

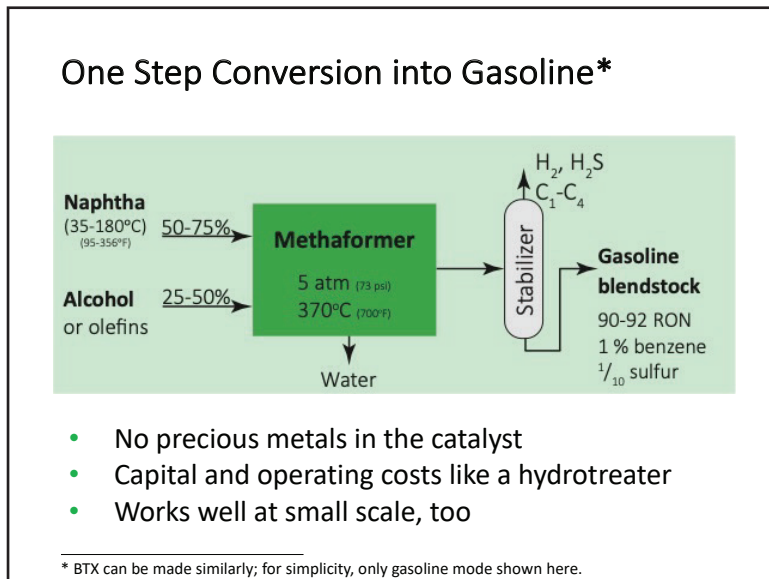
**Make gasoline or BTX
at 1/3 the cost**

Reduce CO₂ by 0.4 t/t

Introduction to Methaforming/Aroforming

Aro- and Methaforming¹ technologies produce gasoline out of naphtha and alcohol at **1/3 of the cost** of traditional processing technologies at comparable yields.

By using ethylene (e.g. from FCC dry gas) or ethanol as the cofeed, refiners get the added benefit of **reducing CO₂ emissions by 300-400 kg per ton of naphtha**.



In the Methaforming process, naphtha and alcohol (methanol, ethanol, etc.) and/or FCC dry gas go through a unit similar to a hydrotreater at modest pressure and temperature.

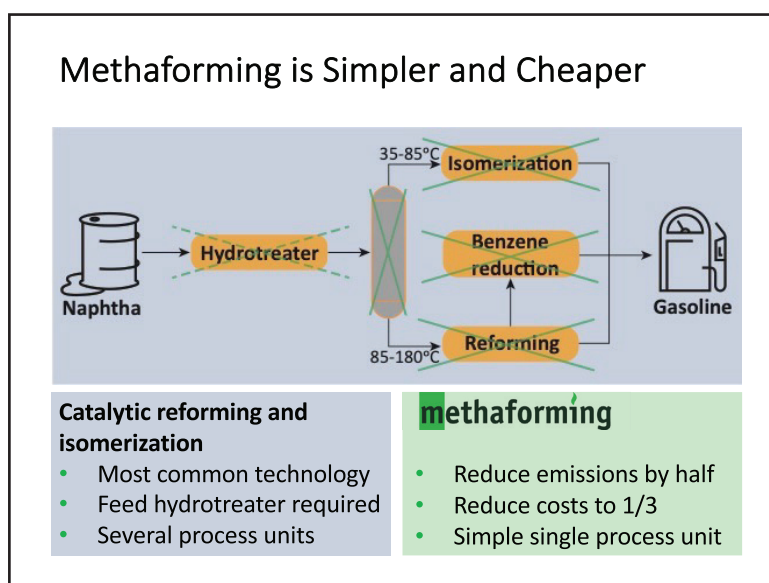
The product is like reformate: a gasoline blendstock with relatively low sulfur and 1% benzene. Just like a reformer, the methaformer produces some light ends, and hydrogen is released. By desulfurizing, there is H₂S in the overhead.

The Methaforming **process flow resembles a hydrotreater**, in which:

- Ethylene and/or an alcohol is used instead of hydrogen,
- There is no recycle compressor, and
- The combination of exo- and endothermic reactions in the same vessel reduces the need for external heat and is responsible for a part of the emission benefits.

The **yields of a Methaformer are similar to a semi-regenerative reformer with an isomerization unit**, except:

- Most benzene is converted to toluene,
- Part of the alcohol becomes water.



The capital and operating cost advantage of Methaforming is because it is a **one step process that replaces four units** and runs on inexpensive zeolite catalyst that does not contain precious metals. This is why **the costs for the entire Methaformer are comparable to a single hydrotreater**.

Unlike a reformer, the Methaformer charges almost any naphtha and reduces its sulfur content by 90%. It replaces the reformer and because

most of the benzene is alkylated to toluene in Methaforming, it avoids the need for benzene-reducing equipment. Methaforming effectively processes light naphtha, thereby eliminating the need for an isomerization unit.

¹ When a light olefin is used as a cofeed we call the process Aroforming. For simplicity, we use the term "Methaforming" as umbrella for both technologies.

Below is a practical example of a small Methaformer recently designed for a client in South-East Asia.

The client's objective is to process inexpensive full range naphtha with a limited amount of methanol into RON 95 gasoline; local standards allow blending.

21k tpa Methaformer: \$3.2m annual margin on \$3m investment

Designed in 2021 for a client in S-E Asia. CapEx \$ 3 million.

		Tons per year
Feed and Blendstock	Full Range Naphtha	21 000
	Methanol	3 000
	Other blendstock	150
Utilities	Natural gas	2 900
	Electric power	2 500 MW-h
Products	Gasoline 95 (after blending)	16 100
	LPG	5 500

- **Operating Margin: \$ 3.2 million / year**
- **Payback period: 11 months.**

With a **payback period under a year**, this Methaformer is an excellent investment.

A conventional processing train (hydrotreater – reformer – isomerization – benzene removal) would be prohibitively expensive and even may not work at this small scale.

Larger refiners operating FCC units and/or other processing equipment that generates light olefins, should pay attention to Aroforming – a variation of our technology that involves light olefins as feed for gasoline or BTX.

With Aroforming, a refiner can **capture the value of the FCC dry gas twice: by upgrading it to gasoline blendstock, and by reducing CO₂ emissions.**

The prices in the table below are US spot prices for October 2021. Carbon emissions are priced for US and Canadian West Coast.

Aroforming: upgrade naphtha and monetize FCC dry gas for a \$330/ton margin

		kg	USD
Feed and Blendstock	Naphtha	1 000	(763)
	Olefins from FCC dry gas	350	(93)
Utilities	Fuel gas	51	(14)
	Electric power	110 kW-h	(7)
Products	RBOB Regular	1 070	943
	LPG	280	199
	CO2 reduction	363	65
Operating Margin			\$ 330 /ton of naphtha feed

Aroforming and Methaforming can be implemented either in a purpose-built facility, or by **converting an existing hydrotreater or a reformer** into an Aroformer or a Methaformer at a modest incremental investment.

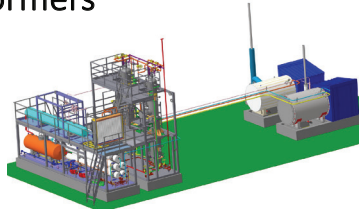
We are in active discussions with several refiners, most of which we can not disclose due to confidentiality obligations.

To check if the Methaforming technology can **benefit your refinery**, please let us have the qualities of your naphtha, and what you want to achieve. We will then forecast the yields and suggest how an Aroformer or a Methaformer can fit into the configuration of your refinery.

If your naphtha is unlike any of the 300+ that we have tested before, we can test it in one of our pilot plants to confirm, and you are welcome to witness the testing. After this, we will develop a process technology package that can be used either by your preferred EPC company or our fabrication partner.

Skid Mounted Methaformers Ready for Order

- Two sizes available:
 - 6 k tpa (150 BPD) for \$1.2 mil (6 mo delivery)
 - 21 k tpa (530 BPD) for \$2.7 million (15 mo delivery)
- Includes all inside battery limits (ISBL)
- OSBL by owner – much may already exist
 - feed and product tankage, MeOH/EtOH receiving
 - hydrogen rich gas H₂S removal, LPG sweetening
 - utilities: fuel gas, electricity, wastewater treating.



Many potential customers are interested in quick delivery, low-cost skid mounted units. We have designed **two versions that can be built quickly.**

These can be delivered within 6 or 15 months, and include all of the equipment necessary inside the battery limits (ISBL).

Scan this code to access our website



Americas, W. Europe: **Stephen Sims**
S.Sims@ngt-synthesis.com
+1 (832) 640-5921

E. Europe, Middle Asia: **Denis Pchelintsev**
D.Pchelintsev@ngt-synthesis.com
+7 (903) 527-2200