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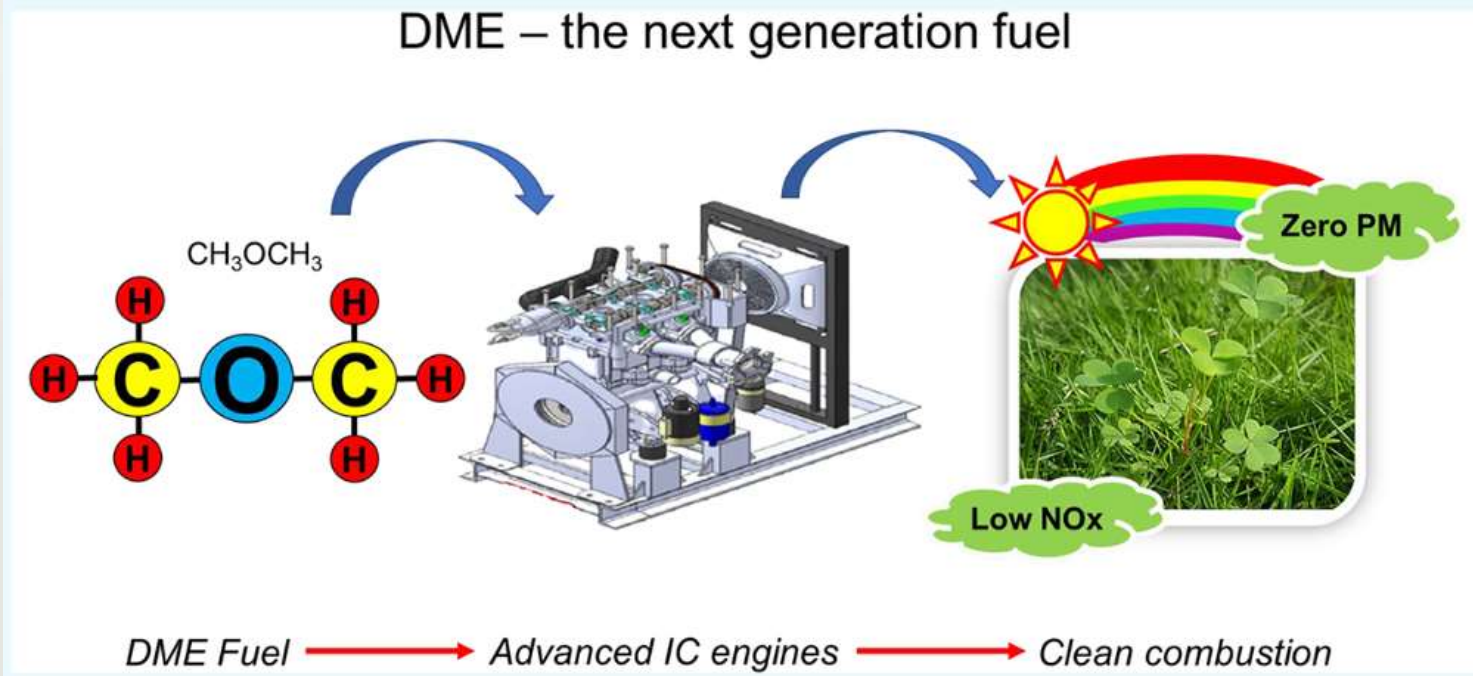
India’s First Dimethyl Ether Fuelled Tractor

Why in News?

Application of DME in internal combustion engines was so far not feasible in India but several countries like Japan, the US, China, Sweden, Denmark, and Korea are already using it to power their vehicles.

India's first 100% Dimethyl Ether (DME) fuelled tractor/ vehicle has been developed by IIT Kanpur that exhibited higher thermal efficiency and lower emissions than the baseline diesel engine

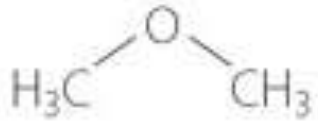


Dimethyl Ether Fuel is an **alternative fuel** that **can be directly used in** specially designed **compression ignition diesel engines** for various purposes.

DME exhibits **calorific valueof 28.4 MJ/KG**

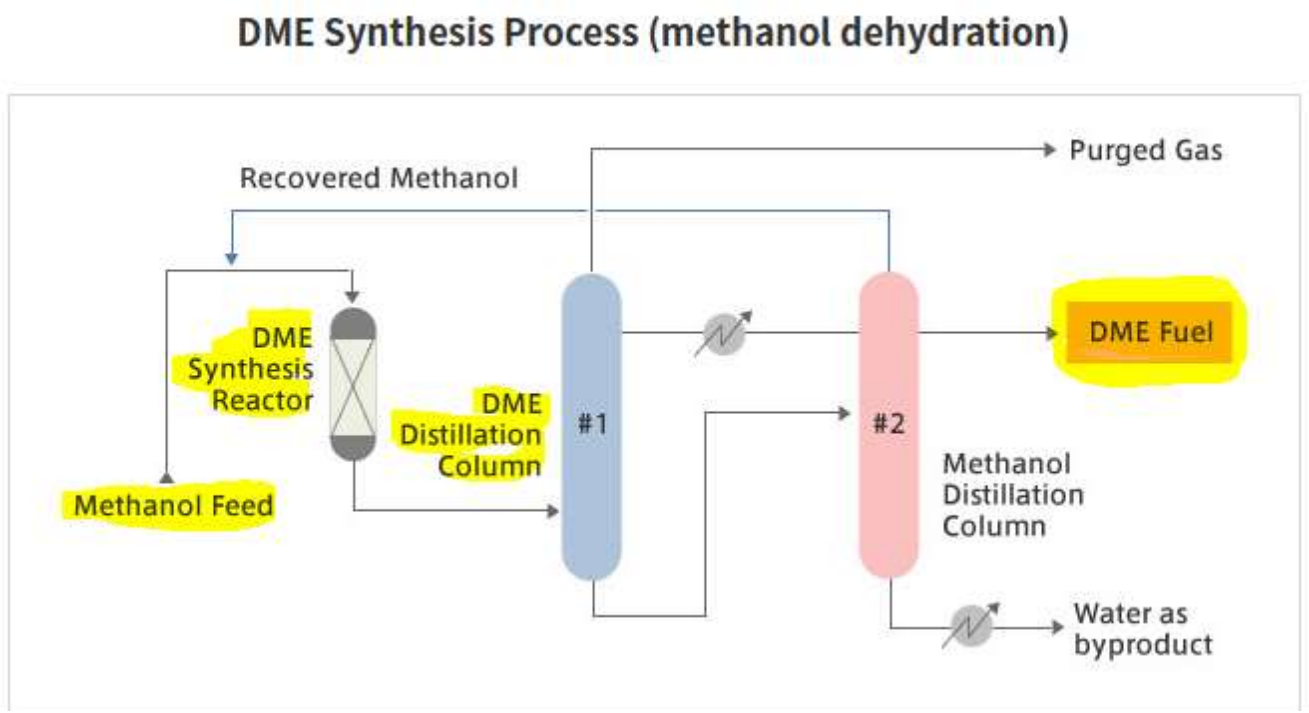
Molecular Formula

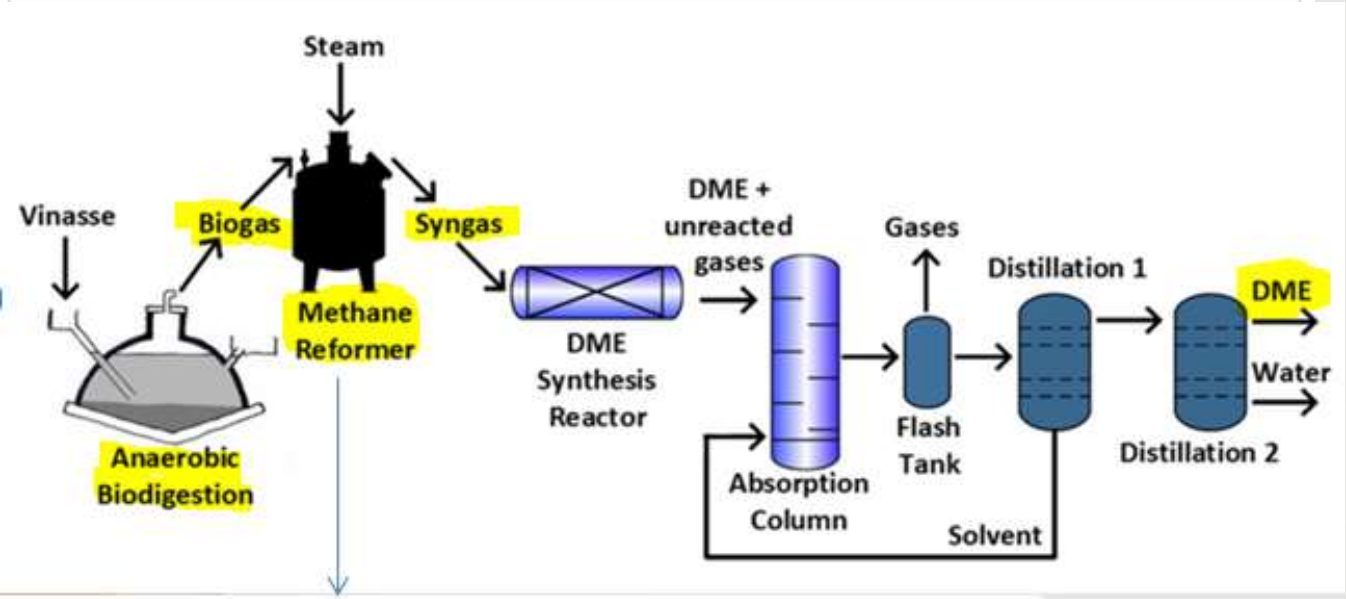
C_2H_6O / CH_3OCH_3



Diesel vs DME

Property	DME	Diesel
Density at 20 °C [kg/l]*	0.67	0.83
Lower heating value [MJ/kg]*	28.4	43.1





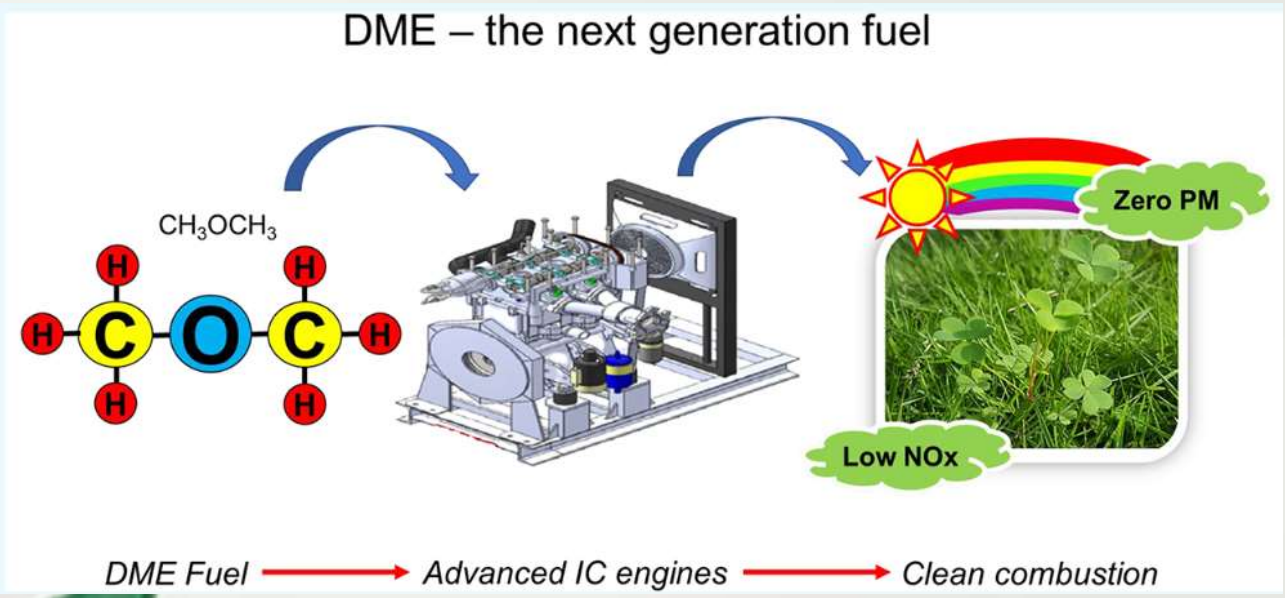
Steam reforming (SR)

(1) $CH_4+H_2O \rightarrow CO+3H_2$

(2) $CO+H_2O \rightarrow CO_2+H_2$

DME- Dimethyl Ether Fuel production

- DME is a synthetically produced fuel
- It can be produced either by dehydration of methanol or from syngas (a mixture of carbon monoxide and hydrogen).

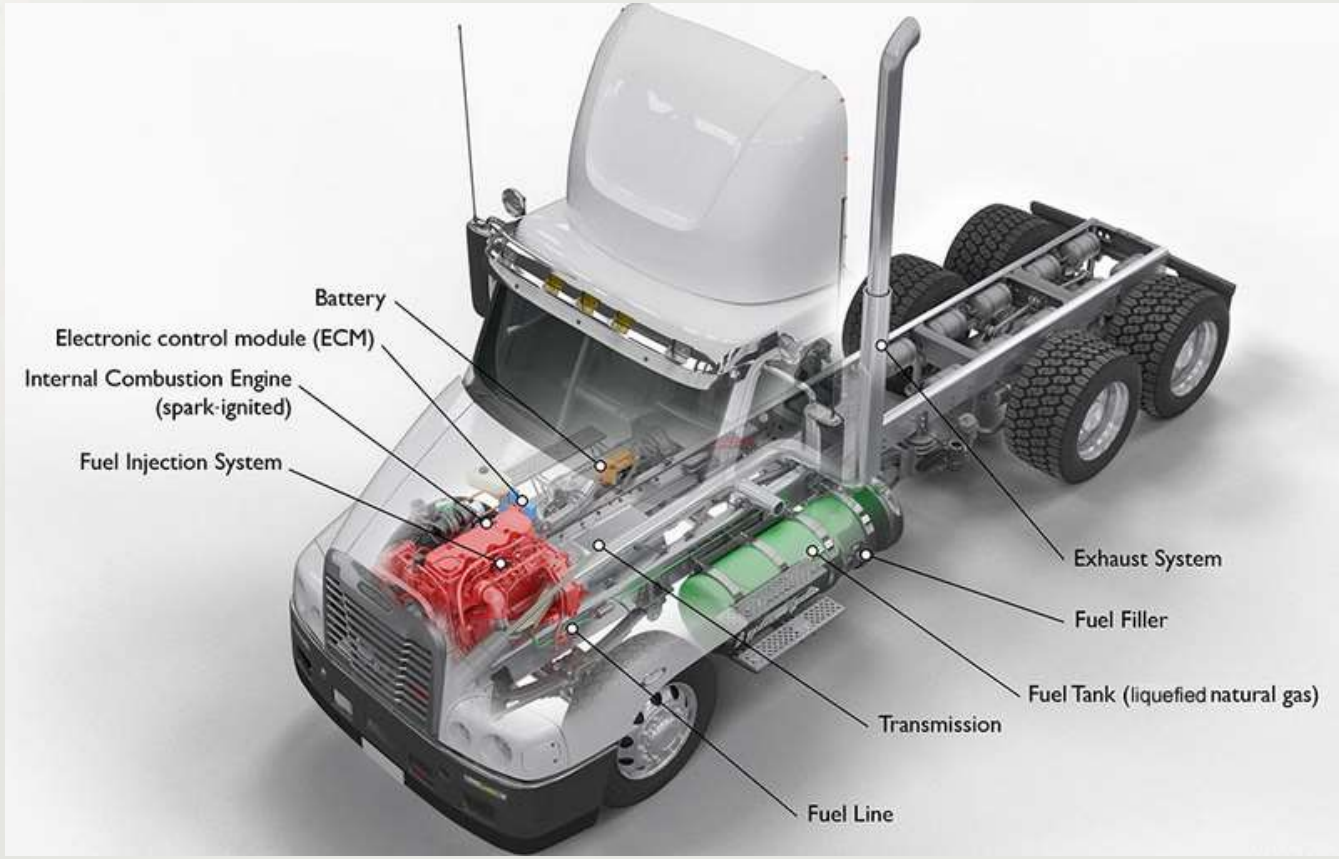


fuels	diesel	dimethyl ether
Chemical formula	$C_nH_{1.8n}$	$CH_3–O–CH_3$
Density/kg/m^3@15.5 °C	827–84	660*(*liq @ 20 °C
Specific combustion enthalpy (net)/MJ/kg	42.5	27.6
Cetane number	52	55–60
Stoichiometric A/F ratio	14.5	9.0
Composition:		
Carbon % mass	86	52.2
Hydrogen % mass	14	13
Oxygen % mass	0	34.8

Environmental Benefits

- The DME-fuelled engine exhibit remarkably low particulate and soot emissions, almost eliminating smoke generation.
- near-zero particulate emission from DME is due to its chemical structure CH3–O–CH3 and the oxygen content of about 35 wt %.
- In addition, combustion products such as CO and unburnt hydrocarbon emissions are smaller than natural gas.

- Dimethyl Ether can be used directly to a conventional internal combustion (IC) engine without any significant modifications.
- Thus, the usage of DME in IC engines has potential to improve engine efficiency and reduce NOx and particulate emissions in the future with minimum attempts
- DME has safe storage, because it doesn't form explosive peroxide.



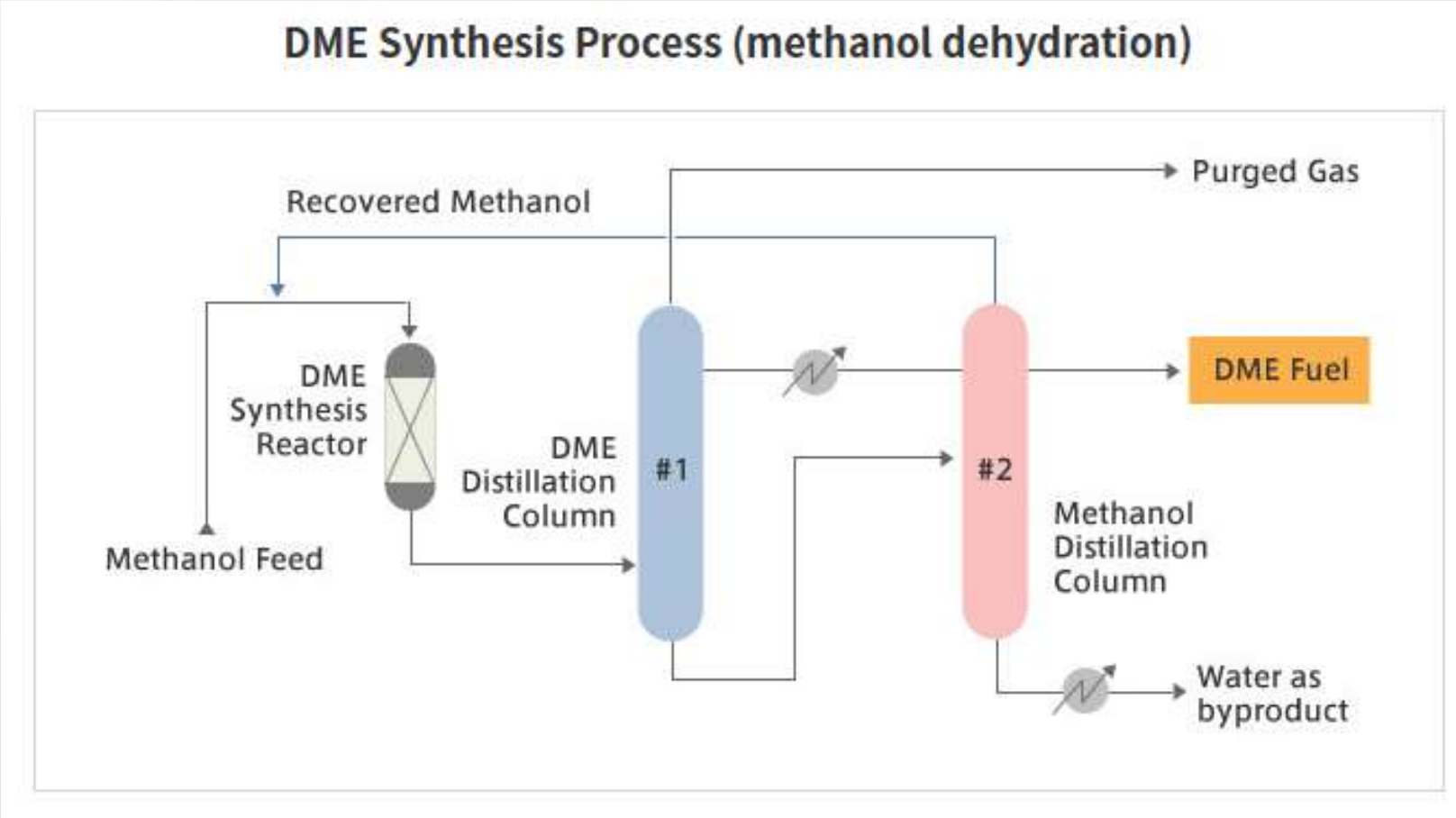
DME as a Renewable Alternative

- DME provides an alternative renewable fuel option that can be produced domestically.
- India imports about 85 per cent of its crude oil requirement
- The net import bill for oil and gas was $11.8 billion in October 2023

Reinforcing Methanol Economy Program:

'Methanol Economy' program of NITI Aayog, aiming to reduce India's oil import bill and greenhouse gas emissions

methanol for DME can be produced by converting vast domestic coal reserves, low-value agricultural biomass waste, and municipal solid waste into methanol



Disadvantages of DME

- poor anti-knock performance.
- Other major problems are the presence of low liquid density and viscosity,
- relatively low heating value, and
- The lower calorific value per unit volume is about half of that for diesel fuel, and it is necessary to double the injection quantity rate of fuel supply. Therefore, it is necessary to increase the capacity of the fuel tank.

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Way Forward

More research is required to make Dimethyl Ether as efficient and clean energy resource

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