

## India's Leapfrog to Methanol Economy

*Table 1 Prelims Booster*

**A) Methanol Economy :** means the replacement of fossil fuels with methanol as means of energy storage, transportation fuels and feedstocks of chemical products

**B) Need for Methanol Economy in India:**

- **Energy security:** India is the 6th highest consumer of petrol and diesel in the world
- **Environmental concern:** India is third highest energy related CO<sub>2</sub> emitter country in the world.
- **Current Account Deficit:** India's crude import bill stands at almost 6 lakh crores
- **Inflation:** The price of fuel has multiplier effect

**C) Applications of Methanol in various sectors of Indian Economy:**

- 1) **Transportation:** Methanol blended with gasoline and diesel or complete substitution + railway engines can run on methanol/DME blends + methanol and DME powered ships → cost cutting and efficiency increase
- 2) **Energy:** India → Huge Coal reserves ; Biomass generated ; Stranded & Flared gases → alternate feedstock and fuels → India's 10% reduction in import dependence of oil and gas by 2022.
- 3) **Manufacturing:** methanol compatible engines under Make in India → FDI investments → employment
- 4) **Marine sector:** liquid form → no SO<sub>x</sub> or NO<sub>x</sub> ; cheaper and cleaner than LNG and Bunker / Heavy Oil. → meeting the stringent emission regulations by the IMO → reduce the costs.
- 5) **Electricity power generation:** as a turbine fuel
- 6) **Agriculture:** Biomass like rice straw or Bamboo in North East → feedstock → additional income to the farmers
- 7) **Telecom Towers:** 2% of diesel consumption → can be replaced
- 8) **Chemicals sector:** Methanol → producing various chemicals like formaldehyde, acetic acid and olefins → can be exported
- 9) **Clean cooking fuels:** Ujjwala Yojana (PMUY) → LPG connections → Methanol or DME blending with LPG or the complete substitution of latter through former can gradually displace LPG imports
- 10) **Swachh Bharat:** opportunity for India to use its landfills to convert it into methanol and avoid problems such as toxins leaching into the soil and release of GHG emissions etc

**D) Global Developments**

- Methanol is being actively pursued by China, Italy, Sweden, Israel, US, Australia, Japan and many other European countries.
- 10% of fuel in China in transport Sector is Methanol. China alone produces 65% of world Methanol and it uses its coal to produce Methanol.
- The Technology has acquired commercial maturity and countries like Iceland are producing in meaningful quantities already.
- The United States ran several methanol programs, especially in California from 1980 to 1990 for the conversion of gasoline run cars to methanol blended fuels
- Israel, Italy have adopted the Methanol 15% blending program with Petrol.
- Methanol is seen by the world as the "Enduring Energy Solution known to Mankind"

**Methanol (CH<sub>3</sub>OH)** It is a single carbon compound that can be produced from coal, natural gas, biomass

**DME and bioDME**

Primarily produced by converting hydrocarbons via gasification to synthesis gas (syngas). Synthesis gas is then converted into methanol in the presence of catalyst (usually copper-based), with subsequent methanol dehydration in the presence of a different catalyst (for example, silica-alumina) resulting in the production of DME

**Alternative fuel due to the advantages**

- Scalable and sustainable fuel as can be produced from a variety of feedstocks.
- Efficient and can be cent percent renewable.
- Less Infrastructure costs
- Emits lesser NO<sub>x</sub> and Particulate matter (PM) than gasoline and produces no SO<sub>x</sub> as there is no sulphur in methanol.
- Can be blended (or be completely substituted) with gasoline to use as a transport fuel

**DME and bioDME**

- commonly used as a replacement for propane in liquid petroleum gas (LPG)
- a viable and clean diesel alternative
- can also be blended with LPG
- a non-toxic compound and is safe to handle

### Methanol Economy

<p><b>WHAT IS IT?</b></p> <ul style="list-style-type: none"> <li>▶ It is also known as methyl alcohol</li> <li>▶ Colourless, light, flammable liquid</li> </ul> <div style="text-align: center;"> <math display="block">\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{OH} \\   \\ \text{H} \end{array}</math> </div> <p><b>HOW IT IS MADE</b></p> <ul style="list-style-type: none"> <li>▶ Manufactured industrially</li> <li>▶ Derived from coal, oil or biomass</li> </ul>	<p><b>WHAT ARE ITS USES</b></p> <ul style="list-style-type: none"> <li>▶ Antifreeze</li> <li>▶ Solvent</li> <li>▶ Fuel</li> </ul> 	<p><b>KEY BENEFITS</b></p> <ul style="list-style-type: none"> <li>▶ Cheaper to produce compared to other fuels</li> <li>▶ Safer than others because of low flammability</li> <li>▶ Wide variety of feed stock can be used to produce methanol</li> </ul> <p><b>BIG USERS</b></p> <ul style="list-style-type: none"> <li>▶ Methanol demand expected to grow strongly with its use as a fuel</li> <li>▶ China, Brazil, Mexico and the US significant players</li> </ul>
--	---	---

**D) Status of Methanol in India:**

- Presently at a nascent stage in production and usage but huge potential in both
- Methanol imports is meeting 90% of India's methanol requirement → because cheaper for India to import vs domestic production → considerable forex outgo
- India imports 99% of its methanol from Iran and Saudi Arabia who produce it from natural gas
- India does not have a commercial coal to methanol plant despite having large coal reserves
- India is producing all of its methanol from imported natural gas
- The Government is likely to go ahead with a target of 15% blending by methanol/DME in gasoline/diesel by 2022
- Recently, Coal India Limited (CIL) planned to set up a coal based methanol plant in West Bengal
- The Namrup-based Assam Petrochemicals Limited (APL) rolled out the country's first methanol-based cooking fuel project-
- 'Green and Clean Fuel Pilot Project on Methanol Cooking Stove'. The project has been promoted by NITI Aayog.

**E) NITI Aayog's Plan for Methanol Production in India:**

- India is producing all of its methanol from imported natural gas since domestic production is not economically viable at present. → it must use abundant domestic high ash coal to make it economically viable → Commercial coal to methanol plants need to be set up wherever necessary.
- It is estimated that a 1600 tons per day of methanol plant will require a capital expenditure of ~INR 1200 Cr which would be able to produce methanol at INR 17- 19 per liter which is comparable with the cost of imported methanol. Whereas, presently, the per liter cost of methanol production in India is INR 25-27 or even more depending on the volatility in the price of imported natural gas.
- Biomass/municipal solid waste and flared natural gas can also be used for methanol production, but the continuous availability of latter would be a challenge.

**F) Challenges:**

- **Water Intensive** → 20 cubic meters freshwater for 1 ton coal-based methanol → wastewater.
- **leakage and explosion** → loss of life and property.
- **Vehicle's** damage → rubber or plastic components + corroding metals such as aluminum, magnesium, zinc
- During the process of making methanol from coal, a large amount of **CO<sub>2</sub> is emitted**.
- **Technology** to co-generate power in methanol plants requires further refinement
- For blending more than 15% of methanol, internal combustion engines **changes in the engine design** are required.

**G) Way Forward:**

1. Create an **innovation fund** → support the R&D activities → a demonstration coal to methanol production plant
2. Have **sufficient domestic methanol production capacity** so that user industries are assured of supply
3. Simultaneous programs for the development of
  - **flexi-fuel vehicles** to run on methanol/DME fuel blends
  - Methanol/DME **cookstoves**
  - Converting diesel powered railway locomotives to methanol/DME based engines.
4. Explore possibility of setting up **a manufacturing facility for methanol/DME in Iran or Qatar** as these countries can provide the natural gas at very low prices
5. **Import Methanol/DME for its direct application** or for further conversion to chemicals like olefins as it is likely to be economically advantageous rather than importing crude
6. Set up a mega coal based **complex for production of power, methanol and fertilizer** in an integrated manner
7. **Methanol Blending Program** with all possible fossil fuels can be implemented on an early basis

**MAINS QUESTION :**

With growing energy needs should India work on exploring methanol production and application ? Discuss the facts and fears associated with Methanol economy in India(250 Words, 15 Marks)