



Fueling the Future: India's Methanol Economy

This editorial is based on [“The power of green methanol”](#) which was published in The Hindu Business line on 10/10/2023. It talks about how green methanol can be a potential alternative fuel for India, as it can reduce carbon emissions and dependence on fossil fuels.

For Prelims: Methanol, Green Methanol, [Methanol Economy](#), Methanol Economy Research Programme (MERP), Methanol Cooking Fuel Programme, Fluidized bed gasification technology

For Mains: Methanol and its benefits, NITI Aayog's Methanol Economy Program and other initiatives, Challenges and Way Forward

[NITI Aayog](#) has prepared a comprehensive plan advocating adoption of methanol as the preferred cooking fuel in households as well as commercially. NITI Aayog believes it can be used to power rail, road and shipping. Besides that, it reckons it can partially replace LPG for cooking. Blending of 15% methanol in gasoline can result in at least 15% reduction in the import of gasoline/crude oil.

What is Methanol?

▪ Definition:

- Methanol is a **low carbon, hydrogen carrier fuel** produced from high ash coal, agricultural residue, CO₂ from thermal power plants and [natural gas](#).
- Methanol, also known as methyl alcohol or wood alcohol, is a **colorless, flammable liquid**.
 - It is the **simplest alcohol**.
- Methanol is commonly used as an industrial solvent, antifreeze, and fuel, but it is perhaps best known for its use as an alcohol fuel in racing cars and as a feedstock for the production of chemicals and plastics.

▪ Applications:

- **Fuel:** Methanol can be used as an alternative fuel or fuel additive. It is often blended with gasoline to improve combustion and reduce emissions. Methanol is also used in the production of biodiesel.
 - Methanol **can be produced from renewable sources like biomass and can be used as a potential energy carrier** or fuel in fuel cells and other energy applications.
- **Solvent:** Methanol is a **versatile solvent used in various industrial processes**, including chemical manufacturing, pharmaceuticals, and the production of paints, varnishes, and coatings.
- **Antifreeze:** Methanol is used as an **antifreeze in automotive applications**, particularly in windshield washer fluid.
- **Chemical Feedstock:** Methanol serves as a **crucial feedstock for the production of**

various chemicals, including formaldehyde, acetic acid, and methyl tert-butyl ether (MTBE).

Green Methanol

Green methanol is **methanol that is produced renewably and without polluting emissions**, one of its variants being generated from [green hydrogen](#). This chemical compound can be used as a low-carbon liquid fuel and is a promising alternative to [fossil fuels](#) in areas where decarbonisation is a major challenge, such as maritime transport.

What are the Benefits of Methanol?

- **Lower Production Costs:** Methanol can be **produced at a lower cost** compared to other alternative fuels, which makes it an economically viable option for various applications.
- **Lower Flammability Risk:** Methanol has a **lower risk of flammability compared to gasoline**, which can enhance safety in certain applications.
- **Environmental Benefits:** When produced from [green hydrogen](#) and with carbon capture technologies, **methanol can contribute to a reduction in [greenhouse gas emissions](#) and [air pollutants](#)**. This makes it a more environmentally friendly option, particularly when used as a fuel or energy source.
 - **Emission Control:** By adding water to the combustion process, **methanol can help meet stringent emission limits**, such as the Tier III regulation for [nitrogen oxide \(NOx\)](#) emissions. This makes it a useful choice in applications where emissions need to be controlled.
- **Handling and Transportation:** Methanol is relatively **easy to handle and transport under normal temperatures and pressure conditions**. It is also compatible with existing infrastructure, which simplifies its adoption in various industries.
- **High Octane and Horsepower:** Methanol has the **ability to produce high octane ratings and can deliver equivalent horsepower to super high-octane gasoline**. This can make it a suitable option for high-performance engines.
- **Versatile Use:** Methanol can be used in various ways as an engine fuel, including in dedicated methanol engines, as part of binary and ternary alcohol blends (such as M15, M85, and M100).
 - It is also **suitable for use in shipping, aviation, fuel reforming** using engine waste heat, and industrial electricity generation.

What is NITI Aayog's Methanol Economy Programme?

- **The Programme:** The NITI Aayog's ['Methanol Economy'](#) program is a strategic initiative in India aimed at achieving several important goals related to energy, environment, and the economy.
- **Key Objectives and Potential Benefits:**
 - **Reducing Oil Import Bill:** One of the primary objectives of the Methanol Economy program is to reduce India's dependence on imported crude oil and petroleum products. **Blending of 15% methanol in gasoline can result in at least 15% reduction in the import of gasoline/crude oil.**
 - **Greenhouse Gas Emissions Reduction:** The use of methanol as a fuel has the potential to reduce greenhouse gas emissions. Compared to traditional fuels like gasoline and diesel, **methanol blending would bring down [GHG emissions](#) by 20%** in terms of particulate matter, NOx, and SOx, thereby improving the urban air quality.
 - **Utilizing Local Resources:** Methanol can be **produced from various feedstocks, including [coal reserves and municipal solid waste](#)**. By converting these resources into methanol, India can make more efficient use of its domestic energy resources and waste materials, contributing to sustainability and reducing environmental impacts.
 - Bharat Heavy Electricals Limited (BHEL) has developed the **fluidized bed gasification technology** suitable for high ash Indian coals to produce syngas and then convert syngas to methanol with 99% purity.
 - **Fuel Diversification:** The Methanol Economy program **promotes the use of methanol in various sectors, including road transport, rail, marine, energy production** (e.g., DG sets and boilers), tractors, commercial vehicles, and even retail cooking.

- This **diversification can help reduce the country's reliance on a single type of fuel** and enhance energy security.
- **Job Creation:** The Methanol Economy program is **expected to create a significant number of jobs, estimated at close to 5 million**, through methanol production, application, and distribution services.
- **Consumer Savings:** The program also aims to save consumers money by blending 20% **Di-methyl Ether (DME)**, a derivative of methanol, in **LPG (liquefied petroleum gas)**. This could result in **savings of Rs 50-100 per cylinder for consumers**, making clean cooking fuel more affordable.

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Methanol Economy

WHAT IS IT?

- ▶ It is also known as **methyl alcohol**
- ▶ Colourless, light, flammable liquid

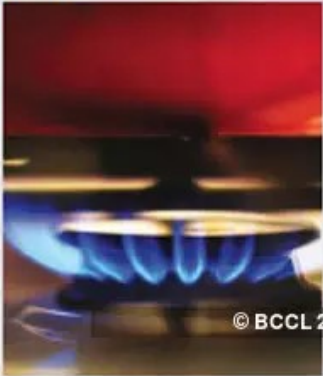
$$\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{H} \end{array}$$

HOW IT IS MADE

- ▶ Manufactured industrially
- ▶ Derived from coal, oil or biomass

WHAT ARE ITS USES

- ▶ Antifreeze
- ▶ Solvent
- ▶ Fuel



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KEY BENEFITS

- ▶ Cheaper to produce compared to other fuels
- ▶ Safer than others because of low flammability
- ▶ Wide variety of feed stock can be used to produce methanol

BIG USERS

- ▶ Methanol demand expected to grow strongly with its use as a fuel
- ▶ China, Brazil, Mexico and the US significant players

Some Other Initiatives to boost Methanol Economy

- **Methanol Economy Research Programme (MERP):** Launched by the Department of Science and Technology (DST) in 2015, focuses on developing novel technologies for methanol production from different feedstocks, such as high ash coal, carbon dioxide, and biomass. The programme also supports research on methanol utilization in direct methanol fuel cells, methanol engines, and methanol blending with LPG.
- **Methanol Cooking Fuel Programme:** Launched by Assam Petrochemicals in 2018, which is the first canister-based methanol cooking fuel programme in Asia. The programme aims to provide a clean, cost-effective, and pollution-free cooking medium to households by replacing LPG, kerosene, and wood charcoal with methanol stoves. The programme has been scaled up to 10 states in India with a target of reaching 1 lakh households.

What are the Challenges Before India's Methanol Economy?

- **Lack of Domestic Natural Gas Resources:** India has limited natural gas reserves and **relies heavily on imports to meet its demand**. Natural gas is the most economical and efficient feedstock for methanol production, but **importing natural gas increases the cost and reduces the competitiveness** of methanol.
- **High Ash Coal and Low Grade Biomass:** India has abundant coal reserves, but most of them are **high ash coal that requires more processing and generates** more emissions than low ash coal.
 - Similarly, India has a large potential for biomass conversion to methanol, but the quality

and availability of biomass varies across regions and seasons.

- These factors increase the technical and economic challenges of producing methanol from coal and biomass.
- **Lack of Infrastructure and Policy Support:** India lacks the necessary infrastructure for methanol production, distribution, storage, and utilization. For example, there are no dedicated pipelines or terminals for methanol transport, no blending facilities or dispensing stations for methanol fuel, and no standards or regulations for methanol vehicles or appliances.
 - Moreover, there is a lack of policy support and incentives for methanol producers and consumers to promote its adoption and use.
- **Lack of Awareness and Acceptance:** India has a large and diverse population with different preferences and habits for energy consumption. There is a lack of awareness and acceptance among the public and stakeholders about the benefits and challenges of the methanol economy.
 - There is also a need to address the safety and environmental concerns associated with methanol production and use.

What are the Solutions to Boost India's Methanol Economy?

- **Developing Novel Catalysts and Processes:**
 - Research and development efforts should aim to improve the efficiency of methanol production from various feedstocks.
 - Consider partnerships with academic institutions, industry experts, and government agencies to facilitate research and innovation.
 - **Environmental impact assessments** are essential to ensure that the new processes are sustainable and eco-friendly.
- **Promoting Methanol as Marine Fuel:**
 - Collaborate with maritime industries to establish guidelines and standards for methanol use.
 - Educate stakeholders on the benefits of using methanol in terms of reduced emissions and compliance with international regulations.
- **Introducing Methanol-Based Fuel Cells:**
 - Investment in fuel cell technology and infrastructure will be crucial for implementing this concept.
 - Ensure that methanol fuel cells are reliable, cost-effective, and have a broad range of applications beyond electricity generation.
- **Encouraging Methanol-Powered Vehicles:**
 - Engage with automobile manufacturers to develop suitable engines and fuel injection systems for methanol.
 - Promote the advantages of methanol-powered vehicles, such as reduced greenhouse gas emissions and improved air quality.
- **Expanding Distribution Network and Infrastructure:**
 - Invest in a comprehensive distribution network with proper storage and dispensing facilities.
 - Ensure safety measures for handling and transporting methanol are in place.
- **Creating Awareness and Incentives:**
 - Launch educational campaigns to inform the public about the benefits of methanol-based fuels and appliances.
 - Consider offering incentives such as tax breaks, subsidies, or discounts to encourage consumer adoption.

Drishti Mains Question

India's Methanol Economy Program is a strategic initiative with various objectives and potential benefits. Discuss the key objectives and potential benefits of the program.

Q. Which one of the following Union Ministries is implementing the Biodiesel Mission (as Nodal Ministry)? (2008)

- (a) Ministry of Agriculture
- (b) Ministry of Science and Technology
- (c) Ministry of New and Renewable Energy
- (d) Ministry of Rural Development

Ans: (d)

Exp:

- The Ministry of Rural Development (MoRD) was involved to act as a Nodal Ministry for launching the National Mission on Biodiesel with special focus on the plantation of Jatropha.
- Jatropha is a plant of Latin American origin, which is now widespread throughout arid and semi-arid tropical regions of the world.
- The plant is well known among the Africans, Asians and Latin American countries as having many uses, particularly in providing renewable energy, controlling erosion, improving soil and reducing poverty.
- Biodiesel is an alternative fuel similar to conventional or 'fossil' diesel. Biodiesel can be produced from straight vegetable oil, animal oil/fats, tallow and waste cooking oil.
- The process of converting these oils into Biodiesel is called transesterification. Biodiesel is environmentally friendly as it is carbon neutral.
- Therefore, option (d) is the correct answer

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