Iran.**
- **Small-Scale LNG:** SSLNG involves **liquefying and transporting natural gas on a smaller scale**, catering to areas without pipeline connections using specialised trucks and vessels.
  - Starting from large-scale LNG import terminals, **SSLNG can supply LNG directly to consumers via cryogenic road tankers** or small vessels, either as a liquid or regasified for traditional uses.
  - It will lead to reduced dependency on **costly gas imports**, especially if it replaces a significant portion of **diesel consumption**, leading to substantial foreign exchange savings.
    - It also promotes cleaner energy and supports India's transition towards sustainable fuel sources.
- **Major Applications:**
  - **Transportation:**
    - **Marine Fuel:** LNG is increasingly used as a fuel for ships and vessels, especially in **emission-controlled areas,** due to its lower emissions of sulphur oxides (SOx) and particulate matter compared to traditional marine fuels.
    - **Road Transport:** LNG is used as a fuel for **trucks, buses, and other heavy-**

duty vehicles, offering reduced emissions of nitrogen oxides (NOx), particulate matter, and greenhouse gases compared to diesel.

- **Industrial Applications:**
  - **Power Generation:** LNG is used in **gas-fired power plants** to generate electricity, providing a cleaner alternative to coal or oil-fired power plants with lower emissions of pollutants.
  - **Heating and Cooling:** LNG can be used in industrial processes for **heating and cooling applications**, such as in manufacturing, food processing, and refrigeration.
- **Energy Storage and Backup:**
  - **Renewable Energy Integration:** LNG can complement **renewable energy sources** like wind and solar by providing backup power when renewable generation is intermittent or unavailable.

- **Related Challenges:**
  - **High Costs**: Building LNG liquefaction and regasification facilities is expensive. Additionally, the transportation process itself requires specialised cryogenic (super cold) carriers, further adding to the cost.
    - Countries like China have successfully integrated LNG in commercial vehicles, but India faces challenges such as **limited availability of LNG vehicles**, higher initial costs, and a **lack of financing and retail networks for LNG.**
  - **Environmental Impacts:** While cleaner than coal, LNG production and transportation still have some environmental impact, such as **methane emissions.**
    - Methane is the **second-most abundant GHG after CO_2.** Although methane dissipates faster than CO_2 in the atmosphere, it has a much stronger planetary warming effect.
  - **Safety Concerns**: LPG is highly flammable and can pose significant safety risks if not handled properly. Improper storage, handling, or use can lead to leaks, fires, or explosions.

What is Compressed Natural Gas?

- **About: CNG** is natural gas that has been compressed under **high pressure,** allowing it to occupy a smaller volume in fuel tanks.
  - It is usually compressed at pressures ranging from **200 to 250 kg/cm²**, reducing its volume to less than **1% of its size at atmospheric pressure.**
    - Unlike LPG, which is a mixture of compressed propane and butane, **CNG primarily consists of 80 to 90% methane in a gaseous state.**
  - The **distinction between CNG and LNG lies in their physical states:** CNG exists as a gas, whereas LNG exists as a liquid which is then regasified for usage.
- **Advantages of CNG:**
  - **Lighter than air,** disperses quickly in case of leaks.
  - Clean burning with minimal residue, reducing engine maintenance.
  - Lower greenhouse gas emissions compared to petrol or diesel.
  - High safety due to its **high auto-ignition temperature.**
  - Cost-effective compared to petrol and diesel, with a higher calorific value.
- **Disadvantages of CNG:**
  - Requires large fuel tanks.
  - Limited range per fill-up.
  - Fewer filling stations available.
  - Retrofitting older vehicles for CNG is challenging.
- **BioCNG:** BioCNG**,** also known as **biomethane**, is a renewable, clean-burning transportation fuel made from organic waste. It's produced by upgrading biogas to natural gas quality.

Way Forward

- **LNG Infrastructure Development:** Investing in expanding LNG import terminals and **regasification facilities** to increase LNG availability.

    - Also, building a robust SSLNG infrastructure, including specialised trucks, vessels, and storage facilities, to reach areas without pipeline connections.
- **Market Development:** Creating awareness and promoting the benefits of LNG and SSLNG among industries, commercial users, and the transportation sector.
    - Encouraging **investment in LNG-powered vehicles and equipment,** offering incentives and financing options for adoption.
- **Regulatory Support**: Developing clear regulatory frameworks and standards for LNG and SSLNG operations, ensuring safety, environmental compliance, and quality control.
- **Investing for Innovation:** Invest in R&D of advanced LNG technologies, such as **cryogenic storage and transport solutions**, to improve efficiency and reduce costs.
- **Push for International Collaboration:** At **COP28,** the **United Nations Framework Convention on Climate Change** mentioned **"transitional fuels" for energy security** in its outcome of the First Global Stocktake, alluding to natural gas.
    - Participating in regional and global initiatives for LNG trade, infrastructure development, and policy harmonisation can strengthen India's position in the global LNG market.

UPSC Civil Services Examination Previous Year Questions (PYQs)

Mains

Q. The question of India's Energy Security constitutes the most important part of India's economic progress. Analyse India's energy policy cooperation with West Asian countries. **(2017)**

Q. "Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs)".Comment on the progress made in India in this regard. **(2018)**