North American Refining
Changing Crude Supply & Qualities

Presented to:

COQA

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CONSULTING ENGINEERS

Today's Speaker

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Strategic planning, FMV, ventures

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TM&C Overview

International consulting practice since 1971

Downstream focus; refinery/chemical engineers

Industry and financial clients

- Strategic Studies
- FMV Assessments & Venture Analyses
- National Policy Studies

Publish various outlook and multi-client subscription reports

- World Crude Outlooks
- North American Crude & Condensate Outlook
- Crude and Refined Products Outlook
- Refinery Construction Outlook
- Special Studies

Today's Agenda

Major Developments in N.A. Crude Supply

- NACCO Projections to 2022
  - U.S. by PADD & Grade
  - Canada
- Changing Crude Flows/Sources
- Impact on Foreign Imports
- Quality Changes
- Crude Exports?

Refinery Yield Impacts

Export Issues

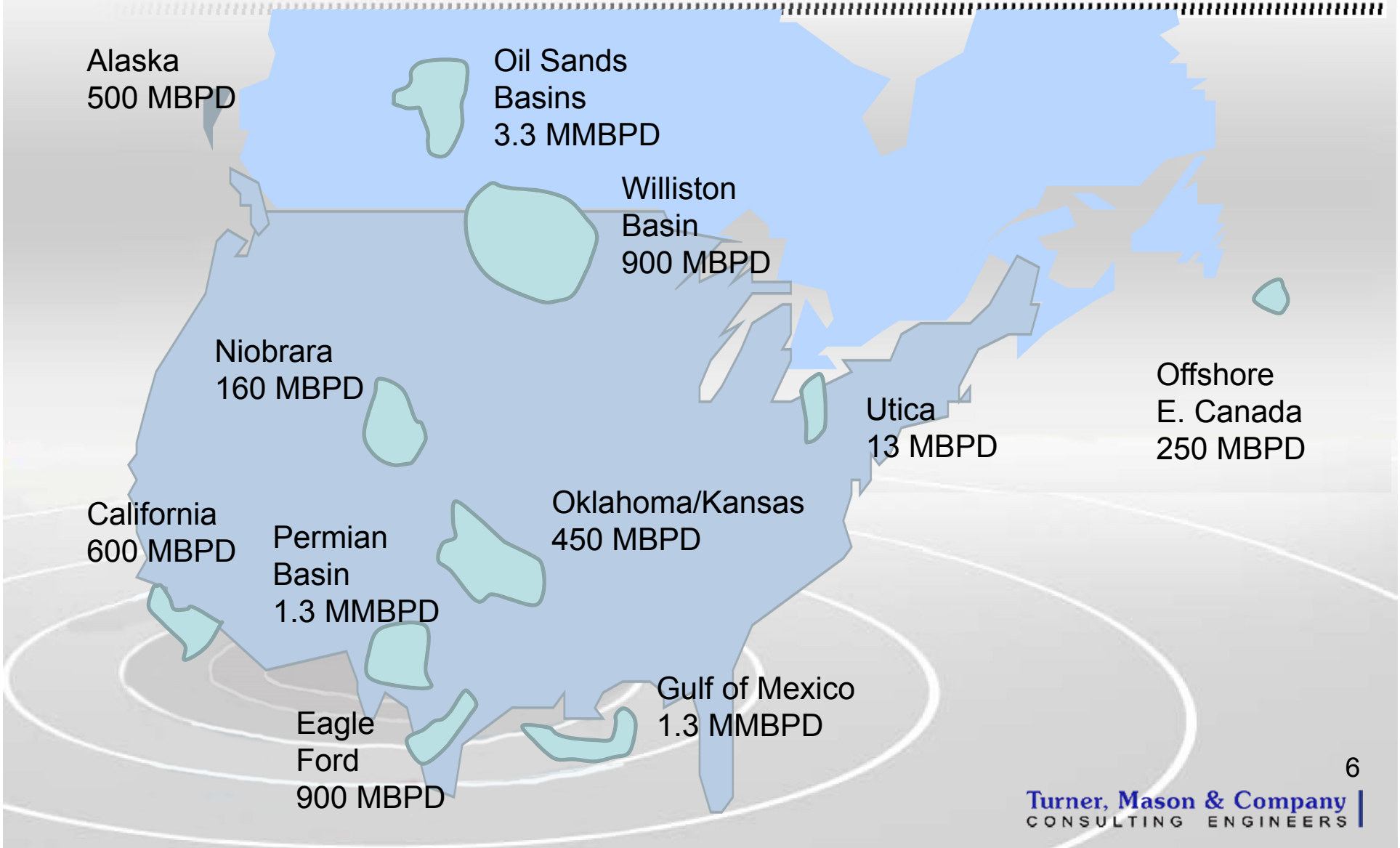
Some Final Thoughts

North American Crude & Condensate Outlook

- Regional forecasts in new TO and conventional areas
- Evaluation of refinery capabilities on a plant-by-plant basis
- Analysis of planned/required logistics
- Evaluate challenges and opportunities for producers, midstream companies and refiners
- Forecast pricing implications
- Initial publications – June & October 2012
- 2013 NACCO released in June

Major N.A. Crude Regions

Approximate Current Production Levels



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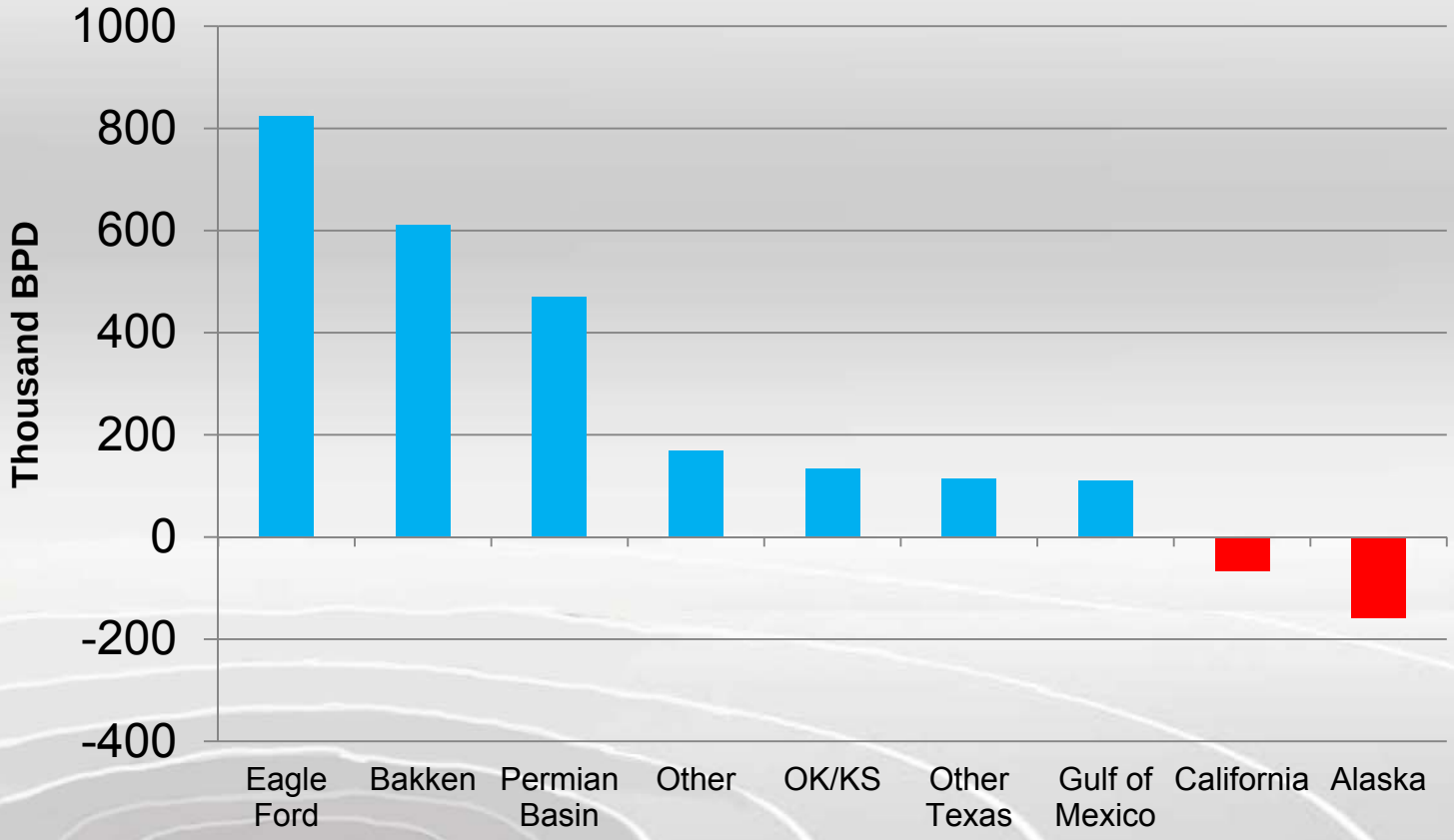
Crude Production Increases – U.S.
2008 to 1H2013



Source: EIA

Projected Production Volumes by 2022

U.S.

- Low Case 9.5 MMBPD
- High Case 12.0 MMBPD

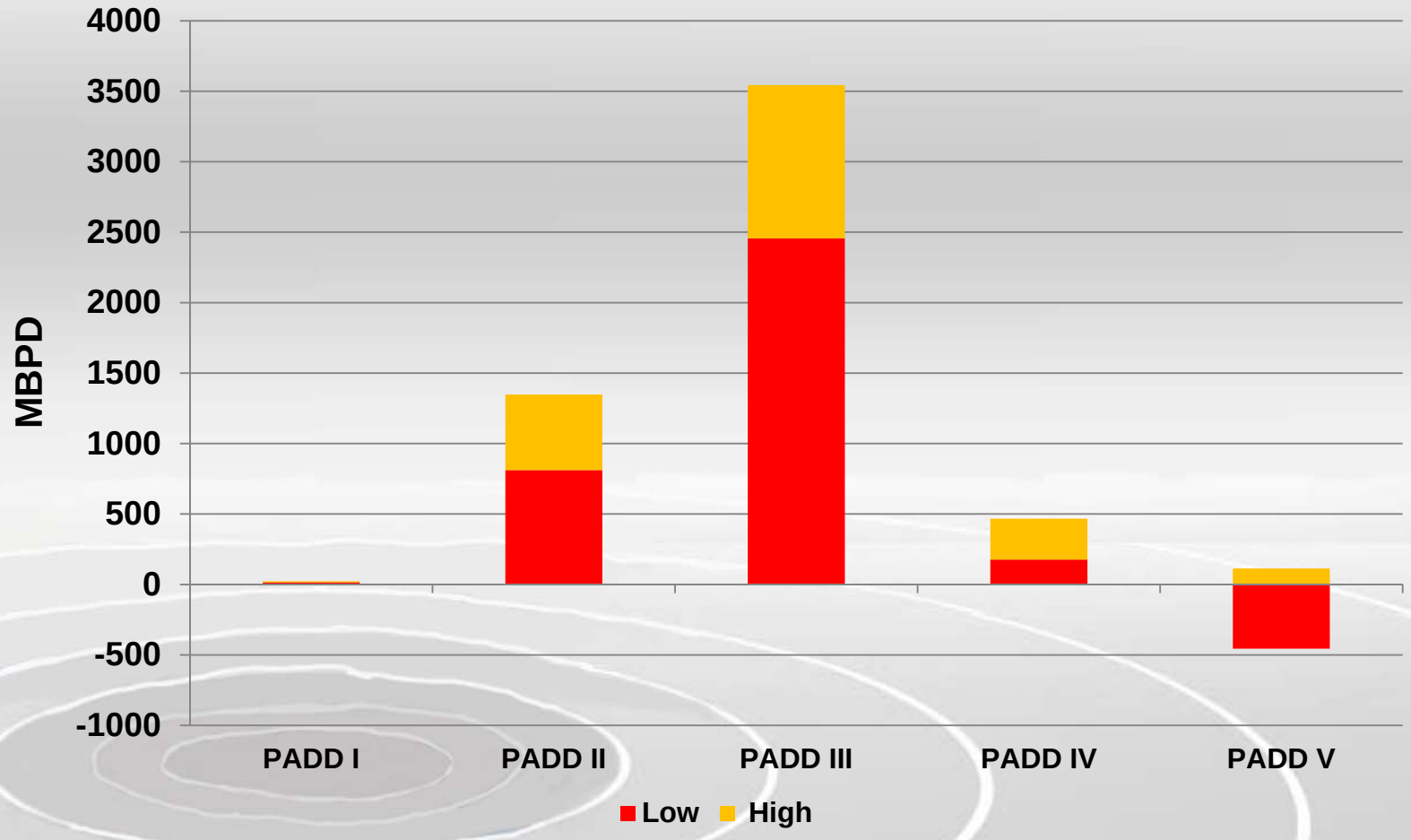
Canada

- 5.5 MMBPD

Forecast Assumptions

- Absolute crude prices (Brent) remain in $80 to $120 range
- Key limitations (manpower, materials, regulatory, financial, etc.)
- Build out of crude transportation assets is critical
- Limited production from some high potential prospects
- High case requires significant crude exports

U.S. Crude Production Change by PADD
2012 to 2022



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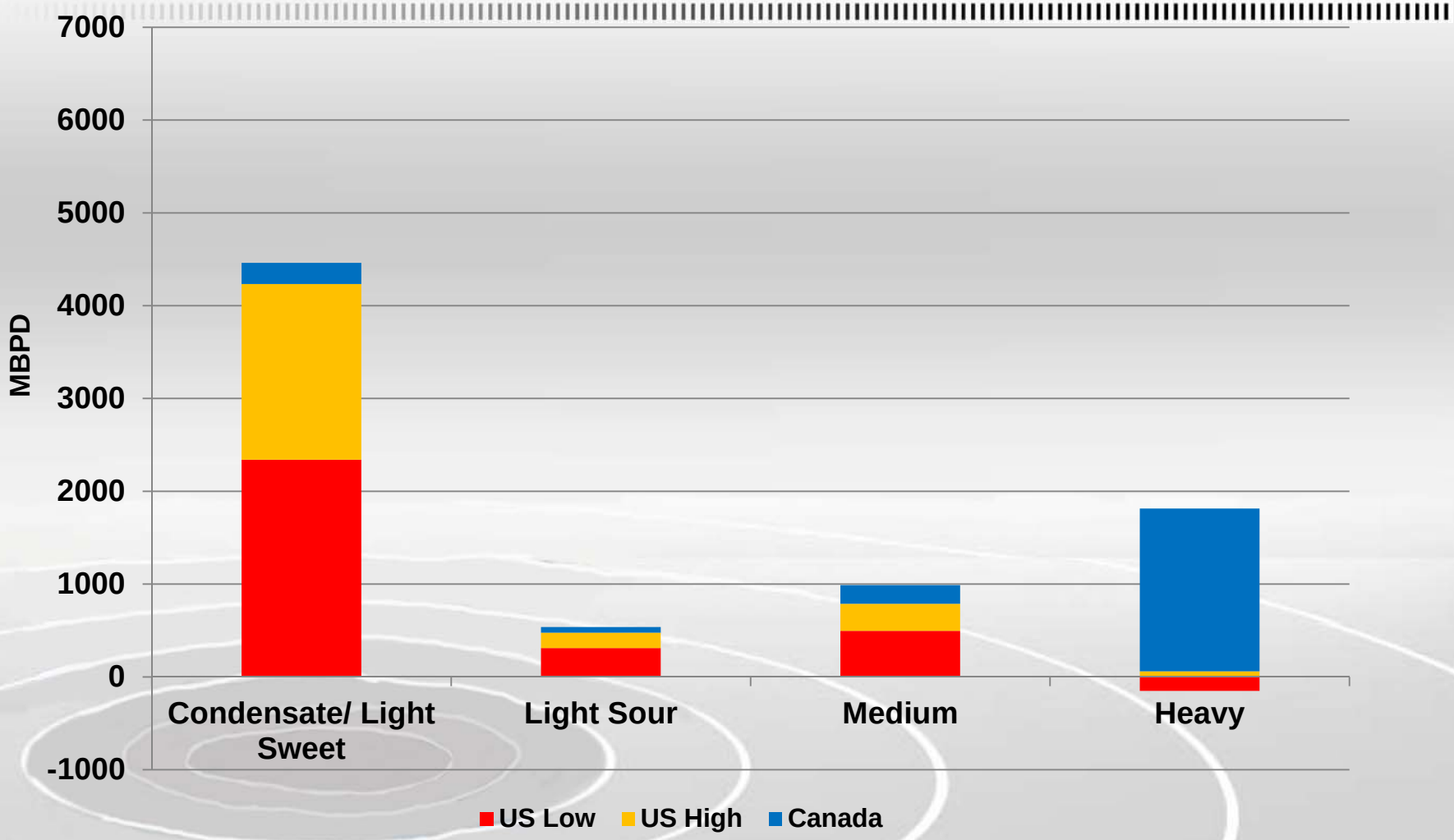
Crude Oil Grades

Crude Oil Categories		
	Gravity °API	Sulfur Wt. %
Condensate	≥ 55.0	All
Super Light	42.0 – 55.0	All
Light Sweet	31.0 – 41.9	≤ 0.99
Light Sour	31.0 – 41.9	≥ 1.00
Medium	24.1 – 30.9	All
Heavy	≤ 24.0	All

Change in Crude Production by Grade
2012 to 2022



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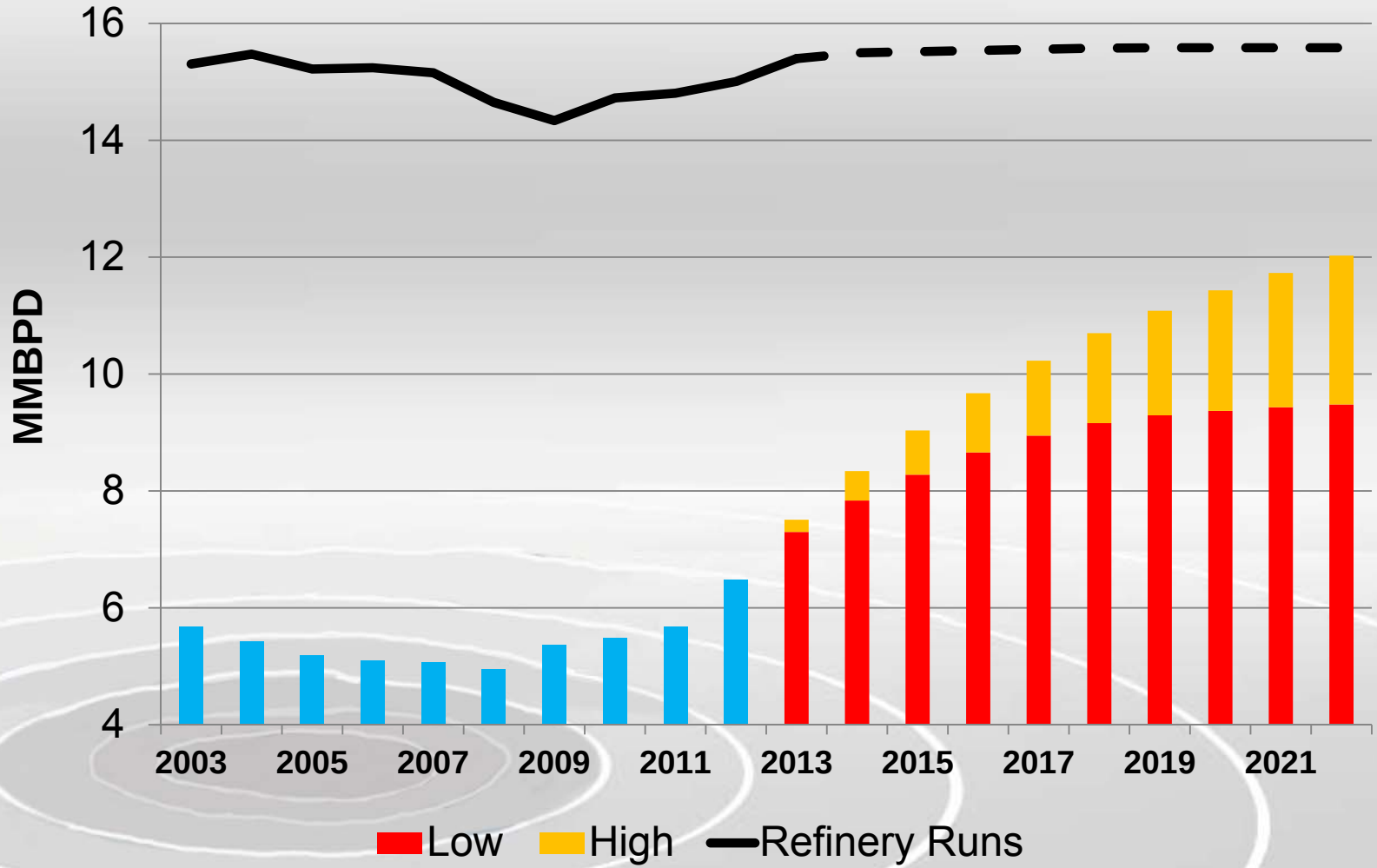
U.S. Crude Supply/Demand



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N.A. Crude Flows

U.S.

- Bakken will flow primarily to the East Coast and the PNW
  - ❑ Movements to PADD III will be largely eliminated by 2014
- Eagle Ford will generally be consumed in PADD III with some volumes moving to Atlantic Coast refineries (both U.S. and Canada)
  - ❑ Exports required in High Production Case

Canadian Production

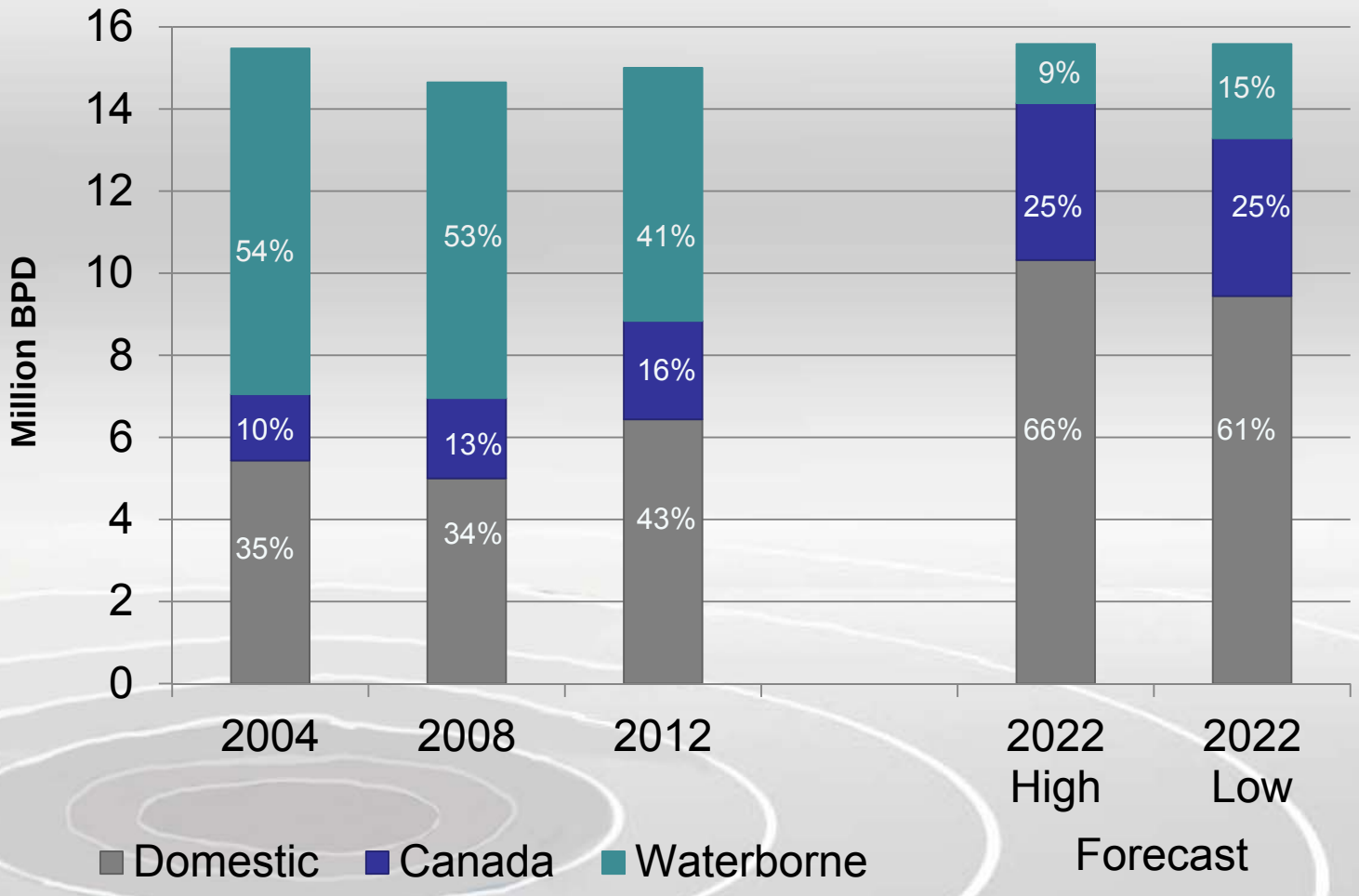
- PADD II heavy crude expansions will soak up most of the addnl. hvy production in the short term
- Significant volumes will not reach the USGC until 2016

N.A. Crude Flows (Cont'd)

Other Foreign Imports

- Lt. Sweets backed out of PADD III by the end of 2013/early 2014
- Most Lt. Sours replaced in PADD III by mid-decade
- Role of foreign Medium grades is declining; some remain as "structural imports" – Motiva/USWC
- High Case has most Medium grades out of PADD III by 2016

Changing U.S. Crude Oil Sources



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Shale Crude vs Displaced Light Imports

Property	Bakken	Eagle Ford	Eagle Ford Cond.	Brent	Bonny Light
API Gravity	41	45	56	39	34
Sulfur, wt%	0.20	0.20	0.15	0.35	0.24
Distillation Yield, volume %					
Lt. Ends, C_1-C_4	3.5	3.8	6.6	3.5	1.3
Naphtha	35.7	40.1	56.7	24.1	20.3
Middle Distillates	30.9	29.7	28.6	35.3	45.5
Gas Oil	24.8	21.2	7.6	27.0	27.4
Vacuum Residue	5.2	5.2	0.5	10.1	5.4

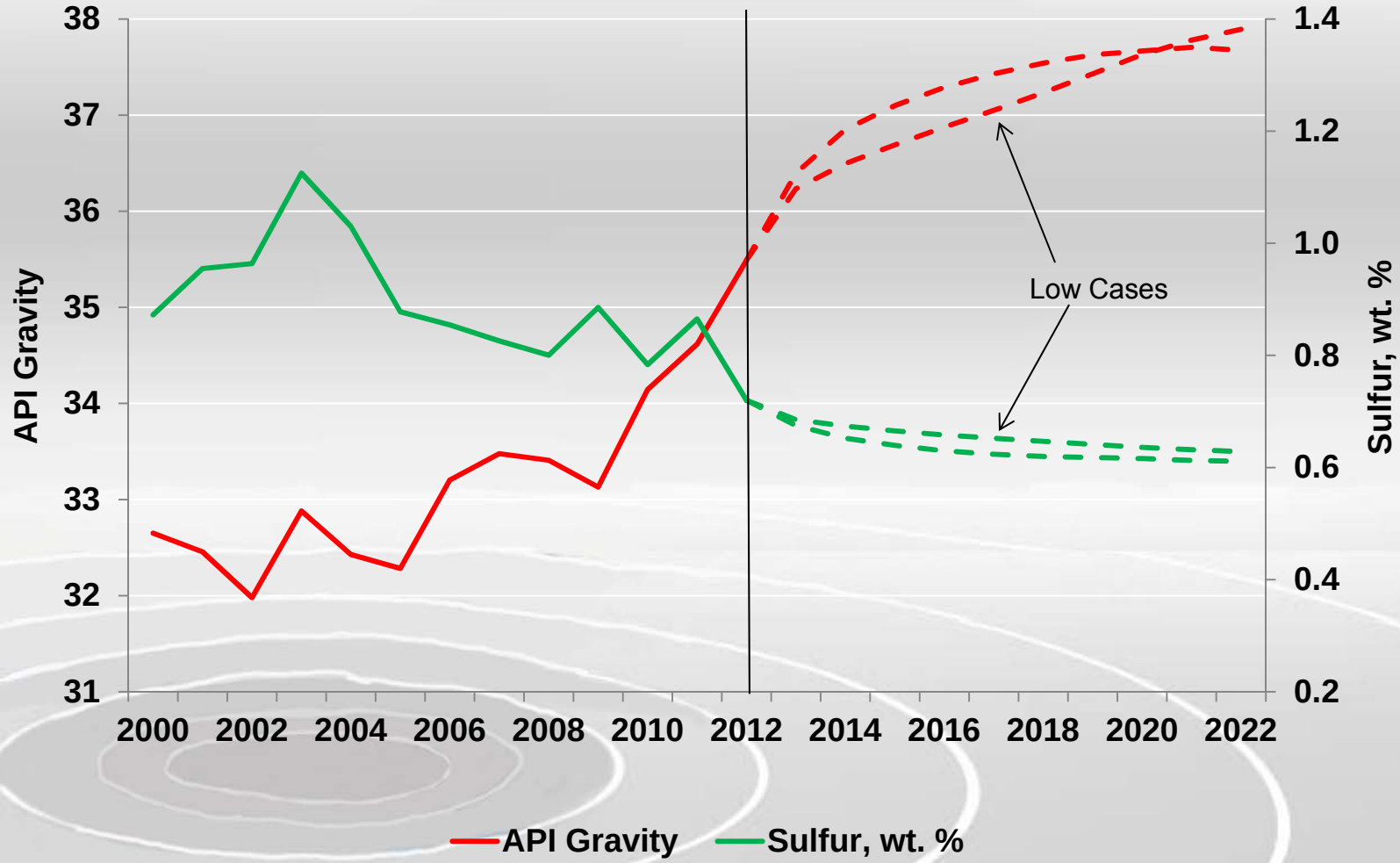
Canadian WCS Quality Shift

Property	Current	2022	Change
API Gravity	20.3	20.3	- -
Sulfur, wt%	3.4		- -
TAN, mg KOH/gm	1.15	1.50	0.35
Distillation Yield, volume %			
Lt. Ends, C_1-C_4	2.7	4.9	2.2
Naphtha	14.0	15.0	1.0
Middle Distillates	21.7	17.8	-3.9
Gas Oil	33.8	31.2	-2.6
Vacuum Residue	27.8	31.1	3.3

Canadian Heavy vs. Latin Heavies

Property	Canadian Heavy (Current)	Canadian Heavy (2022)	Mexican Maya	PDVSA Merey
API Gravity	20.3	20.3	20.5	16.0
Sulfur, wt%	3.4	3.5	3.7	2.5
TAN, mg KOH/gm	1.15	1.50	0.20	0.7 – 0.9
Distillation Yield, volume %				
Lt. Ends, C_1-C_4	2.7	4.9	0.9	0.1
Naphtha	14.0	14.9	16.0	7.1
Middle Distillates	21.7	17.8	23.1	24.1
Gas Oil	33.7	31.2	27.0	34.2
Vacuum Residue	27.8	31.1	33.0	34.5

Quality of U.S. Crude Oil Production



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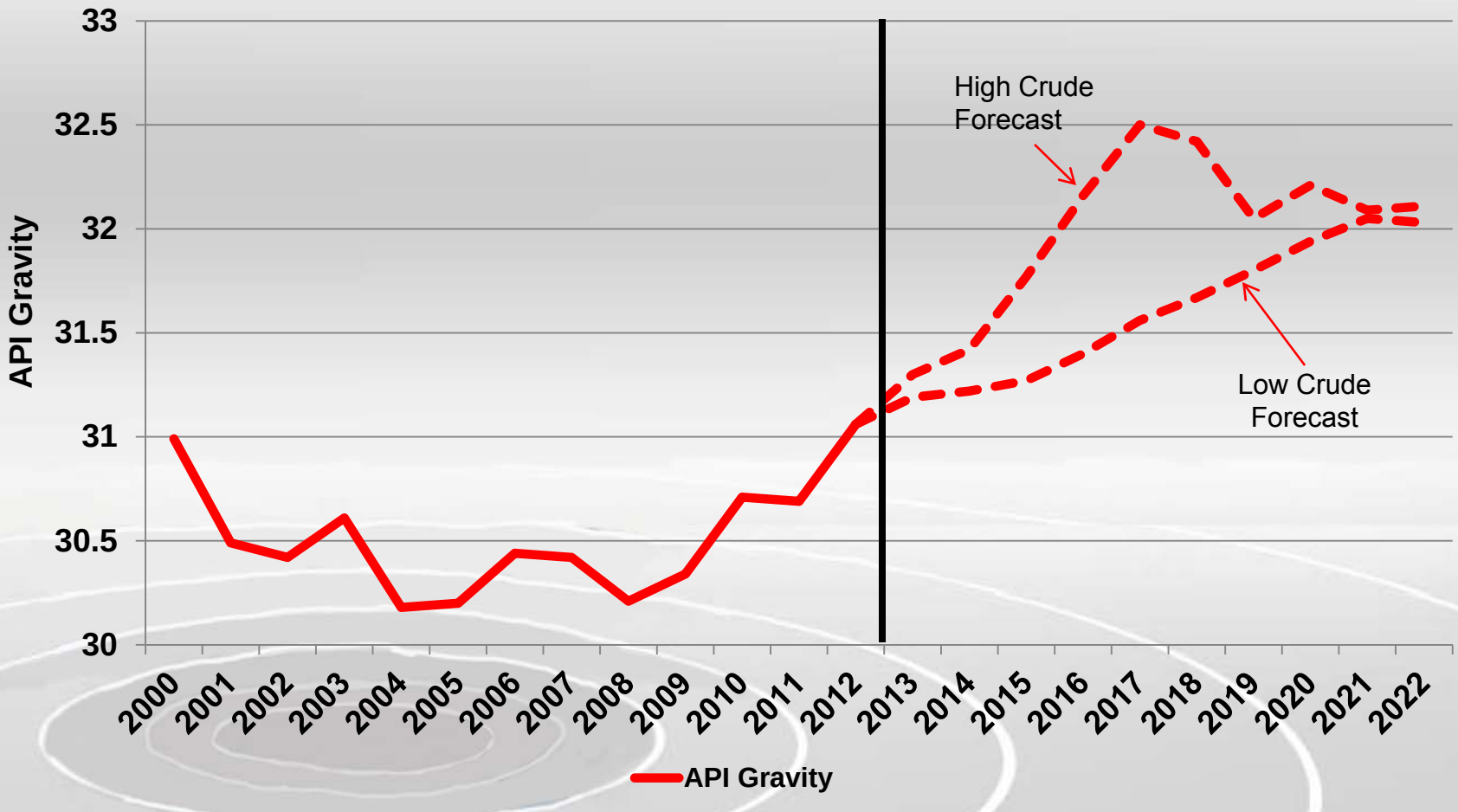
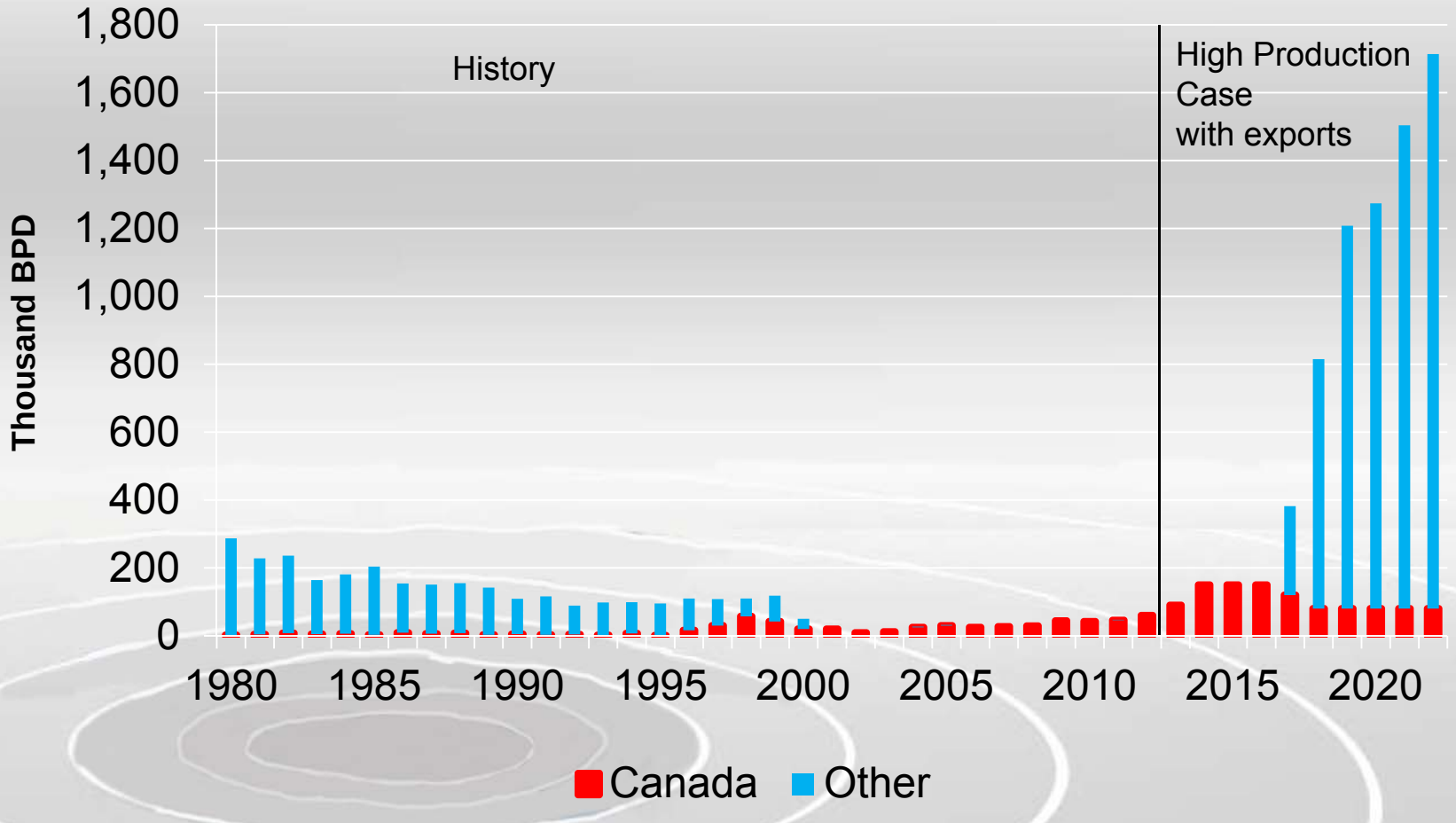
API Gravity of U.S. Refinery Crude Slate



U.S. Crude Oil Exports



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Crude Exports

- By 2022, N.A. crude production vs. refinery runs will be close to balanced (~18.0 vs. 17.5 MM BPD) if crude exports are allowed.
- Crude exports of ~2.0 MM BPD:
  - Necessary to balance against “structural imports” from PDVSA, Pemex, S.A. etc.
  - Mostly from Eagle Ford, Permian and ANS
  - Canadian will export from both coasts (dependent on midstream expansion)
- Crude access/logistics will continue to be key margin determinant
- Export policy decisions critical

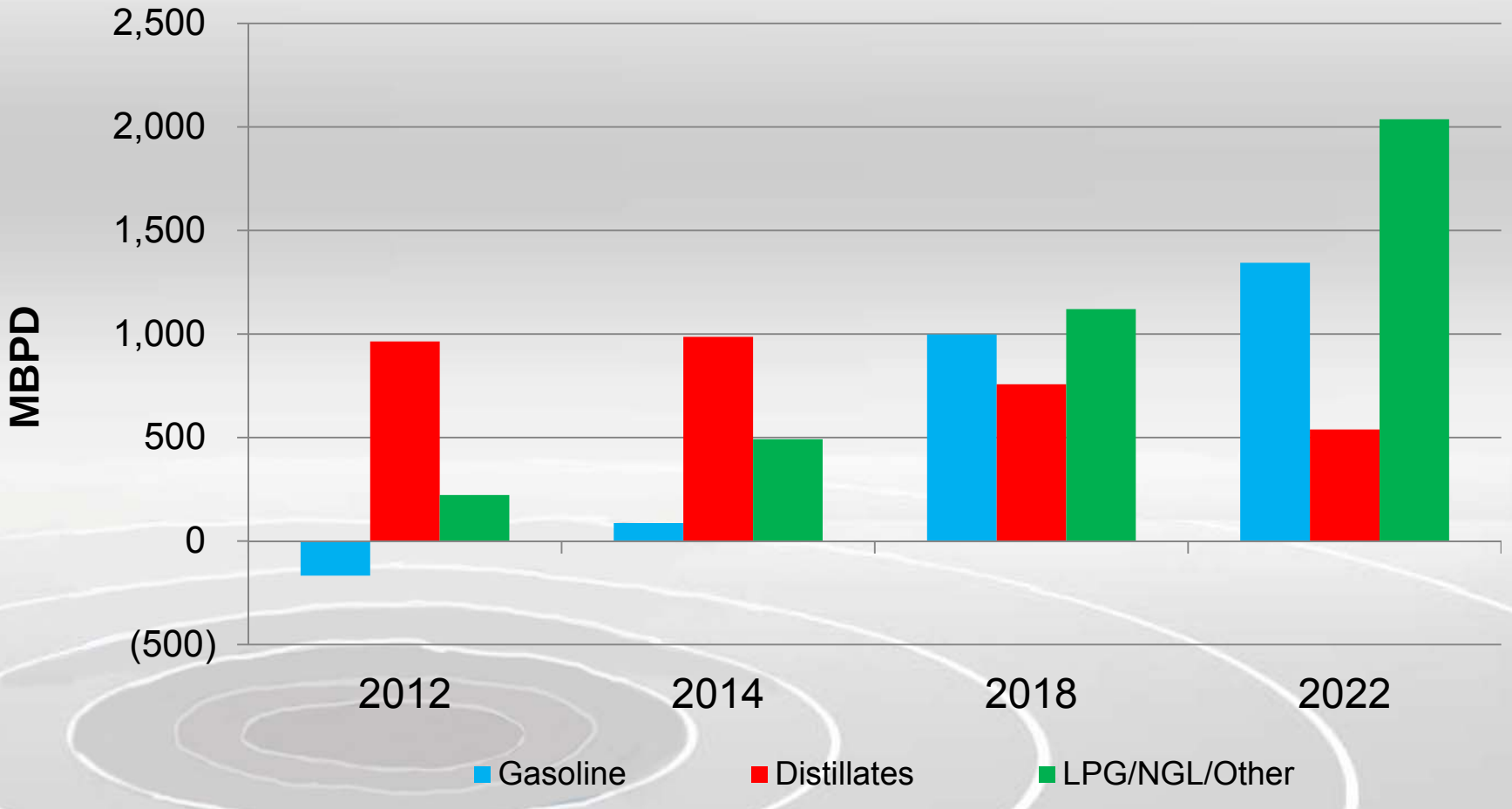
Refinery Yield Impacts

- "Dumbbelling" of Crude Slate
  - Higher LPG and naphtha
  - Lower middle distillate
  - Resid yields up in Canadian heavy crudes; still generally lower than in Latin heavy

- Implications
  - Higher LPG yield adds to surplus from field production
  - Higher naphtha/lower distillate yields runs counter to demand growth patterns
  - Will lead to increasing exports of LPG's/gasoline; decreasing ability to export diesel
  - Light naphtha surplus a particular issue – some can be used as diluent for Can. bitumen

- Remedies
  - Construction of hydrocracking units – very capital intensive
  - Development of LPG/NGL, light naphtha and gasoline export markets
  - Export of particularly problematic crudes – export limitations; condensate splitting
  - Incentivize high distillate yielding GTL projects

U.S. Net Product Exports



Final Thoughts

NA Boom in Crude Production

- Significant “game changer” with international implications
- Well decline rates in some tight oil formations are 80%+ but production growth will continue for several years before reaching a plateau
- Permian has the most long-term potential
- Ability to export crude will be key to continued growth

Implications for U.S. Refining Sector

- Less expensive crude
- Lower natural gas cost
- Adds to existing advantages – higher complexity, developed infrastructure, more flexible work force – to make U.S. refineries the most competitive in the world

Facilitates Ability to Export Products – Requirement due to Declining Domestic Demand

- U.S. transitions from big net importer to large net exporter
- Sustainable trend; increased competitiveness of U.S., growing demand in developing countries; lack of success in building/running refineries

Final Thoughts (Cont.)

U.S. Crude Boom Also Presents Challenges

- Will require downstream capex along with investment outside refinery gates
- Major impact on refinery yields/product balances – more gasoline/less diesel
- Particularly long on light naphtha/condensate
- Quality of new production (mostly shale) major unknown

Threats to Product Export Model

- Growing dependence on volatile markets in Latin America and elsewhere
- Dependent on continuing difficulty of countries to supply own demand
- Increasing volumes of gasoline more difficult to place
- Threats from other export refineries – SATORP/Jubail, YASREF/Yanbu, others
- Potential of U.S. export restrictions; unlikely despite political posturing

Regulatory/Policy Issues

- U.S. policy on crude exports
- RFS – Ethanol Blendwall/Soaring RIN Costs/Increasing volumes of alternatives
- Potentially more restrictive CAFÉ standards
- Tier 3 Rules – More investment/increased costs
- Carbon restrictions –tax/cap and trade/LCFS
- Other – XL pipeline approval?/LS heating oil, bunker fuel/Jones Act

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