



June 18, 2019

# Refining company perspective & approach to high quality asphalts

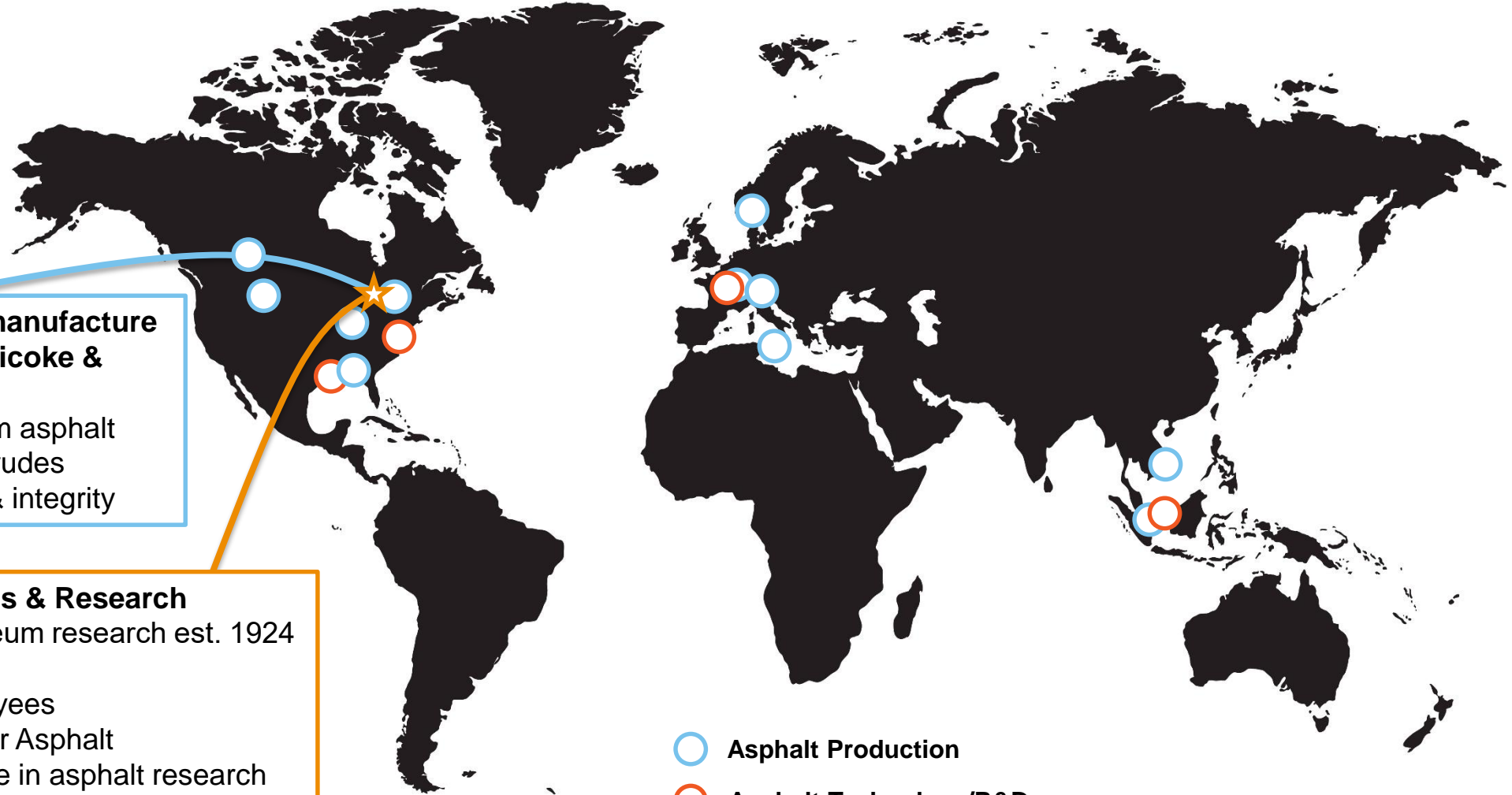
Pavel Kriz, Ph.D., P.Eng.  
Americas Asphalt Group & Discipline Technical Leader

*This communication may contain confidential information for the use of the entity to which it is addressed. If you are not the intended recipient, you are hereby notified that any use, dissemination, distribution, or copying of this communication is prohibited. If you are the intended recipient, information may not be reproduced or further distributed out of your organization without the originator's authorization in writing. 2019 © Imperial Oil Limited. All rights reserved.*

# Imperial & ExxonMobil: Funding Members of Asphalt Institute



# Global Asphalt Operations



**In NA Imperial & ExxonMobil manufacture asphalt at Joliet, Billings, Nanticoke & Strathcona Refineries**

- Produce over 2MTa of premium asphalt
- Utilize high quality WestCan crudes
- Committed to product quality & integrity

**Sarnia Technology Applications & Research**

- Canada's first & largest petroleum research est. 1924
- 700+ patents
- ~40+ PhDs out of ~100 employees
- Global Centre of Excellence for Asphalt
- Long heritage & deep expertise in asphalt research

○ Asphalt Production  
○ Asphalt Technology/R&D

# Crude Oil

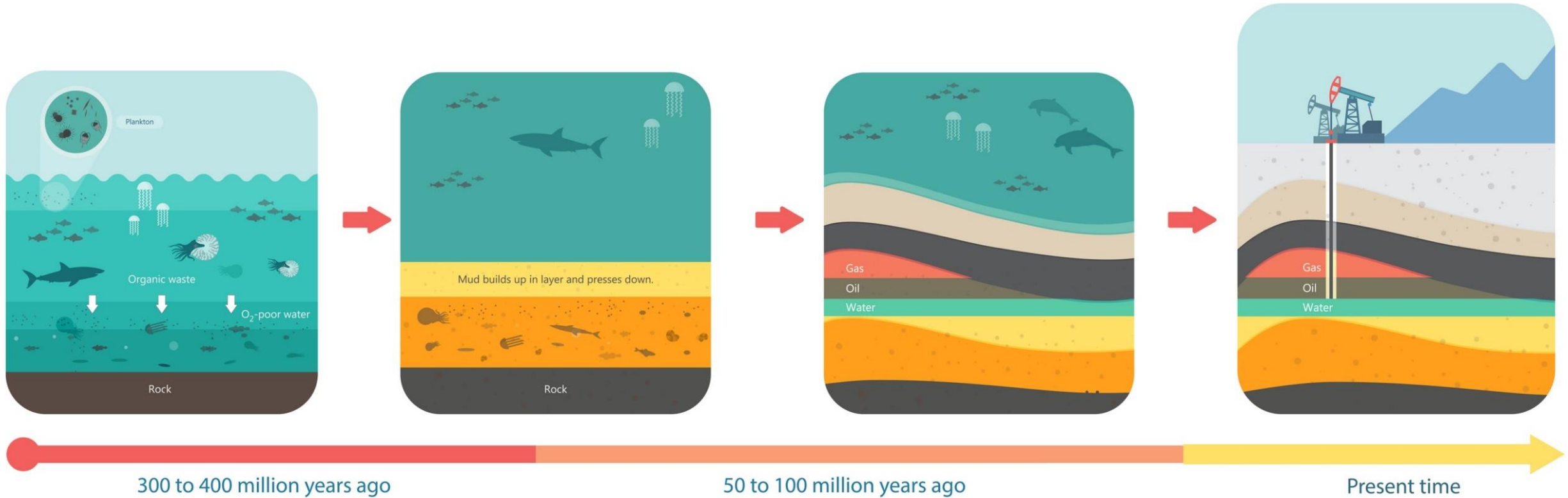
- “Crude oil is a naturally occurring, yellowish-black liquid found in geological formations beneath the Earth's surface”
- It is a mixture of a large number of different hydrocarbons
- Each oil has a unique mix of molecules, which define its properties, like color and viscosity

## Composition by weight

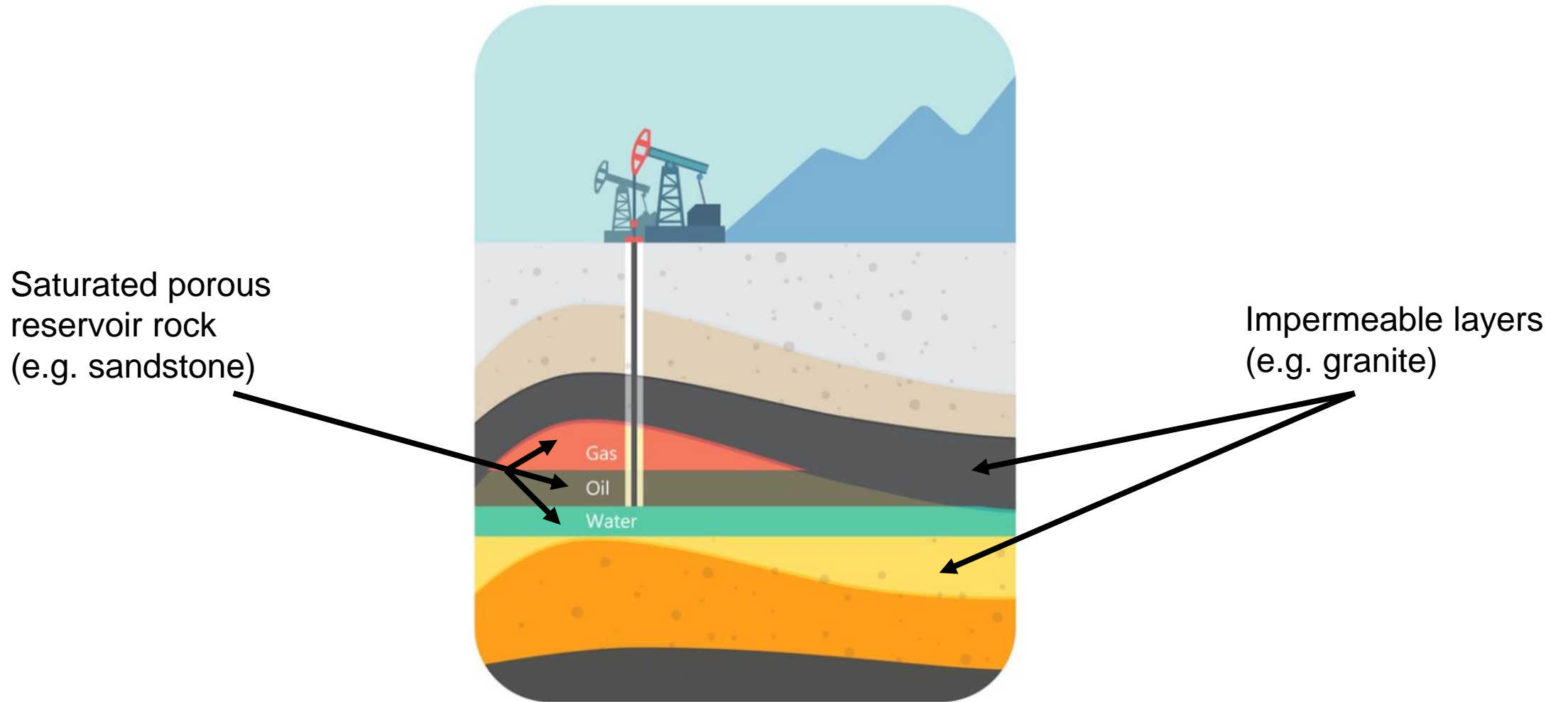
Element	Percent range
Carbon	83 to 85%
Hydrogen	10 to 14%
Nitrogen	0.1 to 2%
Oxygen	0.05 to 1.5%
Sulphur	0.05 to 6.0%
Metals	< 0.1%



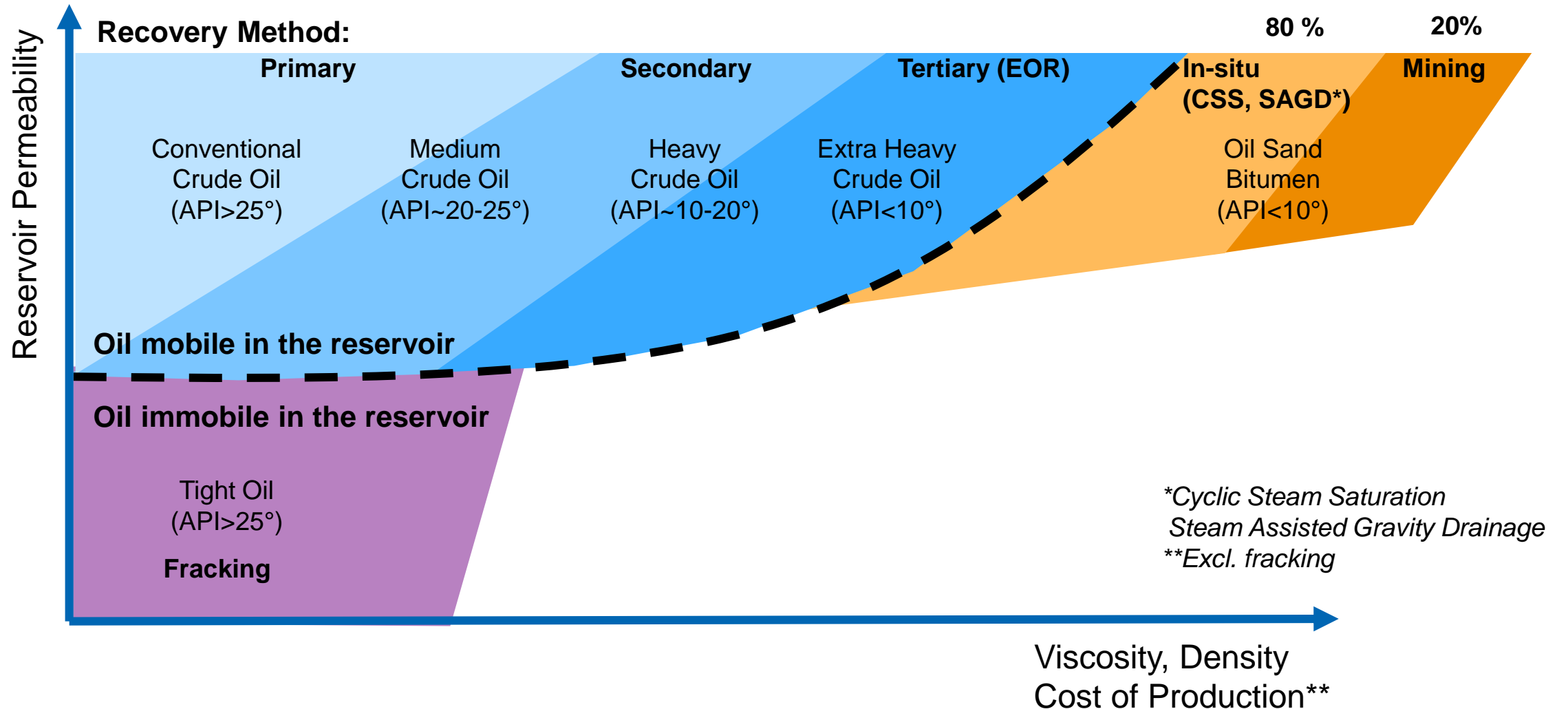
# Crude Oil Origin



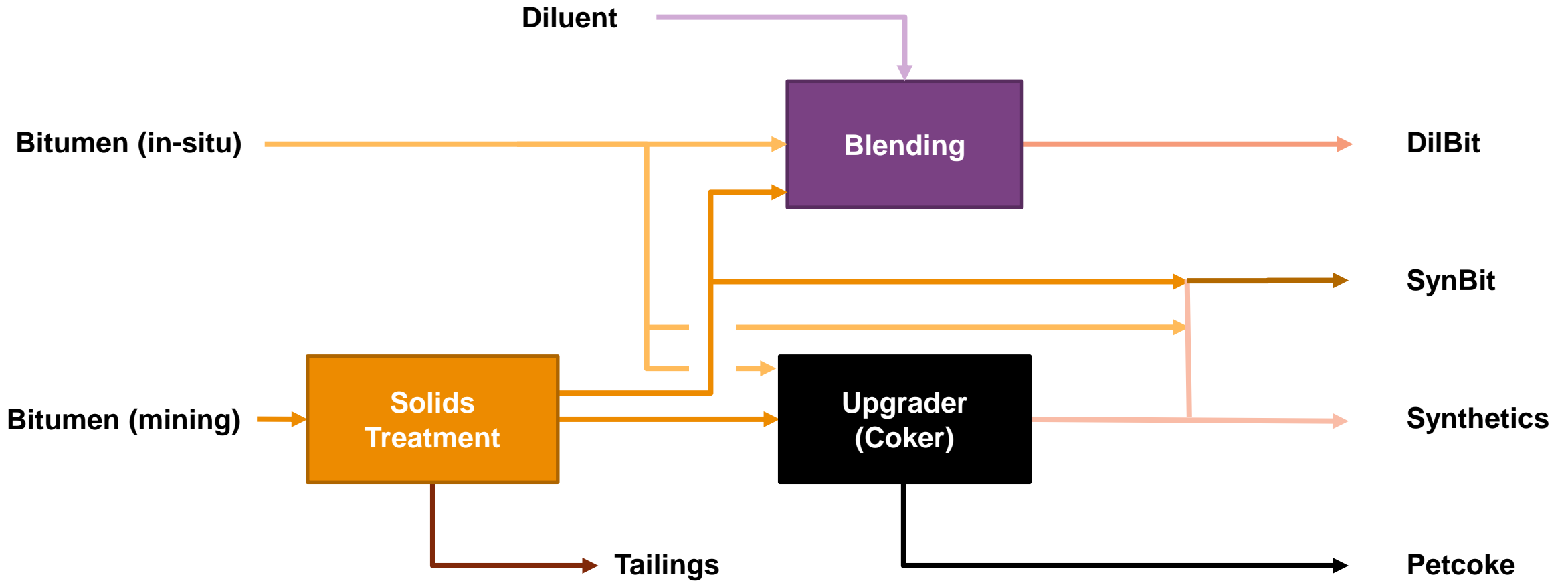
# Crude Oil Reservoir



# Types of Crude Oils & Recovery Methods

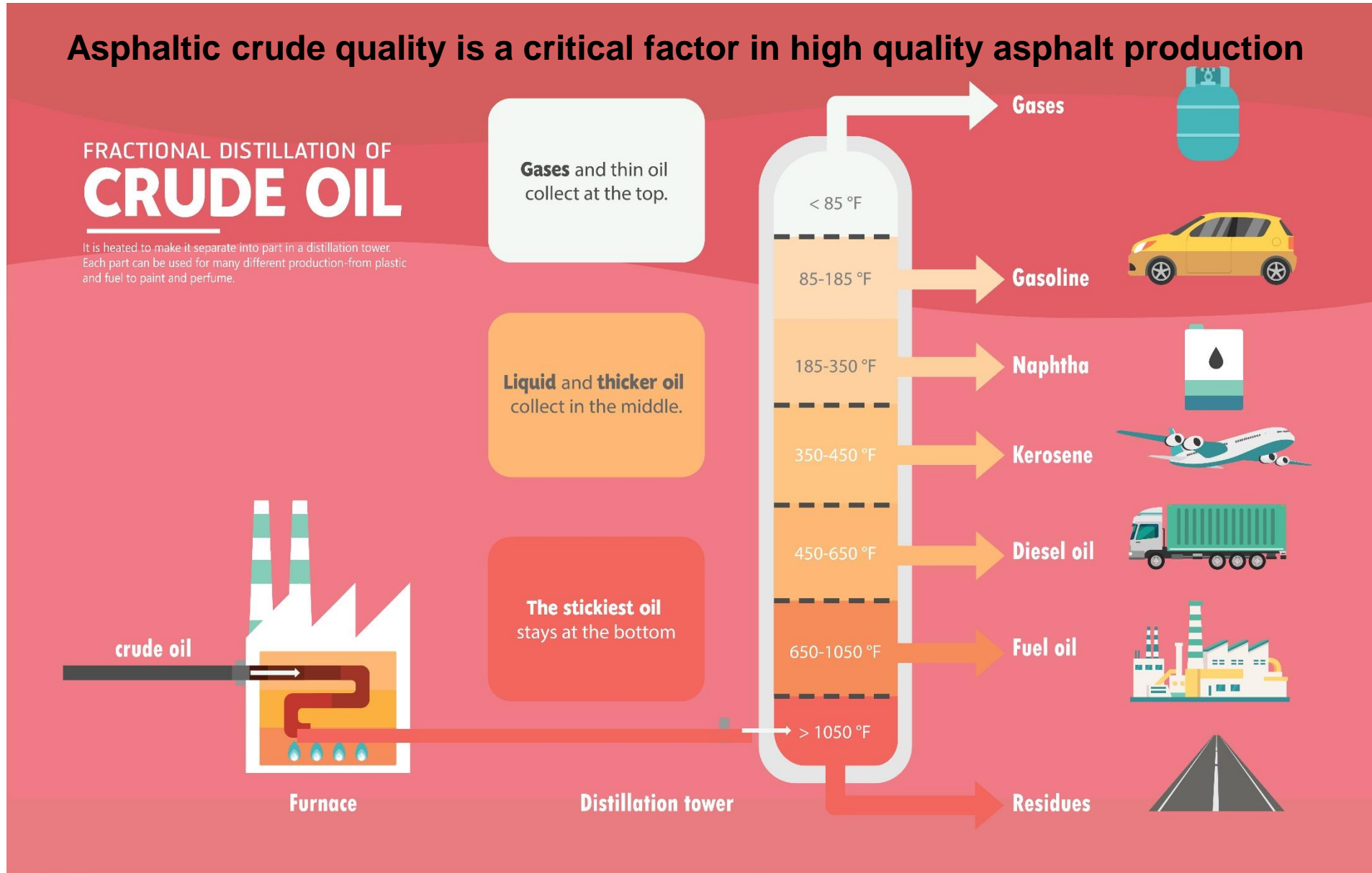


# Further Oil Sand Bitumen Processing

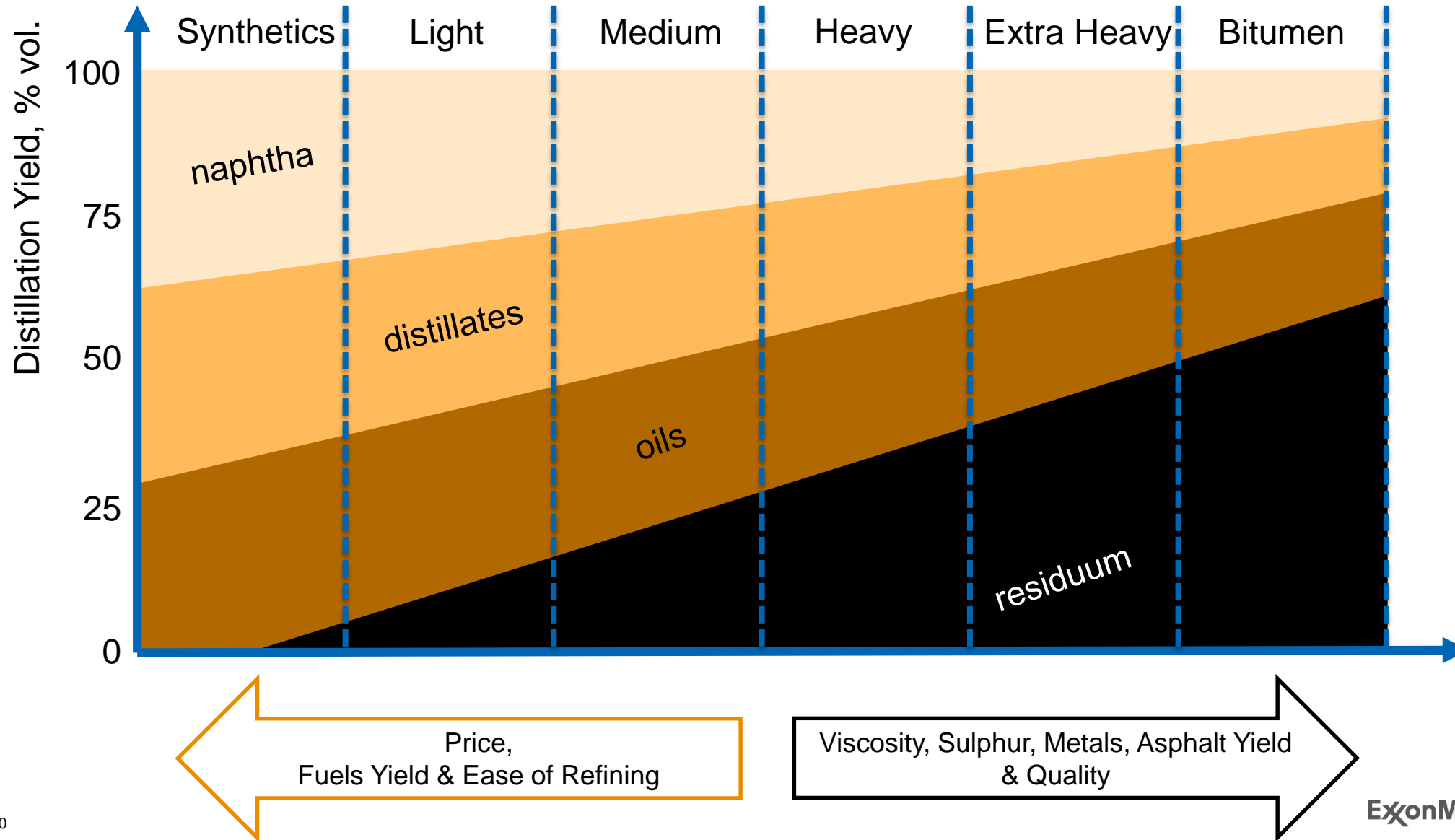




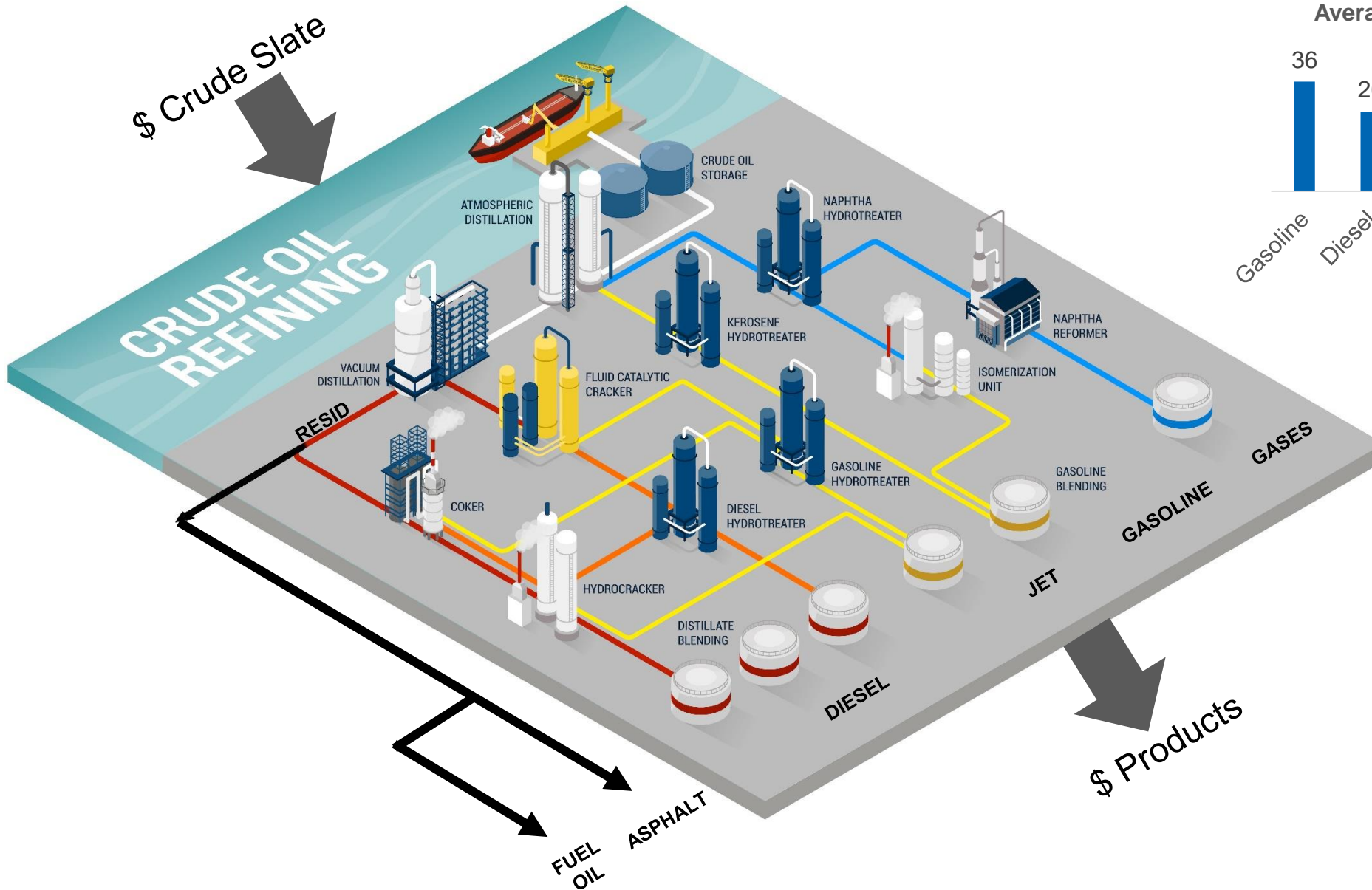
# Straight-run Asphalt = Vacuum Distillation Residue



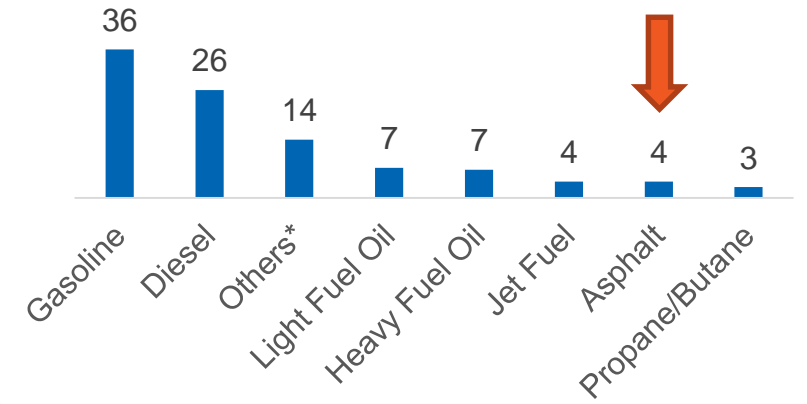
# Crudes Vary in Composition & Value



# Refineries Optimize Inputs & Outputs, Configuration Limited

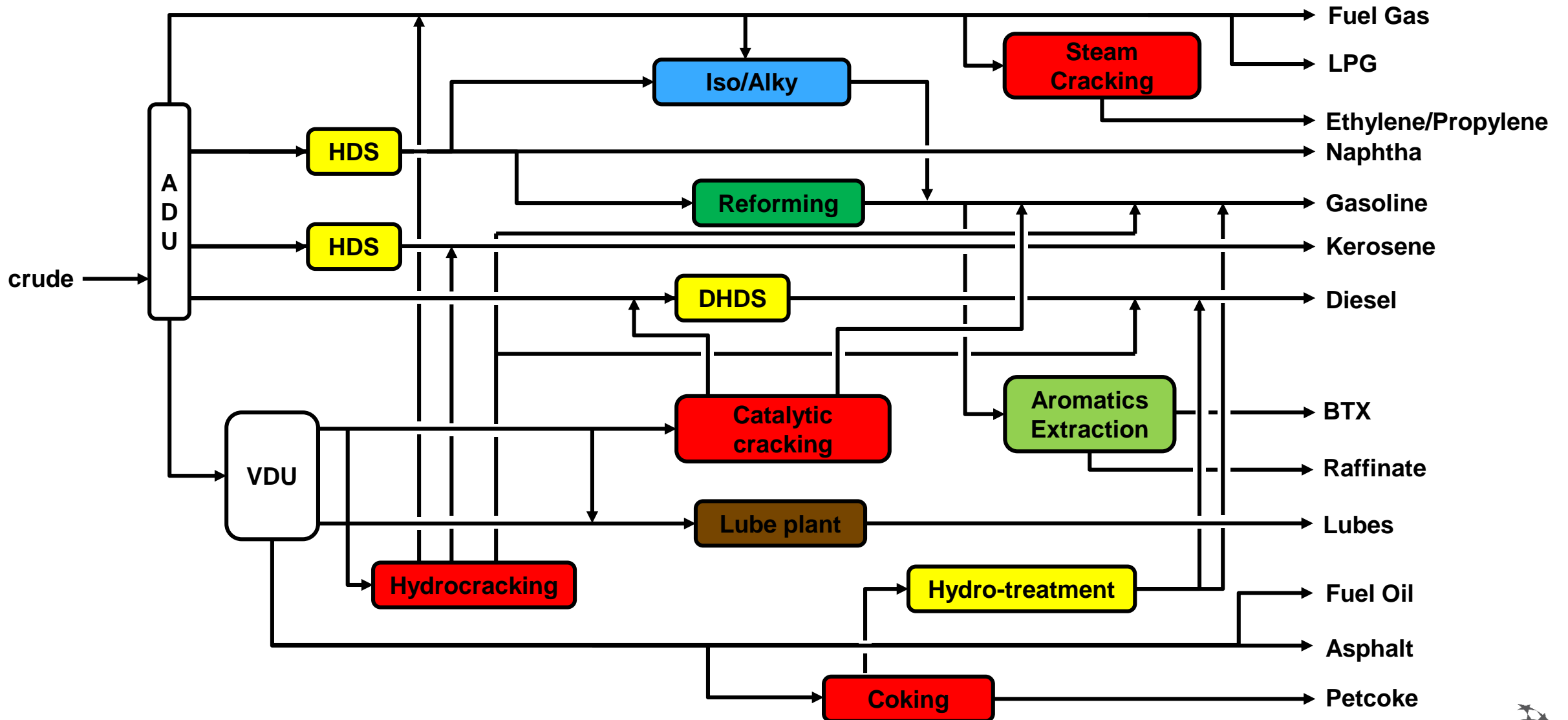


Average Output (%) from Oil in Canada

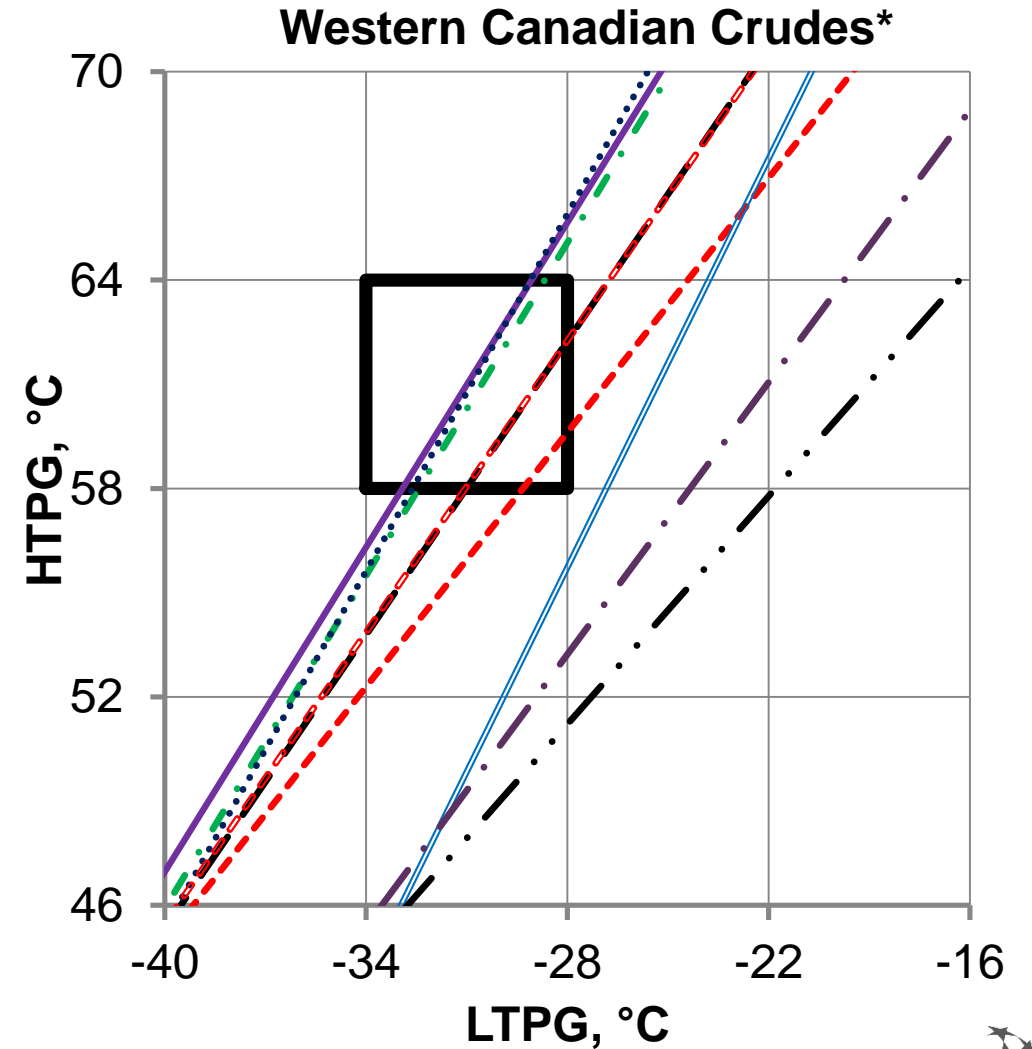
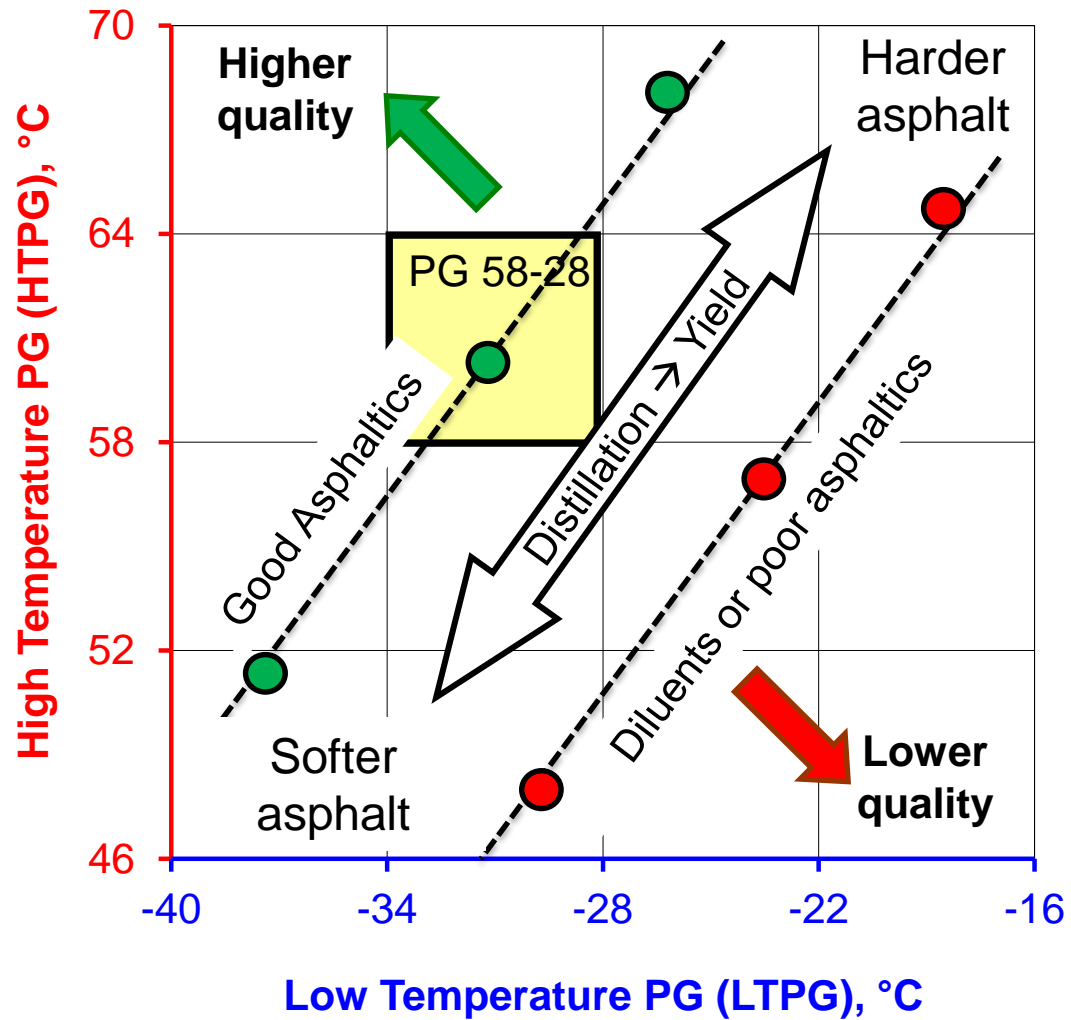


\*Lubes, Petrochemical Feeds, etc.  
Source: Canadian Fuels Association, 2017

# Refinery Configuration Drives Input & Output Choices

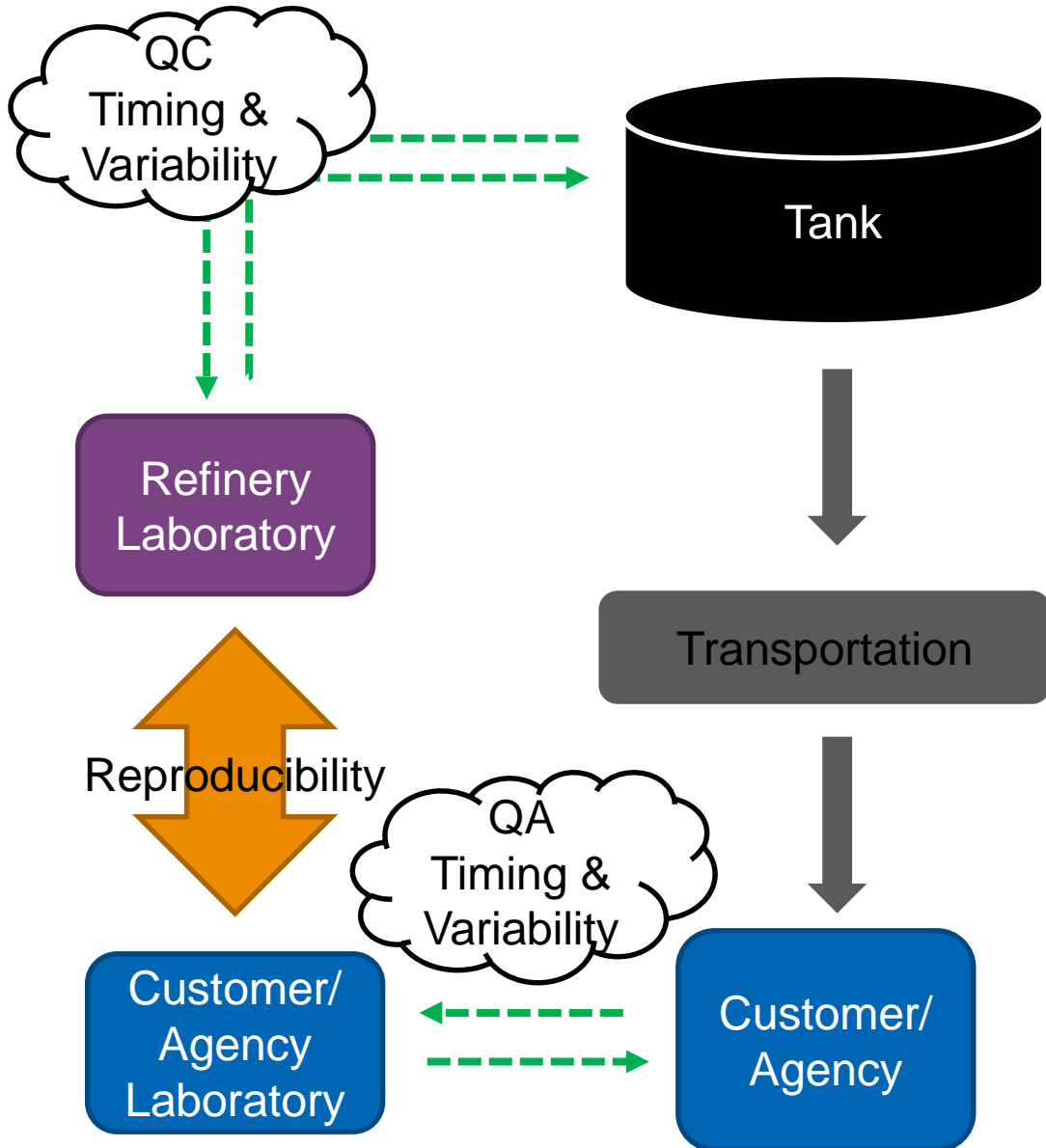


# Asphaltic Crude Quality & Distillation Target = The Two Levers to Target a PG Asphalt



\*Kriz, P. et al, CTA 2012

# Quality Assurance & Testing

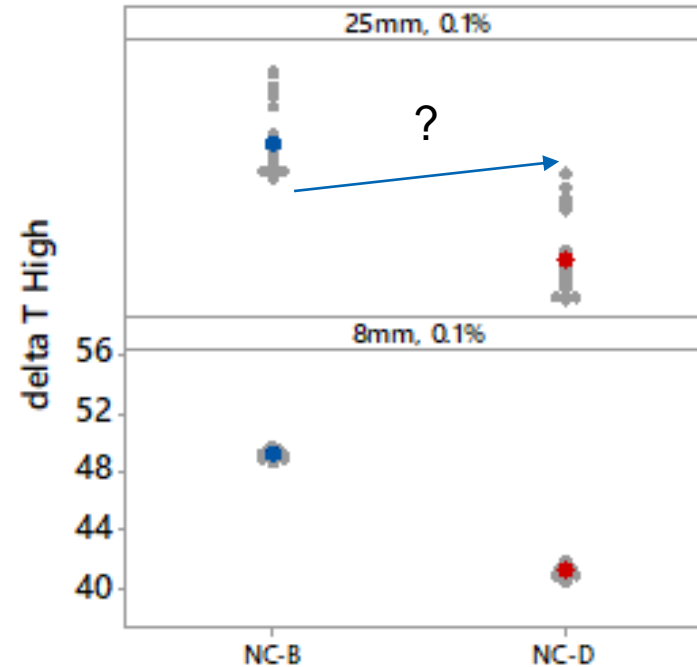


Testing needs to be based on science & field validation, & also must be fast, practical & reproducible

Test duration & variability increase cost

- More tanks, heating, corrections, delays, disputes etc.

Simple parameter change may invalidate the test outcome



17 laboratories  
2 samples  
Two plate sizes

# Product Integrity – We are Responsible from Cradle to Grave

Crude  
Production

Production of top tier  
asphalt crudes



Crude  
Management

Crude assays &  
selection process



Manufacturing  
Control

Straight-run asphalt  
State-of-art process  
control



Product  
Certification

Certified laboratories  
Robust PQ systems



Customer &  
End-use Application

Trusted advisor  
Performance testing in  
customer application



Century-long commitment to customers & industry – Expertise, Research & Leadership

Investment to future: Asphaltic crude production, dedicated asphalt facilities, R&D (internal/external) & **people**

# Industry Trends

## International Maritime Organization Low Sulphur Fuel Oil

- Effective Jan 1, 2020, Sulphur content limit in marine fuel reduces from 3.5 to 0.5 %

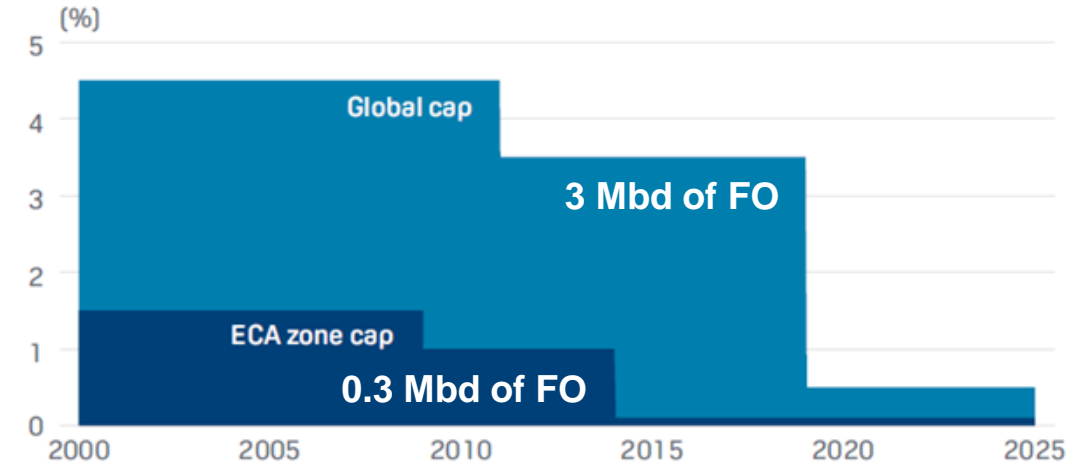
## Increasing recycling rates vs. refining objectives to produce more fuels & petrochemicals

- Many new “softeners” enter market

## Asphalt market globalization

- Large refineries become competitive trans-regionally (e.g. EU imports to US East Coast)

## MARPOL ANNEX VI SULFUR LIMITS



Source: IMO

Global asphalt business is ~1.7 Mbd





# Key Takeaways

- ExxonMobil/Imperial is has over a 100 years long history of asphalt manufacturing
- Canadian oil sands yield top tier asphaltic feedstock
- Straight-run refinery operation yield premium asphalt grades
- Refineries exist to produce fuels, asphalt is 4% → maximize residual molecule uplift
- Imperial & ExxonMobil heavily invest in asphalt R&D to help to sustain the industry
- Support science based, field validated, practical & reproducible specifications
- Responsible manufacturer ensures product integrity beyond sales specification
- New challenges on the horizon: IMO, more conversion, global market