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Bitumen Upgrader Residue Conversion to Incremental Synthetic Fuel Products



EXPANDER ENERGY INC.
INNOVATIVE ENERGY SOLUTIONS

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Legal Disclaimer

This presentation contains forward looking statements based on management's assessments of future plans that involve engineering, operational and financial estimates of future production, capital expenditures, cash-flow and earnings. A number of risks and uncertainties that may or may not be within control of the company and may cause these results to vary materially from those predicated herein and the reader is therefore cautioned that such information is speculative in nature.

Introduction

- **Current State & Outlook Alberta Hydrocarbon Industry**
- **Introduction to FTCrude® Technology**
- **Review FTCrude® Process Configurations**
 - FTCrude® **Partial Upgrader** to produce 20° to 24° API PUB
 - FTCrude® **Full Upgrader** to produce 30° to 38° API Sweet SCO
 - FTCrude® **Refinery** to produce ULSG, ULSD, ULSJ
- **Basic FTCrude® Economics**
- **Summary – Why FTCrude®?**

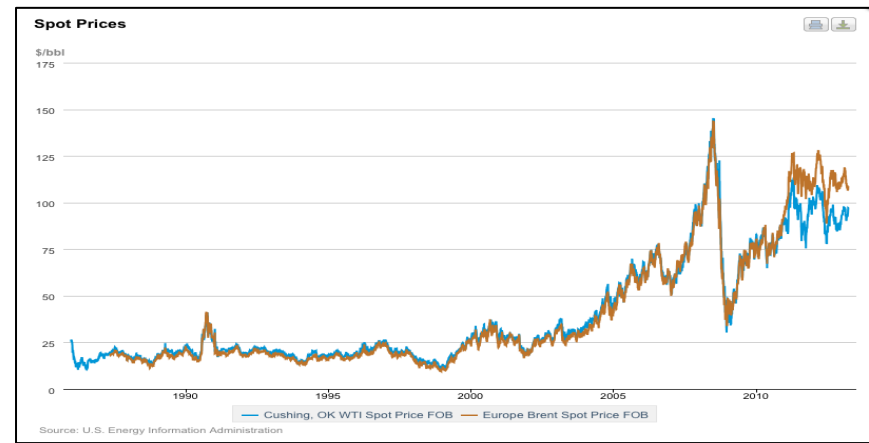
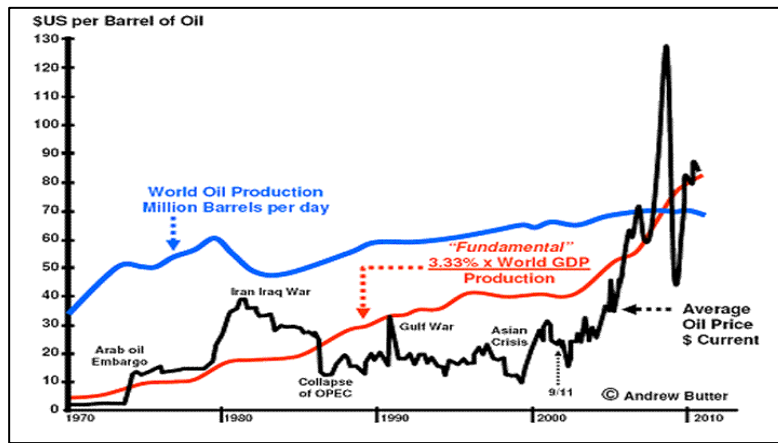
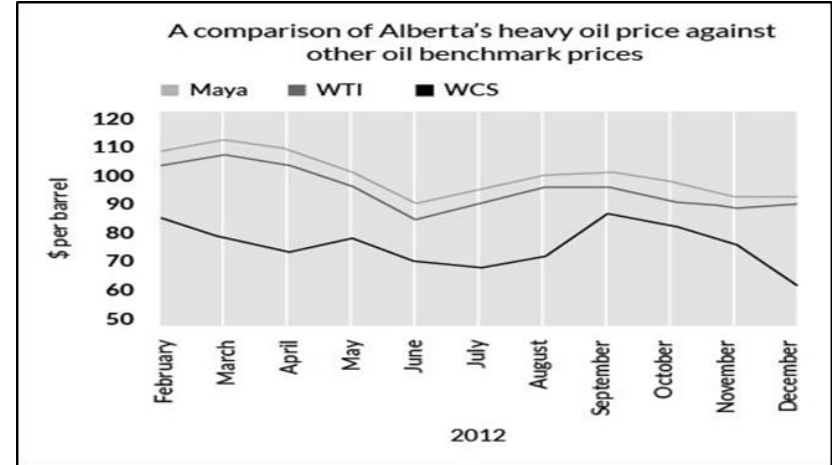
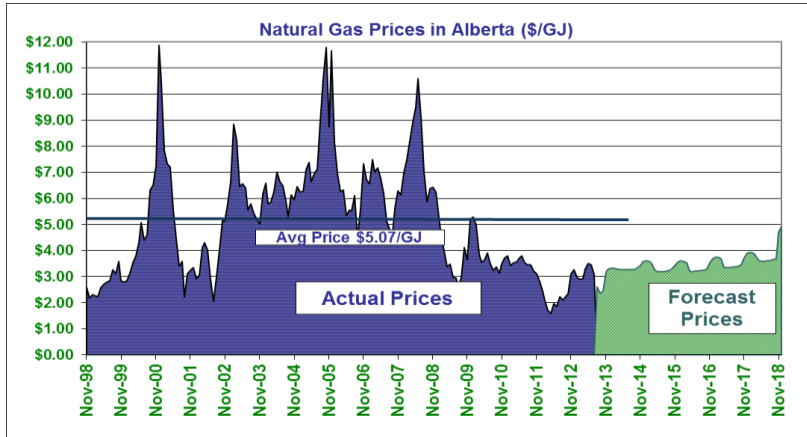


Current State of Alberta Hydrocarbon Industry

- **Surplus of Natural Gas in North America** – Alberta Gas not competitive in US markets - prices very low and Alberta Royalty recovery 30% of peak
- **Disconnect** between North American NG Price and Oil Price
- Alberta **Oil Markets Restrained** due to lack of Pipelines
- Alberta Oil (Non–diluted Bitumen) **discounted by 40%** from WTI Price
- Potential **shortage of low cost Diluent** to transport Alberta Bitumen
- Alberta Oil (Bitumen) has **no access to Foreign Markets** and cannot enjoy favourable world “Brent” pricing
- Alberta Oilsands Image low – **“dirty oil”, high GHG emissions**
- Alberta at risk of NOT achieving **GHG emission reduction goals for 2020**



Long Term View of Energy Pricing?

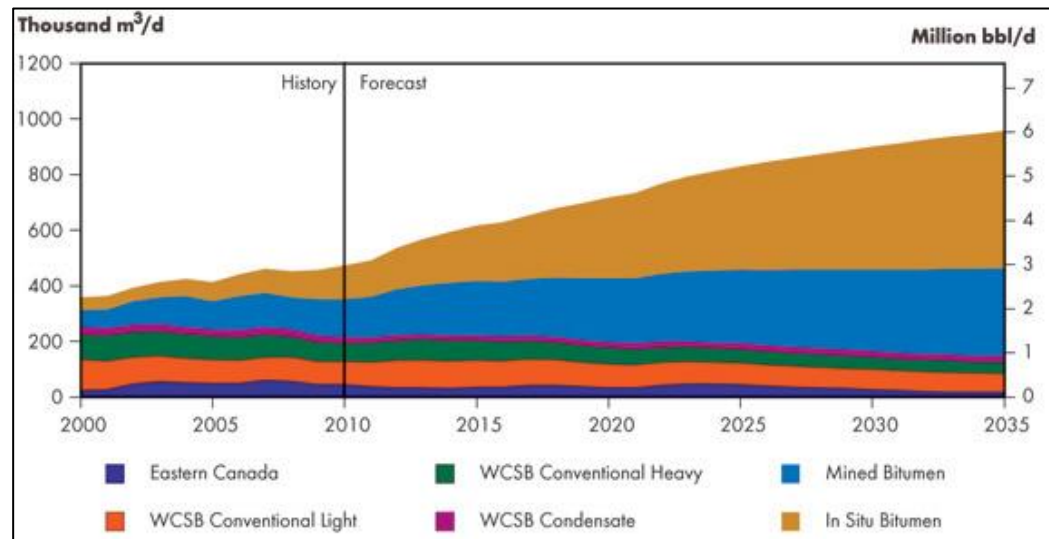


Forecasted Growth of Alberta Oilsands

Table 2.3 Oil Sands Production

<i>million b/d</i>	2012	2015	2020	2025	2030
Total*	1.80	2.28	3.22	4.45	5.21
Mining	0.81	0.98	1.23	1.65	1.68
<i>In Situ</i>	0.99	1.30	2.00	2.81	3.52

*Total may not add up due to rounding.



Proposed Solution to Alberta Oilsands Market

Future Canadian Oilsands Production = 2,800,000 BPD

Enbridge Northern Gateway
525,000 BPD

TCPL Energy East
850,000 BPD

Kinder Morgan Exp
590,000 BPD

TCPL Keystone XL
830,000 BPD

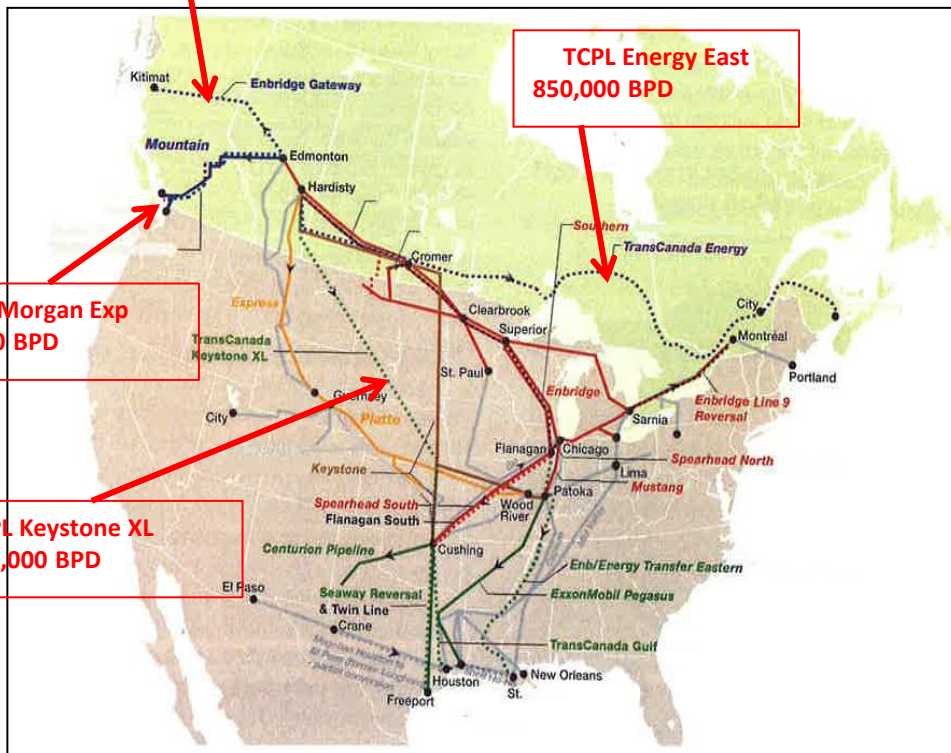
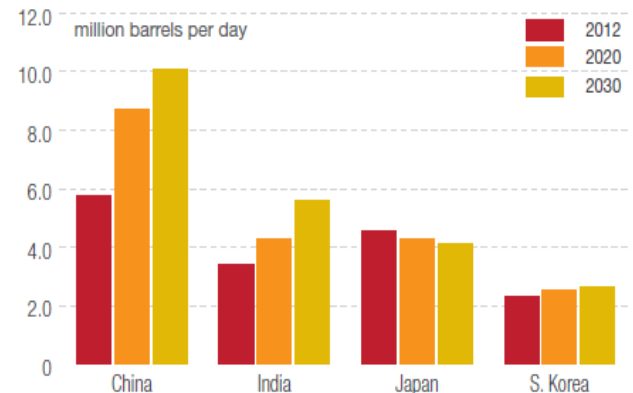


Figure 3.14 Net Oil Imports: Asia 2012 to 2030



Source: EIA 2013 Annual Energy Outlook, Early Release

Outlook for Hydrocarbon Industry

- ❑ NG (AECO) Price expected to be less than \$4.00 per GJ long term
- ❑ World Oil price expected to be greater than \$100 per BBL long term
- ❑ Market pressure on Alberta Bitumen reducing value to less than \$50 per BBL
- ❑ Future high growth crude markets will be Asia; China, India
- ❑ Production of Petcoke facing rising public opposition
- ❑ Rising public pressure to reduce GHG emissions
- ✓ **Need for more efficient way to create value for 100% Alberta Oilsands Resources without diluent or Petcoke and produce highest quality transportation fuels and lowest GHG emissions to earn respect in world market!**

Solutions for Alberta

- ❑ Current Natural Gas Solutions
 - Export gas to high value market – LNG
 - Add value to Natural Gas – GTL, Methanol, DME, Ammonia
- ❑ Build east/west oil pipelines to tidewater to gain access to new global markets
- ❑ Add value to Bitumen through partial or full upgrading
 - Dilbit does not add value
- ❑ Add value to Bitumen using “cheap” natural gas

“Convert Bitumen Residues to incremental Synthetic liquids”

FTCrude® concept can offer the solution

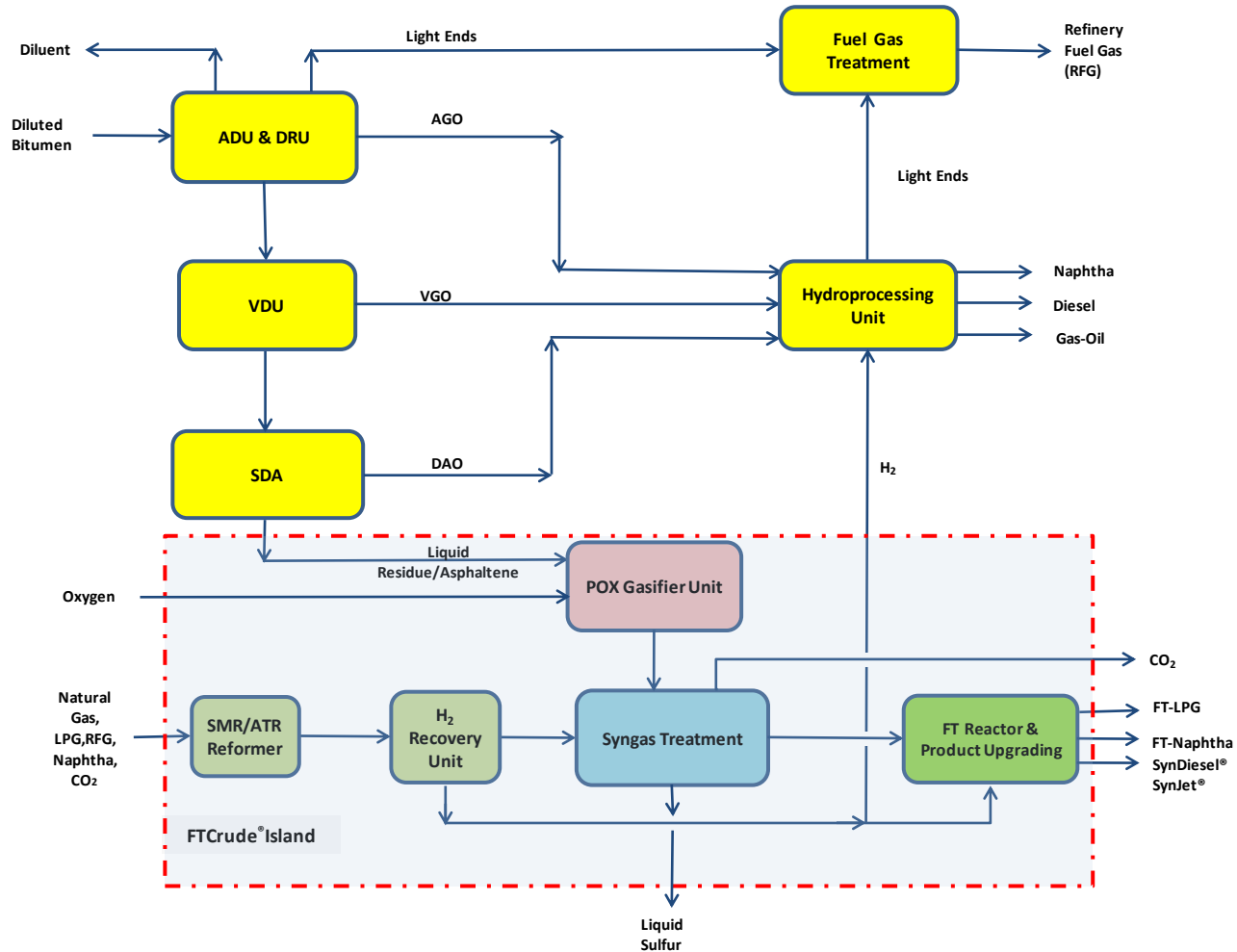




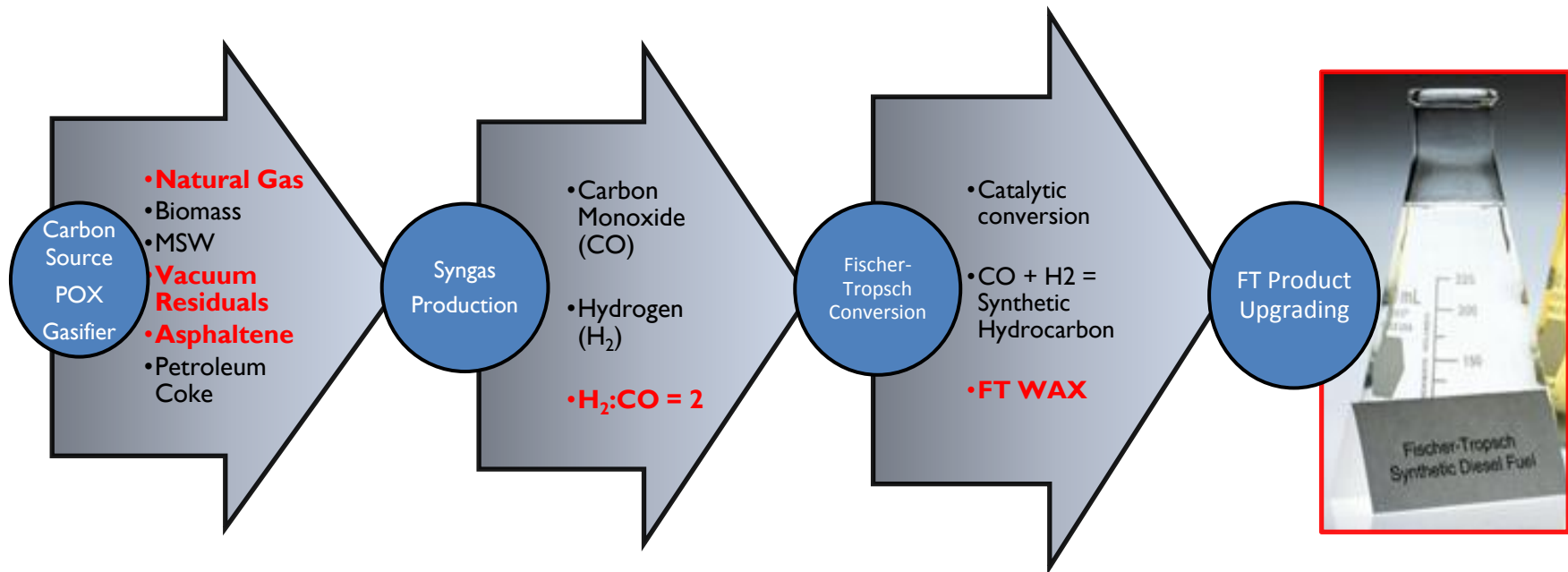
- **FTCrude® converts asphaltenes and other residues to synthetic fuels**
- **Residues are gasified to produce syngas for subsequent Fischer-Tropsch (FT) catalytic conversion to produce incremental synthetic liquids**
- **Natural gas is used in a parallel syngas generator to provide high hydrogen content syngas to satisfy required stoichiometric ratio for the FT synthesis**
- **This syngas generator also provides hydrogen for the upgrading operation**



FTCrude® Concept Schematic

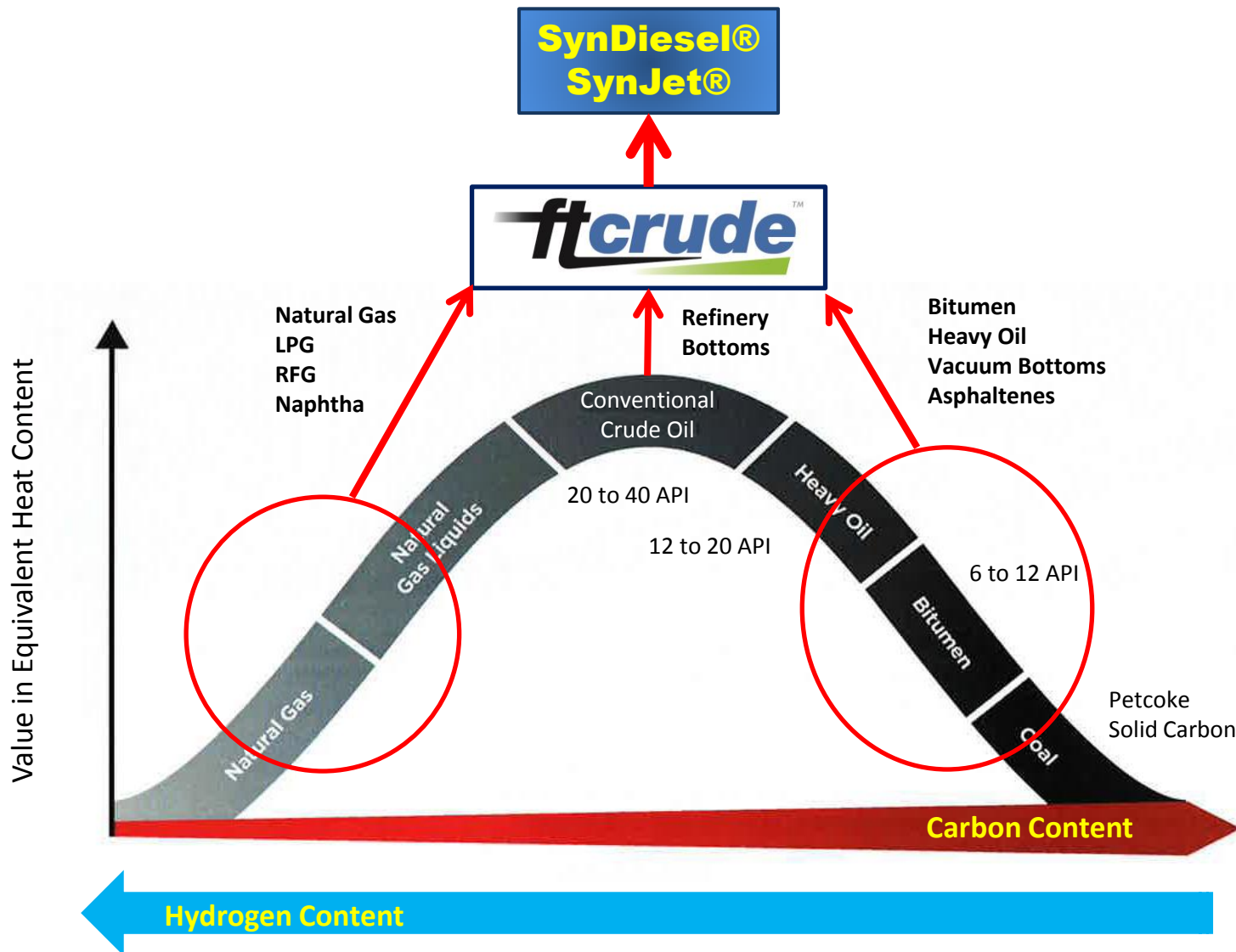


Fischer-Tropsch (FT) Process



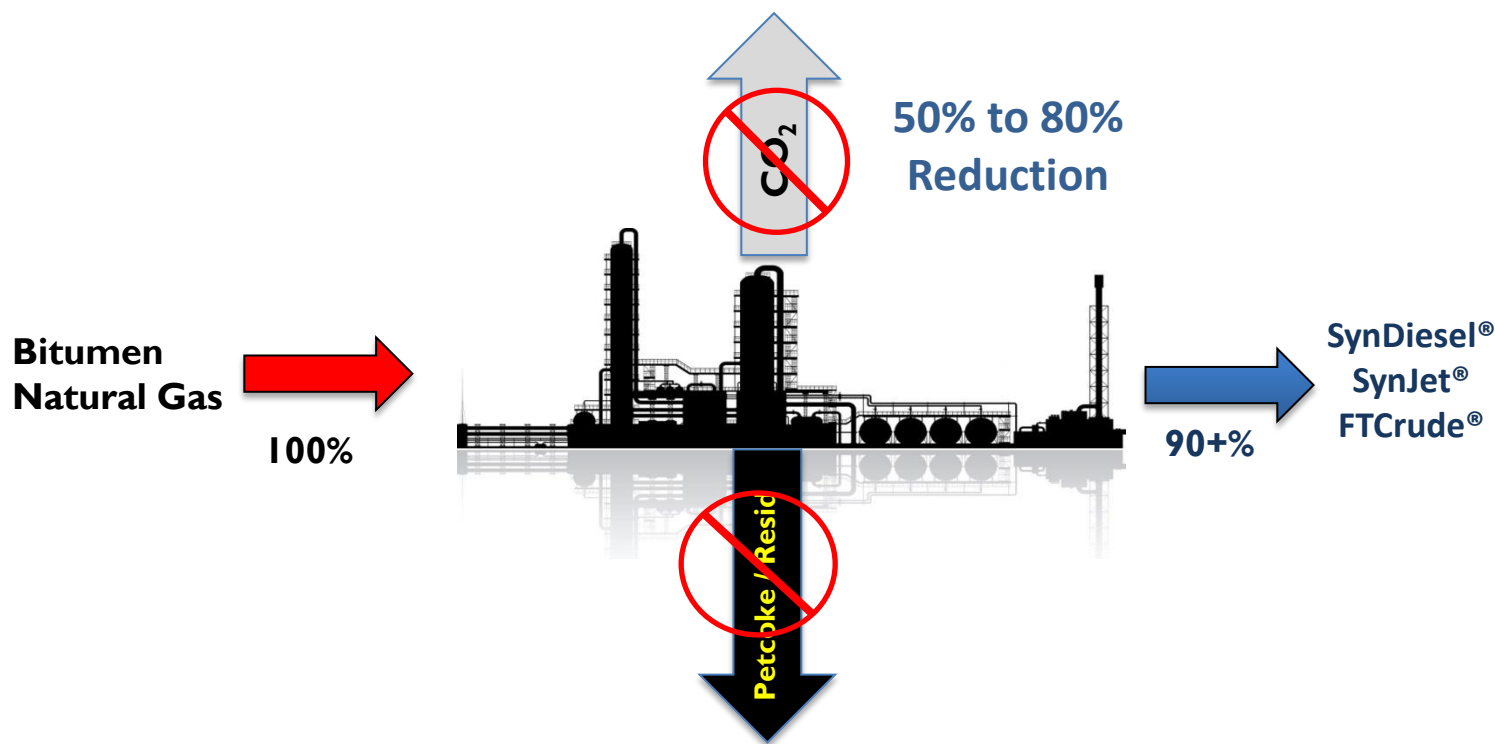
Zero sulfur, No aromatics, High cetane (70+) Synthetic Fuels





Carbon Management Story

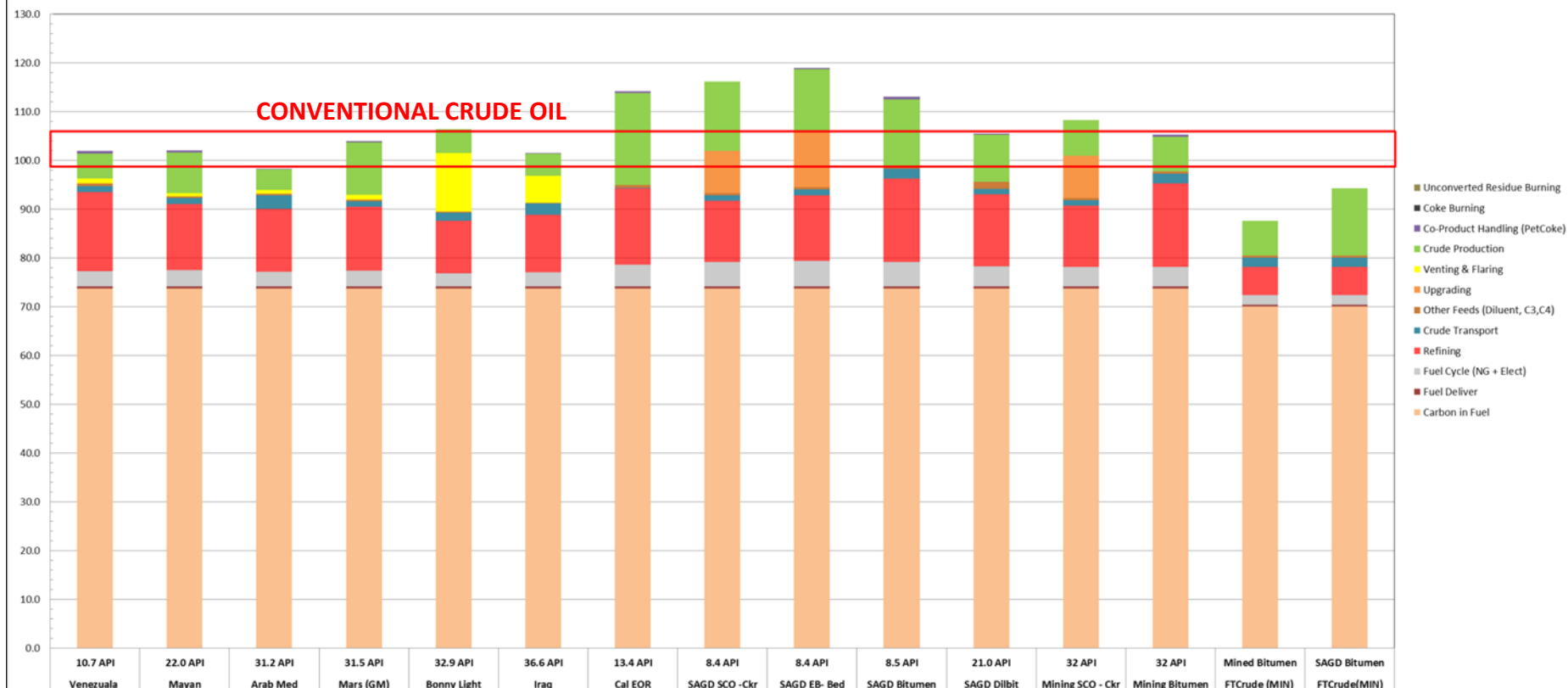
- ✓ **Maximum Retention of Carbon**
- ✓ **Maximum Conversion of Carbon**
- ✓ **Minimum Carbon Rejection – low GHG emissions, high carbon efficiency (90+%)**
- ✓ **Maximum Conversion of low value carbon to high value transport fuels**



FTCrude® Life Cycle GHG Emissions

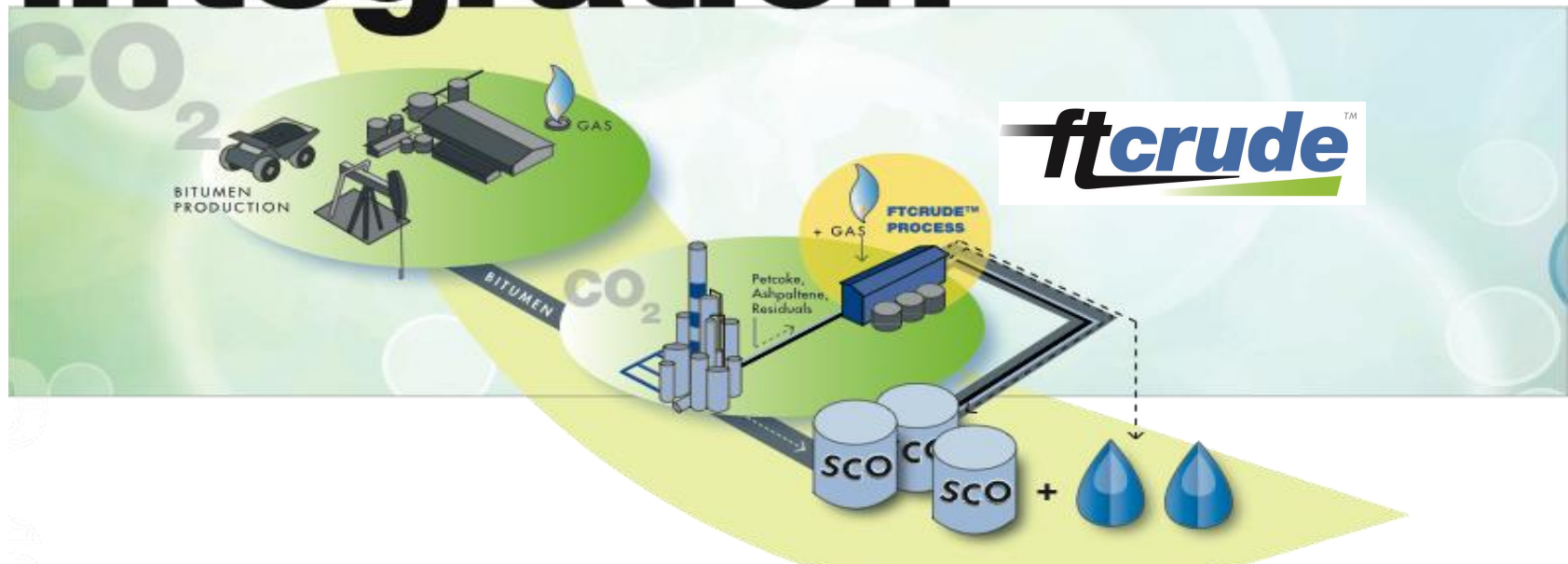
(Jacobs Figure E-6 FTCrude® Process and credit for excess Power Credit added)

Life Cycle Assessment of WTW GHG Emissions for Crude and Bitumen to RBOB (g CO₂ / MJ Gasoline)



Significant Benefits from Integration of GTL Plant with Heavy Oil & Bitumen Production

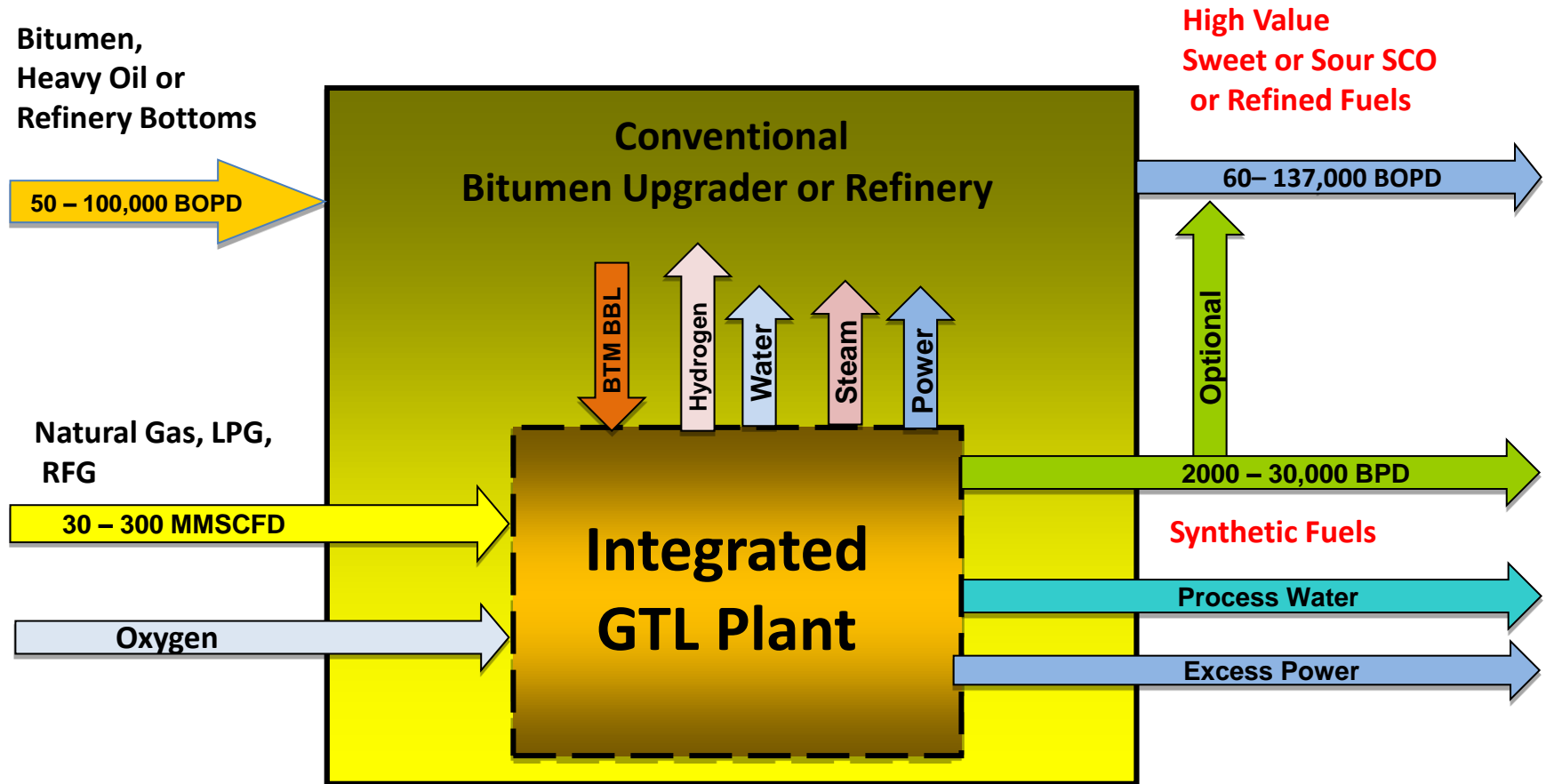
integration



Typical GTL Plant = 1000 BBL FT Liquid/10 MMSCF Natural Gas
FTCrude® = 2000 BBL FT Liquid/10 MMSCF Natural Gas & NO Petcoke



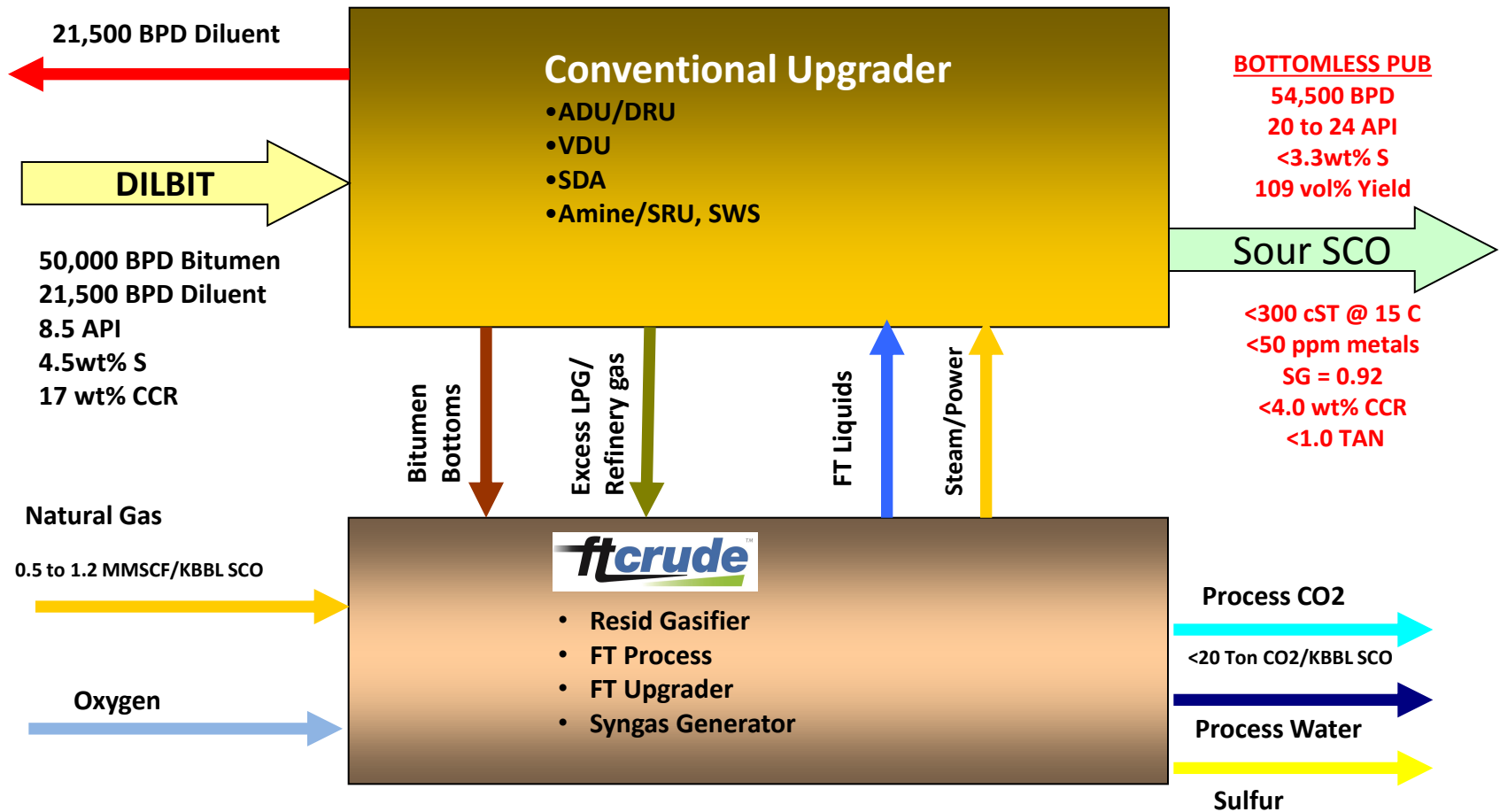
FTCrude[®] Additional Benefits



FTCrude® Products and Application

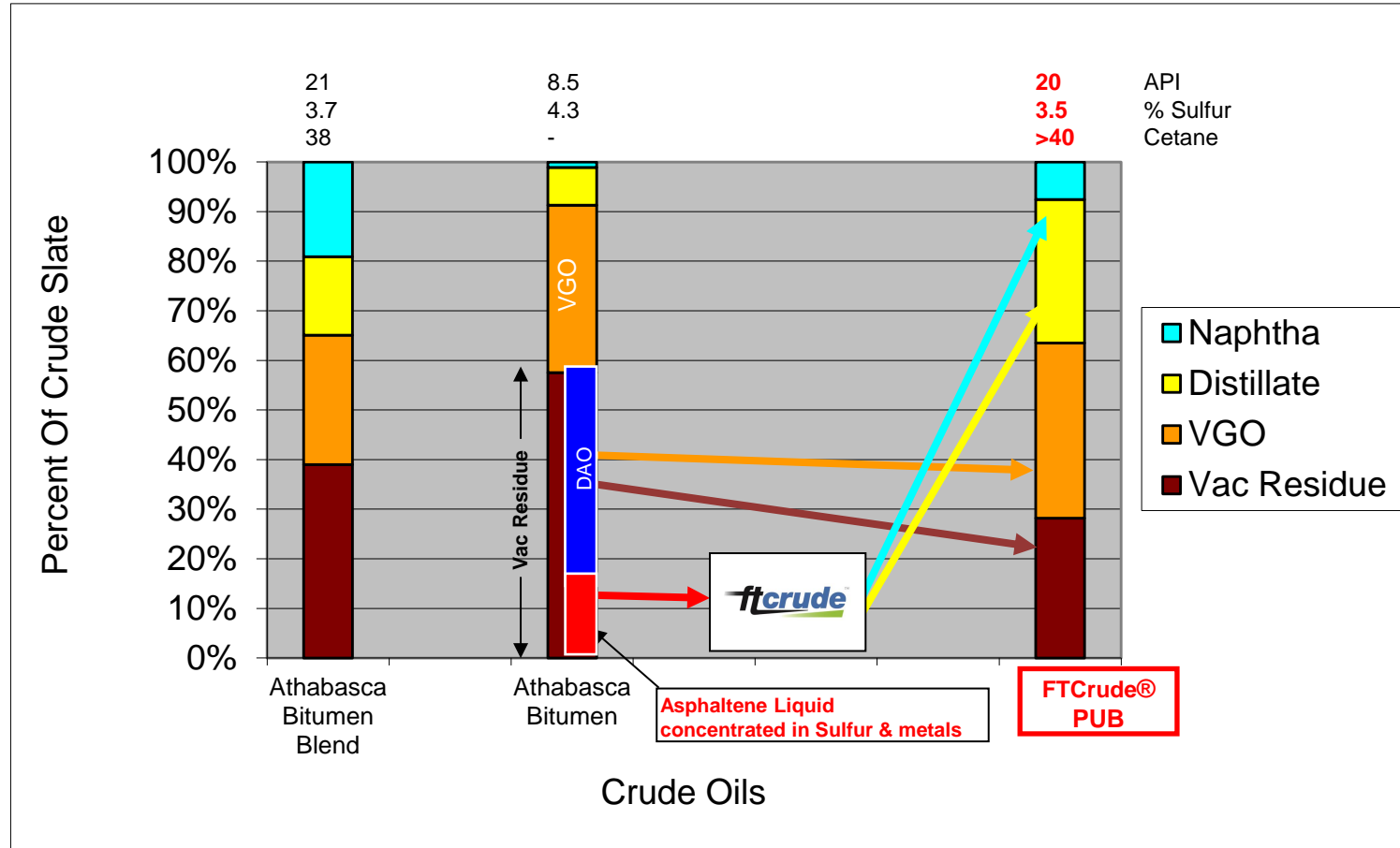
- ☐ All process units within the concept are proven technology and commercial licenses are available
- ☐ Concept is patented & patent pending technology, licensed by Expander Energy Inc., Calgary, Alberta, Canada
- ☐ The principal products are high value paraffinic naphtha and diesel/jet fuel
- ☐ FTCrude® concept can be applied to wide range of applications including Partial and Full bitumen upgrading or bitumen refinery producing all light transportation fuels - gasoline, diesel/jet fuels
- ☐ It can also be applied as a debottlenecking option to existing upgraders that use gasification of residues for hydrogen production

FTCrude® Partial Upgrader

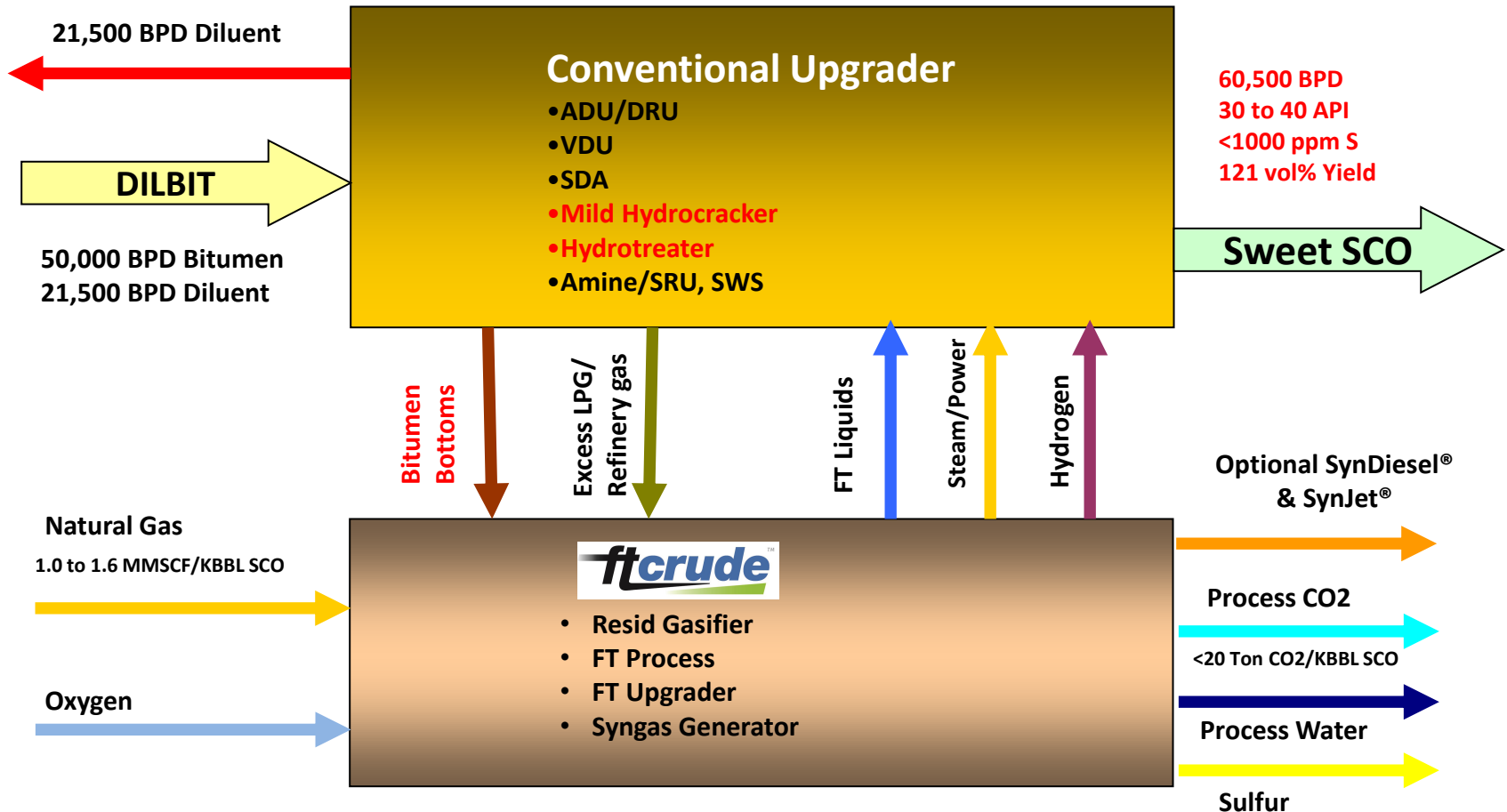


Patent Issued & Pending

Typical Bitumen Assay

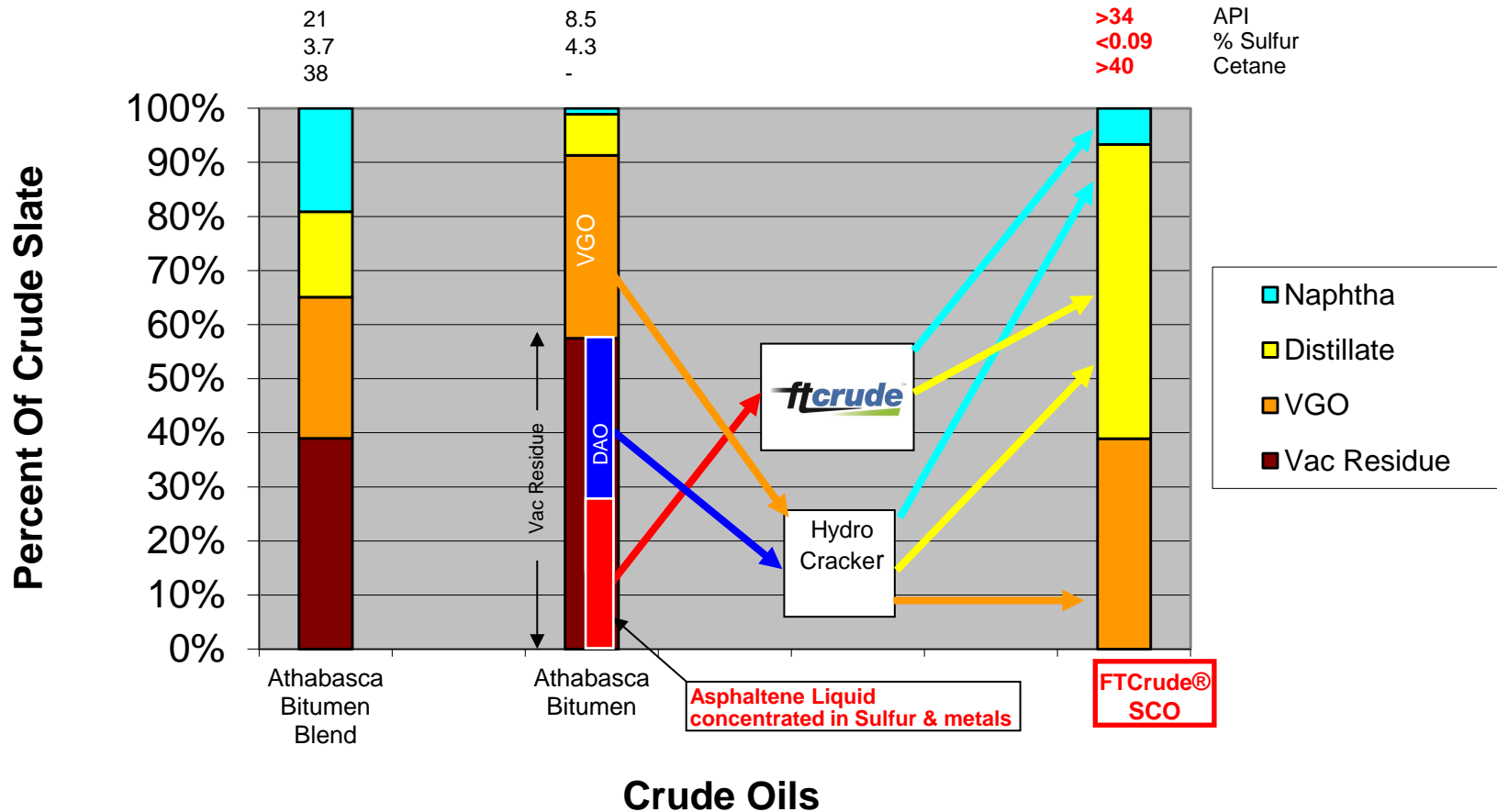


FTCrude® Full Upgrader

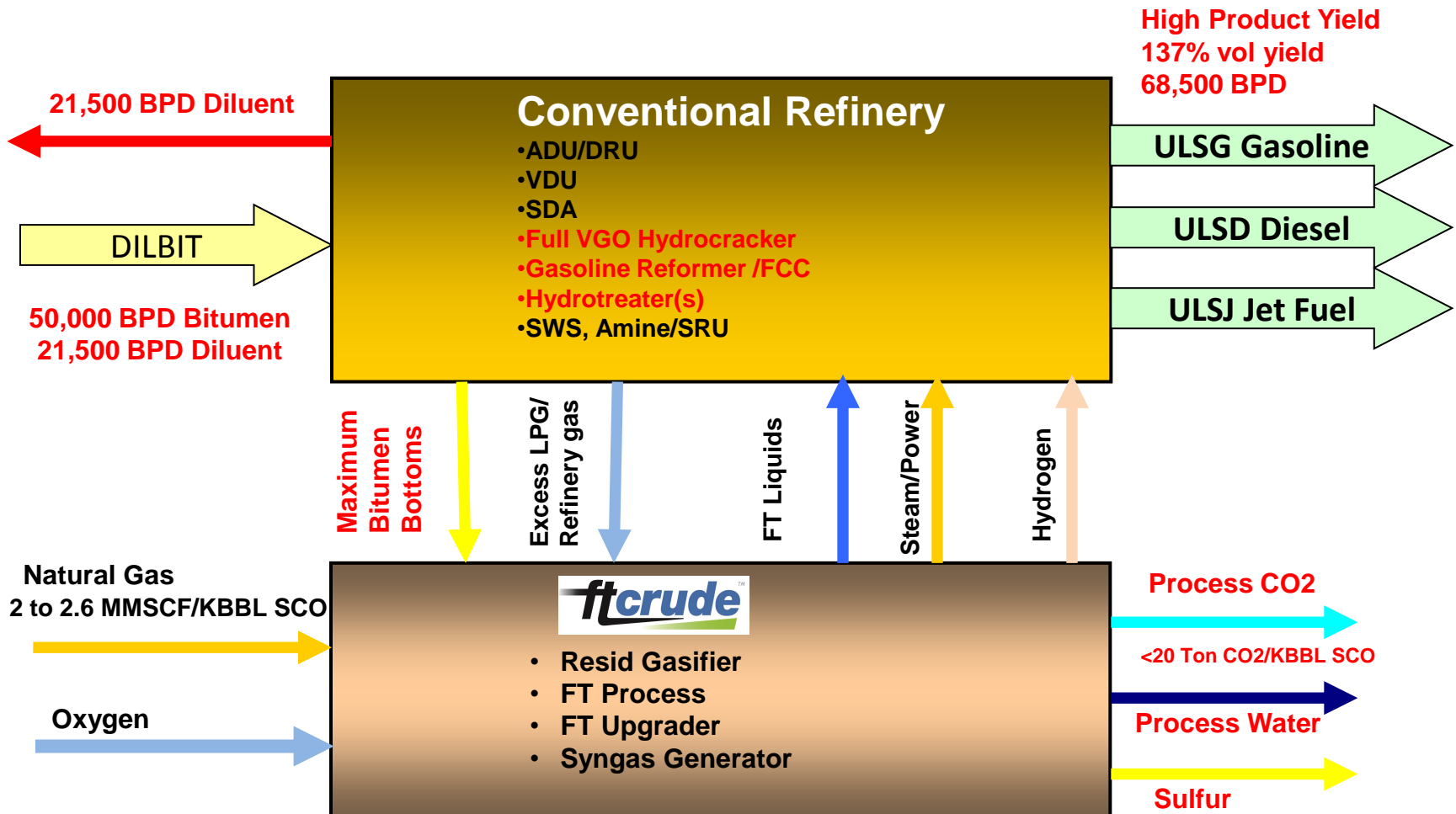


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Typical Bitumen Assay

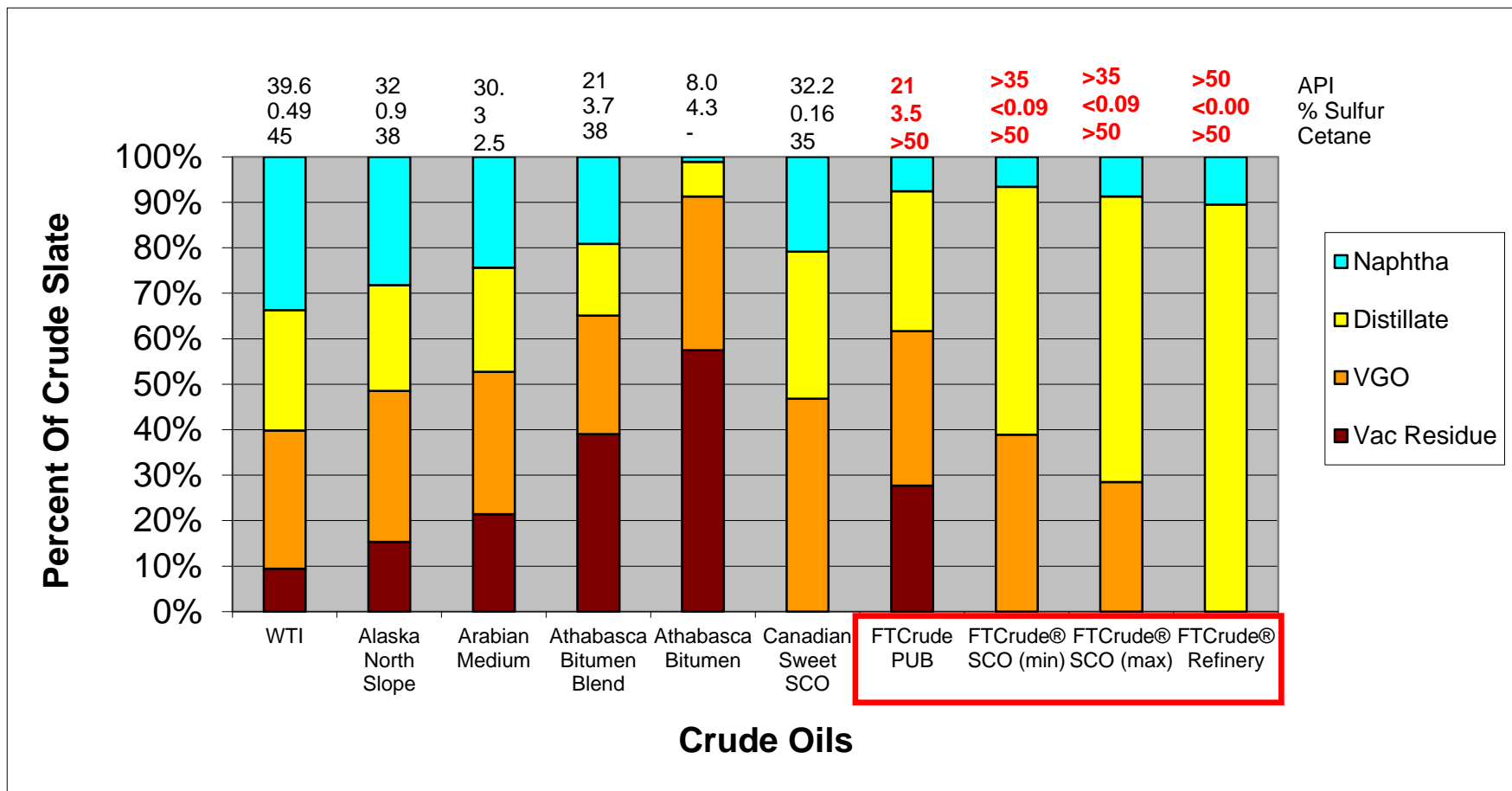


FTCrude[®] Refinery

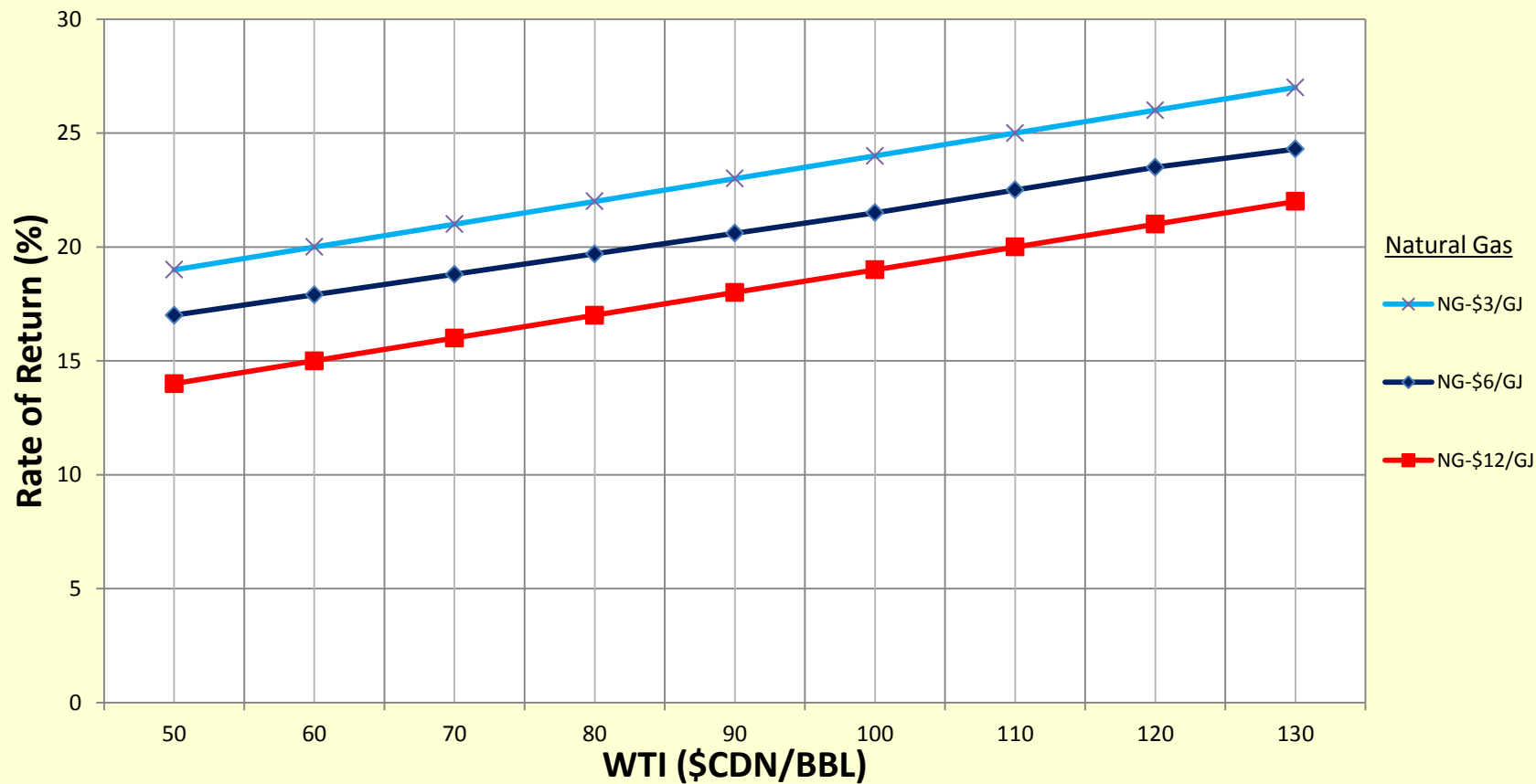


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Typical Crude Assays



FTCrude[®] Economic Feasibility Chart



FTCrude® Partial Upgrader Economics

CAPEX for 50,000 BPD FTCrude® Partial Upgrader
= \$1,600 M total over 2 years

Revenues

- FTCrude® PUB Sales 54,500 BPD X \$75/BBL X 347 day/yr = \$1,418 M/yr

Estimated Operating Cost

- Bitumen Feed Cost 50,000 BPD X \$50/BBL X 347 day/yr = \$ 868 M/yr
- Oxygen Supply 1050 TPD X \$50/Tonne X 347 day/yr = \$ 18 M/yr
- Natural Gas Requirement 60 MMSCFD X \$4/MSCF X 347 day/yr = \$ 83 M/yr
- Additional Fixed Opex 4% X Capex = \$ 64 M/yr

Net BT Revenue

= \$ 385 M/yr

Est BT IRR = 22%

Est NPV@15% = \$703 M

Note 1: PUB Value = \$WCS + \$5 = \$75 /BBL

Note 2: Cost of Diluent Use = Cost Diluent + Handling – Cost Recovery = \$20 / BBL Bitumen



FTCrude® Refinery Economics

**Est Capex for 50,000 BPD FTCrude® Refinery
= \$4,600 M total over 2 years**

Revenues

- **FTCrude® Synfuel Sales** 68,500 BPD X \$120/BBL X 347 day/yr = \$ 2,852 M/yr

Estimated Operating Cost

- **Bitumen Feed Cost** 50,000 BPD X \$50/BBL X 347 day/yr = \$ 868 M/yr
- **Oxygen Supply** 1850 TPD X \$50/Tonne X 347 day/yr = \$ 32 M/yr
- **Natural Gas Requirement** 143 MMSCFD X \$4/MSCF X 347 day/yr = \$ 198 M/yr
- **Additional Fixed Opex** 4% X Capex = \$ 180 M/yr

Net BT Revenue

= \$1,574 M/yr

Est BT IRR = 30%

Est NPV@15% = \$4,687 M

Note 1: Cost of Diluent Use = Cost Diluent + Handling – Cost Recovery = \$20/BBL Bitumen



Summary - Why FTCrude®?

- ❑ All process units are **proven technology** and commercial licenses available – low technical risk
- ❑ **100% conversion** of Alberta Bitumen to high value transportation fuels
- ❑ Greater than **120% volume yield** of refined products to bitumen supply
- ❑ Greater than **50% GHG emission reduction** through high carbon retention/conversion by the system
- ❑ Concept is **economically robust** for a wide range of natural gas and crude oil prices (gas as high as \$12/mmbtu)
- ❑ Concept will **benefit from long term pricing** -natural gas (<\$5/mmbtu) and high crude oil prices (~\$100/bbl)



QUESTIONS?

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Thank you

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