Refining – Cracking Thoughts

COMMENT

Season Finale (2016)

In the final edition of our 'Cracking Thoughts' series for the year, dubbed 'Season Finale', we package our key papers into one with one extra thought piece, specific to the recent update from the International Maritime Organization (IMO). There are many moving parts, which makes longer term planning difficult in the refining sector. If China works through its excess, consistent with government policy, and Russia liberalizes the sector longer term, the outlook for the industry should be brighter than the base case of many, including ourselves, as long as demand does not diverge significantly. For now, our medium term outlook remains unchanged; this cycle should be better than the last for international refining driven by (a) lower energy costs, (b) more favourable crude spreads, and (c) a better spare capacity situation.

- **Capacity update.** We extend our model to 2022 and see more additions in the early parts of 2020s than the latter part of the 2010s due to current development hiccups and project deferrals – merely a timing issue. That said, further slippages should not be ruled out. Project cancellations have materialised, even those already under construction, in more recent periods as project sponsors battle with funding issues. Overall, this means that this cycle should see fewer refinery additions on average than the last cycle.

- **Europe should follow the lead of Japan.** Japan and Europe have one thing in common, which is structural decline in oil demand over time. This triggered METI (the regulator in Japan) to implement two phases of restructuring, which by March/April 2017 would have taken out significant capacity. This is harder to implement in Europe, yet further capacity closures will be needed over time. The absolute number may be lower (0.5-1mbd) than many think (>1mbd) or at least deferred should other regions do their own restructuring. This includes Russia, but China is also a relevant driver. With China's nameplate capacity of ~14mbd and crude runs of ~11mbd, China has room in theory to increase runs. We are of the view that China wants to be merely self-sufficient, and the details of the 13th Five-Year Plan indicate that it plans to reduce the excess over time.

- **Russia may liberalise.** We think Russian refining will undergo a dramatic transformation as export duty is abolished over time (2020+) and the refining sector essentially liberalized. It is a matter of 'when', not 'if', in our view, and this could potentially see its current ~2mbd in oil product exports potentially removed. Should this materialize, the negative implications from the IMO regulations on high sulphur fuel oil (to be implemented from early 2020) may be partly mitigated as significant amount of fuel oil export from Russia may be lost. That said, the full implementation of the IMO regulations by Jan 2020 looks tough and less likely, in our view. Generally, those with coking capacity, of which there are many in India and the US (very few in Europe), are better positioned in such an environment.

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Source: BP Statistical Review, Credit Suisse Research; Note: there is a difference between consumption and refinery throughput as more demand bypassed the refining system (eg direct crude burn, biodiesel, NGLs etc)

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Source: BP Statistical Review, Credit Suisse Research; Note: there is a difference between consumption and refinery throughput as more demand bypassed the refining system (eg direct crude burn, biodiesel, NGLs etc)

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Source: Company data, FGE, Credit Suisse estimates

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Source: Company data; Note: there is a difference between consumption and throughput as more demand bypassed the refining system (eg direct crude burn, biodiesel, NGLs etc)

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Source: Credit Suisse Research, IEA, JODI, EIA, Country Data

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Source: Credit Suisse Research, IEA, JODI, EIA, Country Data
Season Finale (2016)

Refining is global: The competitive environment in the refining industry constantly evolves, driven by numerous factors, including the changes in crude supply and product demand patterns, construction of new refineries, closures of others, new government regulations etc. While regional factors matter (e.g. crude spreads in the US over 2010-14) to drive earnings, oil product markets are driven by global market trends (i.e. opportunities can be quickly arbitraged). It is, therefore, important to monitor behaviour and policies of the bigger exporters. The exporters that we monitor closely include the US Gulf Coast, the Middle East, India, South Korea, China and Russia. Apart from the latter two, the others are more market-driven and easier to gauge. The latter two are more unpredictable given evolving domestic policies. For example, the tax changes in early 2015 in Russia put significant pressure on downstream economics thereby impacting refinery runs.

China has surprised the market since mid-2015 as higher export quotas were granted. We remain of the view that Chinese policy is not one of being a ‘permanent’ exporter of oil products à la India – its long standing aim is to be self-sufficient and more recently to increasingly drive for cleaner fuel (stricter fuel standards). When policy makers overestimate demand growth, an excess is created. Refineries are also built to capture expected demand growth, hence initially regionally there will be an excess. Teapot refiners have also emerged as relevant players of late as policy-makers started to grant crude import quotas and more recently product export quotas. As policymakers are deferring/ even cancelling projects, we think overall Chinese policy remains largely unchanged and that the excess in China should be worked through slowly, but surely over this cycle. The regulator has also started to do a review of the teapot refining companies, whether they have abided by their part of the agreement in return for getting crude import quotas.

Russia is also in the middle of a modernization phase – one that initially failed to kick off, until the government implemented changes to the tax regime and thereby incentivized the upgrade of refineries. With the right incentive, companies adopted this program and went on to invest in upgrades, which led to higher runs and therefore Russia increasing exports of clean products (most notably diesel) over the past five years or so. The more recent tax changes that the government introduced in early 2015 – to support upstream economics at the time of weak oil prices – however created significant pressure on the refining industry in Russia, and investments thus started to be deferred. Refinery runs have come under pressure, although not necessarily exports as demand lagged (e.g. sanctions related). We think Russian downstream will undergo a dramatic transformation as export duty (ED) is abolished over time and the refining sector essentially liberalized. It is a matter of ‘when’, not ‘if’, in our view, and this could see its ~2mbd in oil product exports potentially removed.

Figure 7: Spare capacity scenarios (kbd) at 86% util rate

Source: Company data; Note: there is a difference between consumption and throughput as more demand bypassed the refining system (eg direct crude burn, biodiesel, NGLs etc)

Figure 8: Global distillation capacity additions (kbd)

Source: Company data, Credit Suisse estimates; Note: nameplate capacity, not time weighted
Going back in time…

The industry has typically reacted slowly to externalities, which was visible in the new millennium. The industry’s response lagged growing demand and the structural changes in demand (shift from fuel oil to light products, especially middle distillates, and tighter specifications), which meant that not only capacity was getting tight, but more importantly upgrading capacity, was lacking. The industry was slow to react, and many projects were sanctioned in the run-up to the recession of 2008, which meant capacity was being added at the wrong time. This was the beginning of the excess period, with margins further pressured by high oil prices until late 2014.

The cycle has seen several periods of excess capacity (e.g., mid 1970s), which with time were eventually balanced out (mid-1980s). With more capacity closures announced (e.g., Europe, Japan, Australia) and more refinery additions deferred (e.g., China, Brazil, India etc), any unplanned outages, which may be more likely as refineries run harder in the new and lower oil price environment, will lead to higher and more prolonged product price spikes to incentivise arb cargoes (once inventories level are more normalized).

We believe that this cycle will be better than the last cycle over 2009-14, partly driven by (a) lower energy costs (oil and gas prices) and (b) better environment for crude optimization. As far as capacity and utilization are concerned, we think (i) net capacity addition is not sufficient over 2016-2022 assuming demand growth of 1mbd pa is the norm (with 20-25% bypassing the refining system), (ii) China will work through its excess, so that diesel and gasoline net exports will gradually decline, and (iii) Russia will change its tax regime to support upstream, which comes at a cost of downstream economics and thus exports. If we are right on the latter two factors, our estimates may be conservative.

Figure 9: Global refinery utilization rates (%)

Source: BP Statistical Review, Credit Suisse Research

A recap of 2015…

Refining margins were very strong globally in 2015 and in Europe reached the highs of the ‘golden age’ of 2004-08. Even simple refiners were running hard. 2015 started off with a cold winter in the Northern Hemisphere together with the ECA-related demand switch supporting middle distillates, but gasoline demand also saw an early boost due to price related demand effects. Gasoline demand kept growing strongly (surprising many to the upside), forcing the global refining system to get more capacity to operate, especially
during April-June when a flurry of secondary unit outages constrained gasoline output (alkylation units are also shut when FCCs are down, thereby impacting octane balances).

These high gasoline cracks forced runs to reach higher highs and also explain the growing middle distillate overhang, which became more visible from 2Q15 onwards. It was not the new MidEastern mega-plants that were responsible for the glut in middle distillates, but instead it was the significantly higher crude runs in Europe and Asia, both middle distillate heavy refining centres. Once refineries started to come back from spring maintenance with a slight delay and cold winter weather failed to materialise in the Northern Hemisphere, diesel cracks went into doldrums in December. We found ourselves then in a strange situation in which the gasoline crack was un-seasonally trading at a premium to diesel.

A recap of 2016…

As we look at 2016, things look different. This year has seen commendable operational performance globally for the first nine months of the year which thereby highlighted that despite recently falling refining spare capacity, that spare capacity remains abundant and can add to product inventories if incentivized to. In the aftermath of the OPEC policy shift in late 2014, a more favorable environment for crude procurement also incentivized refiners to run units at full tilt, where operationally possible. The crude procurement environment remains attractive at this stage. This all meant that despite strong demand growth, the crude glut has turned into a product glut, which in turn could cap oil prices as runs may start to come under pressure (it looks to have been the case during October/November when refinery runs were running than expected).

Where from here? One question that arises is whether additional demand will be met by higher refinery runs or from drawing down of stocks; while another is what the sources of both demand and supply for the various types of products would be. The refinery maintenance season looks to have been heavier, which would indicate there has been a greater degree of demand being met by drawing down on stocks, which is a positive. The outlook for runs, aside from demand growth (including seasonal weather related demand this coming winter), may also be determined by MidEast crude exporters marketing (OSP) strategies, and clearly the implementation of the OPEC cut will be key – both for crude spreads (light-heavy crude diffs) and oil prices (energy costs). European refiners have benefitted from more favorable crude pricing since the OPEC policy shift in late 2014.

Figure 10: Refining EBITDA/bbl – on a rolling four quarter basis by company/benchmark

Source: Company data, Credit Suisse Research
Looking forward – better outlook?

Development hiccups, project deferrals and even cancellations in certain instances have been prevalent of late, which means the period 2016-22 will see fewer new refinery adds than consensus expectations, in our view. Further slippages are possible, and it is also worth highlighting that when new greenfield mega complexes come onstream, they also often take longer to ramp-up to normal and stable levels. For example, it typically takes a complex mega refinery 9-12 months to completely stabilize operations and to further integrate the secondary processing units; however, in emerging countries, where the bulk of the new capacity will come onstream, this has often taken longer (e.g. ~18 months if managed by India’s SOEs). Who is building/developing the facility matters, and also where it is being built (e.g. lower risk in the US, higher risk in the emerging markets).

Otherwise, we have not seen mega refinery FIDs of late, albeit more recently select refiners have been discussing new proposals more frequently. Nothing firm has been laid out, however, and firming up such proposals will take time (maybe another 12-18 months) and only a few of them may move forward, depending on whether such projects secure partners and therefore funding (more discussions fail than succeed) and get all the necessary environmental permits (not always a given). For crude exporters looking to secure an outlet, there are a number of options. Buying shares in refineries is one way to secure market share. Other means include building own refineries (domestically or internationally in partnership), SPAs and favourable pricing (OSPs). It would not surprise us to see NOCs buy into more refining assets in ‘growth’ markets – while discussions have been many, updates (e.g. Rosneft/Essar) have been few and far between at this stage.

The period from 2005-2008 saw a period of ‘excess FIDs’, which created an excess at the wrong time subsequently (e.g., in the aftermath of the 2008 financial crisis), and that excess is being worked through now with spare capacity expected to continue to tighten on average over the next few years, in our view. It is now a number of years since the last large scale refinery has taken FID. There is still spare capacity in the system, but the level has fallen, while demand for oil products continues to grow, and will do so beyond 2020, in our view. If we assume oil demand grows by ~5.1mbd between 2016-2020 (or at an average rate of ~1mbd pa), this goes against our net capacity addition (net of announced closures) of ~3.7mbd. However, some demand will bypass the refining system, which could, according to industry experts, amount to ~0.7mbd (or less than 20% bypassing the refining system). In other words, spare capacity should still tighten over the medium term, in our view. The outlook beyond, as far as new builds are concerned, remains uncertain. More refineries longer term (2020+) will be needed (and plans remain patchy for now due
to the lack of FIDs); new capacity and upgrades are needed not just for demand growth but to replace existing, yet outdated plants; provide greater flexibility to process changing crude qualities; and to meet more stringent product specifications and other government imposed regulations. Yet, the process from conception, through design, financing, construction and start-up is far from straight forward.

There are many variables to consider when we think of ‘probability of success’ for a new build. These can include (a) the regional workforce (e.g., availability, skill set, work rules), (b) quality of management and technical staff, (c) proximity to suppliers, (d) local/national politics, (e) regional climate, (f) economic stability, to name but a few. Logistics associated with moving critical equipment will be difficult in regions with limited infrastructure. For example, building a refinery in northern Canada (cold weather) or in the Middle East (heat, sand storm) can create challenges and thus increase costs and extend completion times, while the US Gulf Coast has many of the aspects that can make projects easier to manage. Suppliers, fabricators, and engineering contractors, for example, are all consolidated in the Gulf Coast.

Many of the PADDs in the US have marine access through lakes or rivers, which removes the need for long overland routes for large equipment that needs to be imported. More importantly, the free market structure and the political stability in the US, which includes an effective work force (i.e., no need to import labour or train them, which is important for highly skilled project management and engineering tasks) are also a critical aspects in getting projects done on schedule – absent strong project management capability, schedules can quickly slip and costs rise, as evident in many other parts of the world. But even there, nothing always runs smoothly; however, generally, projects on average run more in line with the base case than elsewhere (e.g. VLO has delivered its expansion projects on time and on budget at its Corpus Christi and Houston refineries).

The above is not applicable across the entire developed world; the US is in many ways an easier place to develop projects. For example, in Europe, there are inflexible labour laws/work rules, which could make managing labour costs more difficult. Strikes can also be disruptive and in Europe, this can be prevalent. The US is not immune from strikes (e.g. it saw the first nationwide strikes in over 30 years in 2015), but the impact even then was minimal and the settlements reasonable. These aspects are critical – political stability and the rule of law can have a significant impact on whether to move forward with a project, during the development of a project (and for continuous investments after completion), and to ensure your investment is protected. The opposite of this is often
evident in Latin America – most refinery projects are developed by their respective NOCs with suboptimal planning and staffing issues; for example, the two refinery projects in Brazil – Comperj and Abreu e Lima – which are also at the root of the ‘Operation Car Wash’ investigation – both have seen budgets skyrocket and development timelines slip significantly with some phases even being cancelled.

Figure 15: Headcount per kbd of refining capacity – explains divergence in opex

Source: Company data, Credit Suisse Research

**Bottom line**, in-region capabilities and a better workforce increase the ability to execute projects on time and on budget, and to create such an environment where these are absent is not easy as it requires social and economic reforms to make it a reality. Partnership with capable operators should also be sought to facilitate smooth operations/developments.

Not all projects are commercially driven – there is the strategic/political aspect, but here we refer to the evolving regulatory requirements, which forces refineries to upgrade to meet new standards. For example, Tier III gasoline regulation in the US will take effect in January 2017, which will reduce sulfur levels to 10ppm from 30ppm, which has led to a number of new desulfurization projects being announced (Europe has already gone through this shift). A number of other countries are adopting Euro-grade specifications for gasoline and diesel, which requires additional processing capabilities. For example, it will be interesting to see what happens to Chinese runs in 2017 with the new standards.

What is worth monitoring is how standards (fuel specs) evolve in China, and whether the refining system has all the units to meet tighter spec. This is debatable as far as teapot refineries are concerned, and may limit the uplift to utilization rates from current levels – hard to call, but time will tell. **Bottom line**, China will likely slow the pace of refining additions and focus instead on promoting the shift to higher fuel quality spec. There will be a roll out of China V nationwide from January 2017, and the subsequent move to China VI. Another more significant regulatory development is the move towards low sulfur bunker fuel by the International Maritime Organisation (IMO) in 2020. This has the potential to force substantial volumes of distillates into the bunker pool to be compliant with the sulfur requirements; there are other options including scrubbers, LNG and non-compliance. Shipping uses ~3.5-4mbd of fuel oil currently, so there could be a material shift.
Yet, it may not be such an easy decision to move forward with a mega refinery project right now – some proposals need to go back to the drawing board as the outlook for diesel is uncertain following VW’s emissions issues. After all, new capacity needs to be built in ways consistent with oil product growth patterns, and right now, there is a high degree of uncertainty in particular, as we have an excess in diesel capacity, which could further exacerbate given the current set of developments which come with high diesel yields. Then, it often takes at least 4-5 years to complete a mega plant. For example, if a capable IOC is helping to develop a mega project, the chance of timely delivery is higher (e.g. Total and Satorp refinery), but absent a capable operator, often refineries in the Non-OECD have, on occasion, taken a multiple of the normal run rate to complete a refinery.

Figure 16: Satorp (Aramco/Total) – this project was exceptionally well managed, delivering slightly ahead of schedule, which does not happen often

Where things have gone wrong

So far we have discussed the aspects that are needed regionally to de-risk refinery project developments as well as what it takes to be able to move forward with a project (many don’t and are just concepts, which consensus needs to properly reflect, in our view). In most regions outside the US, refinery projects usually miss widely on delivery and as we provide examples on this, investors should be better equipped in understanding the timeline of project delivery (those under development) versus latest guidance, but also whether or not certain projects can even become a reality.

The upsurge in shale output has recently initiated the next wave of refinery expansions/condensate splitter build in the US – these were sanctioned with the view to take advantage of the feedstock advantage. If the environment up to 2014 had prevailed, we would be certain that these projects would come onstream mostly on time and on budget, but the environment has changed (including the lifting of the crude export ban), so that certain projects may well be ‘intentionally’ deferred. This is likely the reason why Western Refining has deferred the ~25kbd expansion at El Paso to beyond 2016.

Russia is also in the middle of a modernization phase – one that initially failed to kick off, until the government implemented changes to the tax regime and thereby incentivized the
upgrade of refineries. With the right incentive, Russian companies adopted this programme and went on to invest in upgrades, many of which led to Russia exporting more clean products. However, the more recent tax changes that the government introduced in early 2015 – to support upstream economics at the time of weak oil prices – created significant pressure even to complex refinery margins in Russia, and companies as a result opted to defer a number of upgrade projects. This is a good example of political and economic stability, or the lack of it, which creates uncertainty on the investment returns for companies.

The Middle East has seen big increases in refining capacity, most notably driven by Saudi Arabia, which brought onstream in recent years two 400kbd refineries in partnership with capable operators, such as Total and Sinopec (Sinopec has built many complex refineries in China). Aramco is in the process of developing another 400kbd refinery in Jizan, however, this project is complex, and regionally being built in a more challenging location, which makes the process less likely as smooth as the other two projects.

Indeed, it has seen many delays. The UAE also brought onstream a 417kbd refinery (Ruwais), but this refinery faced significant challenges after completion, which shows that it is not easy to operate a refinery, in particular to ramp one up. In Kuwait, the plan is to build a new 615kbd refinery (Al Zour), but owing to political instability, this refinery has been discussed for 10 years or more, and while the (political) commitment seems to be there now, the project has yet to make visible progress to even consider the advertised timeline of ~2021. Having said that, we do carry it for 2021, and treat it as potential risk factor for delay.

Overall, building refineries in the Middle East does make sense – demand growth is strong, while the region's abundant crude supply will ensure that refinery projects are competitive and relatively profitable, but it is not straightforward as climate can be a major hurdle as well as lack of developed infrastructure, both to support construction (i.e. the need to build out utilities and roads, which adds to costs of a project) and operations.

In Latin America, most projects are sponsored by NOCs, similar to the MidEast and Asia, but unlike the MidEast and Asia, Latin American countries have pursued such developments on their own without partnering with potentially better project managers – a decision or an outcome they may be regretting, in our view. The issues have ranged from bad planning, corruption and incompetency, in our view. For example, in Brazil, the Abreu e Lima project's Phase 2 is running over four years behind schedule, and the whole project will now cost over $20bn versus an initial budget of ~$4bn.

The Comperj refinery, as we previously highlighted, faces similar issues with the second phase now cancelled. The start-up of this refinery, now contingent on finding a partner, will be beyond 2020, and compares to a target of ~2016 start-up initially. In Colombia, the story is also not that encouraging. Ecopetrol recently started up the expansion of the Cartagena refinery, which was announced in 2009 and originally scheduled for completion in 2012. While Ecopetrol is widely perceived as a capable operator of projects, the execution of this expansion has been poor. We also highlight projects in Ecuador, Venezuela, Peru where the story is similar, even for smaller projects such as Peru's upgrade of the Talara refinery.

A large chunk of the new capacity built over the past cycle has come from Asia. Significant capacity has been added in China and India in recent years, and project delivery was not as bad as other examples on average. Further capacity additions going forward should somewhat slow. With nameplate capacity of 14mbd-plus against demand of ~11mbd, China is already in oversupply mode. Hence, it is understandable that project start-ups have been pushed back of late in light of a softer demand outlook – China has a stated policy of only adding capacity as internal demand rises, but clearly the excess that we see now is likely a reflection of China having overestimated demand growth in the past. We recall the 13th Five-Year Plan (2016-20) for Energy Sector states that there will be no new approvals for greenfield projects (both Refining & Petrochemical) in the first 3
years i.e. 2016-18. Those who already got approvals will still go ahead. Essentially that means there will only be four greenfield projects over the next five years (vs four per year on average for the past 15 years).

In reality, its policy, unlike India, is not to become a major exporter of oil products, despite growing exports of late. Thus, in the absence of a growing export quota, the increasing surplus in refining capacity in China looks largely irrelevant in theory. However, since June 2015, product (diesel) exports have seen a surge. This is a function of pushing out unwanted middle distillates to meet sharply rising domestic gasoline demand. The problem is that Chinese refineries are geared to diesel and incremental gasoline output comes with large amounts of unwanted diesel – with the economic transition, demand for gasoline is growing fast, while with the slow-down in industrial production demand for diesel is in the doldrums. Thus, to meet sharply rising gasoline demand, there was pressure on the NDRC by the SOEs to grant higher export quotas.

This trend was further exacerbated by the NDRC giving private teapot refineries direct access to crude (prior to that, the excess in China was better managed or kept in check as the Chinese government kept tight controls over the crude supply), which is now creating more pressure in the international markets and therefore questioning economics of a number of projects in neighbouring countries. Otherwise, Chinese refineries are also protected when the oil price is below $40/bbl. The government stopped lowering product prices when oil fell below $40/bbl at the start of the year, which helps, even though much of the excess profit is placed in a fund that aims to improve energy security/fuel quality.

In India, there has been strong growth in refinery capacity as well but this has been driven more by private companies than by state-owned entities. Reliance has two mega facilities with capacity now amounting to ~1.2mbd, while Essar has a mega facility in Vadinar (~400kbd); all of this, often incentivized by tax reliefs which expired a few years ago, led to India becoming a major exporter of oil products. Beyond China and India, many other (smaller) countries in Asia have ‘grand’ plans to build new refineries, which include Indonesia, Malaysia, Cambodia – but they often lack central planning and therefore proposals are not just uncertain in size and quality, but also on timing. More critically, however, the key for any project is to secure funding, which is not a straightforward process, even if certain major crude exporters currently are looking to participate in new refinery projects to secure a crude outlet – updates have been so far mostly mixed.
Europe longer term remains challenged?

Structural vs Cyclical – understanding a cycle. There are structural and cyclical factors at play – the cyclical uptick of late keeps everyone happy, yet the structural issues have not fully disappeared (even if this cycle is a better cycle), but merely deferred. What is good about this cycle for Euro refiners is (a) the optimization of crude intake, and (b) energy savings from a lower oil price. Crude quality spreads will remain subject to multiple influences, with specific logistical factors for each region key to the behavior of representative spreads. In a world where we are likely to see more ‘abundance’ as opposed to ‘scarcity’ pricing, crude spreads in Europe should remain more favourable this cycle than the last cycle. With that, energy costs should remain lower too.

Yet, as difficult as it may seem, long term planning is important in keeping the European refining industry competitive, and government policy can help with this matter. Europe is a market, where oil demand growth will likely structurally go back to decline from 2017 onwards. As such, we have argued in the past that Japan with its METI Ordinance is forward looking, and that such similar policies should be adopted in Europe; something that was echoed by CEPSA in 1H17 at a public forum.

Our prior conversations with a number of senior executives of major players would agree that the METI Ordinance would be positive and should be considered in Europe, but in the past these executives have also highlighted limitations more specifically to the implementation of such policies on a continent such as Europe (or the European Union). A think tank (Clingendael International) published a paper earlier this year, which shows a potentially dire outlook for North West Europe (NWE) in the period post 2025, albeit this is based on an assumption that global spare capacity will widen, not tighten (recall we see the potential for global spare capacity to tighten). Nevertheless, the interesting conclusion from this paper is that many refineries would be closed (we agree more need to be closed, but not as many as highlighted by this paper), but IOCs are relatively less impacted as they have been more proactively managing their portfolio and transitioned to a set of refineries more complex and integrated. RDS looks to be better positioned. Total less so.

**Figure 17: Japan: Historical Oil Demand (mt)**

![Figure 17: Japan: Historical Oil Demand (mt)](source: BP Statistical Review, Credit Suisse Research)

**Figure 18: EU: Historical Oil Demand (mt)**

![Figure 18: EU: Historical Oil Demand (mt)](source: BP Statistical Review, Credit Suisse Research)

Lessons from Japan. Japan's oil demand growth is in structural decline regardless of GDP growth – this is due to a declining population, ageing society, improving vehicle fuel efficiency etc. Japan through implementation of two phases since mid-2010 will have cut refining capacity by 1.3-1.4mbd or down to ~3.2mbd by March 2017 (as of early 2016, capacity stands at ~3.6mbd). By 2020, crude runs could drop further to ~2.8mbd (from ~3.25mbd in 2015), and beyond 2020, further decline should be the base case. As such there may be a case for another phase to be implemented by METI at a later stage, or opt
to let the invisible hand of the market to do the final touches of the restructuring, which seems to be the preferred option by the Japanese refining industry.

- **METI Phase I**: It was implemented with the objective of improving the sophistication of Japanese refineries by April 2014, and in order to achieve this, refiners could either upgrade their heavy oil cracking units or reduce their crude distillation unit capacities. In the end, refiners had significantly reduced their CDU capacities (in excess of 900kbd) as they could not justify the major investments that were needed to upgrade these facilities in light of a stagnant demand outlook.

- **METI Phase II**: During this phase, the objective is to improve residue processing ratio from 45% to 50%. This phase allows for nameplate capacity reduction as opposed to having to close entire CDU towers, and also encourages collaboration. Via operational tie-ups, CDU capacity reductions can be achieved jointly. Some refiners may be unable to achieve the required improvement by themselves, which would then require possible merger with others and/or regional integrations. As part of METI Phase II, the industry generally expects ~400kbd of capacity will likely be mothballed (plus PBR’s closure of its ~90kbd refinery in Japan), albeit no refiner has made official announcements. The industry needs to deliver these policy objectives by March 2017.

Another issue in Japan is that most refineries are relatively old with no new refinery built since 1975. This coupled with many of the longer term issues/challenges Japan is facing, many of which are similar in Europe, a METI type policy framework should be considered in Europe or at least part of this policy openly discussed and debated, in our view.

**Good Old Europe – Where from here?** Clingendael International – a Dutch think tank – recently published a paper on the European Refining industry. It focused on the five principal countries in North West Europe (or NWE), namely Belgium, the Netherlands, Germany, France and the UK. **Bottom line**, in total 21 refineries out of 34 refineries are thought to overcome the threat of growing imports as they either have strategic characteristics or face substantial barriers to exist. This leaves 13 refineries with 2.6mbd in capacity with a questionable future, or 4.5mbd of capacity would run covering close to 70% of overall regional demand. But as with many things, this is generally a subjective exercise, and we are of the view that further changes are needed, but not so drastically, given our view that fewer new refineries are being built in emerging markets.

Similar to Japan, European oil demand is in structural decline. Other disadvantages include higher energy/labour costs, less sophisticated refineries and a lack of access to cheaper and secure feedstocks, which means a ‘globalised’ refining industry would favour investment in ‘export oriented source refineries’ or ‘high growth regions’, and let imbalances be fixed through a two-way trade. Also following the 2008/09 recession, the need for a long term solution for regional imbalances in NWE became more acute as traditional outlets for surplus oil products, such as gasoline, started to disappear (e.g. US and the MidEast, albeit more recently due to lower pump prices, US demand is well and growing). This means refineries need to upgrade to stay fit for longer.

The paper identified four ‘must run’ categories, which include (a) captive demand refineries, (b) petchem integrated refineries, (c) upstream integrated refineries and (d) surplus coking capacity refineries. The table on the following page provides more detail on this. These four categories are likely to include refineries that are strategic to a supply chain or cluster, tying a refinery’s existence to the survival of the entire system, and this in turn will secure continued investment in upgrades and thereby supporting a competitive position.
Characteristics
It is not viable to convert the existing crude pipeline to a refined product pipeline. Refinery supply matches captive demand. And if local refinery supply is expected to exceed captive demand, the refinery must have significant coking capacity (at least 50kbd).
The long term viability of production in the crude oil region is critical to the strategic value of the upstream. The refinery must have direct access to a land-locked crude long region.
Steam cracker feedstock flexibility requires trading outlets for excess production when economics favours. Refinery integrated steamcracker > 1,000kt/a of ethylene capacity + feedstock flexibility > 20% (between at least 2 world scale
There must either be a lack of refined product pipelines serving the refinery’s hinterland or existing refined product infrastructure. There must not be alternative premium outlets for the crude.
Access to surplus residual oil supplies. The refinery must have >15% of its coking capacity available to upgrade third party residue oil supplies.
Inland location
Crude pipeline connection
Refined product pipeline is lacking or constrained
Inland waterway is lacking or constrained
Crude to product pipeline conversion not viable
Refining capacity locally intra-marginal
Direct petchem integration
World scale steam cracker or aromatics capacity
Outlet for excess refinery produced feedstocks
Petchem cluster long term viable
Direct access to a crude long region
No alternative premium outlets for the crude
Not viable to convert existing crude to refined product infrastructure
Crude oil production long-term viable
Significant coking capacity
Surplus coking capacity
Access to surplus residual oil supplies

Source: Clingendael International, Credit Suisse Research

It concluded in the more extreme ‘must-run’ scenario that only 12 (~3mbd) out of the 34 refineries (~7.1mbd) in the region would be fit for purpose, which would imply that the post 2025 refining sector would only cover ~40% of overall oil product demand. These 12 refineries are on average larger and more complex and benefit from deeper integration, connections to a trading hub, and/or specific captive demand. Most of these are located in the ARA (Amsterdam-Rotterdam-Antwerp) hub, Rhine Ruhr and southern Germany, whereas the weaker links are in France, the UK and northern Germany.

Out of the 12 refineries, 10 are owned by IOCs, and in general the IOCs come out better on this screen, which is not a surprise as they have been more proactively managing the portfolio (as we said in Royal Dutch Shell The World is Dutch vol II dated 1st June 2016) and shifting refining portfolios towards large, complex and advantageous located plants. Amongst the Majors, RDS looks to be better positioned in Europe, whereas Total and XOM less so on this analysis. It does, however, say that there are limitations to its analysis. For example, by lowering certain thresholds, several refineries turn out to be close to the ‘must-run’ status. The model also focuses on strategic considerations and ignores operational refinery performance as a source of potential structural competitive advantage vis-à-vis refined product imports, and we believe Total has been doing a good job lowering its break-evens of its French refineries in recent years. Also if Russia were to implement tax changes that could see its refining industry liberalized from the early parts of 2020s, then we could see a significant reduction in oil product exports from Russia, and the equation/required restructuring of European refining looks different to that discussed.

Also substantial barriers to exit will prevent economically exposed refineries from being closed, according to this paper. Of the 22 so called exposed refineries in the must-run scenario, 9 are expected to be closure constraint because they are plausible for political or merchant refining deals. And finally, substantial refinery closures might prove premature in certain parts of the market and their infrastructural developments.

Figure 19: Refinery screening tool for the ‘must-run’ scenario

<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captive demand</td>
<td>Inland location</td>
<td>The refinery must be located inland</td>
</tr>
<tr>
<td></td>
<td>Crude pipeline connection</td>
<td>The refinery must be connected to an inland crude pipeline</td>
</tr>
<tr>
<td></td>
<td>Refined product pipeline is lacking or constrained</td>
<td>There must either be a lack of refined product pipelines serving the refinery’s hinterland, or existing refined product infrastructure.</td>
</tr>
<tr>
<td></td>
<td>Inland waterway is lacking or constrained</td>
<td>There must either be a lack of inland waterways serving the refinery’s hinterland or existing waterways</td>
</tr>
<tr>
<td></td>
<td>Crude to product pipeline conversion not viable</td>
<td>It is not viable to convert the existing crude pipeline to a refined product pipeline.</td>
</tr>
<tr>
<td></td>
<td>Refining capacity locally intra-marginal</td>
<td>Refinery supply matches captive demand. And if local refinery supply is expected to exceed captive demand,</td>
</tr>
<tr>
<td>Refiney integrated</td>
<td>Direct petchem integration</td>
<td>The refinery must have various direct pipeline connections to petchem production units.</td>
</tr>
<tr>
<td></td>
<td>World scale steam cracker or aromatics capacity</td>
<td>Refinery integrated steamcracker &gt; 1,000kt/a of ethylene capacity + feedstock flexibility &gt; 20% (between at least 2 world scale</td>
</tr>
<tr>
<td></td>
<td>Outlet for excess refinery produced feedstocks</td>
<td>Steam cracker feedstock flexibility requires trading outlets for excess production when economics favours</td>
</tr>
<tr>
<td></td>
<td>Petchem cluster long term viable</td>
<td>The refinery should be part of a viable petchem cluster that exhibits internal competition and is likely to survive increased competitive pressure from nex/expanding clusters in the US and the MidEast.</td>
</tr>
<tr>
<td></td>
<td>Direct access to a crude long region</td>
<td>The refinery must have direct access to a land-locked crude long region.</td>
</tr>
<tr>
<td></td>
<td>No alternative premium outlets for the crude</td>
<td>There must not be alternative premium crude from the land-locked region.</td>
</tr>
<tr>
<td></td>
<td>Not viable to convert existing crude to refined product infrastructure</td>
<td>It must not be viable to convert the existing crude oil infrastructure (eg pipelines) to directly supply refined products from the crude long region.</td>
</tr>
<tr>
<td></td>
<td>Crude oil production long-term viable</td>
<td>The long term viability of production in the crude oil region is critical to the strategic value of the upstream</td>
</tr>
<tr>
<td>Upstream integrated</td>
<td>Significant coking capacity</td>
<td>The refinery must have significant coking capacity (at least 50kbd).</td>
</tr>
<tr>
<td></td>
<td>Surplus coking capacity</td>
<td>The refinery must have &gt;15% of its coking capacity available to upgrade third party residue oil supplies.</td>
</tr>
<tr>
<td></td>
<td>Access to surplus residual oil supplies</td>
<td>The refinery must have access to surplus residue oil supplies from nearby refineries that are actively using the barrel upgrading capacity (coking or residue gasification).</td>
</tr>
</tbody>
</table>

Source: Clingendael International, Credit Suisse Research
Russia: tax changes lead to less oil product exports

**Gradual policy shift.** The Russian government introduced the so-called ‘Tax Maneuverer’ in January 2015, which has had a detrimental impact to the downstream industry. Refinery runs have come under pressure, although not necessarily the level of exports as demand lagged due to sanctions imposed to Russia by the Western World. Further fiscal changes are likely from 2017 with the export duty (ED) likely lowered to 30% (from 42%) further impacting runs. We have always argued policy shift will take time, and if implemented, tend to be incremental and gradual in nature. This has been the case in Russia. Longer term, we could envision a scenario whereby the refining sector in Russia is fully liberalized, which could lead to over 2mbd of nameplate capacity becoming redundant.

**Figure 20: Russian refining margins to NWE ($/bbl)**

![Graph showing refining margins from January 2012 to October 2016.](source: Argus, Credit Suisse Research)

**Figure 21: Throughput versus 2014 (monthly comp)**

![Graph showing throughput comparison from January 2015 to October 2016.](source: The Ministry of Energy, Credit Suisse Research)

**Medium term (2017-19) –** The Russian government introduced the so-called ‘Tax Maneuverer’ in January 2015, which is meant to gradually decrease the crude ED and hike the mineral extraction tax (MET). In early 2015, the ED was cut to 42% from 59% previously, but in 2016 it didn’t cut it further. At the same time a switch in oil products export taxation was implemented, supporting gasoline / diesel output at the cost of heavier fuel oil output. We argued that the main reason for this transition was a need to incentivize upstream, the main source of the budget revenues, by providing extra tax stimuli. But the Oil and Gas sector taxation is a zero-sum game, which means any benefits to the crude producers have to be sourced from the refiners’ pocket, unless the government is ready to sacrifice some of its tax profits, which is an unlikely option for Russia.

From our understanding, there are three scenarios of how tax terms may evolve over the short-term. The government may revert to the initially proposed terms setting the coefficient at 30%. Alternatively, it may defer the maneuver by one year, i.e. moving to 36% in 2017 and 30% in 2018. Additionally, to add flexibility over the budget deficit, the duty coefficient could be kept unchanged. Taking into account Bashneft privatization, we think it’s more likely that the coefficient will be at 30% in 2017 (proceeds amounted 330bn rubles), which is our base case. When we think of Russia and the fiscal priorities, one should think of it as the order of importance: (1) budget, (2) upstream and (3) downstream. A cut to the export duty to 30% in early 2017 would impact runs, most notably those of the less complex in nature, and therefore fuel oil exports. In other words, when one looks at complexity and product yield across regions, Europe would stand to benefit from this.
**Longer term (2020+) – Self-sufficiency.** We think Russian downstream will undergo a dramatic transformation as ED is abolished over time and the refining sector essentially liberalized. It is a matter of 'when', not 'if', in our view, and this could potentially see its current ~2mbd in oil product exports removed. The location of many plants make Russian refineries uncompetitive in the export market; i.e. the industry set-up is inefficient and rationalization is a must, in our view. In essence, there is >2mbd of unnecessary nameplate capacity in Russia, of which around half sit in Rosneft's portfolio.

Yes, this has been in discussions for >10 years, but we are seeing a gradual shift to the policy framework. We are going down to an export duty (ED) of 30% in 2017, in our view, which is a decrease from 66% ten years ago, the refining system today is more complex than ten years ago following the ongoing modernization program, and it will be more challenging now for the Russian upstream industry to grow and sustain upstream production than it was ten years ago. In other words, something has to give – changes are forthcoming over time as such.

We have always argued that policy shift will take time, and if implemented, tend to be incremental and gradual in nature. This has been the case in Russia as well. We do, however, expect changes to continue from those implemented in 2015, albeit more gradual in nature, in particular in light of the presidential elections in 2018. Our base case, thus, is for ED to be lowered to 30% and to stay at this level over the medium term. Longer term (2020+), we would expect the downstream industry to be more liberalized, which can have severe implications to the global refining industry unless a partial off-set is implemented. Instead of exporting ~2mbd in oil products today, Russia may become merely self-sufficient with exports merely seasonal matter. This will be the case despite the ongoing modernization plan. The location, and therefore the onerous transportation cost to the key export markets often explain the uncompetitiveness of the assets.
Refining – Cracking Thoughts

Figure 24: Theoretical net exports under different scenarios assuming mid-cycle European margins

<table>
<thead>
<tr>
<th>CS deck ($/bl)</th>
<th>30% coefficient</th>
<th>20% coefficient</th>
<th>10% coefficient</th>
<th>0% coefficient *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>3,651</td>
<td>3,651</td>
<td>3,651</td>
<td>3,651</td>
</tr>
<tr>
<td>Profitable production at 93%</td>
<td>5,507</td>
<td>4,914</td>
<td>4,861</td>
<td>2,721</td>
</tr>
<tr>
<td>Excess supply / net export</td>
<td>1,856</td>
<td>1,263</td>
<td>1,210</td>
<td>-930</td>
</tr>
</tbody>
</table>

$55/bl

| Demand        | 3,651           | 3,651           | 3,651           | 3,651           |
| Profitable production at 93% | 5,507           | 4,914           | 4,464           | 2,721           |
| Excess supply / net export | 1,856           | 1,263           | 813             | -930            |

$45/bl

| Demand        | 3,651           | 3,651           | 3,651           | 3,651           |
| Profitable production at 93% | 4,914           | 4,852           | 4,350           | 2,721           |
| Excess supply / net export | 1,263           | 1,201           | 699             | -930            |

Source: Company data, Credit Suisse estimates, Argus, Ministry of Energy of Russian Federation, IEA. * This case assumes no export duty (0% for all coefficients in the formula).

Figure 25: Spare capacity scenarios (kbd) at 86% util rate

This assumes 1mbd pa oil demand growth

Figure 26: Russian Cost curve ($/bbl) in 2020 under 30% ED @ $50/bbl Brent – mid-cycle margins

Figure 27: Russian Cost curve ($/bbl) in 2020 under 0% ED @ $50/bbl Brent – mid-cycle margins

Source: BP Statistical Review, Credit Suisse Research; Note: assumes 86% utilization rate

Source: Company data, Credit Suisse estimates

Figure 28: Russian Cost curve ($/bbl) in 2020 under 0% ED @ $50/bbl Brent – peak-cycle margins

Source: Company data, Credit Suisse estimates
Understanding the Middle Kingdom (China)

The broader policy of China, as we said before, is to keep runs more or less in line with local demand and importing or exporting modest deficit or surplus – historically that has been the case, but the situation is a little more complicated today. Between 2000-15, Chinese demand has grown by ~6.5mbd and refinery capacity by ~8.9mbd. This ‘overbuild’ was split between major Chinese oil companies (or the national oil companies or NOCs) and the smaller teapot refineries, and was largely kept in check as the Chinese government kept tight controls on the crude supply. Teapot refiners have historically played second fiddle to the NOCs (the more relevant downstream players being Sinopec and PetroChina) – often acting as a swing producers of refined products in times of tight markets. So historically, in the absence of growing export quotas for oil products, the increasing surplus in refining capacity in China was largely disregarded. The situation has changed somewhat since the middle of 2015.

Recap of events. In mid-2015, with sluggish diesel demand and surging diesel stocks, the regulator NDRC came under intense pressure from the NOCs to grant them higher export quotas. The NOCs, most notably Sinopec and PetroChina (who control the majority of Chinese capacity) were concerned as they were near tank tops with diesel. Gasoline demand is growing fast amidst low pump prices, while diesel demand turned sluggish – as Chinese refineries are more geared to producing diesel, to meet internal gasoline demand, diesel was produced as a by-product as a result – this recent shift in diesel and gasoline demand growth poses a question for medium and long term planning. Meanwhile, the government is now allowing teapot refineries to source crude, which thereby allowed them to increase refinery runs. Something has to give as the government expects the NOCs to maintain high crude runs to satisfy surging gasoline demand. Growing export quotas implies that runs may continue to increase. Overall, growth in runs and the strength in domestic demand remain the key driver in pacing the expansion in product exports. Throughput in 2016 should be up ~0.4mbd; with domestic diesel demand likely flat y/y, diesel net exports should rise y/y by 200-250kbd – supported by higher export quotas.

Since 2H15, 19 teapot refiners have been granted crude import quotas. Subject to teapot runs, overall product exports, especially diesel, is growing, which now represents ~20% of distillates exported from the US. With China’s nameplate capacity of ~14mbd and crude runs of ~11mbd based on the latest monthly data available (average global refinery utilisation rate is ~82% in 2015 vs Europe at ~84% vs the US at 88-89%), China has room in theory to increase runs (unclear how compliant all refineries are with tighter specs coming up more broadly in Jan 2017, but a phased implementation for certain parts is largely expected for up to six months) putting increasing pressure on both proposed and
existing projects the poorer neighbors have and are planning with. That said, over the medium term, the slow-down in refining capacity build up in China as the government reigns in on expansions, amongst other things, should keep a lid on diesel export growth. Recall that the 13th Five-Year Plan (2016-20) for Energy Sector states that there will be no new approvals for greenfield projects (both Refining & Petrochemical) in the first 3 years i.e. 2016-18. Those who already got approvals will still go ahead. Essentially that means there will only be four greenfield projects over the next five years (vs four per year on average for the past 15 years).

**Figure 31: Global refinery utilization rates (%)**

A 'temporary' exporter? We think the intention of the Chinese policy makers is in the first instance to be self-sufficient as opposed to becoming a major exporter of oil products – cycle in and cycle out. It is generally difficult to get a good handle on Chinese refinery projects, but those that we monitor more closely, have seen several delays as the government balances out refining capacity with demand, revising start-up dates and project capacities as they progress. In the longer term, refinery closures in China may also become a factor for the market as the government is anxious to improve air quality in urban centres. Refineries near major cities, such as those in Shanghai, Beijing, Nanjing and Dalian have been targeted for relocation to coastal areas (away from residential districts), which may permit capacity rationalisation. Competitive pressures on teapot refineries may also accelerate closures. That said, the ability of unprofitable industrial installations to remain at least nominally operational should also not be underestimated.

**Figure 32: Chinese net oil products import/(export), kbd**

**Figure 33: Chinese net diesel import/(export), kbd**
What are teapot refineries? Teapots are small, inefficient oil refineries supported by the provincial governments, often with tax benefits. Initially, they were expected to close (and many did reportedly) or be taken over by the NOCs. With no ability to import crude or directly sell products, they were beholden to the NOCs for fuel oil as feedstock and to sell products back to them. These refiners often operate at the will of regional governments.

A lot has changed since – they are now seen as a new force opening competition. The government has opened up quotas for crude imports, allowing for increased access to feedstocks. Since 2H15, the NDRC gave the final nod for crude import quotas to 19 teapot refining companies. Since 2016, they were also granted export quotas for oil products. So far in 2016, independent refiners have been granted ~150kbd in export quotas (150kbd just for gasoline and diesel, or a total of 168kbd if we include kerosene and fuel oil); while these volumes look insignificant, it is a sign the government may look to gradually open up the export market. This meant utilization rate improved to ~50% ytd from ~40% in 2015.

![Figure 34: Chinese refinery runs (kbd)](image)

![Figure 35: Shandong teapot refinery utilisation rates (%)](image)

Source: CEIC, FGE estimates, Credit Suisse Research

Source: CEIC, Credit Suisse Research; Note: Shandong has nameplate capacity of ~3mbd

It is also important, however, to highlight that the government places a great amount of importance on improving the environmental footprint. These teapot refineries, whilst partly upgraded yet often still small in size (20-100kbd facilities), tend to pollute more, have more accidents etc. Thus, the central government issued a variety of new policies in an attempt to consolidate teapot refineries, shut down the smaller, less efficient and higher polluting ones and provide benefits to those that are more competitive. These benefits came in the form of crude import quotas. The province with the highest number of teapot refineries is Shandong, where ~20% of Chinese refined products is produced.

**Recent changes.** The central government has constantly tried to shut down these teapot refineries because of their environmental and safety records. The government mandated teapots below a certain size to be shut down which, in turn, resulted in expansions or alliances, but also many survived under the protection of local governments (these have provided employment for the local community, and proved important economically).

- **NDRC guidelines:** In early 2015, the NDRC set out a policy allowing teapot refiners to process imported crude, but without the authority to import the volumes directly. Under guidelines issued, a refiner must have CDU (crude distillation units) capacity of at least 40kbd to qualify for these crude import quotas. Another condition to qualify for these quotas included companies would have to close small(er) units. The quota allotted to the refiners in theory is linked to the crude processing capacity that it shuts down, but cannot exceed existing processing capacity.

- Furthermore, independent refineries will need to sustain crude imports for three consecutive years after receiving import rights, or else these licenses are revoked.
Refineries also need to meet certain environmental requirements, and have at least five years of trading experience in the international oil business, and strong bank credits. The NDRC also mentioned that refiners can get additional quotas if they build LNG, CNG, or underground storage tanks. Refiners have the freedom to acquire and shut down smaller refiners to get the quota they desire, and we have seen reportedly a lot of this. The NDRC has designated China Petroleum and Chemical Industry Federation (CPCIF) to review import quota applications submitted by teapot refineries and to handle the reviews and carry out site inspections. The NDRC will still be in charge of final approvals for the import quotas, including the volume allotted.

**Figure 36: Rising crude import quotas meant fast growing crude oil demand from refiners (mbd)**

![Figure 36](image1.png)

**Figure 37: China (domestic) refining margin vs the Singapore benchmark margin, $/bbl**

![Figure 37](image2.png)

**Dynamics – domestic vs exports.** Increasing domestic product supply, driven by increasing runs by the teapot refineries, is squeezing the market share of the NOCs and forcing the NOCs to the export market. The NOCs have the majority share of the export quotas, and the size of the export quotas no longer is a limiting factor as they remain largely under-utilized. There has been a stronger incentive of late to sell domestically in China (not just due to the normal transportation cost driven inland premium), but there is only so much you can sell domestically, thereby being forced into the export market.

- In China, domestic gasoline and diesel pump prices are regulated by the NDRC and adjusted based on a pass-through mechanism. The current refined product price mechanism in China was first introduced in early 2009 (post-GFC) and refined in 2013. The way the mechanism works is that it tracks international crude oil price movement over the last 10 days and adjusts retail prices if the trailing average prices moves up and down. The crude basket that the mechanism tracks was not disclosed – but are believed to be Brent, WTI & Dubai. Over the past 3 years, the pass-through mechanism has worked well and hence domestic refiners’ profitability are in a way better protected. Between 2009-2013, during the time of the old mechanism, the NDRC had pass-through delays amid high oil price and/or high CPI pressure in China, but these issues are unlikely to be an interference to the mechanism in the near future.

- In January 2016, the NDRC introduced a price floor on top of the current mechanism, whereby domestic gasoline and diesel retail price adjustments will stop when international crude oil prices are <$40/bbl. But the supernormal profit that the domestic refiners earn will have to be handed back to the Chinese government and placed in an Oil Special Fund – for future capex spend on fuel upgrade, emission reduction and environmental protection. That said, the supernormal profit currently is temporarily placed at the NOCs P&L as was evident in the quarterly results so far this year.
Diesel exports is rising as a result of subdued domestic diesel demand in the recent past. Along with accelerated crude import quotas awarded to teapot refineries coupled with the latest move to grant export permission paves the way for more players to gain access to the export market in light of growing products surplus domestically.

There are, however, a few caveats worth highlighting:

- Decisions on export volumes (capped by the quotas) are governed for each refinery based on domestic market conditions and export economics, and any unutilised quotas can be rolled over to the subsequent quarter within the same year. The volume of export quotas granted to the independent is limited, but the improved access to imported crude supply is giving a significant boost to operating rates. Growing oversupply of domestic products, driven by accelerated operating rates of teapot refineries, will in turn pressure NOCs to export more out of China.

- But the NOCs are worried that their export margins will be depressed if they export more, but exports may be necessary (unless runs are cut) to assuage inventory pressure. The NOCs now complain that these teapot refineries have too many tax benefits, which has placed them at an advantageous situation versus the NOC refineries. Equally, these teapot refiners are not perfect competitors, and generally a lot less efficient. Other constraints include logistics, the need to upgrade to meet increasingly tighter fuel standards (2017 will be interesting for this), and often lack international credit lines.

Teapot capacity outlook. Teapot refineries will continue to close capacity over the medium term, perhaps by up to another ~700kbd (FGE estimate). As we said before, they have been under pressure for long to consolidate, yet managed to survive despite many headwinds, including tighter fuel specs, crack down on tax avoidance, a slowing economy etc. In return for gaining access to crude imports, we have seen a wave of closures amongst teapot refining companies in 2015 (~370kbd was shuttered in exchange for greater access to imported crude, according to FGE). While the majority of these plants that had been shut down were underutilized, it is still a positive trend to permanently remove such capacity. It is, however, now interesting that while reportedly closed in return for getting crude import quotas, both Reuters and Argus cite the NDRC questioning the teapot refiners on the compliance of the agreement.

David vs Goliat. We find two articles published on Argus and Reuters during August interesting, which make forecasting potential runs and thereby exports of products somewhat less predictable – such unpredictability may imply exports of certain products now are at their peak. Time will tell – we closely monitor the situation over the next 6-12 months. The two articles stated "China has issued strongly worded guidance on how it plans to tackle tax fraud and capacity misreporting in the oil industry...the point of liberalization was to compensate teakettles for closing outdated or inefficient crude processing capacity. Many have ignored their side of the bargain, the NDRC says. The agency has called the NEA and the Shandong government to do more to ensure the sector's compliance. This is the first time that the central government has issued a formal warning to the teakettle sector since it opened up crude imports last year...Teakettles found still to be operating crude unit capacity that they agreed to close in exchange for import quotas will have their quotas reduced in size, or cancelled, the NDRC says....The NDRC has also pledged a crackdown on evasion of consumption tax payments. The move comes after NDRC officials launched an intensive round of site visits to teakettle plans in Shandong last month. Refineries in the province have been told that fuel oil invoices supplied by trading firms cannot be used as the basis for tax rebates. Teakettles pay far less tax on domestic sales of oil products than conventional refiners, as they are often able to procure invoices that show that the crude they refine is fuel oil....But the actual amount of fuel oil that they refine is negligible. "
Implications from IMO regulation: upgrade or close

The International Maritime Organization (IMO) is a special agency of the United Nations which was created to set global standards for the safety, security, and environmental regulations for the international shipping industry. The goal of the IMO is to create a regulatory framework that is fair and effective and universally adopted and implemented. The promotion of sustainable shipping and sustainable maritime development is one of the major priorities of the IMO. The IMO was established in 1948 and has grown to include 171 member states. The IMO was established to adopt legislation, not implement legislation. Key to any IMO legislation is that it is up to the member states (Governments) to implement any legislation established by the IMO.

Unlike gasoline and diesel, the development of stricter standards for resid based fuels, such as bunker fuel, has been slower and began to get the attention of regulators only in the last ten years or so, albeit this is being pursued on a more global basis as opposed to gasoline and diesel, where more stringent standards were introduced on a country by country basis with European countries leading the way since the 1990s. The group in charge of the rules for bunker fuels is the IMO. Thus far, the effort has been focused on lowering sulfur levels in fuel used while ships were operating in defined Emission Control Areas (ECAs). Rules reducing the sulfur level in these areas has systematically been lowered, with the last step taken effective in early 2015, reducing the level to 0.1% sulfur in all of the ECAs. While the sulfur limits for bunker fuel usage in the ECA’s are tight (in fact, tight enough that they can only effectively be met by using marine gasoil), their impacts have not been substantial because total usage in these areas is quite small.

A much bigger impact will come when the standards for ‘open water’ transit come into effect by 2020 as decided by the IMO at the 70\textsuperscript{th} meeting of IMO’s Marine Environmental Protection Committee (MEPC 70) that took place in London between 24-27\textsuperscript{th} October 2010. The IMO’s decision allows shippers several ways to comply with the requirements, including adding scrubbers to smokestacks or converting boilers to burn LNG. The bulk of the switch will likely involve ships moving to burning marine gasoil, possibly in blends with lower sulphur fuel oil, due to its ability to be used in engines previously fueled by residual fuel oil. What is not clear at this stage, however, following our conversation with a number of industry players on the refining side is the ‘rate of phasing’, and the bigger challenges will be faced by the shipping industry should a day 1 implementation be enforced. Current estimates put the potential fuel cost increase at >$300/tonne based on current vessel configurations, according to our shipping analyst, which would boost daily voyage expenses by $10,000 to $20,000 per day based on size and speed of the vessel.
**The fix.** While LNG as a fuel is viewed as a potential fix, this is already happening with LNG vessels which are fueled by the boil off of cargo. Retro-fitting the rest of the fleet with LNG propulsion is cost prohibitive and not really a work around. While future newbuilds could be built with LNG as their primary bunker fuel source, global infrastructure limits this as a practical solution any time soon. A potential near term fix would be the installation of scrubbers. In speaking with ship owners none are aware of any traditional scrubbers that have been installed to date. Rough estimates by our shipping analyst put the installation costs of a scrubber at $3-4mn for smaller vessels with the price rising accordingly for larger vessels. The decision to install scrubbers will ultimately be dictated by the health of the shipping markets. With scrubber installations currently costing more than the scrap value of some vessels we would expect these vessels to be retired as opposed to be upgraded.

What is changing? By January 2020, the IMO is asking the marine industry to reduce the global 3.5% maximum sulfur content in marine fuels down to 0.5%. This is to reduce SOx emissions from ships. If the IMO determined that the supply of 0.5% sulfur bunker in 2020 is insufficient to meet global demand, it has the authority to delay the implementation to January 2025. The official IMO study by CE Delft indicated that low sulfur bunker fuel can be produced without distillate diversions, but many in the industry dismiss this study, including studies by IPIECA and BIMOC, which took the opposite position. The base case view by industry, including ourselves, is that significant volumes of the world’s low sulfur bunker fuel will be produced by blending large volumes of distillate fuels – in other words, we, similar to the global refining industry are not concerned about the ability to produce sufficient 0.5% sulfur bunker fuel, but that it would be produced with distillate diversions. In 2020, the bulk of the global bunker fuel demand will simply be met by blending very low sulfur distillate stocks into a smaller amount of fuel oil to produce a 0.5% sulfur blend. In fact, the process by which 0.1% sulfur bunker is currently being produced to meet the requirements of the North American Emission Control Area (ECA) which went into effect in 2015, is almost entirely distillate based. In other words, the two dominant sources of bunker blendstocks in 2020, should the IMO regulation be fully implemented by January 2020 which is not a given, will be the lower sulfur resids and distillates.

**The market.** Refineries generally do not make bunker fuel, but rather, they produce fuel oil (e.g. vacuum tower bottoms). Bunker fuel is mostly produced by blending terminals, which purchase fuel oil along with distillates to produce a variety of bunker grades. Global fuel oil demand is ~8mbd (BP Statistical Review), of which 3-4mbd is linked to bunker fuel, according to various industry estimates. Otherwise, fuel oil is also used for electricity generation, heating and for a variety of industrial purposes. In 2015, the fuel oil component represented only slightly more than half of the total bunker demand, with the rest being...
mostly distillates. The dominant method by which low sulfur bunker fuel will be produced will be from the blending of very low sulfur distillates. Blenders will utilise whatever lower sulfur heavy oils available and blend these base stocks down to 0.5% sulfur with the distillates, forcing high sulfur fuel oil out of the bunker pool. Rather than product availability, the dominant issue may become the alternate disposition of the high sulfur fuel oil, which will have to be backed out of the bunker pool. Non-bunker consumption of resid fuels (primarily for power generation) will likely decline slightly, yet gradually, and these requirements are already being met by existing sources of resid production.

**What it means for the refining industry.** The primary challenge for global refiners is not the ability to produce low sulfur bunker fuel, but rather where to place the surplus high sulfur residual fuels being displaced by the distillates, and how much it represents is also not a perfect science. This is because it is dependent on how much bunker fuel can be produced by lower sulfur resid. Many crudes (e.g. Saharan Blend, Bakken, a number of Western African crudes etc) produce low sulfur resid suitable for producing 0.5% bunker fuel, but many of these volumes are comingled with higher sulfur crudes when processed in refineries, and there is almost no ability to segregate the lower sulfur fuel oil molecules. To retain the sulfur benefits, these grades would need to be processed in blocked mode in separate crude units. How many refineries would operate in such a fashion is not clear.

After producing the available, segregated low sulfur resid, the remaining bunker requirements would come from the distillate pool. The IMO previously estimated that ~2mbd of distillates would be required (some argue even more depending on total demand projection and scrubber/LNG penetration). This would back out ~1.8mbd (BTU adjusted) of higher sulfur fuel oil. This would in fact represent (if fully implemented and complied from day one, which is unlikely) a step change compared to annual trend line growth with middle distillate demand growing on average by ~440kbd pa since 1980 and fuel oil declining by ~210kbd pa since 1980. The sudden supply of an extra ~1.8mbd in the fuel oil market would certainly be disruptive, in our view. It is also tough to see, between now and the implementation year, enough coking capacity being constructed.

**Figure 42: Select company product slate (%)**

![Product slate graph]

Source: Company data, Credit Suisse estimates

**Pricing implications.** The full and timely implementation of the IMO regulations in 2020 would have positive effects on distillates prices, which currently are somewhat under
pressure. What may also happen is as the new 0.5% sulfur bunker fuel, which may become increasingly more distillate based, should see its price rally too, while the high sulfur price will fall and likely much steeper than other product groups. Low sulfur gasoil would become an acceptable supply source for bunker fuel and is generally priced at a discount to gasoline and diesel. Whatever the final level, low sulfur bunker prices, thus, in theory could rise from a discount to crude oil currently to potentially a premium over crude. Prices for the surplus high sulfur fuel oil, however, will decline significantly. The severity of the decline will be dependent on the ability of the system to quickly develop alternate markets. Its theoretical floor could be as feedstock to coking refineries in competition with heavy crude prices. This determination is complicated and would entail a shift to light crude grades in conjunction with the high sulfur fuel oil.

**Market opportunities from the IMO regulation.** The initial response of most refiners in this situation would be to reduce the volume of high sulfur fuel oil by shifting to a lighter crude slate. A lighter crude grade is higher priced and have different yield patterns, which may be incompatible with the refinery hardware configuration in some instances. A potential disposition for the unneeded fuel oil would be to blend it back into crude oil. The potential exists to blend new crudes using the fuel and other, lighter crudes to produce synthetic heavy grades. For example, taking 60/40 Mars/Fuel Oil gives you a gravity similar to Maya (API of ~21). These grades could then be sold to coking refineries. This would substantially increase the supply of heavy crude grades and as a result widen the light heavy crude diffs. There is also the potential of coking refineries using high sulfur fuel oil as a replacement for heavy crude grades. This would also widen the crude spreads.

**The bottom line.** Coking refineries, of which there are many in the US (very few in Europe), will benefit, so should asphalt refineries, but with the risk that some fuel oil refineries may attempt to enter the asphalt market. Even those refineries in the US that do produce fuel oil, many of these will be well suited to produce low sulfur bunker fuel because of their low sulfur crude slate. The refineries most at risk after 2020 are refineries which process higher sulfur crudes and produce fuel oil, albeit the degree of challenges also depends on the potential liberalization of the Russian refining sector, in our view, which could see significant reduction in the fuel oil output and therefore exports. Europe seems to be not so well positioned amongst the developed world markets – refineries in Europe are predominately cracking facilities with low level of coking capacity (the weakest links are France).

### Figure 43: Coking capacity as % of CDU capacity by select countries

Source: OGJ (data from early 2015), FGE, Company data, Credit Suisse Research
## Refining and Chemical margins

### Refining margin summary

**Figure 44: Summary: Crude prices and spreads, regional refining margins and product crack spreads**

<table>
<thead>
<tr>
<th>Crude oil prices ($/bbl)</th>
<th>1Q15</th>
<th>2Q15</th>
<th>3Q15</th>
<th>4Q15</th>
<th>1Q16</th>
<th>2Q16</th>
<th>3Q16</th>
<th>4Q16</th>
<th>Last 4 weeks</th>
<th>Prior 4 weeks</th>
<th>Last 2 weeks</th>
<th>Prior 2 weeks</th>
<th>Last week</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTI</td>
<td>48.6</td>
<td>57.7</td>
<td>46.6</td>
<td>41.9</td>
<td>33.4</td>
<td>45.6</td>
<td>44.9</td>
<td>47.9</td>
<td>46.2</td>
<td>49.4</td>
<td>44.9</td>
<td>47.5</td>
<td>45.2</td>
</tr>
<tr>
<td>Brent</td>
<td>53.92</td>
<td>62.1</td>
<td>50.1</td>
<td>43.3</td>
<td>34.5</td>
<td>46.0</td>
<td>45.8</td>
<td>48.1</td>
<td>46.4</td>
<td>49.4</td>
<td>45.2</td>
<td>47.6</td>
<td>45.3</td>
</tr>
<tr>
<td>Urals</td>
<td>52.2</td>
<td>60.6</td>
<td>46.6</td>
<td>40.7</td>
<td>31.8</td>
<td>43.4</td>
<td>43.4</td>
<td>45.8</td>
<td>44.4</td>
<td>46.6</td>
<td>43.2</td>
<td>45.6</td>
<td>43.3</td>
</tr>
<tr>
<td>Dubai</td>
<td>52.3</td>
<td>61.3</td>
<td>50.0</td>
<td>30.8</td>
<td>33.0</td>
<td>43.0</td>
<td>43.4</td>
<td>46.2</td>
<td>46.2</td>
<td>47.6</td>
<td>42.7</td>
<td>45.7</td>
<td>42.4</td>
</tr>
<tr>
<td>Bonny Light</td>
<td>54.9</td>
<td>62.7</td>
<td>50.8</td>
<td>43.7</td>
<td>34.7</td>
<td>46.3</td>
<td>47.0</td>
<td>48.5</td>
<td>46.8</td>
<td>50.0</td>
<td>45.7</td>
<td>48.0</td>
<td>45.9</td>
</tr>
<tr>
<td>Dubai - Brent spread</td>
<td>-1.6</td>
<td>-0.7</td>
<td>-0.1</td>
<td>-2.3</td>
<td>-3.7</td>
<td>-3.0</td>
<td>-2.4</td>
<td>-1.9</td>
<td>-2.2</td>
<td>-2.5</td>
<td>-2.5</td>
<td>-1.9</td>
<td>-2.9</td>
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<tr>
<td>Urals - Brent spread</td>
<td>-1.72</td>
<td>-1.5</td>
<td>-1.5</td>
<td>-2.7</td>
<td>-2.7</td>
<td>-2.6</td>
<td>-2.4</td>
<td>-2.3</td>
<td>-2.0</td>
<td>-2.8</td>
<td>-2.0</td>
<td>-2.0</td>
<td>-2.0</td>
</tr>
<tr>
<td>Bonny Light - Brent spread</td>
<td>1.0</td>
<td>0.7</td>
<td>0.6</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
<td>1.2</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
<td>0.5</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>WTI - Brent spread</td>
<td>-5.3</td>
<td>-4.3</td>
<td>-3.5</td>
<td>-1.4</td>
<td>-1.1</td>
<td>-0.4</td>
<td>-0.9</td>
<td>-0.2</td>
<td>-0.2</td>
<td>-0.1</td>
<td>-0.3</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

### Refining margins ($/bbl)

| CS NWE Indicator margin - Medium complex | 8.6 | 9.3 | 10.2 | 7.0 | 5.7 | 6.2 | 5.7 | 7.4 | 7.2 | 7.7 | 6.3 | 8.0 | 6.0 |
| US PADD 1 margin - Simple               | 5.2 | 6.0 | 7.2 | 3.4 | 2.4 | 2.9 | 2.2 | 4.4 | 4.3 | 4.3 | 3.4 | 5.2 | 3.1 |
| US PADD 2 margin - Simple               | 12.2| 12.6| 12.4| 8.8 | 7.7 | 10.1| 9.0 | 10.9| 11.3| 10.6| 10.4| 12.2| 9.5 |
| US PADD 3 margin - Simple               | 16.3| 20.9| 24.2| 14.2| 10.0| 17.2| 14.6| 10.2| 8.8 | 13.1| 7.6 | 9.9 | 8.0 |
| US PADD 4 margin - Simple               | 17.7| 22.6| 20.9| 10.8| 11.1| 13.3| 12.9| 12.0| 11.1| 13.5| 9.6 | 12.7| 8.9 |
| US PADD 5 margin - Simple               | 21.5| 29.0| 23.2| 21.6| 18.6| 19.4| 17.0| 18.5| 18.7| 19.2| 15.4| 21.9| 12.5|
| Asia (Singapore 6-2-3-1)                | 12.4| 12.5| 10.4| 11.5| 10.1| 8.5 | 8.3 | 11.1| 12.0| 9.9 | 11.4| 12.6| 11.3|
| Asia (Singapore 3-1-1-1)                | 9.1 | 9.3 | 7.0 | 7.9 | 7.4 | 5.4 | 5.6 | 8.3 | 9.3 | 7.0 | 8.9 | 9.7 | 8.8 |
| Asia (Japan 8-3-2-2-1)                 | 15.4| 16.0| 14.6| 14.9| 13.4| 11.7| 10.4| 13.0| 13.7| 12.0| 13.1| 14.3| 13.0|
| Russia - Complex export to NWE         | 11.3| 11.7| 11.4| 8.2 | 6.0 | 7.2 | 8.2 | 10.1| 10.1| 10.1| 9.9 | 10.4| 9.3 |
| Russia - Simple export to NWE          | 4.3 | 3.6 | 3.6 | 1.6 | 0.4 | 0.7 | 2.5 | 4.0 | 4.2 | 3.8 | 4.2 | 4.3 | 3.7 |
| Russia - Teapod export to NWE          | 1.3 | -0.1| -0.9| -1.9| -2.6| -3.6| -1.0| 1.2 | 1.7 | 0.7 | 1.9 | 1.5 | 1.4 |

### Product cracks (NWE)

<table>
<thead>
<tr>
<th>Product</th>
<th>Cracking Thoughts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude oil</td>
<td>Refining margin summary</td>
</tr>
<tr>
<td>Gasoline</td>
<td>11.4</td>
</tr>
<tr>
<td>Heating oil</td>
<td>13.1</td>
</tr>
<tr>
<td>Diesel</td>
<td>17.6</td>
</tr>
<tr>
<td>LSFO (1%)</td>
<td>-9.3</td>
</tr>
<tr>
<td>HSFO (3.5%)</td>
<td>-13.7</td>
</tr>
<tr>
<td>Naphtha</td>
<td>-2.4</td>
</tr>
<tr>
<td>Jet</td>
<td>18.4</td>
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### Product cracks (US)

<table>
<thead>
<tr>
<th>Product</th>
<th>Cracking Thoughts</th>
</tr>
</thead>
<tbody>
<tr>
<td>US PADD 1 gasoline</td>
<td>9.5</td>
</tr>
<tr>
<td>US PADD 2 gasoline</td>
<td>13.0</td>
</tr>
<tr>
<td>US PADD 3 gasoline</td>
<td>15.9</td>
</tr>
<tr>
<td>US PADD 5 gasoline</td>
<td>22.5</td>
</tr>
<tr>
<td>US PADD 1 distillate</td>
<td>19.1</td>
</tr>
<tr>
<td>US PADD 2 distillate</td>
<td>22.9</td>
</tr>
<tr>
<td>US PADD 3 distillate</td>
<td>21.3</td>
</tr>
<tr>
<td>US PADD 5 distillate</td>
<td>20.6</td>
</tr>
</tbody>
</table>

### Product cracks (Singapore)

<table>
<thead>
<tr>
<th>Product</th>
<th>Cracking Thoughts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>15.5</td>
</tr>
<tr>
<td>Distillate</td>
<td>15.9</td>
</tr>
<tr>
<td>HSFO</td>
<td>-4.2</td>
</tr>
</tbody>
</table>

Source: Platts, Argus, Credit Suisse Research
Regional refining margins

Figure 45: CS Indicator NWE refining margins ($/bbl)

Source: Platts, Credit Suisse Research

Figure 46: US East Coast 6-3-2-1 ($/bbl) (Brent based)

Source: Platts, Credit Suisse Research

Figure 47: USGC 3-2-1 ($/bbl) (WTI based)

Source: Platts, Credit Suisse Research

Figure 48: US West Coast 5-3-1-1 ($/bbl) (ANS based)

Source: Platts, Credit Suisse Research

Figure 49: 6-2-3-1 Singapore Refining margins ($/bbl)

Source: Platts, Credit Suisse Research

Figure 50: Russian Complex export margins ($/bbl)

Source: Argus, Credit Suisse Research
Key global crude differentials

Figure 51: WTI-Brent differentials ($/bbl)

Source: Platts, Credit Suisse Research

Figure 52: LLS-Brent differentials ($/bbl)

Source: Platts, Credit Suisse Research

Figure 53: LLS-Maya differentials ($/bbl)

Source: Platts, Credit Suisse Research

Figure 54: Urals-Brent differentials ($/bbl)

Source: Platts, Credit Suisse Research

Figure 55: Bonny Light-Brent differentials ($/bbl)

Source: Platts, Credit Suisse Research

Figure 56: Brent-Dubai differentials ($/bbl)

Source: Platts, Credit Suisse Research
North West Europe (NWE)

Figure 57: CS Indicator NWE refining margins ($/bbl)

Source: Platts, Credit Suisse Research

Figure 58: NWE Complex vs Simple margins ($/bbl)

Source: Platts, Credit Suisse Research

Figure 59: NWE gasoline cracks ($/bbl)

Source: Platts, Credit Suisse Research

Figure 60: NWE naphtha cracks ($/bbl)

Source: Platts, Credit Suisse Research

Figure 61: NWE 10ppm diesel cracks ($/bbl)

Source: Platts, Credit Suisse Research

Figure 62: NWE 1.0% fuel oil cracks ($/bbl)

Source: Platts, Credit Suisse Research
United States of Americas (USA)

Figure 63: US East Coast 6-3-2-1 ($/bbl) (Brent based)

Source: Platts, Credit Suisse Research

Figure 64: USGC 3-2-1 ($/bbl) (WTI based)

Source: Platts, Credit Suisse Research

Figure 65: USGC 3-2-1 ($/bbl) (LLS based)

Source: Platts, Credit Suisse Research

Figure 66: USGC 3-2-1 ($/bbl) (MAYA based)

Source: Platts, Credit Suisse Research

Figure 67: US Mid-Continent 3-2-1 ($/bbl) (WTI based)

Source: Platts, Credit Suisse Research

Figure 68: US West Coast 5-3-1-1 ($/bbl) (ANS based)

Source: Platts, Credit Suisse Research
US: Gulf Coast and East Coast spreads

Figure 69: USGC gasoline cracks ($/bbl) (LLS based)

Source: Platts, Credit Suisse Research

Figure 70: USGC distillate cracks ($/bbl) (LLS based)

Source: Platts, Credit Suisse Research

Figure 71: USGC gasoline cracks ($/bbl) (WTI based)

Source: Platts, Credit Suisse Research

Figure 72: USGC distillate cracks ($/bbl) (WTI based)

Source: Platts, Credit Suisse Research

Figure 73: USEC gasoline cracks ($/bbl) (Brent based)

Source: Platts, Credit Suisse Research

Figure 74: USEC distillate cracks ($/bbl) (Brent based)

Source: Platts, Credit Suisse Research
The price premium for premium gasoline spiked in 3Q15.
Asian refining margins

Figure 81: 8-3-2-2-1 Japan Dubai based margins ($/bbl)

Figure 82: 6-2-3-1 Singapore Dubai based margins ($/bbl)

Figure 83: Singapore gasoline cracks ($/bbl)

Figure 84: Singapore diesel crack ($/bbl)

Figure 85: Singapore fuel oil (FO) crack ($/bbl)

Figure 86: Singapore diesel over FO spread ($/bbl)

Source: Platts, Credit Suisse Research
Russian refining margins

Refining margins in Russia came under pressure in 2015. This was due to the implementation of the so-called tax maneuver, which came into force on 1 January 2015.

One of the parameters of the tax change included the reduction in export duties, designed to stimulate upstream economics. Given domestic oil prices are calculated on a netback basis (i.e. oil prices net of export duties), a reduction in export duties leads to higher domestic oil prices (i.e. higher feedstock prices for refineries). The other factor that put pressure on the downstream sector was the RUB weakness.

Figure 87: Russian refining margins to NWE ($/bbl)

Source: Argus, Credit Suisse Research

Figure 88: Complex Russian margins to NWE ($/bbl)

Source: Argus, Credit Suisse Research

Figure 89: Simple Russian margins to NWE ($/bbl)

Source: Argus, Credit Suisse Research

Figure 90: Teapot Russian margins to NWE ($/bbl)

Source: Argus, Credit Suisse Research
29 November 2016

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Figure 91: ‘Complex’ Russian margins to NWE ($/bbls)

Figure 92: ‘Complex’ Russian margins to Med ($/bbls)

Source: Argus, Credit Suisse Research

Figure 93: ‘Simple’ Russian margins to NWE ($/bbls)

Figure 94: ‘Simple’ Russian margins to Med ($/bbls)

Source: Argus, Credit Suisse Research

Figure 95: ‘Teapot’ Russian margins to NWE ($/bbls)

Figure 96: ‘Teapot’ Russian margins to Med ($/bbls)

Source: Argus, Credit Suisse Research
Refinery Throughput
Summary – crude runs

Figure 97: Global crude runs (mbd)

Source: IEA, Credit Suisse Research

Figure 98: OECD crude runs (mbd)

Source: IEA, Credit Suisse Research

Figure 99: US refinery runs (mbd)

Source: DOE, Credit Suisse Research

Figure 100: Original EU 16 refinery runs (kbd)

Source: Eurol, Credit Suisse Research

Figure 101: Chinese refinery runs (kbd)

Source: CEI, Credit Suisse Research

Figure 102: Russian refinery runs (kbd)

Source: The Ministry of Energy, Credit Suisse Research
Key global refinery data

Data for US, China, Russia, India, Saudi, Japan, South Korea, Brazil, Mexico, Germany, UK and France.

Figure 109: Aggregated refinery runs (kbd)

Figure 110: Oil Products Net Exports (kbd)

Figure 111: Gasoline output (kbd)

Figure 112: Fuel Oil output (kbd)

Figure 113: Gas/Diesel output (kbd)

Figure 114: Gas oil/ Diesel net exports (kbd)

Source: JODI, Credit Suisse Research
US crude runs by PADDs

Figure 115: US refinery runs (mbd)

Figure 116: PADD II (Mid-Continent) crude runs (mbd)

Source: EIA, Credit Suisse Research

Figure 117: PADD III (US Gulf Coast) crude runs (mbd)

Figure 118: PADD III utilization rates (% of operable capacity)

Source: EIA, Credit Suisse Research

Figure 119: PADD IV crude runs (mbd)

Figure 120: PADD V (West Coast) crude runs (mbd)

Source: EIA, Credit Suisse Research
US key product export/import data

Figure 121: PADD 3 Diesel net export (kbd)

Figure 122: US diesel export to Latam (kbd)

Source: EIA, Credit Suisse Research

Figure 123: US diesel export to Europe (kbd)

Figure 124: PADD 1 Gasoline net import (kbd)

Source: EIA, Credit Suisse Research

Figure 125: PADD 1 Gasoline import from Europe (kbd)

Figure 126: US Gasoline exports to West Africa (kbd)

Source: EIA, Credit Suisse Research
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Chinese product demand data (1/2)

Figure 127: Chinese refinery runs (kbd)

- 2012
- 2013
- 2014
- 2015
- 2016

- Total Oil Products

Source: CEIC, Credit Suisse Research

Figure 128: Shandong teapot refinery utilisation rates (%)

Source: CEIC, Credit Suisse Research; Note: Shandong has nameplate capacity of ~3mbd

Figure 129: Oil products demand, 3MMA y/y growth (mbd)

Source: CEIC, Credit Suisse Research

Figure 130: Oil products demand, y/y (%)

Source: CEIC, Credit Suisse Research

Figure 131: Gasoline demand, 3MMA y/y growth (mbd)

Source: CEIC, Credit Suisse Research

Figure 132: Diesel demand, 3MMA y/y growth (mbd)

Source: CEIC, Credit Suisse Research
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Figure 133: Crude Oil demand trend (mbd)

Source: CEIC, Credit Suisse Research

Figure 134: Oil products demand trend (mbd)

Source: CEIC, Credit Suisse Research

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Source: CEIC, Credit Suisse Research

Figure 136: Diesel demand trend (mbd)

Source: CEIC, Credit Suisse Research

Figure 137: Naphtha demand trend (mbd)

Source: CEIC, Credit Suisse Research

Figure 138: Fuel Oil demand trend (mbd)

Source: CEIC, Credit Suisse Research
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Figure 139: Net total oil products import/(export), kbd

![Graph showing net total oil products import/export from January to December for 2012 to 2016.]

Source: CEIC, Credit Suisse Research

Figure 140: Net gasoline import/(export), kbd

![Graph showing net gasoline import/export from January to December for 2012 to 2016.]

Source: CEIC, Credit Suisse Research

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![Graph showing net diesel import/export from January to December for 2012 to 2016.]

Source: CEIC, Credit Suisse Research

Figure 142: Net jet/kero import/(export), kbd

![Graph showing net jet/kero import/export from January to December for 2012 to 2016.]

Source: CEIC, Credit Suisse Research

Figure 143: Net Naphtha import/(export), kbd

![Graph showing net Naphtha import/export from January to December for 2012 to 2016.]

Source: CEIC, Credit Suisse Research

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Source: CEIC, Credit Suisse Research
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Source: The Ministry of Energy, Credit Suisse Research

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Source: The Ministry of Energy, Credit Suisse Research

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Source: The Ministry of Energy, Credit Suisse Research

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Source: The Ministry of Energy, Credit Suisse Research

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Source: The Ministry of Energy, Credit Suisse Research

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Source: The Ministry of Energy, Credit Suisse Research
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Source: PPAC, Credit Suisse Research

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Source: PPAC, Credit Suisse Research

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Source: PPAC, Credit Suisse Research

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Source: PPAC, Credit Suisse Research

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Source: PPAC, Credit Suisse Research
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Source: PPAC, Credit Suisse Research
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Source: JODI, Credit Suisse Research
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**Figure 169: Japanese refinery runs (kbd)**

![Graph showing Japanese refinery runs (kbd)](image)

Source: JODI, Credit Suisse Research

**Figure 170: Oil Products Net Imports (kbd)**

![Graph showing oil products net imports (kbd)](image)

Source: JODI, Credit Suisse Research

**Figure 171: Gasoline output (kbd)**

![Graph showing gasoline output (kbd)](image)

Source: JODI, Credit Suisse Research

**Figure 172: Fuel Oil output (kbd)**

![Graph showing fuel oil output (kbd)](image)

Source: JODI, Credit Suisse Research

**Figure 173: Gas/Diesel output (kbd)**

![Graph showing gas/diesel output (kbd)](image)

Source: JODI, Credit Suisse Research

**Figure 174: Gas oil/ Diesel net exports (kbd)**

![Graph showing gas oil/diesel net exports (kbd)](image)

Source: JODI, Credit Suisse Research
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Source: JODI, Credit Suisse Research

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Source: JODI, Credit Suisse Research

**Figure 177: Gasoline output (kbd)**

Source: JODI, Credit Suisse Research

**Figure 178: Fuel Oil output (kbd)**

Source: JODI, Credit Suisse Research

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Source: JODI, Credit Suisse Research

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Source: JODI, Credit Suisse Research
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Source: JODI, Credit Suisse Research

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Source: JODI, Credit Suisse Research

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Source: JODI, Credit Suisse Research

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Source: JODI, Credit Suisse Research
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Figure 190: Europe Total Oil stocks (mb)

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Figure 192: Asia Oceania Total Oil stocks (mb)

Source: IEA
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![Graph showing global inventories (mb) from Dec 2010 to Dec 2016]

Source: Credit Suisse Research, IEA, JODI, EIA, Country Data

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![Graph showing global including China SPR inventories (mb) from Dec 2010 to Dec 2016]

Source: Credit Suisse Research, IEA, EIA

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![Graph showing global demand cover (days) from Dec 2010 to Dec 2016]

Source: Credit Suisse Research, Country Data

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![Graph showing OECD demand cover (days) from Dec 2010 to Dec 2016]

Source: Credit Suisse Research, Country Data

**Figure 197: Global gasoline inventories (mb)**

![Graph showing global gasoline inventories (mb) from Jan to Dec 2010-2016]

Source: Credit Suisse Research, IEA, JODI, EIA, Country Data

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![Graph showing global diesel inventories (mb) from Jan to Dec 2010-2016]

Source: Credit Suisse Research, IEA, JODI, EIA, Country Data
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Source: EIA, Credit Suisse Research

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Source: EIA, Credit Suisse Research

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Source: EIA, Credit Suisse Research

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Source: EIA, Credit Suisse Research

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Source: EIA, Credit Suisse Research

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Source: EIA, Credit Suisse Research
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Source: EIA, Credit Suisse Research

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Source: EIA, Credit Suisse Research

Figure 207: OECD gasoline inventories (mbbls)

Source: EIA, Credit Suisse Research

Figure 208: OECD middle distillate inventories (mbbls)

Source: EIA, Credit Suisse Research

Figure 209: Original EU 16 gasoline inventories (mbbls)

Source: EIA, Credit Suisse Research

Figure 210: Original EU 16 MD inventories (mbbls)

Source: EIA, Credit Suisse Research
Credit Suisse view on net refinery capacity additions

**Figure 211: Global refinery net capacity addition forecasts (kbd) – nameplate capacity (not utilization rate adjusted)**

Source: Company data, FGE, Credit Suisse estimates
### Global Refiners' Valuation Summary

#### Global Refiners: Summary Valuations

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<tr>
<td>Marathon Petroleum Corp.</td>
<td>MPC</td>
<td>D</td>
<td>$41.3</td>
<td>6.3%</td>
<td>11.5%</td>
<td>17.3%</td>
<td>39.7%</td>
<td>38.3%</td>
<td>3.1%</td>
<td>0.9%</td>
<td>21.1%</td>
<td>22%</td>
<td>48%</td>
<td>2.5%</td>
<td>3.6%</td>
<td>430</td>
<td>350</td>
<td>545</td>
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### Capex and Free Cashflow

#### Capex and Free Cashflow

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<tr>
<td>Marathon Petroleum Corp.</td>
<td>MPC</td>
<td>D</td>
<td>$64.8</td>
<td>21%</td>
<td>9%</td>
<td>15%</td>
<td>33%</td>
<td>19%</td>
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<td>0.9%</td>
<td>21.1%</td>
<td>22%</td>
<td>48%</td>
<td>2.5%</td>
<td>3.6%</td>
<td>430</td>
<td>350</td>
<td>545</td>
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</table>
Companies Mentioned (Price as of 25-Nov-2016)
Alon USA Energy, Inc. (ALJ.N, $9.55)
BP (BP.L, 484.95p)
Bharat Petroleum (BPCL.BO, Rs639.65)
Caltex Australia (CTX.AX, A$30.35)
Delek US Holdings, Inc. (DK.N, $20.01)
ExxonMobil Corporation (XOM.N, $87.12)
Hindustan Petroleum (HPCL.BO, Rs462.2)
Holly Frontier Corp. (HFC.N, $28.09)
Indian Oil Corp Limited (IOC.BO, Rs296.5)
Marathon (MPC.N, $48.2)
Motor Oil (MO:AT, €12.07)
Neste (NESTE.HE, €38.35)
PB Energy INC (PBF.N, $25.22)
PetroChina (0857.HK, HK$5.36)
Phillips 66 (PSX.N, $84.89)
Reliance Industries Limited (RELI.BO, Rs993.65)
Royal Dutch Shell plc (RDSa.L, 2011.0p)
Saras (SRS.MI, €1.67)
Sinopec Engineering (2386.HK, HK$6.65)
Tesoro Corp. (TSO.N, $96.48)
Thai Oil (TTP.BK, Bt73.0)
Total (TOTF.PA, €44.1)
Tupras (TUPRS.IS, TL66.05)
Valero Energy Corporation (VLO.N, $64.86)
Western Refining Inc. (WNR.N, $37.24)

Disclosure Appendix

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<th>Rating</th>
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<th>Of which banking clients (%)</th>
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<tr>
<td>Outperform/Buy*</td>
<td>44%</td>
<td>(63% banking clients)</td>
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<tr>
<td>Neutral/Hold*</td>
<td>38%</td>
<td>(59% banking clients)</td>
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<tr>
<td>Underperform/Sell*</td>
<td>15%</td>
<td>(55% banking clients)</td>
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<td>Restricted</td>
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