Strategic Shifts in Refining

U.S. Refining and Crude Exports
CSIS
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Strategic changes are not new

- Examples of refining industry shifts in the past
  - Shift towards more heavy crude oil
  - Shift to accommodate product slate change (less gasoline, more diesel)

- Now – more light "tight oil"

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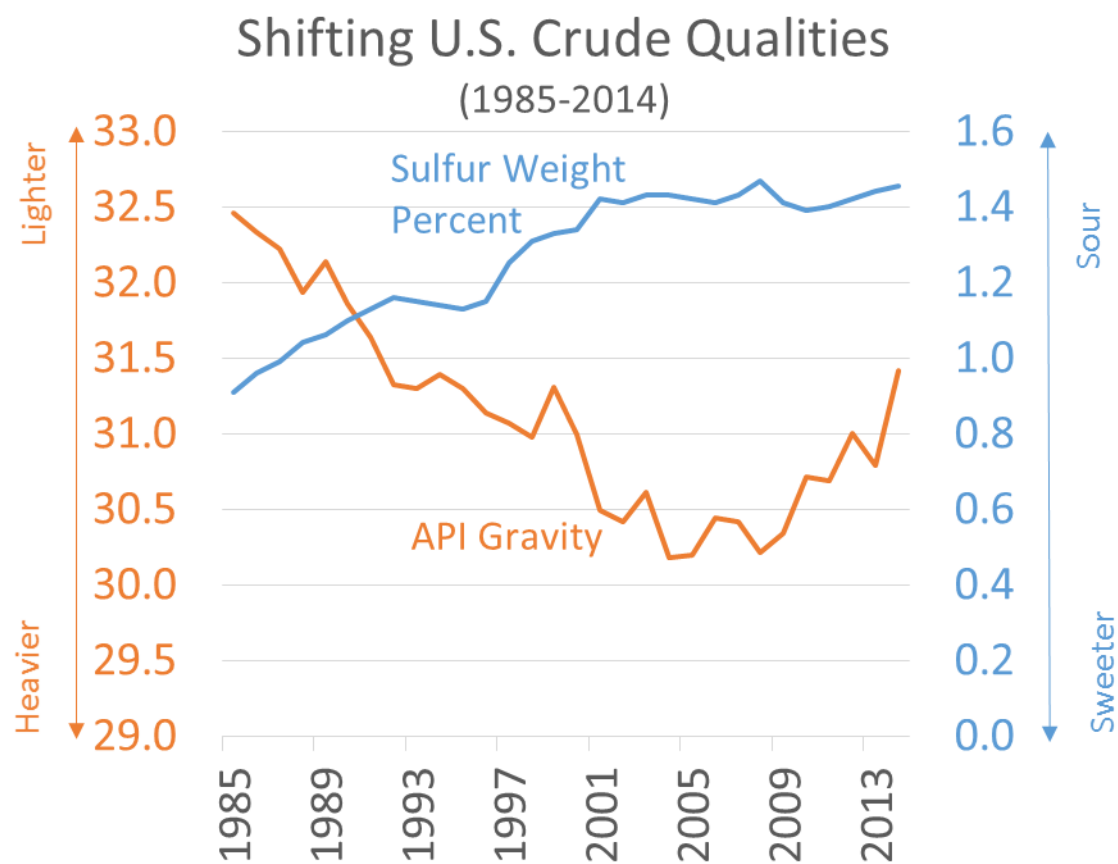
Supply shift: More heavy crude use

Heavy crude increases drove average U.S. API gravity down and increased sulfur content.

- First on Gulf Coast using Mexican, Venezuelan and some Middle East heavy crudes
- Then in PADD 2 with Canadian heavy oil sands

Recent growth in U.S. light crude oil production turned API gravity around.



Sources: Energy Information Administration Petroleum Supply

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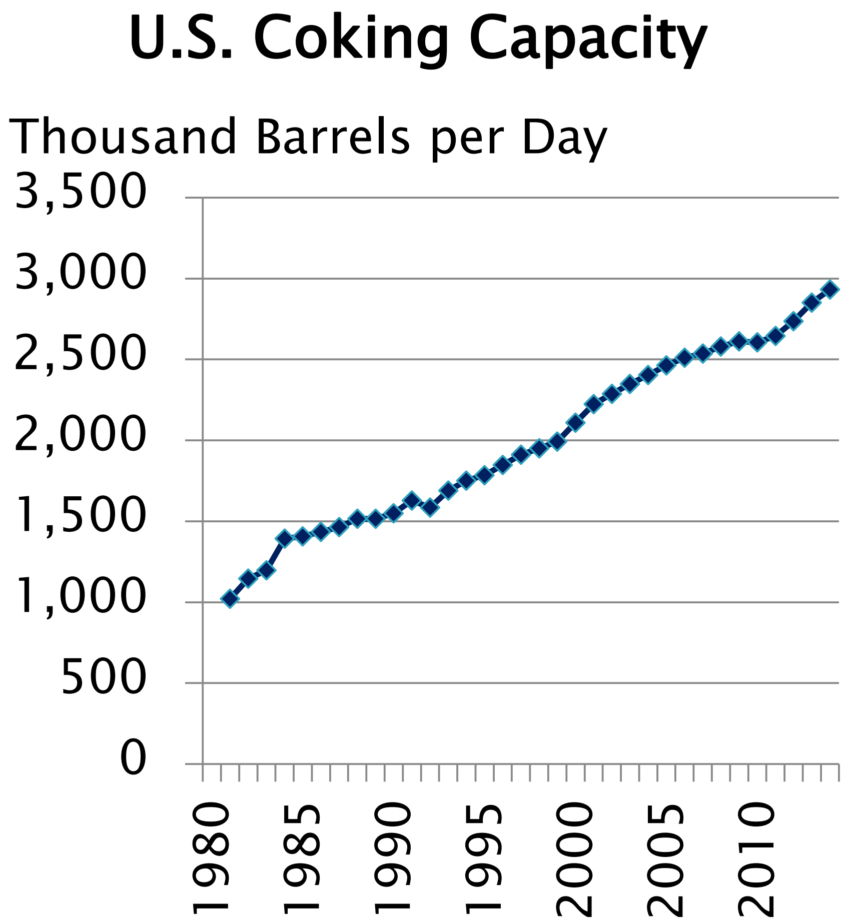
How refiners responded to heavy crude oil supply opportunities

- Increasing use of heavier crude oils has required more coking capacity in US refiners
- Coking is a thermal cracking process applied to the "heavy material" in crude oil
- Expensive processing unit



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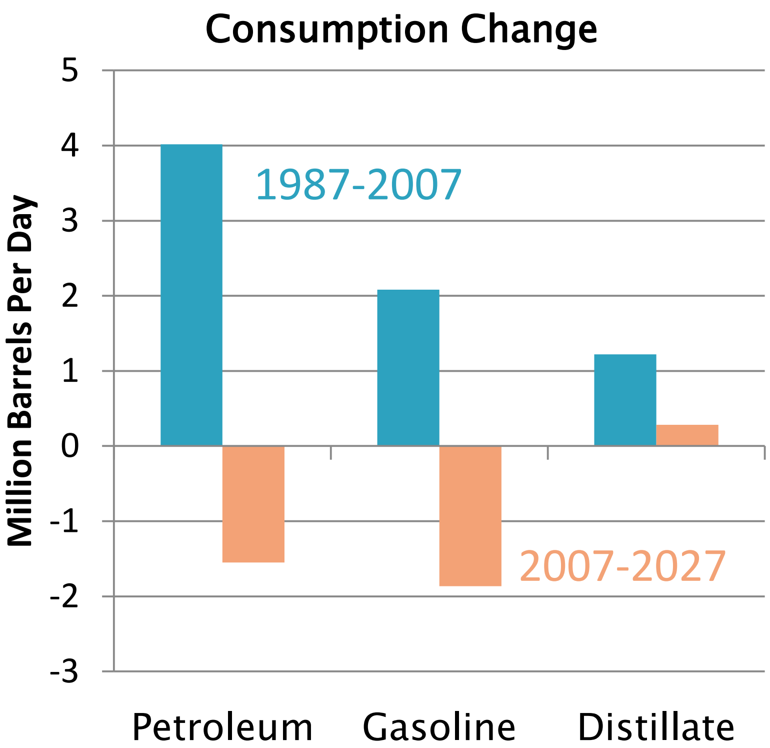
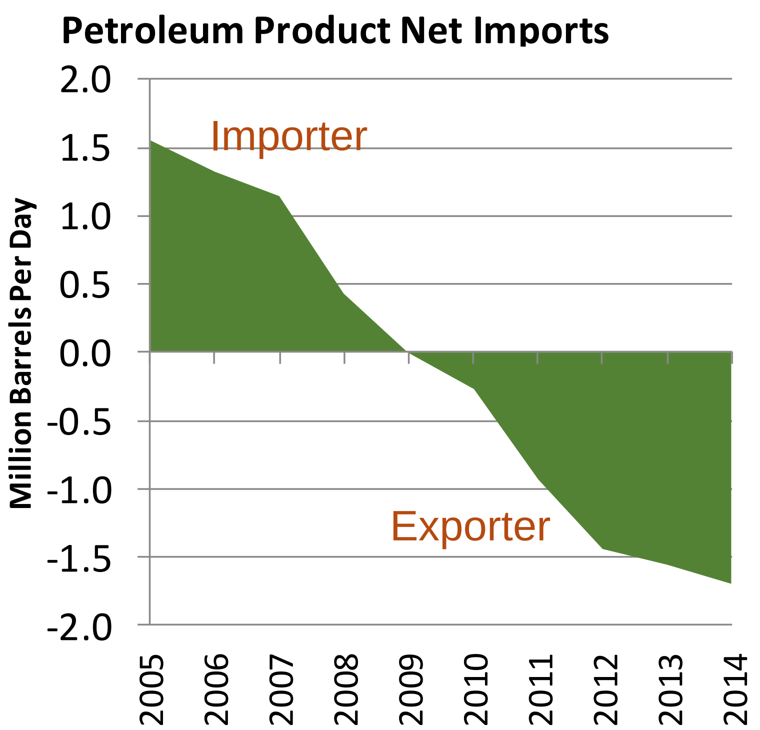
Sources: Energy Information Administration Capacity Report

Demand shift: From growth to decline & how refiners are responding

From rising consumption to falling outlook



From fears of too little refining capacity to surplus for exporting



Sources: EIA Petroleum Supply and AEO 2014 Reference Case

How refiners are responding to increasing diesel/decreasing gasoline

- Some companies are installing hydrocrackers to produce more diesel and less gasoline
- Valero, Marathon, Motiva have all added large hydrocracking facilities in Gulf Coast refineries that can export
- Large investments

Now: Light tight oil opportunities (function of price and access)

- Getting the oil (distribution and storage infrastructure build out)
- Back out imports of “look alike crudes”
- Adjust crude mix
- Invest
  - Currently most REFINING INDUSTRY expenditures to use more U.S. light crude are going to distribution/logistics

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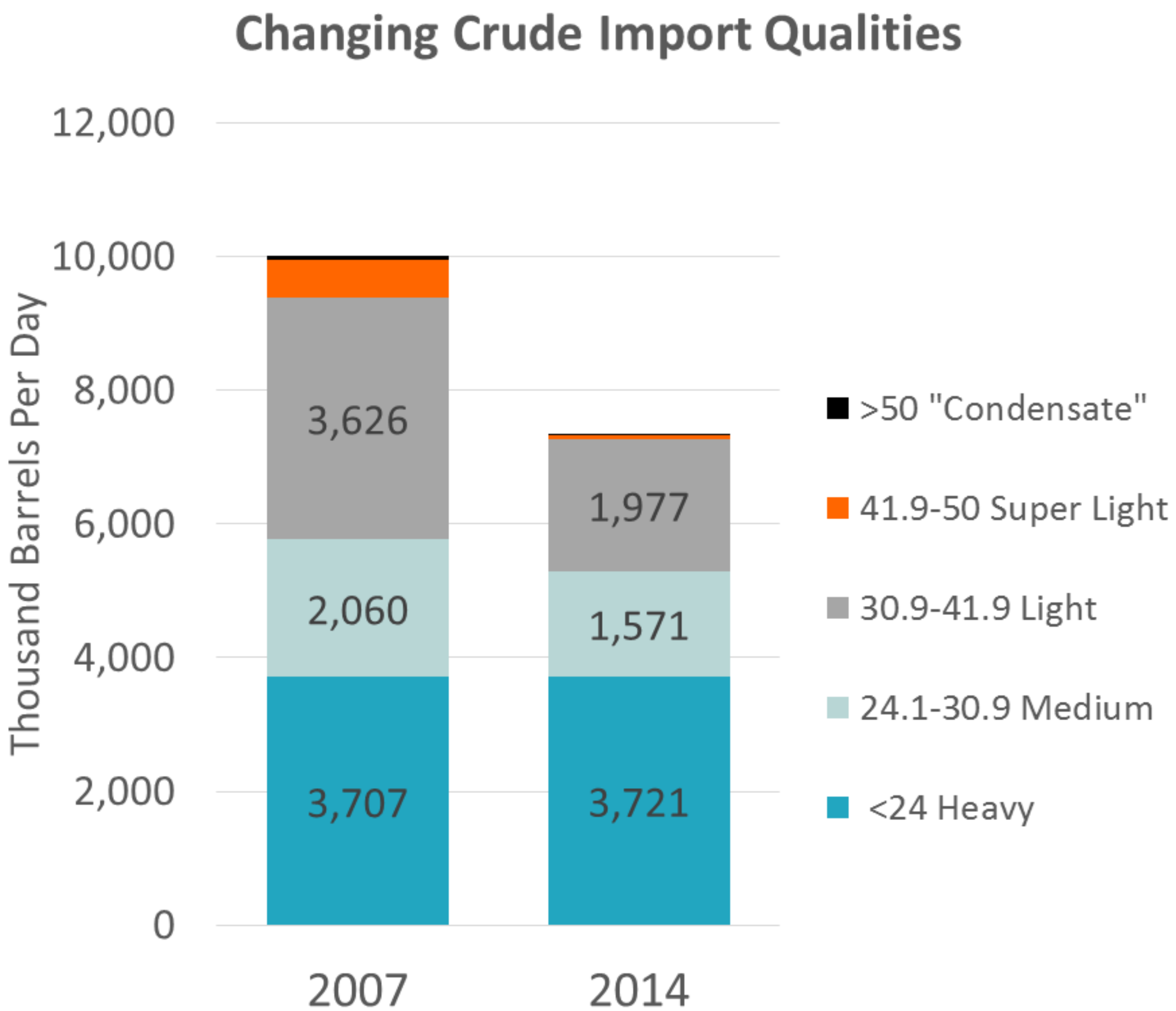
Backing out super light, light and medium imports



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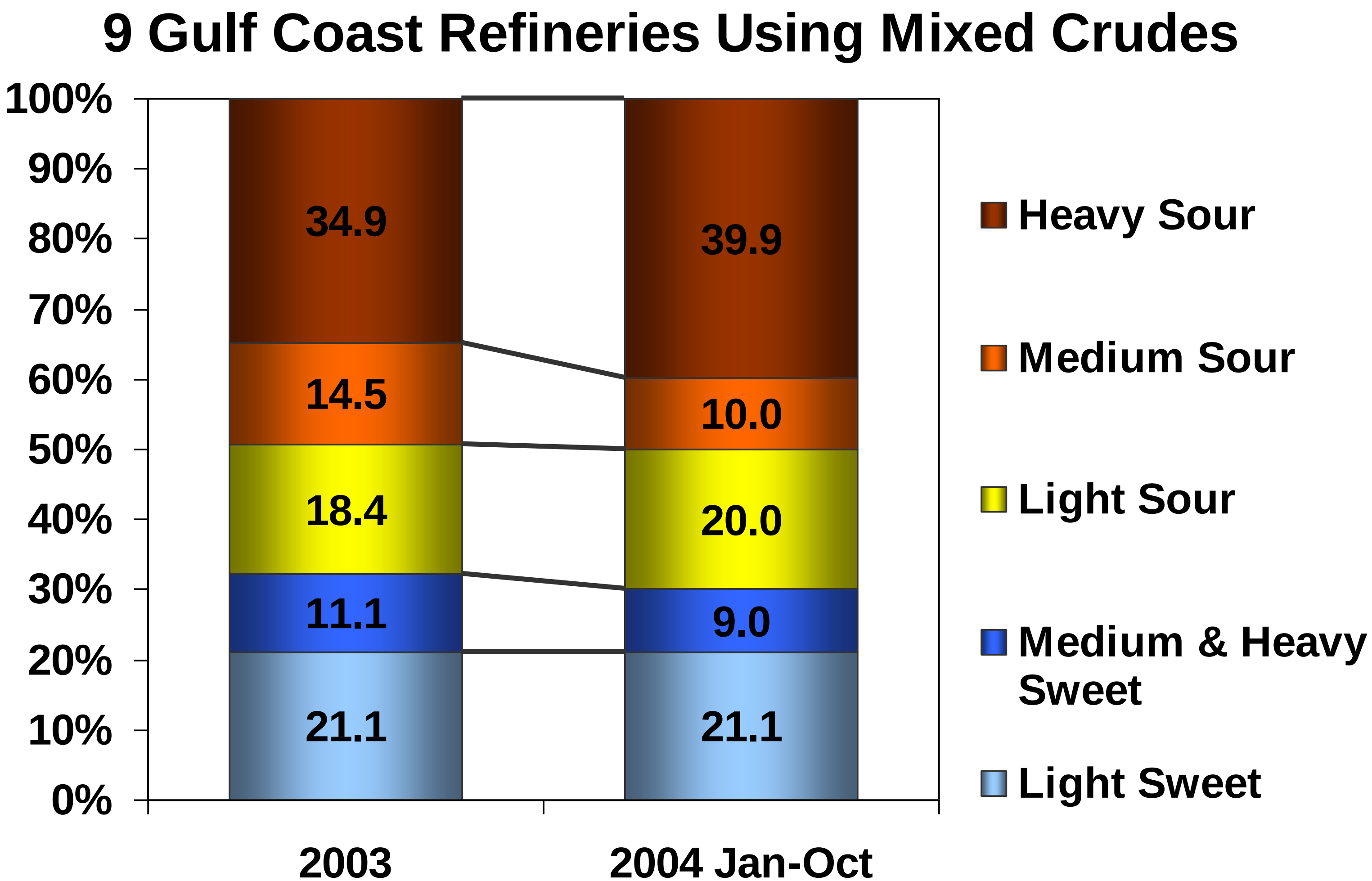
Sources: Energy Information Administration Company Level Imports

Complex Refiners Used More Heavy Sour As They Optimized Multiple Crude Types in 2004



Sources: Energy Information Administration Company Level Imports

Investment considerations

- Outside the refinery
  - Future markets – for product, for crude oil
  - Future regulations
  - Competitive position

- Inside the refinery
  - Feedstock (mainly crude oil)
  - Operating costs
  - Yields of product output (revenues)

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Comparing refinery configuration economics

Using the same crude oil (MARS), the table shows how a refinery with coking has slightly higher operating and feedstock costs (with same crude)

But the coking refinery makes up for this cost increase by producing more higher value products and less money-losing products (e.g., residual fuel)

		Cracking	Cracking & Coking
Feeds (KB/D)	**Price $/Bbl**	**KB/D**	**KB/D**
Med Hvy Crude	112	100	100
Normal & Iso Butane	84	2.7	4.2
Products	**Price $/Bbl**	**Yield %**	**Yield %**
C2 & Lighter		3	4
LPG	84	6	7
Gasoline	128	41	51
Distillates	134	31	38
Residual Fuel	100	24	3.5
Coke	17	0	5.5
Margin Estimate		**$/Bbl**	**$/Bbl**
Product Revenue		123.06	126.52
Feed Costs		114.24	115.54
Operating Cost		3.24	3.44
Margin: $/Bbl Crude		5.58	7.53

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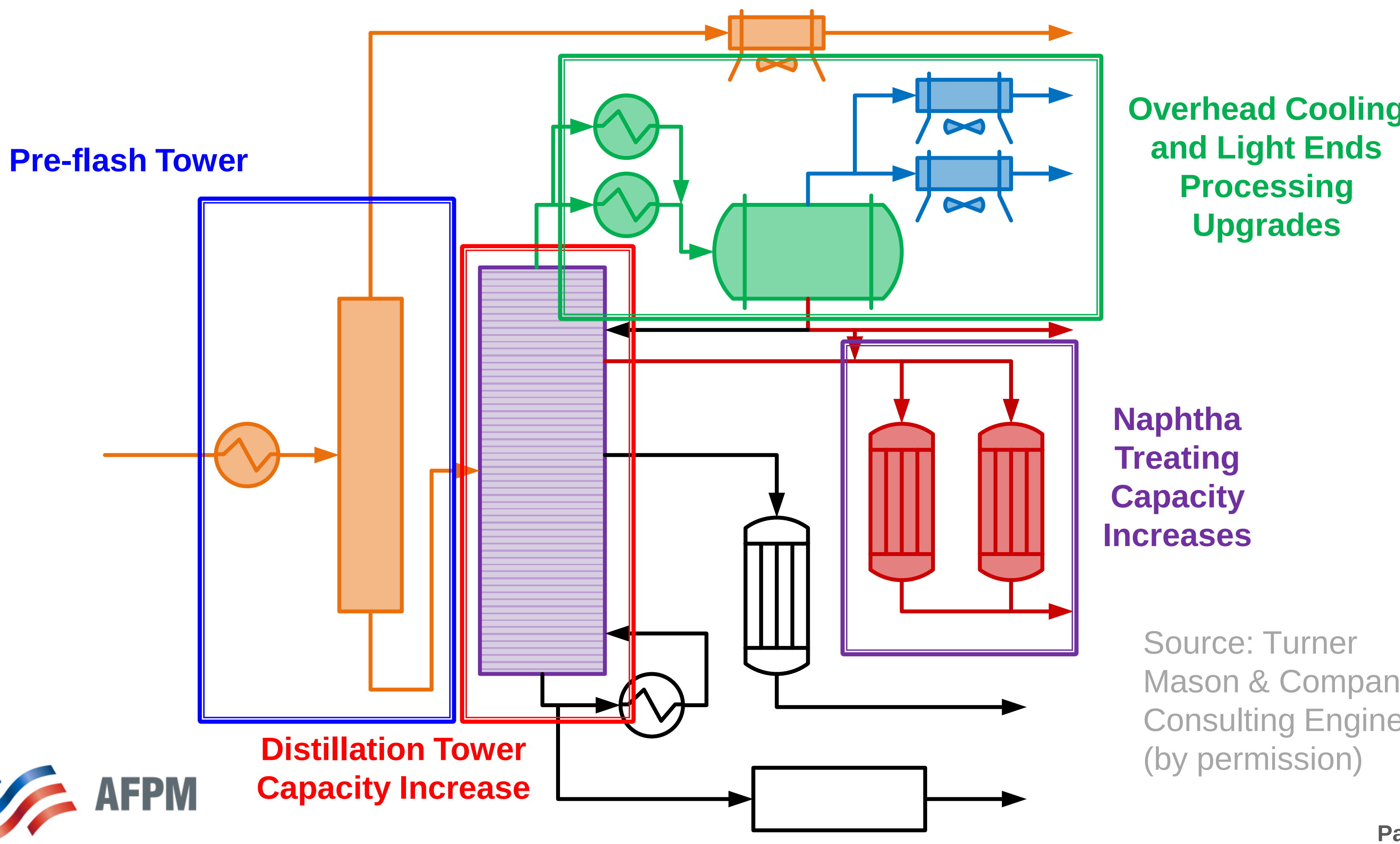
Illustrative light tight oil investments

Investment needs are refinery specific but not “large”



Source: Turner Mason & Company, Consulting Engineers (by permission)

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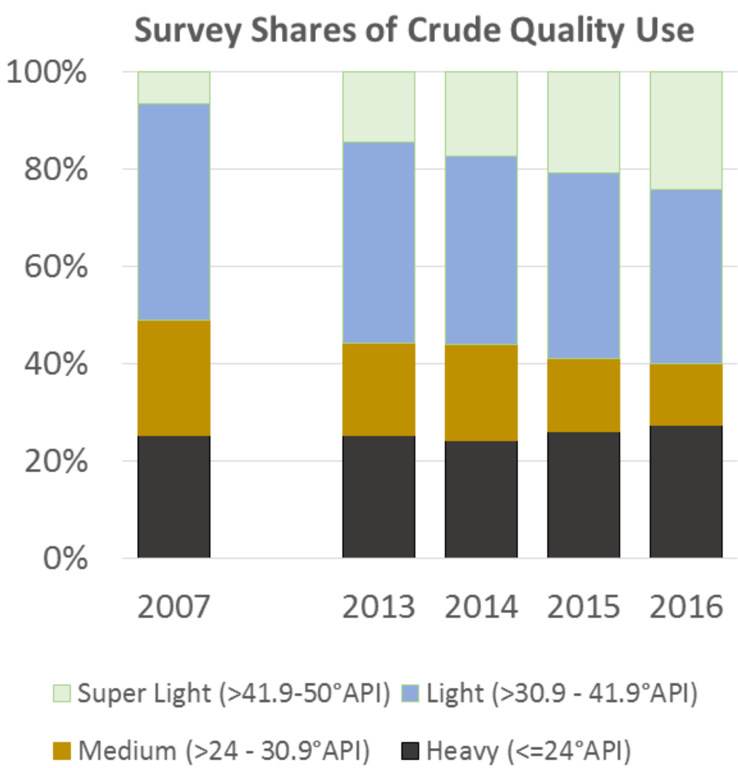
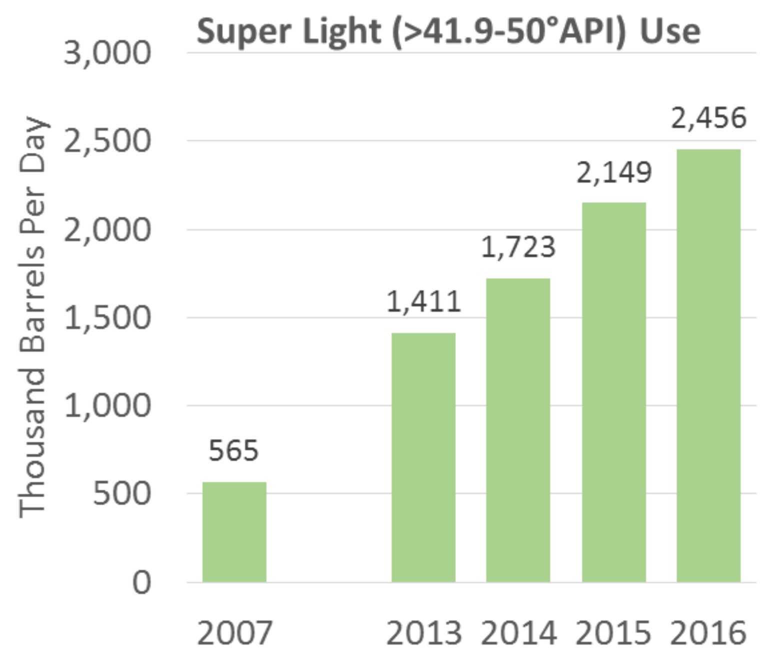
As share of super light grows; light then medium qualities are backed out

Changing Crude Quality Use & Plans



Super Light U.S. Crude Use Growth Continues



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Source: AFPM survey representing 61% of U.S. refining capacity

Questions

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