Toil for Oil Spells Danger for Majors
Unsustainable Dynamics Mean Oil Majors Should Become Energy Majors

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   (energy return on capital invested)
"It goes so heavily with my disposition that this goodly frame, the earth, seems to me a sterile promontory; this most excellent canopy, the air, look you, this brave o’erhanging firmament, this majestical roof fretted with golden fire, why, it appears no other other thing to me but a foul and pestilent congregation of vapours"

William Shakespeare
Hamlet
(Act II, sc. ii)
Key points

- The IEA’s base-case scenario (New Policies Scenario) has global primary energy demand rising by 33% over 2012-35.
- At the same time, the NPS has global CO2 emissions rising by 20% over 2012-35.
- The IEA expects global upstream capex to remain broadly at current levels (c.$700bn p.a.) out to 2035.
CO2 emissions under NPS and 450-scenario

Key points

- The difference in CO2 emissions from energy over 2013-35 under the NPS and the 450-Scenario is 156Gt
- The oil industry accounts for c.30% of this difference
- IEA estimates imply that c.80bn barrels of oil would not be burned under 450S that would be burned under NPS

Source: IEA, Redrawing the Climate-Energy Map, 2013
"Like one that draws the model of an house
Beyond his power to build it, who, half-through,
Gives o’er, and leaves his part-created cost
A naked subject to the weeping clouds,
And waste for churlish winter’s tyranny"

William Shakespeare
King Henry IV Part II
(Act I, sc. iii)
1) Toil for Oil:
E&P a much harder game since 2005
The capital intensity of US shale-oil production is phenomenal

Key points

- North America accounts for 18% of global oil production but 50% of global upstream capex
- The decline rates for US shale-oil plays are astronomical, averaging 30-40% already in the second year of production
- By contrast, oil sands are also very capital-intensive upfront but have very long production lifetimes

Source: IEA, 2013 World Energy Outlook, (© OECD/IEA)
Upstream oil & gas capex, costs, and prices

Key points

- Upstream capex has nearly trebled in real terms since 2000, reaching $700bn in 2013 versus $250bn in 2000
- Prices have also increased roughly threefold in real terms over 200-13, but since 2011 prices have been flat
- Over the same period, however, headline production of petroleum liquids has increased by only 14%

Source: IEA, 2013 World Energy Outlook (© OECD/IEA)

Notes: The IEA Upstream Investment Cost Index, set at 100 in 2000, measures the change in underlying capital costs for exploration and production. It uses weighted averages to remove the effects of spending on different types and locations of upstream projects.
Change in upstream oil capex and crude-oil supply since 2000, indexed to 100

Key points

- Upstream oil capex has nearly trebled in real terms since 2000, reaching $700bn in 2013 versus $250bn in 2000
- Prices have also increased roughly threefold in real terms over 200-13, but since 2011 prices have been flat
- Over the same period, however, headline production of crude oil has increased by only 11%
Oil majors’ capital productivity has declined sharply since 2005

Key points

- The majors’ capital productivity has declined more sharply than that of the industry overall

Source: Bloomberg via Astenbeck Capital Management
2) The IEA’s Projections to 2035: A Critique
IEA estimate of future production from currently producing oil fields if all capex were stopped today

Key points

- IEA estimates that if all upstream-oil capex stopped today, output would fall to 13mbd by 2035 v. 74mbd today
- This implies an average annual natural rate of decline in production of c.2.6mbd, or c.3mbd for all petroleum liquids
- We estimate that this implies just over half of all currently producing fields are past their peak

Source: IEA, 2013 World Energy Outlook, (© OECD/IEA)
IEA expectation of future trend in natural decline rates for crude-oil fields

Key points

- Decline rates are measured both on “natural” and “observed” basis, meaning with and without maintenance capex.
- IEA estimates the natural decline rate for post-peak fields globally at c.9%, and the observed decline rate at 6.2%.
- This varies by region, but IEA sees natural decline rates increasing over 2013-35.

Source: IEA, 2013 World Energy Outlook, (© OECD/IEA)
Change in world oil output by source, OPEC & non-OPEC, 2013-35 (mbd)

Key point
- Change in OPEC output fairly evenly balanced, non-OPEC output becomes much more focused on unconventional
Change in world conventional and unconventional Crude-oil output by source, 2013-35 (mbd)

Key point

- IEA is betting very heavily on Iraq, Brazil and Kazakhstan to limit the decline in conventional crude-oil production
- At the same time, the world will become much more dependent on unconventional crude in future

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 World Energy Outlook
Projected change in net exports of crude oil between 2012 & 2035 in IEA’s NPS (mbd)

Key points

- IEA betting very heavily on Iraq, Brazil, Canada, and Kazakhstan for growth in global crude-oil exports out to 2035

Source: Kepler Cheuvreux estimates based on IEA data from 2013 World Energy Outlook
The IEA has recently increased its capex estimates for the upstream oil industry over 2013-35

Key points

<table>
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<th>Region</th>
<th>2013 WEO *</th>
<th>WEIO 2014*</th>
<th>Change ($bn)**</th>
<th>Change (%)**</th>
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<td><strong>20.1</strong></td>
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Source: *IEA, 203 WEO, and IEA World energy Investment Outlook, June 2014 (© OECD/IEA); ** Kepler-Cheuvreux estimates
3) Pricing Scenarios, Future Capex Risk, and Energy Return on Capital Invested (EROCI)
Trend in Brent crude-oil price, with IEA projections under base-case scenario from 2013

Key points

- Oil prices increased by 180% between 2000 and 2013, so IEA forecast looks conservative in comparison.
- Indeed, this is especially the case given that IEA projects a continuation of oil-supply trends seen since 2005.

Source: IEA, 2013 World Energy Outlook (© OECD/IEA)
Key points

- IEA says prices would need to go higher by $15/bbl if investments delayed by OPEC later this decade and early next
- But the point is investments are already being delayed as Majors announced cuts to capex in Q1
Projected growth in world oil demand by activity to 2035 (mbd)

Key points

- Transport accounts for overwhelming majority of future oil-demand growth

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 World Energy Outlook
Projected growth in world oil demand by country and region (mbd)

Key points

- China is 43% of total global demand growth to 2035, and China ad India together 75%

*Source: Kepler-Cheuvreux estimates based on IEA data from 2013 World Energy Outlook*
Key points

- Transport accounts for 12mbd out of total projected demand growth of 14mbd by 2035
- However, IEA sees only minimal growth in EVs by 2035, which makes investments made today and over next decade in high-cost, high-carbon oil projects vulnerable to stranding if real oil prices rise and renewable-energy costs continue to fall.
Net EROCI of oil versus solar PV and wind based on today’s economics (2014)

Key points

- Onshore wind already today almost competitive with oil at $25/bbl for powering EVs versus conventional automobiles
- All renewables more competitive than oil at $100/bbl – renewables have a higher net EROCI today than oil at $100/bbl

Source: Kepler-Cheuvreux estimates
Net EROI of oil versus solar PV and wind based on KC estimates of 2020 economics

Key points

- Assuming higher real oil prices of $125/bbl by 2020 (in constant 2012 $), and cost reductions of 10% in real terms for onshore wind and 15% for solar PV and offshore wind.

- All renewables much more competitive than oil at both $100/bbl and $125/bbl.

Source: Kepler-Cheuvreux estimates
Net EROCI of oil versus solar PV and wind based on KC estimates of 2035 economics

Key points

- Assuming higher real oil prices of $145/bbl by 2035 (again, in constant 2012 $), and real-terms cost reductions of a further 10% versus 2020 for onshore wind and 15% for solar PV and offshore wind.
- Net EROCI of all renewables much more competitive than oil at both $125/bbl and $145/bbl.

Source: Kepler-Cheuvreux estimates
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