

# ***An Alternative Route for Coal To Liquid Fuel***

## ***ExxonMobil Methanol to Gasoline (MTG) Process***

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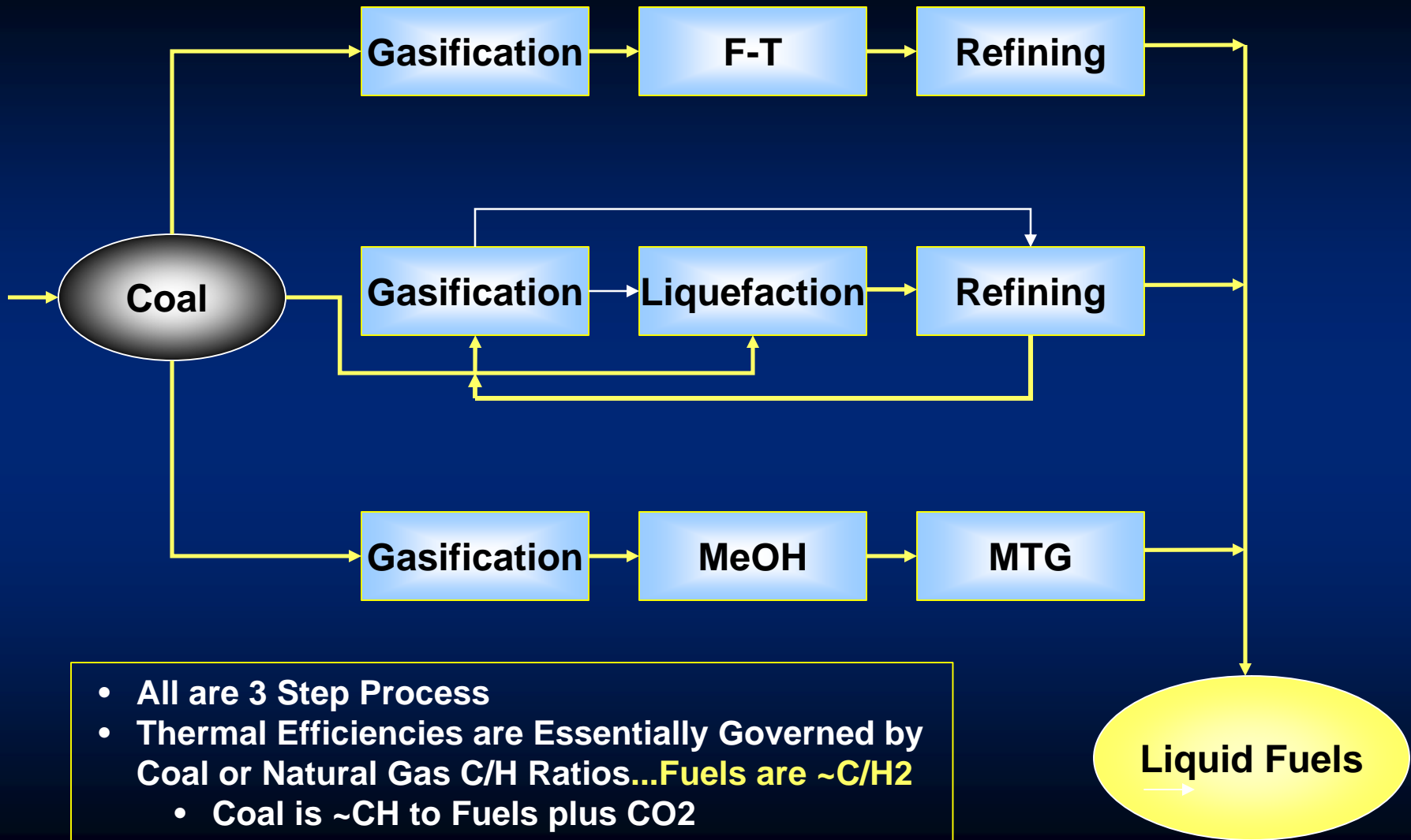


World CTL 2008

***First World Coal-to-Liquids Conference***  
***April 3-4, 2008, Paris, France***

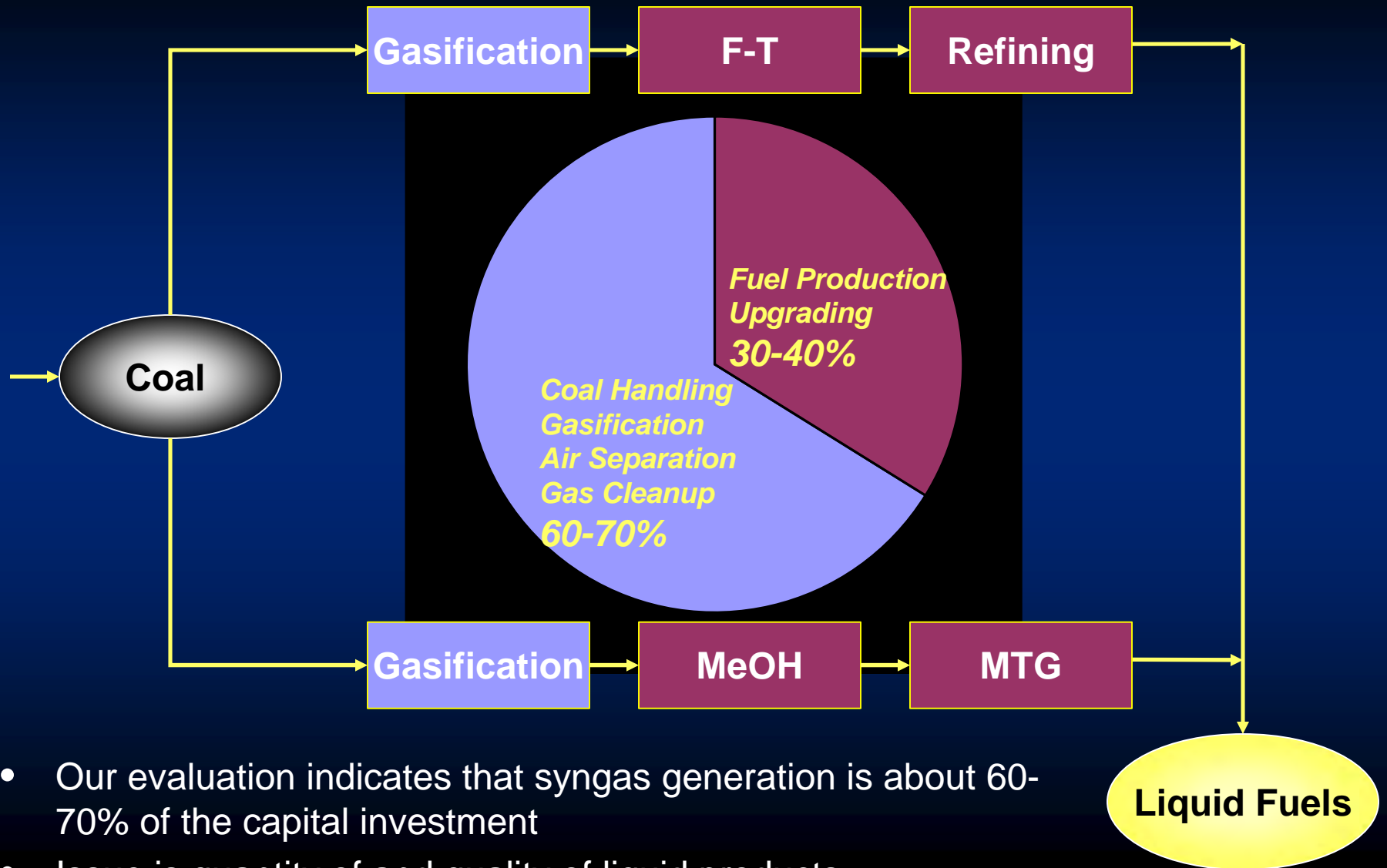
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# Options for Coal To Liquids



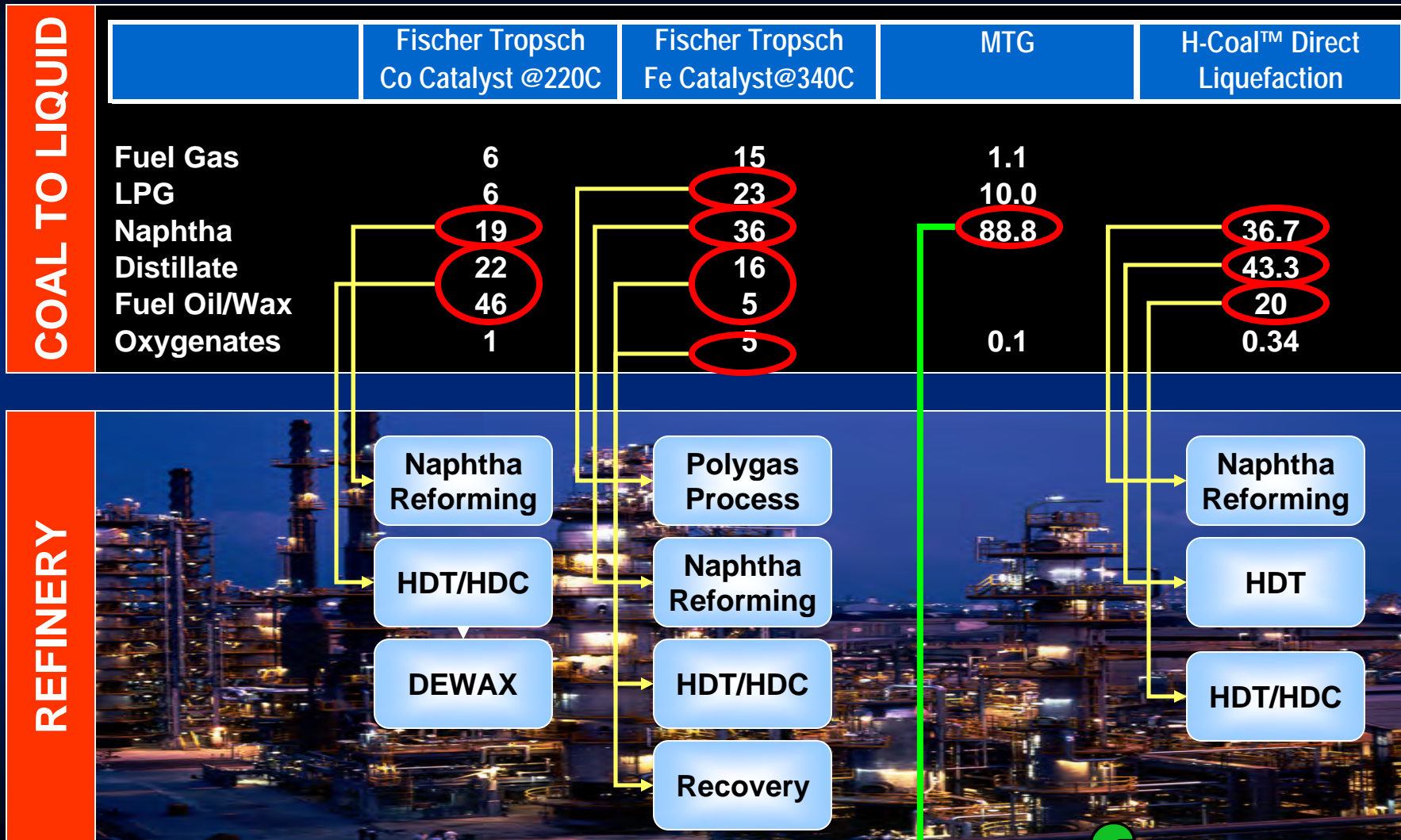
- All are 3 Step Process
- Thermal Efficiencies are Essentially Governed by Coal or Natural Gas C/H Ratios...**Fuels are ~C/H2**
  - Coal is ~CH to Fuels plus CO2
  - Natural gas is CH4 to Fuels plus H2O

# Syngas Generation Dominates Capital Investment



- Our evaluation indicates that syngas generation is about 60-70% of the capital investment
- Issue is quantity of and quality of liquid products.

# Product and Process Simplicity for MTG

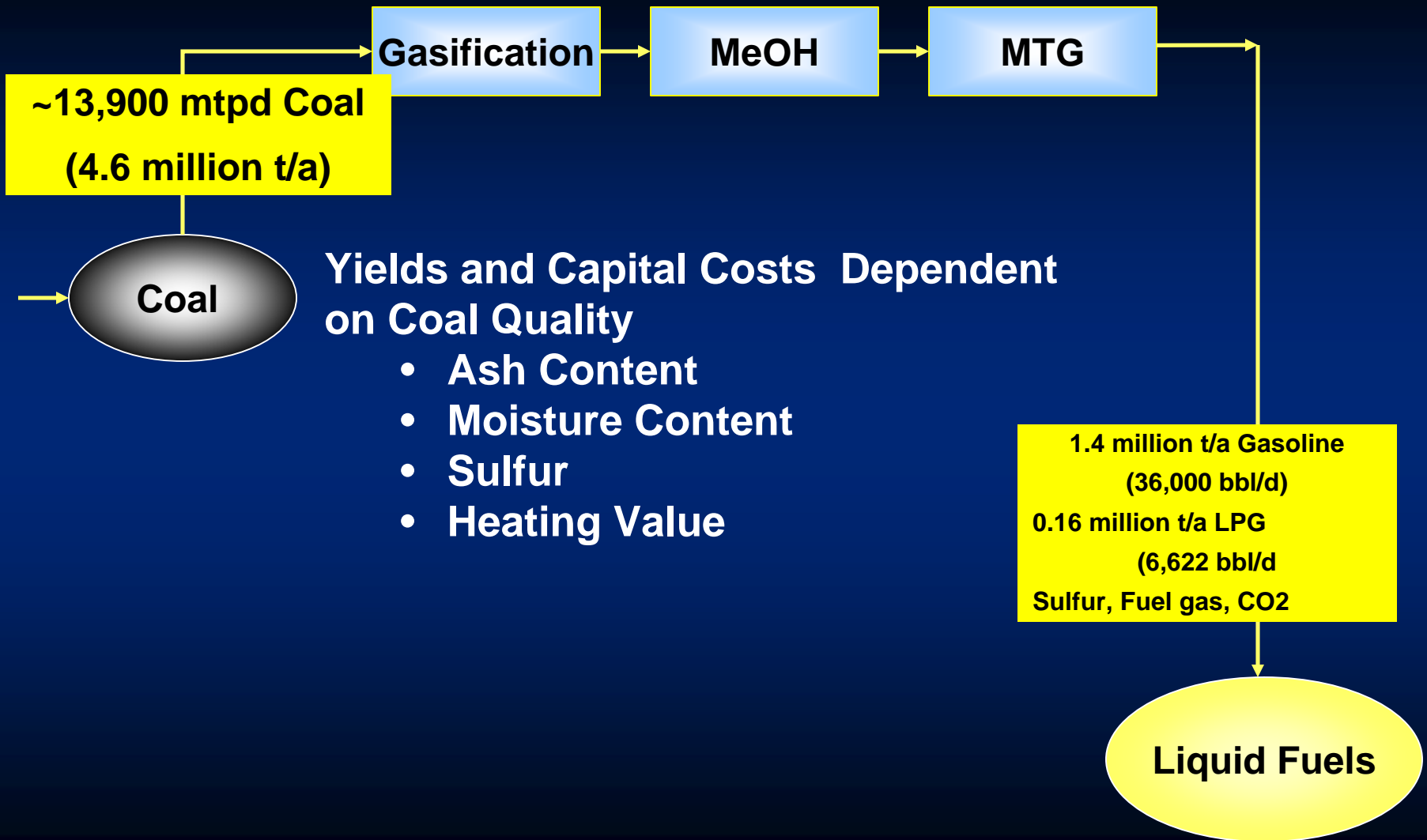


Date Sources: FT Date Sasol 2004 publication. H-Coal data from HRI1982 publication

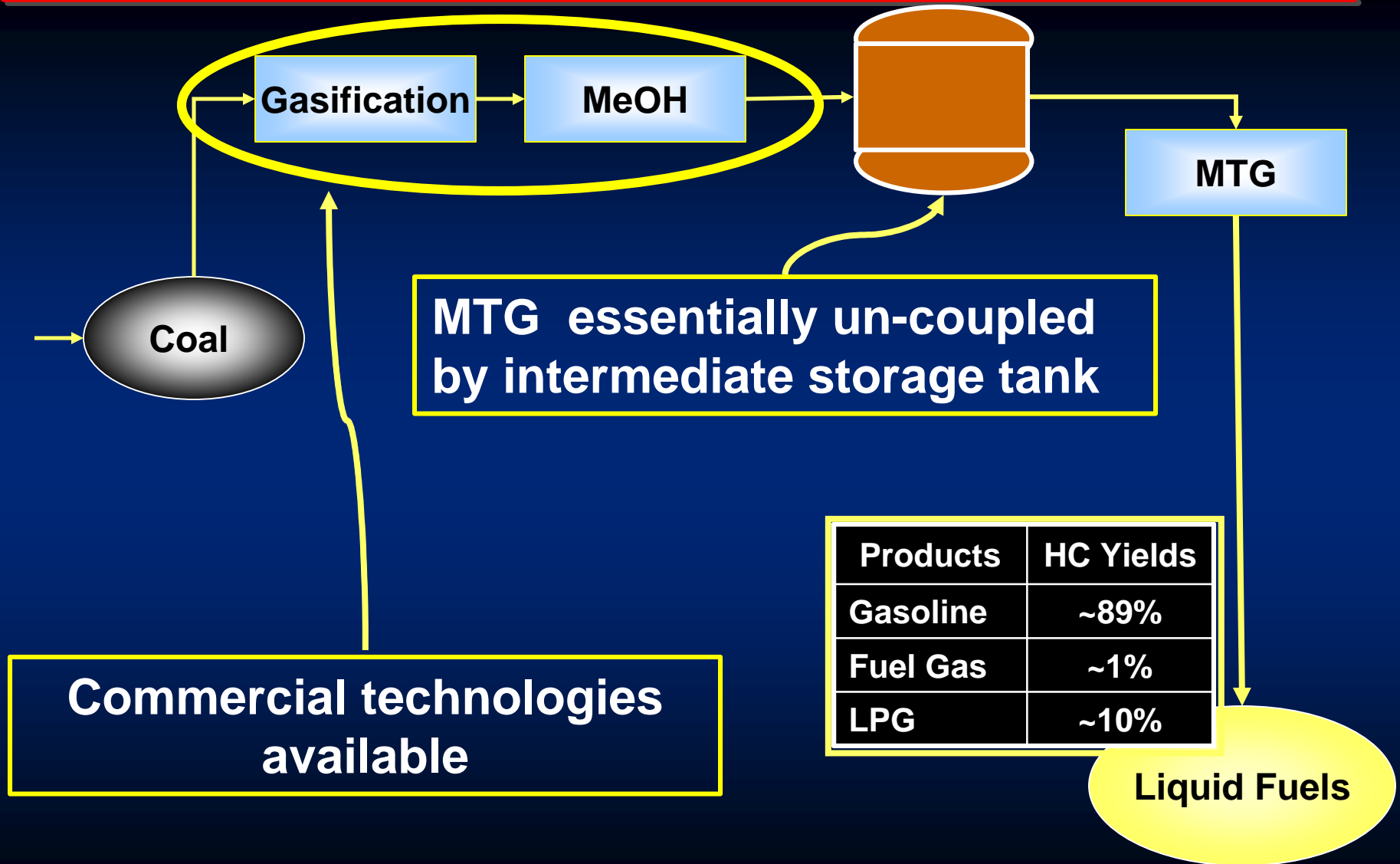


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# CTL Plant: Example Overall Mass Balance



# MTG is Relatively Un-coupled Technology



MTG essentially un-coupled by intermediate storage tank

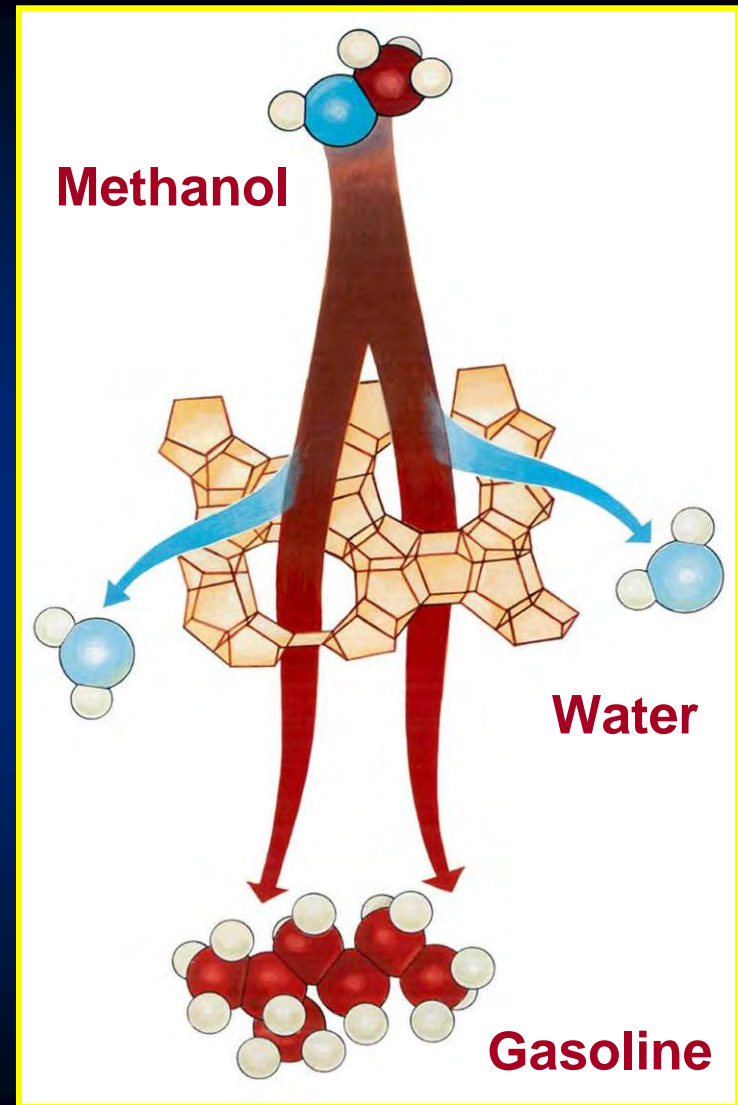
Commercial technologies available

Products	HC Yields
Gasoline	~89%
Fuel Gas	~1%
LPG	~10%

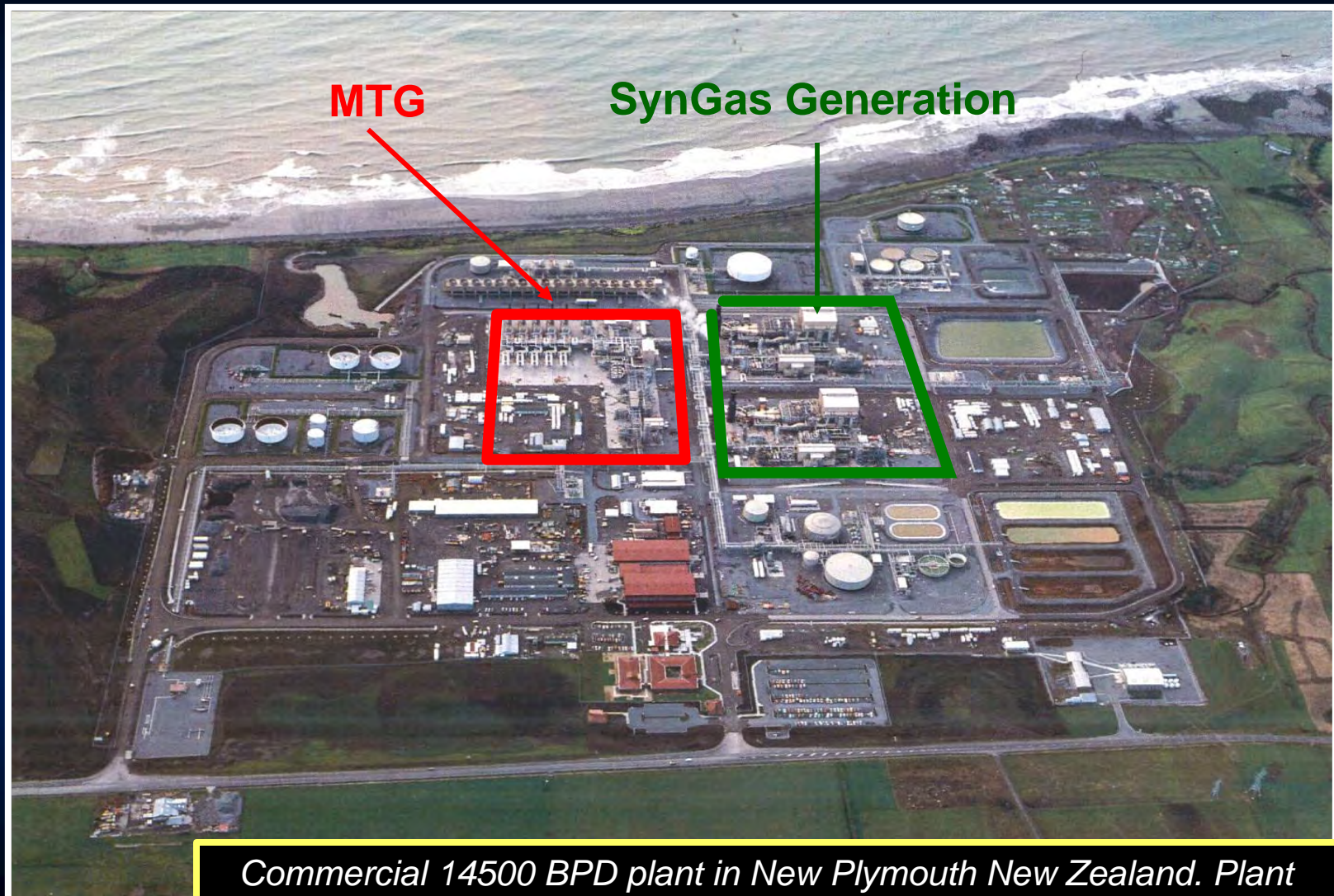
Liquid Fuels

# Unique Shape Selective Chemistry

- Unique “*Shape Selective*” chemistry discovered in the early 1970’s
- Development done through the 70’s/80’s on a variety of process options
- Plant started up 1985 and operated successfully for ~10 years until conversion to chemical grade Methanol production
- Second generation Coal based plant scheduled for YE 2008 start-up in China
- Additional plant in Engineering for Medicine Bow, Wyoming

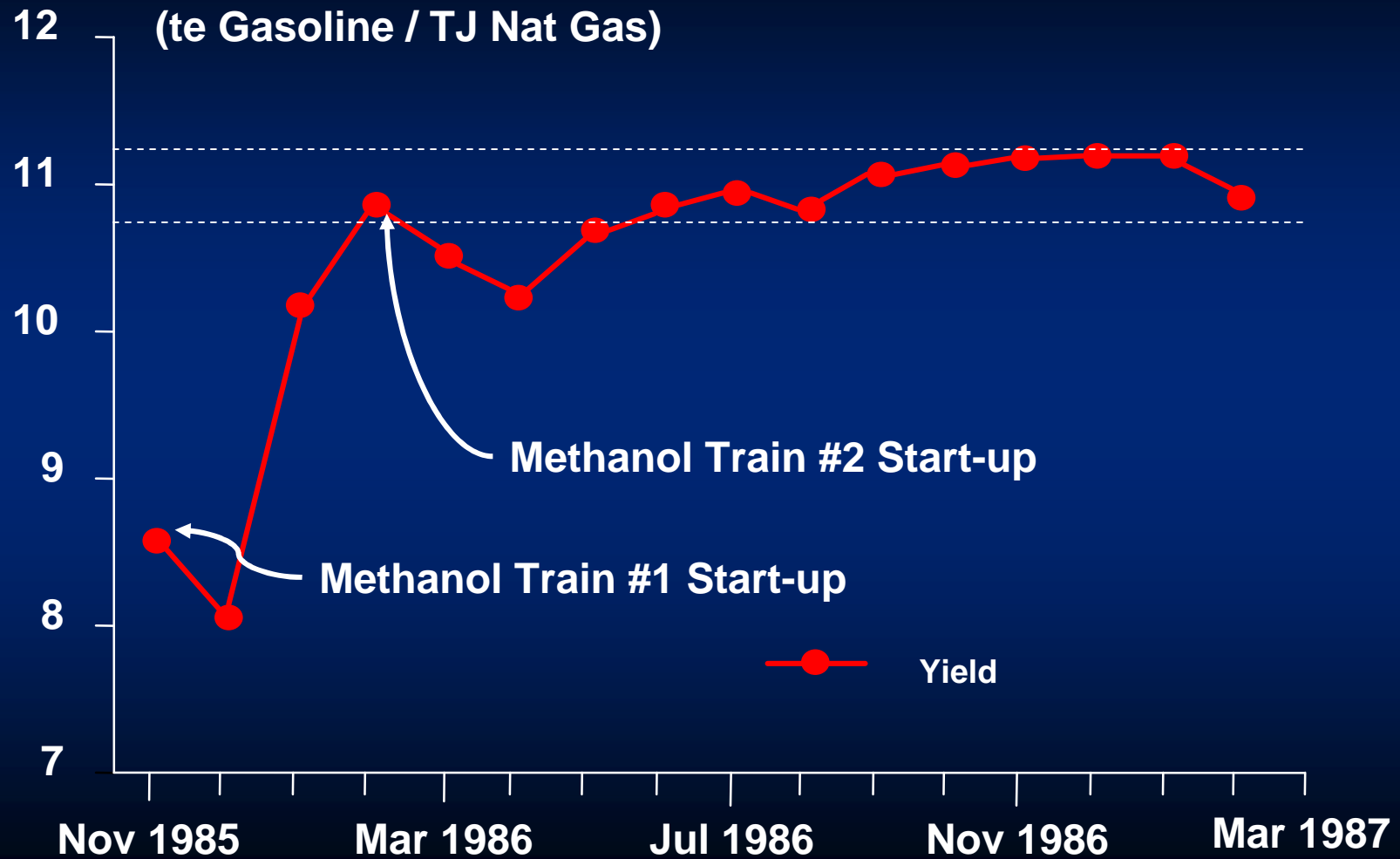


# ***MTG Was Commercially Operated***

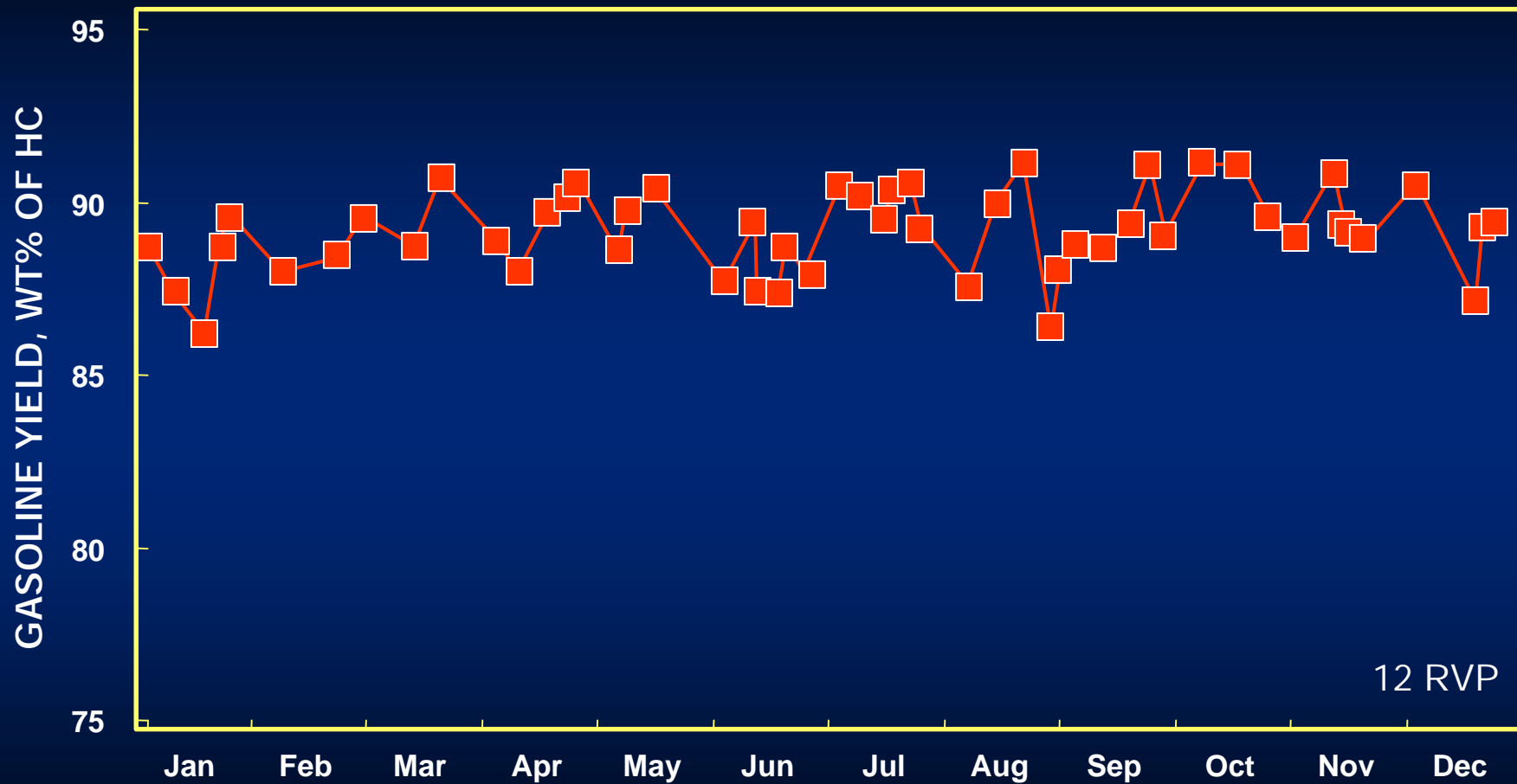


*Commercial 14500 BPD plant in New Plymouth New Zealand. Plant ownership 75% NZ Government and 25% ExxonMobil.*

# Plant Start-up: Total Gasoline Yield



# New Zealand MTG Unit Gasoline Yield



12 RVP

# New Zealand MTG Unit Gasoline Octane



# ***New Zealand Finished Gasoline Quality***

	<b>Average</b>	<b>Range</b>
<b>Octane Number, RON</b>	<b>92.2</b>	<b>92.0 – 92.5</b>
<b>Octane Number, MON</b>	<b>82.6</b>	<b>82.2 – 83.0</b>
<b>Reid Vapor Pressure, kPa</b>	<b>85</b>	<b>82 – 90</b>
<b>Density, kg/m<sup>3</sup></b>	<b>730</b>	<b>728 – 733</b>
<b>Induction Period, min.</b>	<b>325</b>	<b>260 – 370</b>
<b>Durene Content, wt%</b>	<b>2.0</b>	<b>1.74 – 2.29</b>
<b>Distillation</b>		
<b>% Evaporation at 70° C</b>	<b>31.5</b>	<b>29.5 – 34.5</b>
<b>% Evaporation at 100° C</b>	<b>53.2</b>	<b>51.5 – 55.5</b>
<b>% Evaporation at 180° C</b>	<b>94.9</b>	<b>94 – 96.5</b>
<b>End Point, °C</b>	<b>204.5</b>	<b>196 - 209</b>

# MTG Gasoline vs. US Conventional Gasoline

- MTG Gasoline is completely compatible with conventional gasoline infrastructure.
- MTG Gasoline contains essentially no sulfur and low benzene contents.

	2005 Summer	2005 Winter	MTG Gasoline	US Regulation
Oxygen(Wt%)	0.95	1.08		
API Gravity	58.4	61.9	61.8	
Aromatics(%Vol)	27.7	24.7	26.5	
Olefins(%Vol)	12	11.6	12.6	
RVP(psi)	8.3	12.12	9	
T50(F)	211.1	199.9	201	
T90(F)	330.7	324.1	320	
Sulfur(ppm)	106	97	0	30
Benzene(%Vol)	1.21	1.15	0.3	1 (0.62)

# 2nd Generation MTG Technology

✍ Second Generation Design based on learning's from 10 years of NZ operation

- Reduced capital cost
- Reduced utilities cost

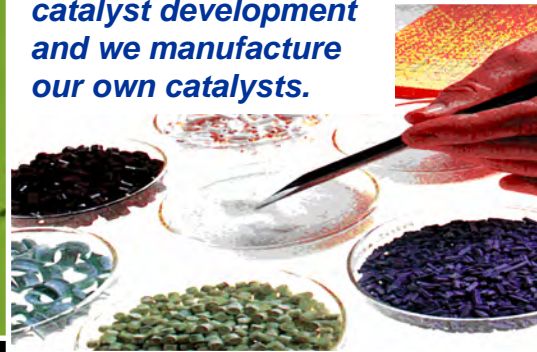
✍ First coal based 2<sup>nd</sup>. Generation plant scheduled for start-up in late 2008 in China. Second plant in Engineering for 2011 start-up in the US

✍ Both plants have MTG Technology from ExxonMobil and Basic Engineering by Uhde

MTG plant currently under construction at Jincheng, Shanxi is second generation MTG Process. The plant is scheduled to start in late 2008.



ExxonMobil is the world leader in catalyst development and we manufacture our own catalysts.



DKRW has selected MTG Technology for its CTL project in Medicine Bow, Wyoming. Producing ~15,000 BPD of gasoline. Basic design of the plant is under way with start-up expected in 2011.

Wyoming



ExxonMobil

# ***Key Project Considerations***

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## **Technical Risk**

- Methanol to Gasoline (MTG) and Coal based Methanol manufacture are both commercially proven technologies

## **Simplicity**

- MTG does not require a “refinery” to make a marketable fuel product.

## **Operability**

- Methanol is storable which enhances operability between stages

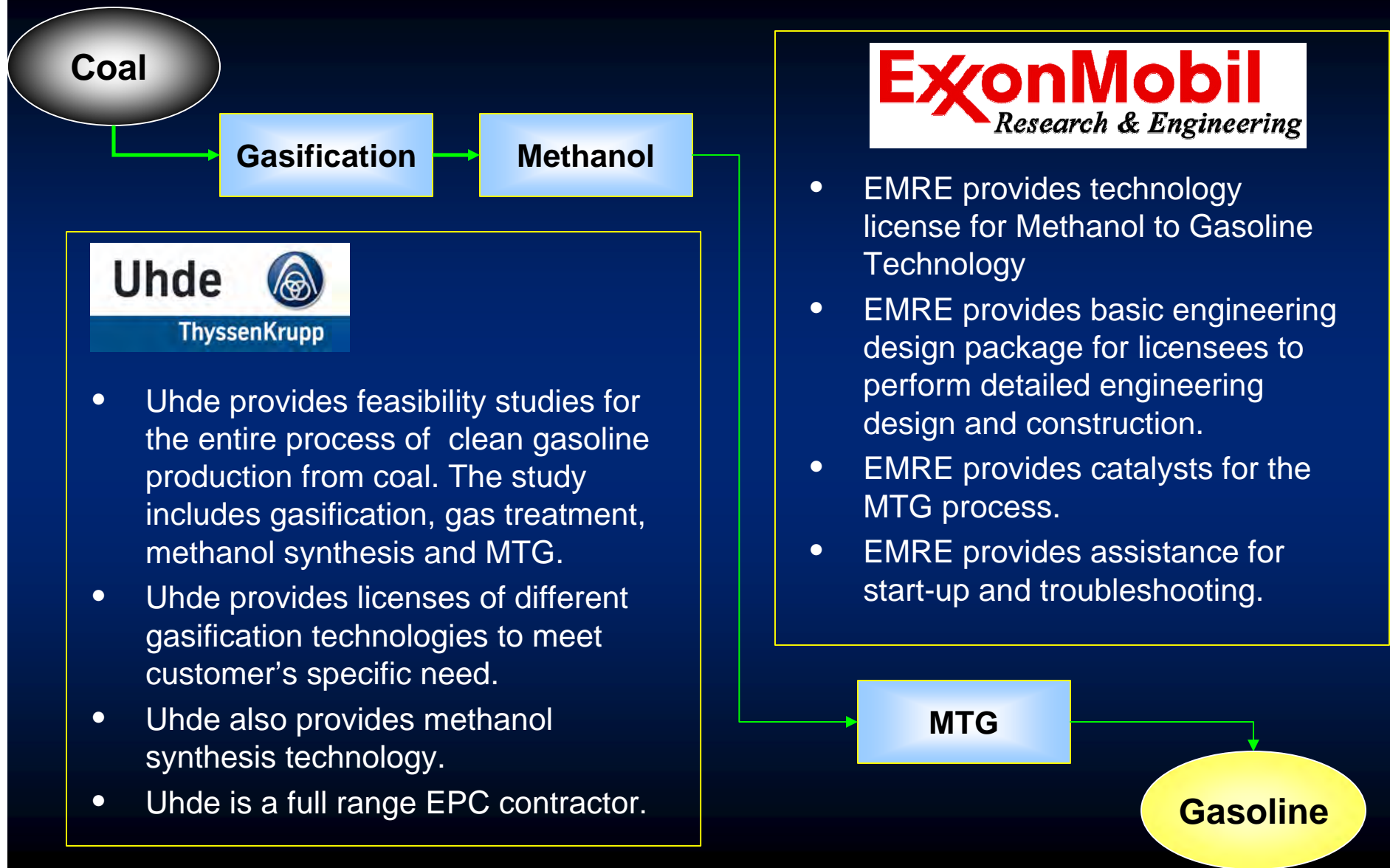
## **Constructability**

- MTG uses gas phase conventional type fixed bed reactors

## **Flexibility**

- MTG can be used for methanol from other sources such as coal bed methane.
- MTG allows staged investment between methanol and gasoline.

# EMRE/Uhde Partnership Provides Full Range of CTL Services



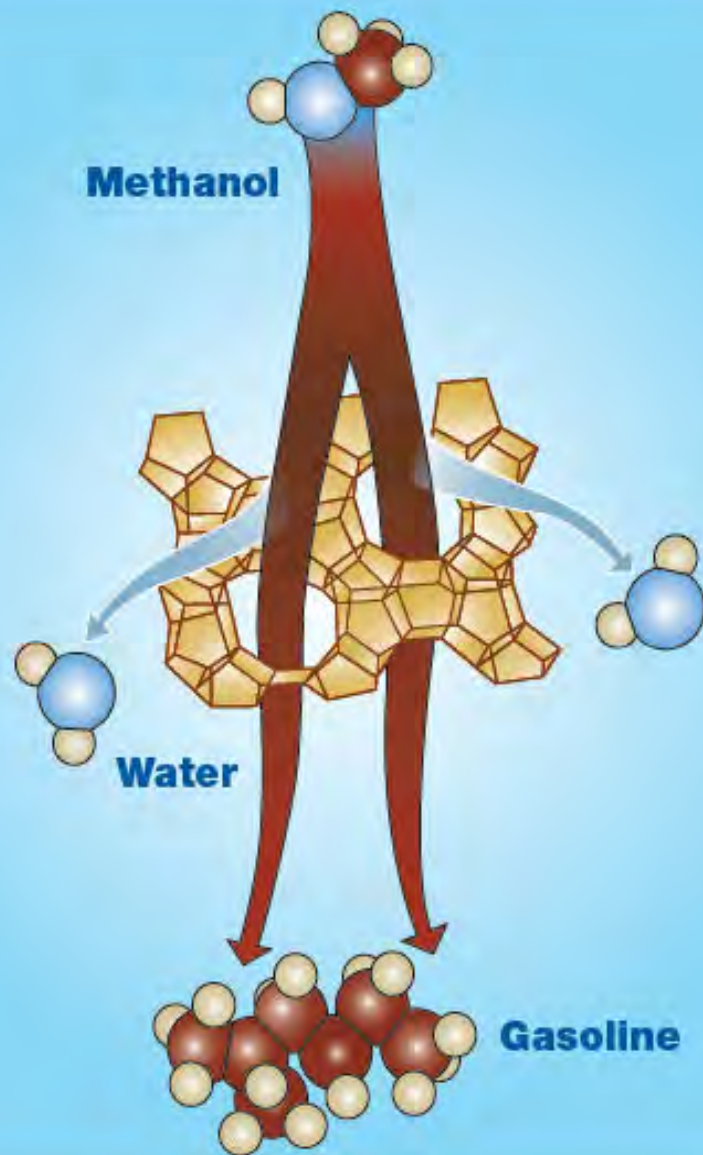
# *NZ Synfuel Plant*

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*Commercial 14500 BPD plant in New Plymouth New Zealand. Plant ownership 75% NZ Government and 25% ExxonMobil.*

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## So Advanced, Yet So Simple.

**Commercially Proven Route for The Production of Clean Gasoline from Coal through Coal Gasification, Methanol Synthesis, and Methanol Conversion**

ExxonMobil's Methanol-to-Gasoline (MTG) Technology, the key step for coal to gasoline conversion, was commercially operated in New Zealand for over ten years. Now we offer the second generation MTG technology which provides:

- Ultra clean, high octane gasoline
- A product fully compatible with refinery gasoline
- Simple, reliable fixed bed reactor design
- A more economically competitive offering

For more information please contact your ExxonMobil representative.

[www.exxonmobil.com/refiningtechnologies](http://www.exxonmobil.com/refiningtechnologies)

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