The Unbearable Lightness of Condensate

Impact On Chemicals, Refining, E&P and MLPs

- **Bottom Line:** This report refreshes our views on the growth in super light crude or condensate production from the US. Since our April 2013 report, the scale of condensate growth in the US has only become larger - we now think US condensate could exceed >2mbd by 2020, rising from 750kbd in 2013. This condensate will need to find a home. Condensate splitters are being built to tap export markets - we raise the capacity of light crude refining capacity additions in the US to 900kbd (from 700kbd). This can help the domestic oversupply. Export policy could also change. However, condensates have a high pentane and naphtha content. Over time, the rising naphtha content of crude could even lead to some pricing stress in global naphtha markets. With potential discounts for stranded molecules, downstream industries such as refining and chemicals may need to invest to get these molecules into end-markets. It's not just condensate; we note most US shale crude is lighter than world averages, driving naphtha supply higher.

- **Known Unknowns:** In a Rumsfeldian manner we run through the many “known unknowns” of our analysis. What is the condensate cut/assay of shale? What are the North America and international end-markets for pentanes or heavier naphtha? If there is oversupply, what are the alternatives? What happens as the North American shale experience goes global. There will be “unknown unknowns” also, an ongoing conversation.

- **Impact on the Upstream:** Black oil producers will likely be less affected near term. Condensate rich plays include the Eagle Ford, parts of the Delaware, Oklahoma basin (e.g. SCOOP) and Utica.

- **Impact on Infrastructure MLPs:** Good news, a 50kbd condensate splitter can cost $200m+ – we may need $8bn+ of investment plus separate pipe infrastructure. Bad news, weaker C5+ pricing would reduce frac spreads.

- **Impact on WTI-Brent:** There is a growing view that “condensate” is not crude. If it can be exported, it would create more head room for black oil growth into US refineries. We see 3yrs of headroom at this point for black oil (assuming +1mbd pa crude production growth) in the US refining system.

- **Impact on Global Chemicals:** In a marginal priced world, if naphtha becomes distressed over time, the US ethane advantage would narrow. However, Brent/Henry Hub will likely remain the main driver of the industry cost curve. In the short term, we worry crude is about to spike higher.
Background

In our deep-dive into the space last year (see our note Potential Naphtha Oversupply: Impacts on Condensate, Chemicals, Refining & LNG from 4/5/13), we suggested that:

- The strong expected growth in condensate rich shale plays such as the Eagle Ford could have a significant impact on global naphtha markets over time, given the high naphtha (and pentanes) yield of condensate (up to 50+%).

- Looking out to 2016, we suggested there was a rising tail risk that naphtha prices could fall vs Brent. In this report, we show the excess of naphtha could be as large as 600kbd in the second half of the decade, rising further over time as shale production grows. If excess naphtha cannot be upgraded into higher value markets, then the heat value alternative could be $20-25/bbl below Brent.

- Assuming an efficient market, every $10/bbl fall in naphtha vs Brent would have around a $4/bbl impact on condensate netbacks for E&P producers (given netbacks and relative yields). This excludes any transport costs/market inefficiencies due to localised condensate oversupply in the US.

- Brent crude prices and Henry Hub natural gas prices would still remain the main driver of the shape of global petrochemical cost curve (with ethane cracking in the US currently advantaged), but keeping abreast of the naphtha market supply and demand given the shale “light molecule” revolution is important. We note that in the very short term, we are worried about a crude price spike given disruptions in the Middle East.

Pushback on our April 2013 report came from E&P producers who felt that the naphtha yields on their crude was unfairly represented and from US based chemical companies who felt that excess naphtha would be upgraded somehow (either into chemicals or gasoline), as it always has been in the past, and hence their ethane advantage would remain wide.

However, the topic remains on industry/investor minds. We believe it remains a key issue. If anything, the size of the growth of naphtha supply from shale is larger than presented in our report last year. That said, there are still many unanswered questions - notably around the ability of end markets to absorb the “unbearable lightness of condensate.” In this update:

1. We raise US lease condensate production forecasts in the US to over 2mbd by 2020. US lease condensate production was 750kbd in 2013, according to the EIA. Note, this excludes natural gasolines (pentanes+) from NGL fractionation plants, i.e. another 300+ kbd, rising to 500+kbd over time.

2. We raise the capacity of US light crude processing additions to 900kbtd (from 700kbtd). This number includes around 500kbd of proposed condensate splitters.

3. We believe some pricing stress could occur in global pentane and naphtha markets over time, given the high yield of light pentanes and naphthas in condensates and smaller end markets than conventional crude molecules.

4. With potential discounts for stranded light molecules, downstream industries such as refining and chemicals may need to invest to get these molecules into end-markets.

5. As the US crude slate lightens, a tipping point may be reached requiring separate infrastructure and splitters for super light barrels.

6. This super light “condensate” conversation appears to be influencing export policy discussions in Washington.

7. From a pentane and naphtha perspective, we note it’s not just condensate - US shale crude is lighter than world averages also.
At the back of the report we include some useful background charts on US condensate rich plays and include some discussion on Canadian diluent demand.

Condensate – an issue or not an issue?

We start with some recent industry quotes from key players - condensate is definitely still an important topic for investors. Refiners are seeing the quality of the crude they buy get lighter and are working on ways to build infrastructure to absorb this lighter crude. E&P investors exposed to plays with high condensate cuts are nervous. US chemical companies are trying to understand how they can profit from capturing disadvantaged shale molecules (not just ethane) and sell them to world markets.

**XEC (1Q14) on crude quality in the Delaware:** The only areas we’re really seeing any adjustment in the Permian are in the Wolfcamp, and so in the Culberson area, as well as in the Reeves. The Wolfcamp and Culberson is a little bit higher gravity, it’s 54- to 58- degree and then when we get over there into Reeves, it’s 46- to 52-degree.

**VLO (1Q14) on condensate opportunities:** We’re taking a hard look at the condensate. We don’t really see that the discounts are wide enough to really warrant a capital investment to be able to run a lot larger volumes of condensates in the Gulf Coast. We are taking a heavy look at this in the Permian Basin in some regions and kind of getting with producers and seeing where they’re seeing the production to see if there is some opportunity.

**Analyst:** Do you think there will be a point where the really light crude will need its own infrastructure rather than being blended into the WTI stream?

**VLO (1Q14) on infrastructure:** Yes, I do. I think ultimately we’ll have to do that because the refineries just can’t reject the light ends.

**PSX (1Q14) on condensate splitters:** What we’re really focused on and we talked about was our initial thinking around a larger condensate splitter in the Sweeny area, where you’re close to the increasing condensate production in West Texas and the Eagle Ford. Collectively we see condensate production increasing and we’re seeing opportunity there on both the transportation and the splitting side.

**DK (1Q14) on the quality of crude from Midland:** What we have seen, and it started probably the middle of last year, is the gravity of the common stream WTI drifting up from around 40 to as high as 43 API coming out of Midland.

**WNR (1Q14) on superlight crude:** We look at the price of those superlight crudes, and right now the discounts for the higher gravity crude do not warrant us running them at the El Paso Refinery. Right now, there is enough other crude material for that superlight crude to clear the market and find a home. But as more superlight crude comes on, and we run out of material to help those barrels clear the market, my belief is those discounts will widen. And as they widen, we will continue to look at those barrels. And I am sure there is a price in which we will try to run more. And then, we will look at specific projects, if warranted, that make sense at the refinery to run those barrels.

**ROSE (1Q14) on condensate pricing:** As it relates to Eagle Ford condensate, we are still seeing roughly the same differential that we’ve seen in the past. In fact, we are looking at some additional deals that would price our condensate based off LLS going forward the next couple of years. And those things are still in the same range of what we talked about before, which is $13 or $14 off LLS. Credit Suisse observation: Please note this is at the well head and so the discount is partly related to quality and partly to transport.

**Magellan (1Q14) on condensate infrastructure in the Permian:** We haven’t had any discussions with producers at this time to construct anything specifically for condensate. We have seen, for lack of a better term, lightening of the crude that we are seeing on Longhorn. In fact, we just in the last month or two changed the spec with all of our
shippers consent on Longhorn to accept lighter crude. But at this point, we are not actually looking at any separate infrastructure in the Permian for condensate removal.

LYB (1Q14) on condensate opportunities: Actually, I think there will be some condensate splitters built and frankly, we’re looking at that as well, because we have some opportunity, potentially, to do that at a very cheap cost. So we think it’s a positive development for us instead of a potential negative. We expect there to be a lot of condensate available, some out of South Texas, already from the Eagle Ford, that has a positive impact on us. To the point where we’re just not taking any Middle East condensate in our US operations anymore. And we expect some additional condensates to come from some of the Northeast US deals, particularly the Utica. So we think there’s an opportunity for us there, both at Corpus at our refinery, and we’ll see how that all develops.”

Global Crude Slate: On the Cusp of Major Changes

The “Unbearable Lightness of Condensate” is a fairly recent phenomenon. For most of the 2000’s global crude was perceived to be getting heavier as world demand needed more OPEC barrels and Canadian heavy. The shale revolution has dramatically changed the supply-demand equation for light molecules.

- **More Supply**: Using global crude assays and forecasted growth by country, we think total naphtha production could grow by up to 2.5 mmbd in 2019 over 2012 levels (or 15+%). This is a meaningful change. A substantial part of this growth will come from US shale plays, particular condensate rich Eagle Ford, Delaware, Utica, and Oklahoma Basin (SCOOP). However, even non-condensate US “crude” likely has a higher naphtha cut than the global average.

- **Less Demand**: On the demand side, shale is creating pockets of cheap ethane (first in the US and eventually overseas) which is reducing the growth rate of naphtha demand from the chemical industry. Automobile efficiency in Western markets is doing the same for end markets on the fuel side for naphtha, e.g. gasoline, though EM demand remains strong.

- **And It Gets Worse Over Time**: Both these supply effects and demand effects for naphtha type molecules will accelerate over the next decade as the US continues to grow, as international shale takes off, and auto efficiency gains accelerate.

**Exhibit 1: Global Naphtha Supply historical and forecast**

![Estimated Naphtha Content of Global Crude](image)

*Source: BP, Credit Suisse estimates*
Much of this lightening of the global crude slate is happening in North America due to the shale revolution. This makes sense — lighter molecules flow more easily from tight rocks. Assuming oil prices stay high, and capital flows freely, then the key plays in North America have room to drive “oil” production higher. Within this “oil production,” condensate makes a substantial contribution. We note that even the shale “oil” (i.e. less than 45 API) is light and likely has more naphtha than global averages.

We introduce the first of our “known unknowns”:

- The EIA does capture some information on US “lease condensate” which is produced at the well head and is included in the “crude” production figures reported. Lease condensate was around 750kbd in 2013. However, we suspect some condensate is also being blended and reported as crude.
- The E&P industry does not break out how much of their production is condensate — they typically quote “oil,” natural gas liquids and gas.
- Some condensate plays could be “retrograde” i.e. the condensate share of production falls as the reservoir is produced over time.
- The pace of delivery of this growth will depend on the ability of the E&P industry to export condensate either through condensate splitters OR directly, if US policy changes, a current debate in Washington.
- Our global projection for the naphtha content of crude is mainly driven by the light shale oil growth in the US. It will also be influenced by the production elsewhere. If light shale takes off elsewhere, and backs out heavier crudes, the naphtha content could rise higher. Countries with light crude such as Libya and Algerian could be impacted by MENA unrest, taking naphtha volumes off the market. Reading the “global naphtha content of crude” tea leaves will be complicated.

Exhibit 2: Condensate Forms a Substantial Share of the Growth in US Production

Exhibit 3: With High Oil Prices and Rising Well Counts, US Light Oil Production Can Continue to Grow

The above chart of condensate growth excludes the 300+ kbd of pentanes that are produced out of the US natural gas liquids processing plants (which will likely grow around 10% pa). It also excludes the growing production of pentanes and naphtha that we would expect from light plays in Canada, such as the Duvernay. The Duvernay in particular can be substantial. In time, it is likely shale goes global also.
Condensate Exports Are an Important Debate, but Only Part of the Answer

Right now, the US is providing most of the net growth in global oil supplies. As the global economy recovers, and against the backdrop of political instability in MENA, and now the FSU, we believe policy makers should be wary of letting the current uncertainty over crude export policy rumble on too long. US refiners do not have infinite room to process more US light oil – potentially 3+ years at 1mbd per annum production growth. However, at some point there will be a bottleneck. If this bottleneck is serious and dents US production growth, gasoline prices at the pump will likely spike, denting consumer pocket books and potentially impacting the global economic recovery. The two charts below are a striking illustration of the need to allow US oil to flow. The export policy stakes appear high.

- Over the past three years, the world has lost 3mbd of working capacity in the Arab Spring (with more potential losses to come from Iraq given the surge of ISIS). We can add Venezuela, Crimea, Nigeria to the list of our supply concerns. The world needs American oil (or oil products).
- Non-OPEC capacity growth outside the US has been close to zero for a decade. It is difficult to grow capacity when the underlying decline could be 4 million barrels per day per annum.

To avoid a potential crude price spike, policy makers face a number of choices:

- **Lift the export ban**: Free market theory would suggest this would have the largest impact on consumer prices. Economics 101 suggests “more supply = lower prices.”

- **Firmly state that the export ban will be in place for 10+ years**: The industry would then have the confidence to invest in new light processing crude capacity to export US crude in product form. It is the current uncertainty provided by the export ban which could be damaging. Clearly this scenario is not perfect, any mismatches between processing capacity additions and supply growth could raise the risk of future price spikes for consumers, relative to full free trade in oil.
Drive harder on the demand side: While freeing up oil markets should reduce consumer price risks, it also makes sense to continue to support investments in energy efficiency. Tighter supervision of the key drilling risks (casing/cement) would also go a long way to alleviating the public’s concern with the shale drilling boom.

So where do condensates fit in to the export question? Right now it is legal to export “plant condensate” from an NGL fractionator but not to export “lease condensate” directly from a well. Allowing condensate exports, which could be over 2mbd, would give the US another 2 years of headroom to be the swing producer for the world and potentially allow time for the MENA political instability to improve or demand side measures to make themselves felt.

Even condensate exports are not the whole answer: the rest of this report looks at the impact which rising light crude can have on two key molecules within condensate – pentanes and heavy naphtha.

How Condensate Is Different to Crude

With the caveat that the quality of condensates and crudes from the shale revolution is still difficult to come by, we show below some assays on more established condensates and crudes from XOM’s assay database. As the API gravity of crude becomes lighter, then the percentage of naphtha and LPG’s in the crude rises, from as low as 20% in Medium grades in the Gulf of Mexico (e.g. Thunder Horse) up to 70%+ in some super light Norwegian crudes. The US superlight grades typically have an API of 45+ and might consist of 15% pentanes and 35% naphtha. Note: condensate also has “higher value” molecules within it e.g. kerosene, diesel which are in shorter supply and trade at wide premiums versus Brent. So it is not all bad for E&P condensate producers.

“Known Unknown”: The industry knows the real assays and molecular composition of US shale crudes and condensates and has the information investors (and this sell-side analyst) need to forecast correctly. It is not just the volumetric yield. The paraffinic or naphthenic/aromatic nature of the molecules will also influence end market values. We add some of our own views on condensate rich US shale basins in the Appendix. In general, we are least worried about the quality of Bakken crude oil. E&P companies should consider publishing the quality of their crude oil streams to address this uncertainty. Investors should certainly ask.

Exhibit 6: Select Crude and Condensate Assays

<table>
<thead>
<tr>
<th>XOM Assays</th>
<th>Sleipner</th>
<th>Ormen Lange</th>
<th>Gippsland Blend</th>
<th>Aasgard</th>
<th>Tapis</th>
<th>Forties Blend</th>
<th>Qua Iboe</th>
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<td>Kerosene (330-480F)</td>
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Source: XOM
In deriving our “naphtha content of global crude,” we have assigned naphtha volumetric percentages to each country in our supply forecast database. As you can see below, most crudes converge on the 18-27% naphtha cut, with an API of 25-40. As crude gets lighter than 40 API, predominantly condensates, and predominantly crudes from the US, then the naphtha cut rises to 30%+ and can be as high as 60%+. The rising naphtha cut of crude has not historically been an issue with US crude production in decline. However, now that shale is taking off in the US, and eventually elsewhere, and given end markets for naphtha are being challenged by fuel efficiency gains in the auto fleet or ethane competition in chemicals, the issue needs to be followed closely.

Exhibit 7: API of Crude versus Naphtha Cut – Select Crudes in XOM Assay Database

As you can see in the chart, the typical light and heavy naphtha cut of crudes lies in the 18-27% range. For “condensates” above 45 API, the naphtha cut of crude can rise substantially.

Source: XOM, Credit Suisse Research

So Where Are the Pentanes and Naphthas Going to Go?

Historically pentanes and naphthas went into two markets – the global gasoline pool and the petrochemical industry (bulk chemicals/solvents). There are various challenges facing the placement of the rising supply of these molecules today:

- Gasoline has historically been the sink for excess light molecules. Heavy naphtha (particularly aromatic heavy naphtha) can be reformed to become a high octane gasoline blending component. C5/C6 can be isomerized to improve the octane of these lighter molecules. Global gasoline demand is slowing due to efficiency gains in the auto fleet, particularly in the West. It is also getting tougher to put light molecules into the gasoline pool due to tougher specifications on density, aromatics, RVP and benzenes.

- For straight chain naphtha which is more difficult to use in the gasoline pool, petrochemical crackers were the destination of choice. Petrochemical demand is growing more quickly than gasoline demand. However a greater share of future petrochemical demand growth might be met by ethane cracking, not just here in the US but also overseas, if other ethane rich “wet” shale gas basins are de-risked.
Looking further beneath the hood, as the assays above show, shales contain not just naphtha but also pentane, which is typically used in the solvent and diluent markets. A large “market” for these molecules has been “diluent,” which is used to blend with heavier crudes such as Canadian Heavy or Colombian heavy so that they can be transported by pipe (and also in some new SAGD approaches). We have two challenges with this “market” – (1) the diluent pentanes still end up in the crude stream – and end up back at refineries – so only the initial inventory and then losses in the system really count as demand. (2) The Duvernay is a light shale play in Canada which could provide some of the pentane demand in Canada as production ramps.

Thus far, naphtha has not derated significantly versus Brent. The tipping point is not yet reached. However, the problem is increasing over time. With up to 600kbd of excess pentanes/naphtha to absorb over and above the underlying market growth in fuels and chemicals, this remains a tail risk that needs watching. We discuss some of the potential end-market problems below.

Known unknown: The ability of the petrochemical and gasoline industry to absorb pentanes (solvents) and heavy naphtha is THE KEY uncertainty, even for industry players. We will continue to provide insights into the supply of the molecules. Addressing the depth of pentane and naphtha end-markets is a significant research piece in itself. It is likely a question which the refining and chemical industry is probably better positioned to answer than the sell-side (not that we won’t attempt to try).

Exhibit 8: Price of Naphtha vs Gulf Coast LLS crude

![Price of Naphtha vs Gulf Coast LLS crude](chart)

Source: Bloomberg

Problems Could Emerge

The problems with the industry’s default assumption that excess naphtha can always find a home could manifest themselves in various ways:

- If US refineries struggle to absorb the “super-light” crude, then this crude will need to be exported. Currently this would require a condensate splitter to be built but there is pressure rising on Washington to allow the export of condensates. Stranded condensate in the US could fall in price versus its theoretical “fair value” (this is not happening yet).
The condensate streams may need separate infrastructure (gathering, trunkline pipes, condensate splitters). It can take 2.5 years or more for this infrastructure to be put in place. That is not a lot of time, given the rising US well count.

If the existing pipes designed for lower RVP crude cannot handle the higher RVP of the light condensates, then certain grades may need to be trucked to the coast – and higher grade specific and regional specific discounts would emerge. It is possible to have a situation where WTI remains relatively tight with Brent (we assume $10/bbl), with wider grade discounts for lighter crudes and condensates.

Exporting condensate may not even be the full answer. As we have highlighted above there may be too much pentanes and/or too much straight chain naphtha for the industry to easily absorb. What typically happens when there is excess supply, is that the price falls to the marginal alternative – in this case heat value, and then the industry finds innovative ways to rebalance the system. We imagine folks are dusting off technology to alkylate C5’s, and other chemical routes to provide upgraded value to stranded naphtha or pentane molecules. Using Asia LPG as a proxy for heat value, the discount could be as wide as $28/bbl. Indeed, if shale takes off in key end markets for heat molecules, then the discount could be wider. US gas is trading at $26/bbl vs Brent at $100/bbl. The NGL barrel at $40-45/bbl. This could be fun.

Reasonably, we classify this as a downside tail risk that the industry and investors need to watch for and understand. It is not a central case. However, the future path is clear – naphtha supply is rising faster than demand. The challenge is when will the tipping point be hit and will the industry preemptively invest to avoid it.

Upstream investors should note that a $10/bbl change in naphtha is typically a $4+/bbl hit to realizations. This is manageable. We’d be more concerned about infrastructure delays in the scenario where pipe specs for RVP are exceeded or US regional refineries cannot take any more superlight grades.

Exhibit 9: Heat Value of Stranded Molecules Is Substantially Less than Crude

Source: Bloomberg
Exhibit 10: Light Capacity Additions, including new condensate splitters – the list keeps growing but new capacity takes time to permit and to build

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<th>Proposed Capacity Addition (KBD)</th>
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<td>Corpus Christi, TX</td>
<td>2016</td>
<td>Condensate splitter with Trafalga</td>
</tr>
<tr>
<td>MMLP</td>
<td>100</td>
<td>Corpus Christi, TX</td>
<td>2016</td>
<td>Condensate splitter</td>
</tr>
<tr>
<td>Castleton</td>
<td>100</td>
<td>Corpus Christi, TX</td>
<td>2016</td>
<td>Condensate splitter</td>
</tr>
<tr>
<td>WNR</td>
<td>25</td>
<td>El Paso, TX</td>
<td>Early 2016</td>
<td>CDU expansion</td>
</tr>
<tr>
<td>3 Tribes</td>
<td>20</td>
<td>Ward County, ND</td>
<td>Mid 2015</td>
<td>New CDU</td>
</tr>
</tbody>
</table>

Total 913
subtotal Condensate Splitters 520

Source: Company data, Credit Suisse estimates

Review of Naphtha Supply and Demand

In this section we present a supply and demand table for naphtha globally. This reflects use of naphtha in three key markets – the gasoline pool, i.e. “fuels,” steam cracking for petrochemicals and BTX (Benzene, Toluene, Xylene) which is another key petrochemical building block. The challenge is that the naphtha component of the global crude stream could be about to accelerate at a faster pace than demand.

Exhibit 11: Naphtha Demand Growth vs. Global Naphtha Supply Growth (*)

Source: IHS, Company data, Credit Suisse estimates. (*) Note: Due to lack of available of data, our naphtha demand model captures ~80% of the global demand for naphtha but excludes some regions including Central/Eastern Europe, Africa and South America.
The net up-shot is that we find about a 3% length of naphtha supply over and above our demand projection. This does not sound much but equates to around 600kbd of excess naphthas to absorb. It is meaningful. Beyond 2019, this excess could increase if light shale oil continues to be a larger part of the global production mix.

**Known unknown:** Matching historical supply and demand on a molecule basis for naphtha and pentanes has inherent error bands given disclosures. We’re pretty confident in the rate of change – supply is growing faster than typical demand growth – new end markets or technologies seem required for marginal barrels, particularly against the backdrop of shale – which is a “light molecule” revolution

**Exhibit 12:** Excess Naphtha Above Our Market Demand Forecasts (versus 2013 as a base)

![Exhibit 12](attachment:image)

*Source: Company data, Credit Suisse estimates*

**Fuels End Market, All Eyes on Emerging Markets**

As you can see above, fuels, i.e. gasoline, has accounted for around 45% of the global naphtha market. Although gasoline consumption has probably peaked in the West, there is still a good rate of growth of gasoline in emerging markets. The challenge is that on road efficiency should start to increase dramatically with new technology – particularly hybrids. US/Western Europe gasoline demand is not quite dead, there will be a cyclical bounce with the economic recovery but the efficiency trends are hard to fight.

As a sub challenge, it is also getting tougher to put light molecules into the gasoline pool due to tougher specifications on density, aromatics, RVP and benzenes. Ethanol is also a good alternative to reformed naphtha as an octane component up to 10% blends, food vs fuel concerns aside.
Exhibit 13: **Efficiency Is Set To Improve Dramatically**

Range of average vehicle efficiency

Exhibit 14: **Hybrids Play an Important Role**

Light-duty fleet by type

Exhibit 15: **The 10 Year Average for Light Distillate Demand is Around 1.4%, Slightly Below Our Forward Naphtha Market Growth Forecasts**

Exhibit 16: **Global Gasoline Demand Forecasts : Non-OECD growth (off an 8MBD base) Needs to Offset Decline in the West (off a 12.4mbd base)**

Source: XOM

Source: BP Statistical Review

Source: JODI, Credit Suisse Commodity Research
Exhibit 17: China Is the Key Driver of Global Gasoline Demand – A 2H13 slump but more recent data is encouraging

Source: Credit Suisse Commodity Research

Known unknowns: Aside from demand growth in fuels end markets, as the specifications of global gasoline become tougher longer term, there could be limits on the ability to push aromatics and light molecules (RVP) into the gasoline pool.

It is also likely that rising supply of gasoline components (naphtha’s and natural gasolines) from the lightening global crude supply, together with automobile efficiency gains, will keep some downward pressure on gasoline refining margins (which already looks reflected in the futures curve below).

Exhibit 18: NYMEX Gasoline and Diesel Futures Versus Brent

Source: Bloomberg

Futures curves are already discounting a weaker outlook for gasoline which looks oversupplied in the West
Chemicals
On the chemicals side, there are three end markets where the pentanes and naphthas in condensate can be used:

- As a feedstock for steam cracking to produce olefins (ethylene, propylene, etc.)
- Via catalytic reforming for the purpose of aromatics extraction/production (known as BTX or benzene, toluene, and xylenes).
- Pentanes typically are used as industrial solvents in a wide range of markets

With the domestic shift toward NGL-based (ethane, propane, etc.) olefin production, we see limited opportunity for increased use of naphtha in the US for steam cracking even if condensate/naphtha trade at a solidly lower value than typical crudes like LLS as it is unlikely to be able to compete with ethane.

On the non-olefin side in the US, with very modest expected growth for the use of aromatics (styrene and its derivatives, polyester fibers, PET resins, etc) as well as for its production through reformate (limited domestic refining/paraxylene capacity growth—also naphtha as a shrinking portion of the ethylene production feedslate limits aromatics production) this is also a market with limited opportunities for naphtha to serve.

Hence the logical market for excess pentanes and naphtha is Asia.

All Eyes on Asia Chemicals
Both steam cracking and aromatics production are sizeable markets internationally. Steam cracking in most regions (outside the US and the Middle East) is dominated by naphtha as the feedstock, and based on the announced expansions of capacity as well as expected modest improvements in operating rates, we believe this end market could see growth of ~3% per year through the end of the decade outside of the US, or slightly higher excluding Western Europe (closer to mid single digits in emerging regions like Asia).

The extraction/production and use of BTX (benzene, toluene and xylenes) in their various end markets (styrene and its derivatives, polyester fibers, PET resins, etc.) are also expected to grow roughly at a similar pace, with industry experts looking for low single digit growth for both.

Naphtha Supply and Demand Revisited
Factoring all of this in, the excess naphtha challenge becomes greater towards the end of the decade, and would be further exacerbated with any shale success in other countries. Light molecules are easier to extract from tight rock. So shale increases the amount of ethane (for cracking) as well as increasing C5/naphtha supply.

To lay out a view of naphtha global demand as well as the potential magnitude of the impact of the US shale-driven naphtha supply, we have laid out the model below in Exhibit 19. Some of the key takeaways include:

- ~1.5-2% demand growth globally for naphtha
- ~3% demand growth globally for naphtha into the chemicals industry.
- <1% growth from the fuels/gasoline pool globally, with decline in the OECD offset by 2-3% pa growth outside North America/Western Europe.
- Note: Due to lack of available of data, our demand model captures ~80% of the global demand for naphtha but excludes some regions including Central/Eastern Europe,
Comparing the demand picture with the naphtha supply potential, we see a meaningful increase from 2013 levels through the end of the decade, when the excess could be 600kbd. At some point a tipping point might be reached where shale has the potential to disrupt the global naphtha supply-demand balance (Exhibit 11).
Some Suggested Questions to Ask Companies

We think the upstream and end-market constraints are more important than infrastructure (which can be solved with money and time), but all issues should be raised with management teams when they visit.

E&P

- How many rigs are you focusing on “crude oil” versus “condensate”?
- What is the quality of the crude and condensate you plan to produce over the next 5 years – by basin – specifically indicative API, rough percentage of pentanes, rough percentage of heavy naphtha? We believe investors have a right to know. It’s not just condensate, even crude can have higher pentane/naphtha cuts.
- How do you plan to market your lightest molecules, specifically pentanes/naphtha?
- Are you seeing any retrograde condensate in the condensate window?

Chemicals/Refining

- If the pentanes cut of crude you receive is too high, what can you do? If you need to invest in new units, how much will this cost? How close is the end-market to saturation?
- If the naphtha cut of crude you receive is too high, what can you do? If you need to invest in new units, how much will this cost? How close is the end-market to saturation?
Infrastructure/MLP

- How long would it take to permit a new condensate splitter? What are the critical path items (air permits, export docks, processing equipment)? How much would a splitter cost given Gulf Coast cost inflation? What downstream units are included in this splitter cost? How much are infrastructure/facilities costs?

- How long would it take to build dedicated condensate infrastructure for the Permian down to the Gulf?
Appendix: Useful Condensate Stuff

For those new to the topic, we include:

- Some general background information on the quality of US shale oil plays.
- We look at Canada heavy oil (seeing as everyone is hoping to market condensate components as diluent).
- We break down our condensate forecast into a “guesstimate of pentane and heavy naphtha” which may be useful for industry readers. Addressing the depth of pentane and naphtha end-markets is a significant research piece in itself, which the industry is probably best positioned to answer.

Quality of US Shale Oil

In the following charts, we highlight those plays which are most likely to contain condensate. We STRESS that condensate is not the only bogey. Most light shale crude also has a higher pentane/naphtha cut than the global average which contributes to the potential imbalances in these end markets down the road. The Eagle Ford condensate window is the biggest driver of our US growth, with other contributions from the Delaware, Oklahoma Basin (SCOOP), the Utica and the Midland. In Canada, we focus on the Duvernay.

Exhibit 21: The Eagle Ford Has A Large Condensate Window

Exhibit 22: Utica Condensate Window – Still Under Test

In the Permian, the Delaware has been the focus. As XEC stated, “The Wolfcamp and Culberson is a little bit higher gravity, it's 54- to 58-degree and then when we get over there into Reeves, it's 46- to 52-degree”. Although wanting confirmation, we suspect there are some lighter barrels within the Midland also. Managements will likely manage drilling
to play off well flow rates versus quality to push the condensate tipping point into the future while meeting investor’s near term production growth hopes.

Exhibit 23: Parts of the Texas Delaware (Ward/Loving/Culberson) Appear to Be Condensate Rich – We Use “Gas” Cuts as a Proxy for the lightness of “Crude” - more data is required

Exhibit 24: Parts of the New Mexico Delaware (Southern Eddy) Appear to Be Condensate Rich – We Use “Gas” Cuts as a Proxy for the lightness of “Crude” - more data is required
Exhibit 25: **Condensate Wells Tend to Be More Prolific Than Nearby Oil Wells**

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<tr>
<td><strong>ANADARKO/WOODFORD</strong></td>
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<tr>
<td>SCOOP Condensate</td>
</tr>
<tr>
<td>Gross IP 30 day (BOED)</td>
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<tr>
<td>Gross EUR (MBOE)</td>
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<tr>
<td>% Liquids</td>
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Exhibit 26: **The SCOOP (Oklahoma) Is an Emerging Condensate Play with Strong Recoveries**

Source: MRO

**Can Canada Diluent Absorb Rising Condensate**

This last section is probably only of interest to a few industry C5+ marketers. A large “market” for C5+ molecules has been “diluent,” which is used to blend with heavier crudes such as Canadian Heavy or Colombian heavy so that they can be transported by pipe (and also in some new Steam Assisted Gravity Drainage upstream heavy oil approaches). We have two challenges with this “market” –

1. The diluent pentanes still end up in the crude stream – and end up back at refineries – so only the initial inventory and then losses in the system really count as end-market demand. E&P companies sell to the heavy oil producers who then sell to refineries which process the crude and still end up needing to find a home for the C5+ (or they recycle the C5+ stream and back haul on rail to Canadian heavy oil producers, a closed loop).

2. The Duvernay is a light shale play in Canada which could provide some of the pentane demand in Canada as production ramps.

3. We have focused here on just the C5 pentane stream for diluent as this is the market which may be shallowest globally. However the diluent spec is 57 API with a density escalator. In practice this means more of the Duvernay production could be used, than is shown in the table overleaf.
Exhibit 27: US and Canada Supply of C5+ versus Heavy Oil Diluent Demand. NOTE: This excludes heavy naphtha which we assume goes into the gasoline pool for the purpose of this table. It also excludes the rising C5 supply from a lightening crude slate in the US, aside from condensate.

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<tr>
<td><strong>US C5 Supply</strong></td>
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<tr>
<td>From US Condensate</td>
<td>158</td>
<td>212</td>
<td>254</td>
<td>283</td>
<td>315</td>
<td>348</td>
<td>382</td>
<td>414</td>
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<tr>
<td>From NGL processing</td>
<td>317</td>
<td>340</td>
<td>365</td>
<td>390</td>
<td>415</td>
<td>440</td>
<td>465</td>
<td>490</td>
<td>515</td>
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<td>Total, US kbd</td>
<td>475</td>
<td>552</td>
<td>619</td>
<td>673</td>
<td>730</td>
<td>788</td>
<td>847</td>
<td>904</td>
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<td><strong>Canada C5 Supply</strong></td>
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<tr>
<td>Canadian Diluent (from NGLs/Upgraders)</td>
<td>139.0</td>
<td>141.0</td>
<td>142.0</td>
<td>144.0</td>
<td>143.0</td>
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<td>Duvernay</td>
<td>6.3</td>
<td>12.8</td>
<td>17.0</td>
<td>24.8</td>
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<td>35.4</td>
<td>39.7</td>
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<tr>
<td>Total Canada, kbd</td>
<td>139.0</td>
<td>147.3</td>
<td>154.8</td>
<td>161.0</td>
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<td>174.7</td>
<td>183.7</td>
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<td><strong>Total, US and Canada</strong></td>
<td>613.6</td>
<td>699.1</td>
<td>773.7</td>
<td>833.5</td>
<td>897.6</td>
<td>962.8</td>
<td>1026.3</td>
<td>1088.0</td>
<td>1150.6</td>
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Oil Sands Demand

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<td>Western Canadian Conventional Heavy</td>
<td>406</td>
<td>410</td>
<td>420</td>
<td>436</td>
<td>438</td>
<td>440</td>
<td>440</td>
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<td>432</td>
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<td>Oil Sands (insitu+mining without upgrading)</td>
<td>986</td>
<td>1119</td>
<td>1240</td>
<td>1368</td>
<td>1587</td>
<td>1827</td>
<td>2021</td>
<td>2134</td>
<td>2229</td>
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<td>Implied Diluent Demand</td>
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<td>376.7</td>
<td>414</td>
<td>454</td>
<td>519.9</td>
<td>592.1</td>
<td>650.3</td>
<td>684.1</td>
<td>711.9</td>
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<tr>
<td>% Diluent</td>
<td>24%</td>
<td>25%</td>
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<td>26%</td>
<td>26%</td>
<td>26%</td>
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<tr>
<td>Bitumen Rail Exports</td>
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<td>450</td>
<td>650</td>
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<td>% diluent</td>
<td>19%</td>
<td>19%</td>
<td>18%</td>
<td>16%</td>
<td>15%</td>
<td>13%</td>
<td>12%</td>
<td>10%</td>
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<tr>
<td>Adjusted Diluent Demand, for Rail</td>
<td>336</td>
<td>374</td>
<td>399</td>
<td>420</td>
<td>457</td>
<td>517</td>
<td>563</td>
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<td>Excess Supply</td>
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<td>325.2</td>
<td>374.5</td>
<td>414.0</td>
<td>440.5</td>
<td>466.2</td>
<td>463.3</td>
<td>502.0</td>
<td>547.6</td>
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Source: CAPP, Credit Suisse estimates

Exhibit 28: A Range of Diluent Demand Forecasts – Note Diluent Comes Back Out in the Processing of Diluted Crude

Source: KMI Investor Presentation
Exhibit 29: Supplying Canada Diluent From the Gulf

- 197 kbdp Committed Capacity on Cochin & Southern Lights
- 91 kbdp remains as Uncommitted Capacity

CERI forecasts Canadian diluent import demand will exceed 500 kbdp by 2020

Kinder Morgan is investing over $900 Million for condensate gathering and processing infrastructure to meet this demand

Source: KMI Investor Presentation
Companies Mentioned (Price as of 10-Jun-2014)

- Calumet Specialty Products Partners, L.P. (CLMT.OQ, $31.46)
- Delek US Holdings, Inc. (DK.N, $30.1)
- ExxonMobil Corporation (XOM.N, $101.46)
- Kinder Morgan, Inc. (KM.N, $35.07)
- Magellan Midstream Partners, LP (MMP.N, $83.29)
- Marathon (MPC.N, $85.69)
- Marathon Oil Corp (MRO.N, $38.17)
- PDC Energy (PDCE.OQ, $63.57)
- Phillips 66 (PSX.N, $82.83)
- Targa Resources Corp. (TRGP.N, $120.62)
- Valero Energy Corporation (VLO.N, $53.3)
- Western Refining Inc. (WNR.N, $39.2)

Disclosure Appendix

Important Global Disclosures

Edward Westlake, Arun Jayaram, CFA, John P. McNulty, CFA, Abhiram Rajendran, John Edwards, CFA, Kenneth Whee, Sanjay Mookim and Mark Lear, CFA each certify, with respect to the companies or securities that the individual analyzes, that (1) the views expressed in this report accurately reflect his or her personal views about all of the subject companies and securities and (2) no part of his or her compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this report.

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- **Underperform (U)**: The stock’s total return is expected to underperform the relevant benchmark* over the next 12 months.

*Relevant benchmark by region: As of 10th December 2012, Japanese ratings are based on a stock’s total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. As of 2nd October 2012, U.S. and Canadian as well as European ratings are based on a stock’s total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. For Latin American and non-Japan Asia stocks, ratings are based on a stock’s total return relative to the average total return of the relevant country or regional benchmark; prior to 2nd October 2012 U.S. and Canadian ratings were based on (1) a stock’s absolute total return potential to its current share price and (2) the relative attractiveness of a stock’s total return potential within an analyst’s coverage universe. For Australian and New Zealand stocks, 12-month rolling yield is incorporated in the absolute total return calculation and a 15% and a 7.5% threshold replace the 10-15% level in the Neutral stock rating definition, respectively. Prior to 10th December 2012, Japanese ratings were based on a stock’s total return relative to the average total return of the relevant country or regional benchmark.

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Credit Suisse's distribution of stock ratings (and banking clients) is:

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*For purposes of the NYSE and NASD ratings distribution disclosure requirements, our stock ratings of Outperform, Neutral, and Underperform most closely correspond to Buy, Hold, and Sell, respectively; however, the meanings are not the same, as our stock ratings are determined on a relative basis. (Please refer to definitions above.) An investor's decision to buy or sell a security should be based on investment objectives, current holdings, and other individual factors.

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