

Syngas to DME by Air Products Process

PEP Review 2026-08

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Glossary

°F	Degree Fahrenheit
¢/lb	Cents per pound
¢/kWh	Cents per kilowatt-hour
\$/t	Dollars per metric ton
atm	Atmospheres
Bcm	Billion cubic meters
BFD	Block flow diagram
BFW	Boiler feedwater
Bhp	Brake horsepower
BLI	Battery limits investment
Btu	British thermal units
Capex	capital expenditure
Cc	cubic centimeters
cP	Centipoise
cf/ft ³	Cubic feet
CW	Cooling water
DME	dimethyl ether
DOE	Department of Energy
FOB	Freight on board
ft dia	Feet diameter
G&A	General and administrative
g	Grams
gal	Gallons
g/cm ³	Grams per cubic centimeter
GHSV	gas hourly space velocity
gpm	Gallons per minute
h	Hours
HAD	hydrodealkylation
HP	High pressure
HVAC	Heating, ventilation, and air conditioning
Kcal	Kilocalories
kcal/kg	Kilocalories per kilogram
kg	Kilograms
kJ	Kilojoules
kPa	Kilopascals
kW	Kilowatts
lb	Pounds
LNG	liquefied natural gas
LPG	liquefied petroleum gas
mgal	Thousand gallons
mlb	Thousand pounds
MMBtu	Million British thermal units
MMlb/y	Million pounds per year
MMt	Million metric tons
MMt/y	Million metric tons per year
MOC	materials of construction
mol%	Molar percent
mol/mol	Mole per mole
mPa	Megapascals
MTBE	methyl tert-butyl ether
MTO	Methanol-to-olefins
opex	operating expense
OSBL	outside battery limits
PEP	Process Economics Program
PFD	Process flow diagram

ppb	Parts per billion
ppm	Parts per million
psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
R&D	research and development
rDME	renewable DME
ROI	Return on investment
s	Second(s)
scf	Standard cubic feet
scm	Standard cubic meter
SL	Standard liter
SS	Stainless steel
sq ft	Square feet
t	Metric ton
TAME	Tertiary amyl methyl ether
t/y	Metric tons per year
TFC	Total fixed capital
vol%	Volume percent
w/w	Weight for weight
wt%	Weight percent

Abstract

Growing global interest in clean, synthetic fuels has renewed attention on dimethyl ether (DME), a sulfur-free, low-emission alternative to diesel and liquefied petroleum gas (LPG). DME can be produced via the conventional two-step route, methanol synthesis followed by dehydration, or by single-step processes that integrate both reactions within a single reactor. Among these emerging single-step technologies, the Liquid Phase DME (LPDME™) process developed by Air Products has been extensively studied as a conceptual approach for producing DME directly from synthesis gas. Although pilot-scale demonstration runs were successfully carried out at the US Department of Energy's LaPorte Alternative Fuels Development Unit, no commercial-scale deployment has been reported to date. The LPDME™ concept integrates methanol synthesis and dehydration within a single slurry-phase reactor, enabling direct production of DME while minimizing the overall equipment count.

In this review, a comprehensive review of a conceptual LPDME™ process is presented, with emphasis on its technological configuration and economic feasibility. The process is particularly relevant for energy-intensive regions such as mainland China, India, Japan, and South Korea, where demand for cleaner alternatives to diesel, LPG, and liquefied natural gas (LNG) continues to grow. In addition to its environmental advantages, DME's physical and combustion properties closely resemble those of LPG, making it suitable for power generation, residential heating, and transportation applications.

The review includes a detailed technoeconomic evaluation based on a conceptual plant design located on the US Gulf Coast, with a production capacity of 665 million pounds per year (MMlb/y). It covers the process flow diagram (PFD), material balance, equipment sizing and specifications, and cost estimates, including battery limits, off-sites, variable costs, capital expenditures (capex), and operating expenses (opex). The economic assessment is based on publicly available, nonproprietary sources such as patents and technical literature, and represents Process Economics Program's (PEP) independent interpretation of the commercial process. While the analysis may not fully reflect actual plant configurations, it is considered sufficiently accurate for conceptual design purposes. An interactive iPEP™ Navigator tool is also included, allowing users to explore process economics across different units and global regions.

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