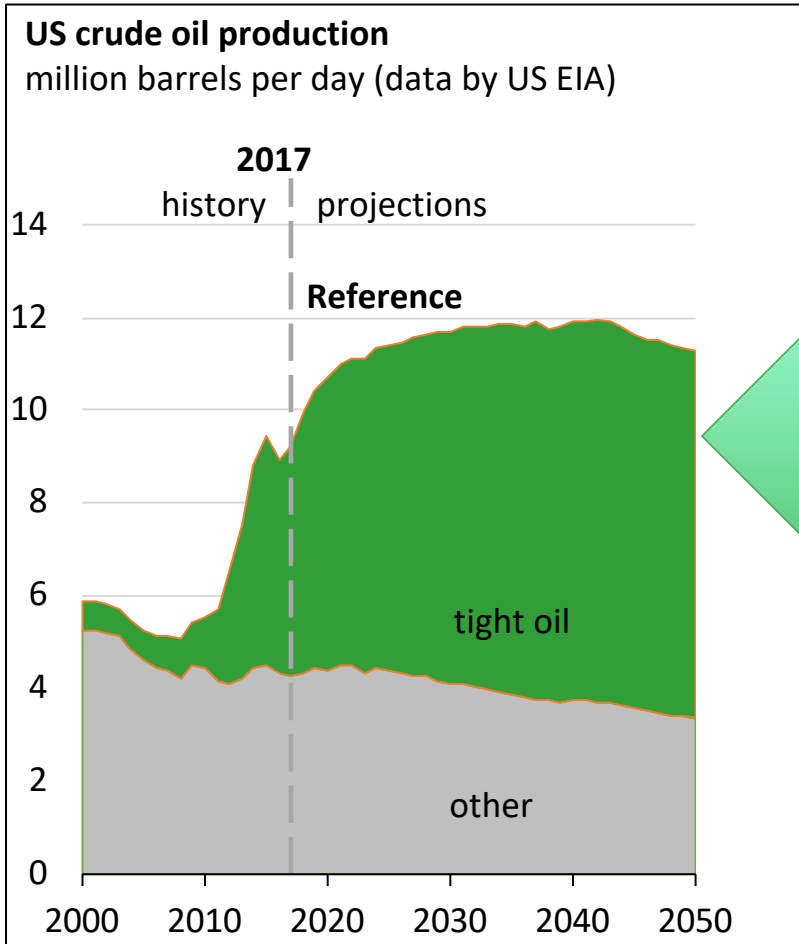


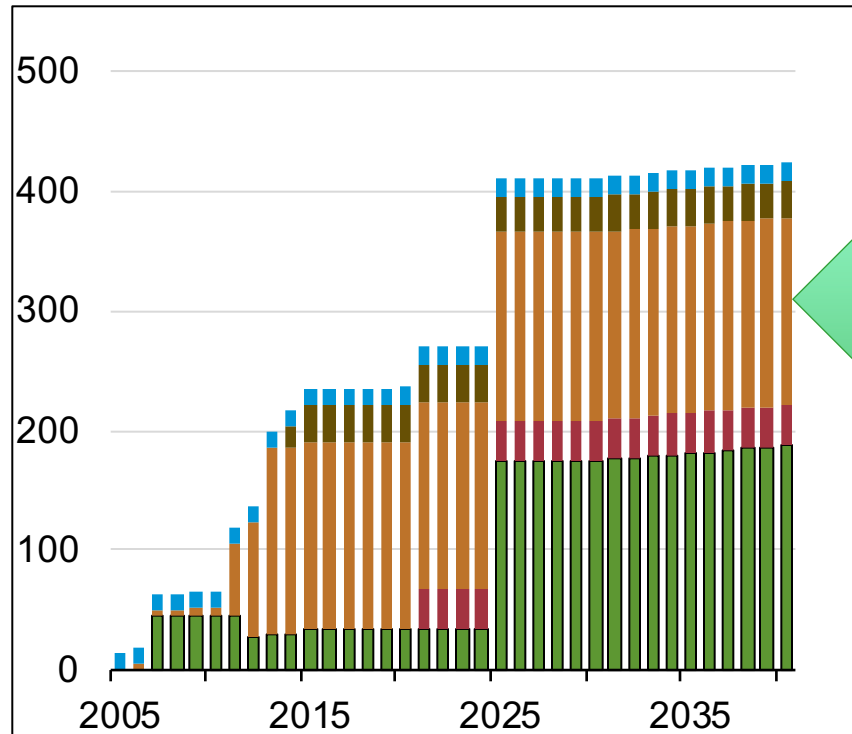
Methaforming:  
Production of gasoline  
from naphtha and  
ethanol at 1/3 the cost



**Trend 1:**  
Refiners do and will need more capacity to process lighter fractions of oil

## Global gas-to-liquids (GTL) plant output

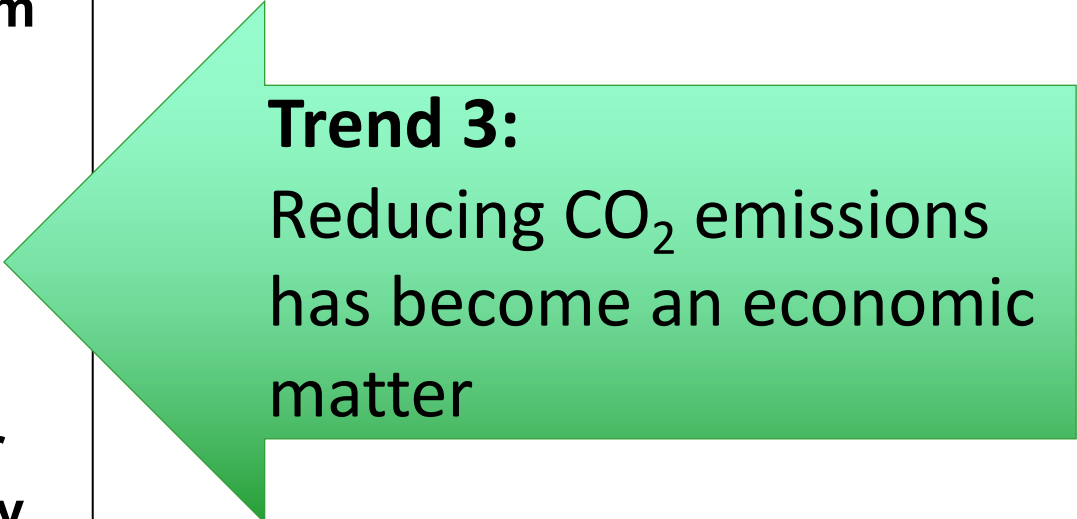
Thousand barrels per day (data by US EIA)



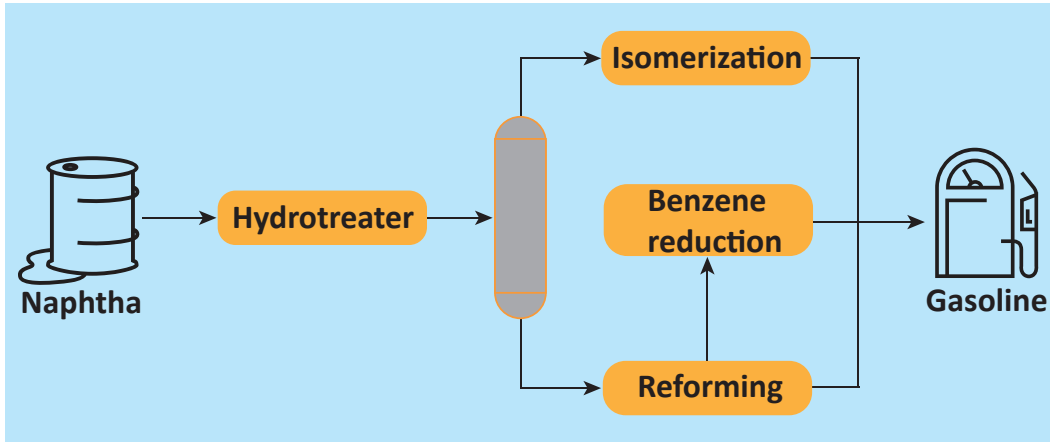
### Trend 2:

GTL plant operators will need to process ~200 k bpd of new GTL naphtha

- **Carbon tax, cap-and-trade; e.g. California LCFS with \$180-200/ton of CO<sub>2</sub>, ~\$200m daily trading volume.**
- **Making 1 gal of gasoline produces 2.5 lb of CO<sub>2</sub>.**
- **At ~1 billion tons of CO<sub>2</sub> per year, the oil refining industry is the world's 3<sup>rd</sup> largest polluter.**

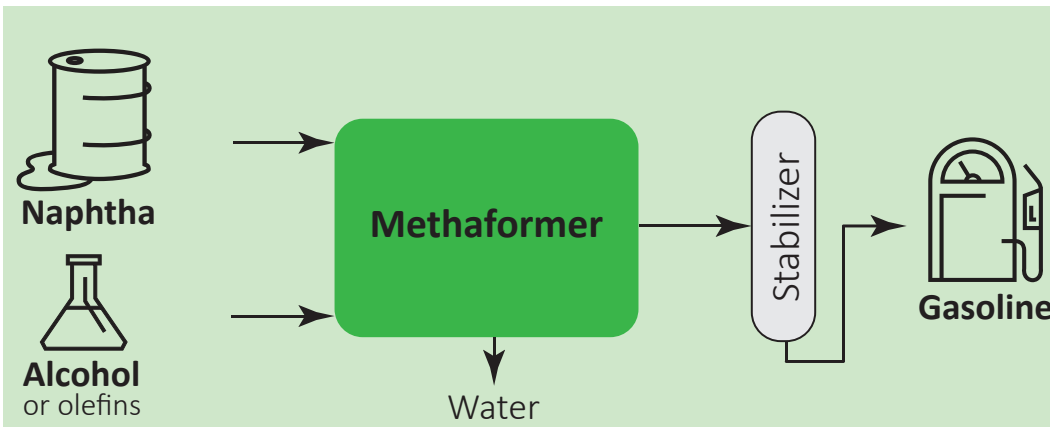


**Trend 3:**  
Reducing CO<sub>2</sub> emissions  
has become an economic  
matter



## Incumbent technology:

- 5 processing steps
- Multiple reheats → fuel burn
- Needs scale to turn a profit (>> 5k bpd, ~200k tpa\*)

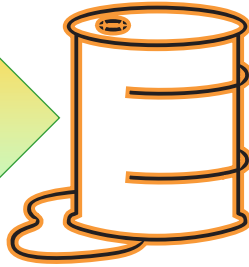


## Methaforming:

- Single step, less fuel burn
- Efficient →  $\frac{1}{5}$  CO<sub>2</sub> emissions
- Can use renewable and low value feeds
- Profitable from 50 bpd, 2k tpa

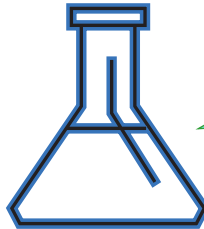
# Feeds (lists are incomplete)

**2/3 to 4/5  
naphtha**



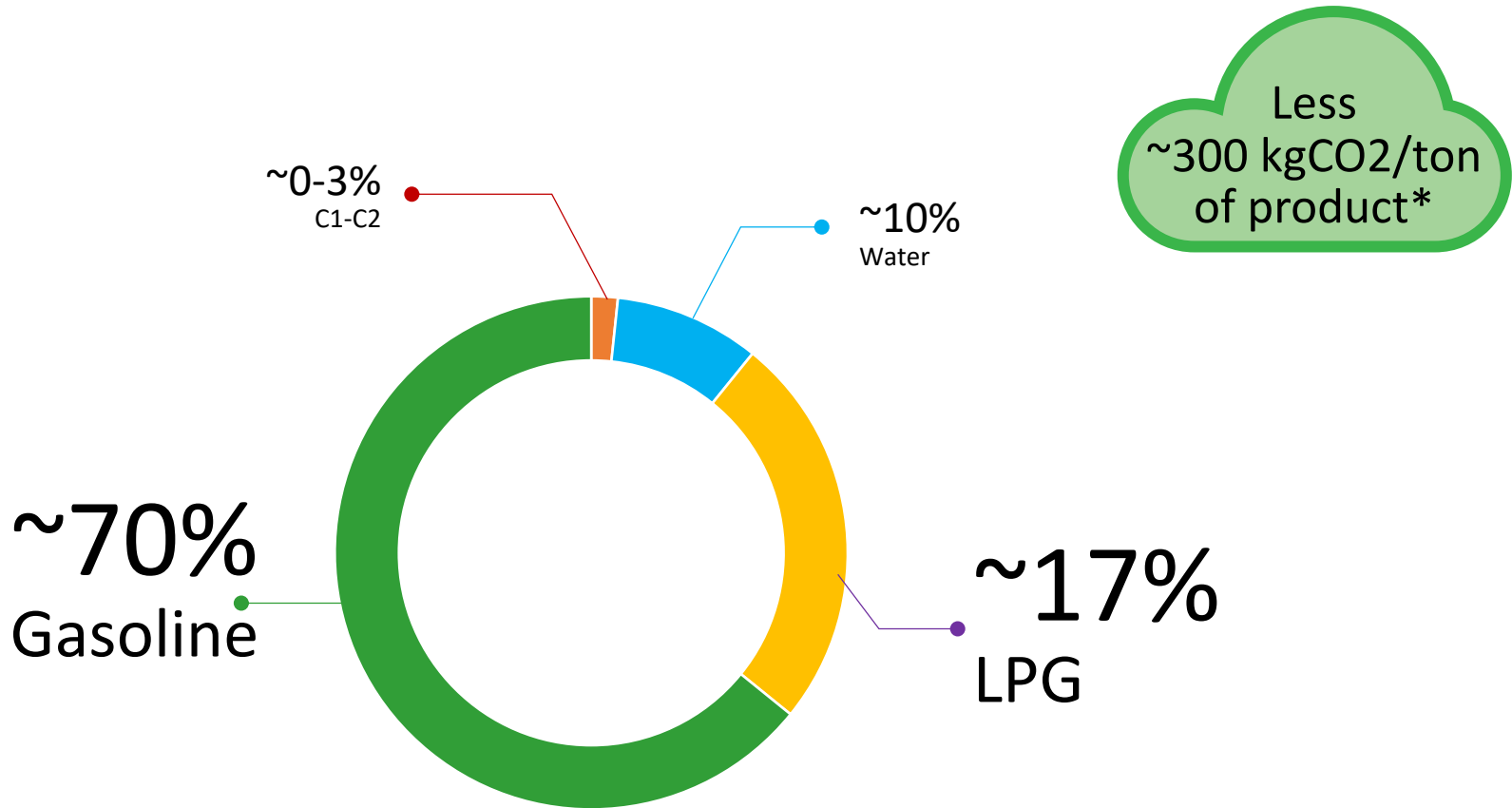
- Light virgin naphtha
- Full range naphtha
- Condensate
- Diluent
- Natural gasoline
- Raffinate

**1/5 to 1/3  
alcohol, ether  
or olefins**



- (Bio) ethanol
- Methanol
- FCC dry gas

# Products



**Value uplift can exceed \$20 per barrel**

\* Compared to traditional processing pathway. Can be worth an additional ~\$50-60 per ton of product.

- **First commercial plant (2017)**
- **150 bpd**
- **Value uplift up to \$45/bbl**







## Gazprom Neft selects 480 k tpa Aroformer for Omsk

Aroforming: production of gasoline from naphtha,  
FCC dry gas and methanol at 1/3 the cost

**Oleg Vedernikov**  
Head of the Refining and Petrochemical;  
Development Gazprom Neft PJSC

**Denis Pchelintsev**  
CEO NGT Synthesis LLC



- **First large scale commercial plant announced in May 2019**

# Methaformer vs Traditional Reforming Suite (HDS+semi-regen)

New 215 K tpa unit (5 K BPD )	Methaforming	Alternative	$\Delta$ Methaforming - Alternative
Yields*, \$ million/yr	29	24	+ 5
OpEx, \$ million/yr	8	12	- 4
CapEx, \$ million	25	55	- 30
Total NPV, \$ million	120	20	<b>+ 100</b>

**Net present value @12% is \$100 million higher**

# Convert Semi-regen Reformer

Existing 860 K tpa unit (20 K BPD )	Methaforming	Alternative	Δ Methaforming - Alternative
Yields, \$million/yr	126	95	+ 31
OpEx, \$million/yr	13	23	- 10
CapEx, \$million	20	-	+ 20
<b>Total NPV, \$million</b>	<b>750</b>	<b>490</b>	<b>+ 260</b>

**Net present value of conversion @12% is \$260 million**

# Grassroots Unit to Process Raffinate and FCC dry gas

New 88 K tpa unit (2 K BPD )	Our Unit	Alternative (direct blending)	Δ Our Unit - Alternative
Yields, \$million/yr	62	41	+21
OpEx, \$million/yr	4	0	+4
CapEx, \$million	14	0	+14
Total NPV, \$million	<b>+100</b>	n/a	<b>+100</b>

**Net present value @12% is \$100 million**

# Summary

- **Upgrade low octane naphtha by \$130-330/ton**
- **Produce gasoline from naphtha and alcohol at 1/3 the cost with comparable yields**

