24 April 2014

Kepler Cheuvreux

Energy transition & climate change

ESG

Sustainability Research

Stranded assets, fossilised revenues

USD28trn of fossil-fuel revenues at risk in a 450-ppm world

Sustainability Research

A 450-ppm world would threaten high-cost, high-carbon revenues

Under a global climate deal consistent with a 2°C world, we estimate that the fossil-fuel industry would stand to lose USD28trn (in constant 2012 US dollars) of gross revenues over the next two decades, compared with business as usual. We derive this number by comparing the IEA's base-case scenario for global energy trends out to 2035 and its scenario consistent with a 2°C world. The oil industry accounts for USD19.3trn of this, gas USD4trn, and coal USD4.9trn. The revenues most at risk would be concentrated in the high-cost, high-carbon sources of production. For the oil industry, this means, above all, deepwater, oil-sands, and shale-oil plays.

But business as usual also has big risks for fossil-fuel companies

The oil industry's increasingly unsustainable dynamics – as manifested, for example, by ongoing capex reductions amid record-high oil prices – mean that stranded-asset risk exists even under business-as-usual conditions: high oil prices will encourage the shift away from oil towards renewables (whose costs are falling) while also incentivising greater energy efficiency.

Engagement now key for stress-testing climate scenarios

Ongoing negotiations in preparation for COP-21 next year are only likely to increase the pressure for greater transparency on carbon risk. Against this backdrop, we think investors need more details on the breakdown of oil companies' assets by project type and on their capital-allocation processes in order to be able to better assess carbon risk and cost/revenue risk. We see an opportunity for the oil industry to engage in a transparent dialogue with investors on the carbon risks it faces and thus provide a transparent stress test of its business model against potential future climate-policy scenarios.

Sustainability research team

Mark C. Lewis (author)
mlewis@keplercheuvreux.com
+33 1 7081 5760

Stéphane Voisin (coord.)
svoisin@keplercheuvreux.com
+33 1 7081 5762

Sudip Hazra
shazra@keplercheuvreux.com
+33 1 7081 5762

Samuel Mary
smary@keplercheuvreux.com
+44 20 7621 5190

Robert Walker
rwalker@keplercheuvreux.com
+44 20 7621 5186

Contents

Fossilised revenues – an overview

We see USD28trn of fossil-fuel revenues at risk in a 450-ppm world

In a carbon-constrained world consistent with the policy goal of limiting greenhouse-gas (GHG) concentrations in the atmosphere to 450ppm of CO2-equivalent (CO2e) and hence restricting the increase in the average global temperature to no more than 2°C above pre-industrial levels, we estimate that the fossil-fuel industry would stand to lose c. USD28trn (in constant 2012 USD) of gross revenues over the next two decades relative to the current trajectory. We derive this number by comparing the IEA's base-case scenario for global energy trends out to 2035 (known as the New Policies Scenario, or NPS) with its 450-Scenario (its scenario consistent with a 2°C world).

Under the IEA's 450-Scenario (450S), both the demand for and the prices of fossil fuels would fall as policies were put in place to restrict CO2 emissions from energy, which diverge sharply under the two scenarios. By 2035, energy emissions under the 450S are 15Gt lower than under the NPS (22Gt and 37Gt respectively), and this gives rise to a cumulative difference over the next two decades of 156Gt. The measures required to achieve these emission reductions under the IEA's modelling include both carbon pricing and mandated measures and standards (particularly with regard to energy efficiency), with the 450S positing higher and more widespread carbon pricing across the world than the NPS.

In terms of the volume impact of these policy measures relative to the NPS, we estimate that cumulative demand for fossil fuels over the next two decades under the 450S would be lower by 45,000m tonnes of oil equivalent (mtoe) – which equates to four years of fossil-fuel demand at the 2011 rate of consumption – with coal accounting for c. 50% of this difference, oil c. 30%, and gas c. 20%. Cumulative oil demand (crude oil plus natural-gas liquids) over 2012-35 under the 450S is lower by 94bn barrels (bbls) than under the NPS, cumulative gas demand by 10.6trn cubic metres (tcm), and cumulative coal demand by 31bn tonnes of coal equivalent (tce).

In terms of the price impact of these measures, prices would be lower for all fossil-fuels under the 450S than under the NPS. Under the 450S the IEA sees oil prices averaging USD109/bbl (in constant 2012 USD) out to 2035 compared with USD120/bbl under the NPS, and coal USD87/tonne under the 450S versus USD105/tonne under the NPS. For gas, the picture is more complicated, as prices vary greatly across the world, but in all regions prices are on average lower under the 450S than under the NPS (by 9% in North America, 13% in Europe, and 10% in Japan).

The net impact of these volume and price effects under the 450S would be to reduce the revenues of the oil industry by USD19.3trn over the IEA's projected timeframe of 2013-35, those of the gas industry by USD4trn, and those of the coal industry by USD4.9trn (all in constant 2012 USD).

Climate politics very tough, but carbon-scenario analysis a useful risk tool

The IEA's 450S is primarily intended to help policymakers make informed choices to put the global energy system on a sustainable pathway consistent with what the climate science says is both necessary and possible if the world is to stand a chance of mitigating the worst impacts of climate change.

In this respect, the third instalment of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change published earlier this month is a timely reminder of why the IEA's modelling of the 450S is so important.

At the same time, though, the usefulness of the IEA's modelling extends far beyond the insights it provides for policymakers, and we think that comparing the very different outcomes for the fossil-fuel industry under the NPS and the 450S can also help investors. Specifically, we think that this kind of comparative scenario analysis can help investors reach a clearer understanding of the magnitude of the risks that fossil-fuel companies face in a world where the threat of a much more carbon-constrained policy framework is one only likely to increase in the future.

This is not to say that we assume the ongoing climate negotiations through the United Nations Framework Convention on Climate Change (UNFCCC) will result in a global policy deal at the 21st meeting of the Conference of the Parties (COP-21) in Paris in December 2015 consistent with a 450-ppm world. On the contrary, we think the political obstacles to be overcome are extremely formidable, and that a deal of such ambition is very unlikely within such a short timeframe.

Rather, it is simply to argue that the fossil-fuel industry can no longer afford to ignore the issue of carbon risk, and that a transparent stress-testing of its business model against the risk of a 450-ppm world would be the best way of kick-starting a dialogue with investors and other stakeholders over a meaningful risk-mitigation process. This is because a transparent stress test of this kind would reveal where the biggest risks lie in fossil fuel companies' portfolios, and would therefore begin an engagement process with shareholders and other stakeholders over how these risks should be managed in the future as climate policies continue to evolve at the national, regional, and global level.

ExxonMobil's recent carbon-risk report was a missed opportunity

In response to recent pressure from shareholders and NGOs, ExxonMobil published a report on 31 March explaining how it evaluates the carbon risk in its portfolio (the report is entitled Energy and carbon – managing the risks). We think Exxon's report was: 1) too dismissive of the risk of a co-ordinated global policy response ever happening; and 2) far too binary in its assessment of the climate-policy risks the oil industry faces.

On the first of these points, we have already acknowledged that a 450-ppm deal by December 2015 does not look at all likely, but the point about global climate policy is as much the direction of travel as the speed, and in effectively dismissing the likelihood of policymakers ever getting genuinely serious in terms of policy ambition, we think ExxonMobil is giving itself a free pass in terms of the need to at least contemplate what a 450-ppm world would mean. Just because it is highly unlikely to happen at COP-21 in Paris next year does not mean that a much more carbon-constrained policy framework will never be implemented. Viewed in this way, stress-testing for a much more carbon-constrained world within, say, a ten-year timeframe, would simply be sensible risk assessment.

On the second point, we think ExxonMobil's report was too binary because carbon risks relate not only to a potential global climate deal, but also to regional and national climate policy. In other words, whether a global policy framework consistent with a 450-Scenario is ultimately put in place or not, there is always also the risk of tighter legislation that could lead to stranded assets in certain markets.

A good example of such a risk at the moment relates to the ongoing debate over the Keystone XL (KXL) pipeline between Canada and the US. If President Obama ultimately decides to veto KXL, this could create stranded assets in the oil-sands plays both for ExxonMobil and other oil companies.

Indirectly, one could argue that the momentum building among institutional investors to screen for carbon risk (as exemplified by the recent pressure applied to ExxonMobil by Arjuna Capital and As You Sow via the shareholder resolution they filed and then withdrew in exchange for Exxon's agreeing to publish a report on the carbon risks it faces) is itself a form of climate-policy risk for fossil-fuel companies. After all, if investors were to start shunning those fossil-fuel companies perceived to be at greatest risk from a more carbon-constrained world, then over time those companies would likely face much greater difficulty financing their operations.

In short, had ExxonMobil published a report looking at a nuanced range of carbon risk to its project portfolio encompassing both extremes of the spectrum – the 450-ppm end on the one hand, and the business-as-usual (BAU) end on the other with an analysis of the potential options in between – this would already have entailed a higher degree of disclosure regarding future revenues potentially at risk and thus have taken the debate over the carbon risk facing fossil-fuel companies to a new level. Instead, Exxon Mobil chose to focus almost exclusively on the business-as-usual case, and in this way did not advance the debate at all.

Revenue risk for oil industry focused on deepwater, oil sands, and shale oil

In our view, the key point about the revenues under threat for the fossil-fuel industry under a 450-ppm framework is that the risks would be concentrated on the marginal producers, i.e. on the companies at the high end of the respective industry cost curves. For the oil industry, the high-cost, high-carbon sources of production – comprising deep and ultra-deepwater plays, Canadian oil-sands projects, and the shale plays in the US – are dominated by the international majors and independent private companies. Indeed, the data given by the IEA suggests that over 70% of current output from these sources is in the hands of the international majors or private independents. This amounts to some 6.1mbd (2.23bn barrels a year) of unconventional production out of total current unconventional production of 8.4mbd (3.07bn barrels a year).

Given that 9.2m barrels per day (3.34bn barrels per year) of crude oil burned under the NPS would be unburnable under the 450S, then on the face of it from a straightforward economic point of view, all of this 8.4mbd of unconventional production would be the first to be shut in under a 450-ppm policy framework.

The key question, though, relates to timing.

In its *2013 World Energy Outlook* (*WEO*), the IEA argues that reserves that are already being produced from existing oil fields *"will produce without additional investment and, because the rate of natural decline exceeds any conceivable rate of demand drop due to climate policies, this category [of oil production] is unlikely to be stranded"* (*2013 WEO*: p.436).

In other words, the IEA is saying that all existing production would probably be safe from being shut in even under a 450S because existing production would exhaust itself both well within the carbon budget assumed for oil under the 450S and well before alternative sources of production could displace it. The production at risk of being shut in under a 450-ppm framework would therefore relate to reserves that are already proven but that are yet to be developed.

And in our view, the proven reserves most at risk of having their future production shut in under a 450-ppm framework over the second half of the forecast period would be the high-cost, high-carbon unconventional plays that are yet to be developed.

However, under the IEA's modelling unconventional output increases over the forecast period even under the 450S, while production from conventional crude oil declines sharply: by 2035, unconventional production under the 450S is 11.3mbd compared with 5mbd in 2012, while conventional crude output is 27% lower in 2035 than in 2012 (51mbd and 69mbd respectively).

We find this counter-intuitive, as if and when global climate policy were to tighten significantly over time, we think this would start to squeeze out the high-cost, high-carbon sources first. In particular, we think that OPEC countries sitting on lower-cost, lower-carbon reserves would likely want to optimize their output in a 450-ppm world. Allowing for the time needed to upgrade infrastructure to enable higher levels of production, we think this would mean higher levels of lower-cost conventional output over 2025-35 than the IEA is assuming under its 450S.

Economics of high-cost, high-carbon plays exposes them to stranding risk

The idea of unburnable carbon as developed by the Carbon Tracker Initiative (CTI) in its 2011 and 2013 reports on this topic has put the question of stranded-asset risk at the centre of debate for energy investors.[1] Since lost revenues ultimately translate into lost earnings and hence lost value, this would suggest to us that it is the undeveloped deepwater, oil-sands, and LTO assets, which, based on the ownership of existing production from such sources, would be predominantly owned by the majors and private independents – that would be most at risk of stranding under a far-reaching global climate settlement.

Moreover, even if the political will to address climate change in a genuinely meaningful way were not forthcoming within the next decade, we would still see a risk of stranded assets to the oil industry under BAU conditions, namely from *rising* prices brought on by constrained supply.

[1] See the reports by Carbon Tracker *Unburnable Carbon: Are the World's Financial Markets Carrying a Carbon Bubble?* (2011), and *Unburnable Carbon 2013: Waste Capital and Stranded Assets* (2013).

Business as usual brings its own risks for fossil-fuel companies

For many other reasons in addition to climate change – for example, increasing costs and capital intensity, increasing reliance on NGLs in the face of stalling crude-oil production since 2005, declining exports of crude oil globally since 2005 as OPEC consumes more and more of its own production, and the ever-present but recently heightened geo-political risks – the oil industry's current dynamics look unsustainable to us. Given all these challenges, it seems reasonable to suggest that there could be significant upside risk to the IEA's base-case scenario for oil prices over the next two decades as set out in its NPS.

Meanwhile, in stark contrast to the observed long-term trend in the oil industry, the renewable-energy industry has achieved tremendous cost reductions in recent years, and we think this trend is likely to continue over the next two decades.

Other things being equal, the steeper the upward trajectory for oil costs and prices into the future, the greater the incentive will be to accelerate the deployment of renewable-energy technologies and to achieve greater energy-efficiency savings.

This suggests, perhaps paradoxically, that there could be a real risk to the oil industry from *rising* oil prices under a BAU scenario, as combined with continuing reductions in the costs of renewable technologies this could drive the accelerated substitution of oil in the global energy mix over the next two decades. In turn, this would risk creating stranded assets over the medium to longer term both for the oil industry itself and – owing to the central role of oil in energy pricing more generally – for the global fossil-fuel industry as a whole.

The implications of such a scenario would be momentous, as it would mean that the oil industry potentially faces the risk of stranded assets not only under a scenario of falling oil prices brought about by the structurally lower demand entailed by a future tightening of climate policy, but also under a scenario of rising oil prices brought about by rising demand under increasingly constrained supply conditions.

We will have more to say on all of this in a forthcoming report. For now, it is enough to note that in its recent report ExxonMobil also missed the opportunity to engage on whether the respective cost dynamics of the oil and renewable-energy industries might lead to much greater substitution of oil by renewables over the next two decades than it is currently assuming.

Engaging the majors on stranded-asset risk

In our view, ExxonMobil's missed opportunity creates a chance for other oil companies to address these risks in a more comprehensive manner and thus gain industry leadership in this area. In this respect we would highlight the following points as the ones oil companies should be engaging on with their investors and other stakeholders.

First, our analysis in this report leads us to conclude that a detailed breakdown of assets by project type (especially those in the high-cost bracket such as deepwater, oil sands, and light-tight oil) would be an essential first step to giving investors greater clarity both on the carbon risk and the cost risk. This would usefully include both the level of current and targeted production from such assets, and the amount of capital already invested in and future investment earmarked for such projects.

Second, companies should be explaining their capital-allocation processes for new projects in greater detail: how are different opportunities benchmarked against one another? How do hurdle rates vary across project types? And how sensitive are internal carbon-price assumptions to different projects, different regions, and different timeframes?

Third, if oil companies are investing in renewable-energy projects, how do their assumptions on all the variables just listed compare with those they use for new oil and gas projects?

There are many other questions that arise out of this subject area, of course, and we will be expanding upon these and other points in our next report. In conclusion here we would simply say that the companies that understand that a new age of engagement on carbon and stranded-asset risk has already begun are the ones that stand to benefit in terms of investor perception and market reputation.

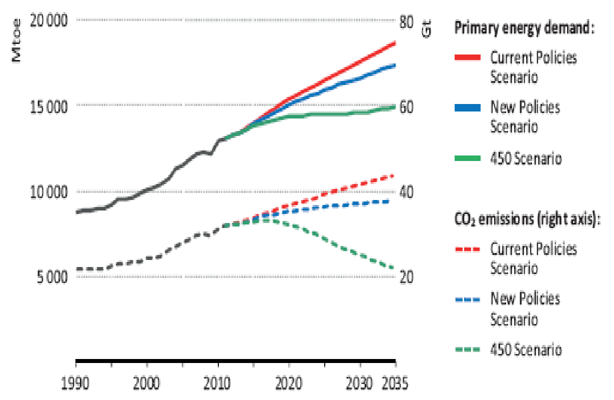
Overview of NPS and 450S

The IEA's *2013 World Energy Outlook* (*2013 WEO*) published last November updated its three scenarios for global energy-market trends out to 2035. These scenarios are:

- The New Policies Scenario (NPS): This is the IEA's base-case scenario for global energy trends out to 2035. The NPS models "*the evolution of energy markets based on the continuation of existing policies and measures as well as cautious implementation of policies that have been announced by governments that are yet to come into effect*" (*2013 WEO*: p. 33);
- The 450-Scenario (450): This models the energy path consistent with a global policy framework aimed at restricting GHG-emissions to 450pmm of CO2e. As such it is the IEA's projection of the energy trends needed to put the world on track *"to have a 50% chance of keeping to 2°C "the long-term increase in average global temperature"* (*2013 WEO*: p. 33);
- The Current Policies Scenario (CPS): This is the business-as-usual scenario, as it *"takes account only of policies already enacted as of mid-2013"* (*2013 WEO*: p. 33) and hence assumes no further tightening of energy or climate policies over the next two decades. The CPS is not directly relevant to our argument in this report, and beyond the brief comparison of all three scenarios immediately below we do not consider it further in this report.

Chart 1 overleaf shows the IEA's modelling of energy demand under these three scenarios and the emissions associated with each one, and Chart 2 shows the change in the energy mix under each scenario.

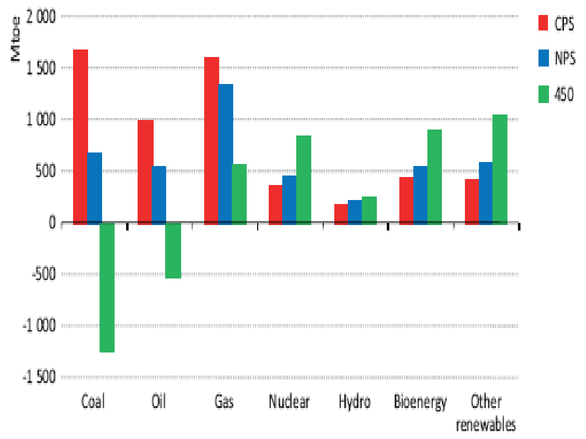
Chart 1: Global demand and emissions by scenario



Note: Mtoe = Million tonnes of oil equivalent; Gt = gigatonnes.

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

Chart 2: Change in global demand by fuel and scenario



Note: CPS = Current Policies Scenario; NPS = New Policies Scenario; 450 = 450 Scenario.

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

Global primary energy demand stood at 13,070m tonnes of oil equivalent (mtoe) in 2011, and as can be seen from Chart 1, it rises out to 2035 under all three IEA scenarios. However, the rate of growth in demand is much lower under the 450S (14%) than both the

NPS (33%) and the CPS (43%), and the composition of demand is also very different (Chart 2). Under the NPS and the CPS the demand for all fossil fuels continues to rise over the next two decades, while under the 450S the demand for both coal and oil declines, with gas the only fossil fuel to see an increase.

As a result of these differing demand-growth and demand-composition profiles, emissions vary greatly under the NPS and the 450S. GlobalCO2 emissions from energy stood at 31.2Gt in 2011, and as Chart 1 shows the 450S is the only one under which energy-related emissions fall over the period. Since emissions have to start falling sharply over the next two decades if the world is to stand a chance of limiting the increase in the average global temperature to 2°C, this means that the emissions profile of the trajectory the world is currently on under the NPS is unsustainable.

Current energy emissions unsustainable in a 450-ppm world

Tables 1 and 2 summarise the projected evolution of global energy demand and emissions out to 2035 under the NPS and the 450S respectively. Under the NPS, global primary-energy demand increases by 33% by 2035 versus 2011 (to 17,386mtoe from 13,069mtoe), with the demand for fossil-fuel energy rising by 24% (to 13,208mtoe from 10,668mtoe). Output from renewable-energy sources grows by 77% and covers 24% of global demand by 2035 compared with 18% in 2011.

Table 1: Global primary energy demand (mtoe) and CO2 emissions (Gt) under the IEA's NPS

			NPS		Change by 2035 versus 2011	
	1990	**2011**	**2020**	**2035**	**(mtoe)**	**%**
Oil	3,664	4,108	4,470	4,661	655	13.5%
Gas	2,073	2,787	3,273	4,119	2,540	47.8%
Coal	2,357	3,773	4,202	4428	445	17.4%
Fossil fuels	**8,094**	**10,668**	**11,945**	**13,208**	**201**	**23.8%**
Nuclear	676	674	886	1119	547	66.0%
Hydro	225	300	392	501	584	67.0%
Bio-energy	1,016	1,300	1,493	1,847	1,332	42.1%
Other renewables	60	127	309	711	4,317	459.8%
Renewables	**1,301**	**1,727**	**2,194**	**3,059**	**1,332**	**77.1%**
WORLD (mtoe)	**10,071**	**13,069**	**15,025**	**17,386**	**655**	**33.0%**
CO2 emissions (Gt)	**23.7**	**31.2**	**34.6**	**37.2**	**6**	**19.2%**

Source: IEA, 2013 WEO (© OECD/IEA)

Under the 450S, global demand increases by a much lower 14% (to 14,907mtoe from 13,069mtoe), with the demand for fossil fuels falling by 24% (to 9,467mtoe from 10,668mtoe). Renewable energy doubles its share of demand from 18% in 2011 to 36% in 2035.

Table 2: Global primary energy demand (mtoe) and CO2 emissions (Gt) under the IEA's 450S

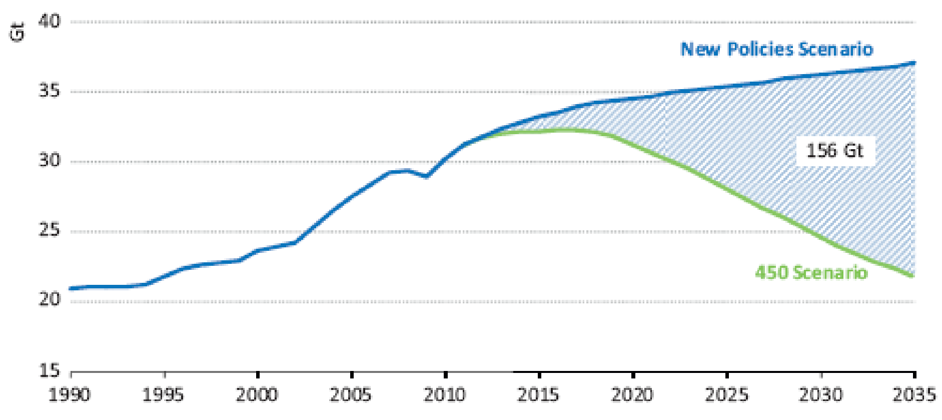
			450S		Change by 2035 versus 2011	
	1990	2011	2020	2035	2020	2035
Oil	3,664	4,108	4,264	3,577	-531	-12.9%
Gas	2,073	2,787	3,148	3,357	570	20.5%
Coal	2,357	3,773	3,715	2,533	-1,240	-32.9%
Fossil fuels	**8,094**	**10,668**	**11,127**	**9,467**	**-1,201**	**-11.3%**
Nuclear	676	674	924	1,521	847	125.7%
Hydro	225	300	401	550	250	83.3%
Bio-energy	1,016	1,300	1,522	2,205	905	69.6%
Other renewables	60	127	342	1,164	1037	816.5%
Renewables	**1,301**	**1,727**	**2,265**	**3,919**	**2,192**	**126.9%**
WORLD (mtoe)	**10,071**	**13,069**	**14,316**	**14,907**	**1,838**	**14.1%**
CO2 emissions (Gt)	**23.7**	**31.2**	**31.7**	**21.6**	**-9.6**	**-30.8%**

Source: IEA, 2013 WEO (© OECD/IEA)

Looking at the cumulative impact over the entire 2012-35 period, we estimate that relative to the NPS demand for fossil fuels under the 450S would be lower by 45,000mtoe – equivalent to four years of fossil-fuel demand at the 2011 rate of consumption – with coal accounting for c. 50% of this difference, oil c. 30%, and gas c. 20%. Cumulative oil demand (crude oil plus natural-gas liquids) over 2012-35 under the 450S is lower by 94bn barrels (bbls) than under the NPS, cumulative gas demand lower by 10.6trn cubic metres (tcm), and cumulative coal demand lower by 31bn tonnes of coal equivalent (tce).

As can be seen by comparing Tables 1 and 2, CO2 emissions from energy diverge sharply under the two scenarios from 2020 onwards, such that by 2035 energy emissions under the NPS are 15Gt higher than under the 450-Scenario (37Gt and 22Gt respectively). Chart 3 shows the cumulative difference in emissions between the two scenarios. Under the NPS, cumulative CO2 emissions out to 2035 are 156Gt higher than they need to be to give the world a reasonable change of restricting the average global temperature increase to 2°C.

Chart 3: World energy-related CO2 emissions by scenario



Source: IEA, Re-drawing the Energy-Climate Map, 2013 (© OECD/IEA)

This stark difference between the two scenarios in terms of global fossil-fuel demand and CO2 emissions reflects the much tougher policy framework assumed under the 450S.

Closing the gap: the policy framework under the 450S

This massive reduction in global fossil-fuel demand and CO2 emissions over the next two decades modelled by the IEA under its 450S pre-supposes a radically more carbon-constrained policy framework than under the NPS.

450S versus NPS: closing the emissions gap

As can be seen by comparing Tables 1 and 2 below, a major driver of the shift away from fossil fuels under the 450-Scenario is the introduction of higher and more widespread carbon pricing across the world than under the NPS.

Table 1 shows the IEA's assumptions for carbon pricing globally under the NPS. Prices reach USD40/t by 2035 in the EU, Australia, New Zealand, and Korea, and USD30/t in China and South Africa, but there is no carbon pricing in either the United States or Canada, even by 2035.

Table 3: CO2 prices under the NPS (in 2012 USD per tonne)

Region	Sectors	2020	2030	2035
European Union	Power, industry, aviation	20	33	40
Australia & New Zealand	All*	20	33	40
Korea	Power and industry	20	33	40
China	All	10	24	30
South Africa	Power and industry	8	15	20

Source: IEA, 2013 WEO (© OECD/IEA); *Agriculture is not assumed to be covered in New Zealand

Under the 450S by contrast, the IEA projects that carbon prices of USD20-35/tonne in real terms (i.e. constant 2012 USD) would be necessary by 2020 across the entire developed world (including the US and Canada), USD95/tonne by 2030, and USD125/t by 2035. Indeed, the 450S assumes that even China, Russia, Brazil, and South Africa will be pricing CO2 emissions at a rate of USD100/t by 2035.

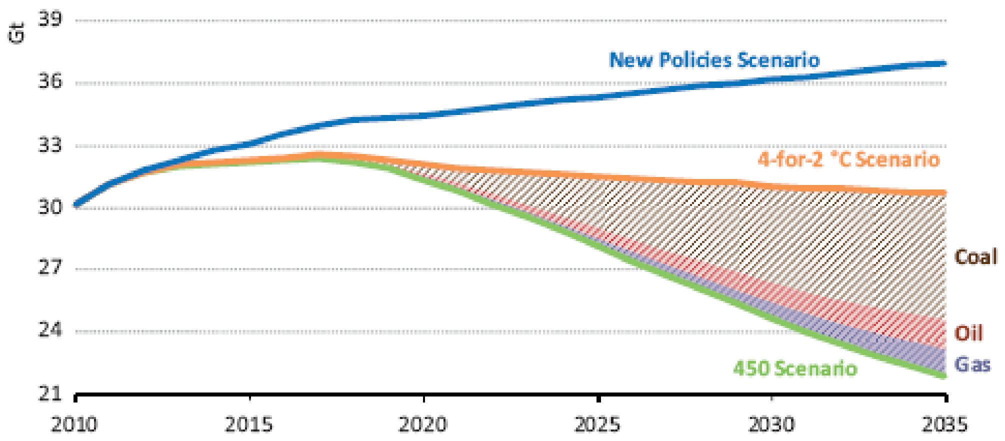
Table 4: CO2 prices under the 450S (in 2012 USD per tonne)

Region	Sectors	2020	2030	2035
United States & Canada	Power and industry	20	95	125
European Union	Power, industry, aviation	35	95	125
Japan	Power and industry	20	95	125
Korea	Power and industry	35	95	125
Australia & New Zealand	All	35	95	125
China**, Russia, Brazil, and South Africa	Power and industry	10	70	100

Source: IEA, 2013 WEO (© OECD/IEA); *All sectors are assumed to be covered in China

In addition to higher and more widespread carbon pricing, the 450S envisages a number of more specific policies tailored for different parts of the global energy system. These measures complement and/or reinforce the carbon-pricing overlay that pervades the global energy system under the 450S. Half of the emissions reductions under the 450S are achieved via what the IEA calls its "4-for-2°C" scenario, and the remaining 50% via the much greater deployment of low-carbon technologies, especially in power generation (Chart 4).

Chart 4: World energy-related CO2 emissions by scenario

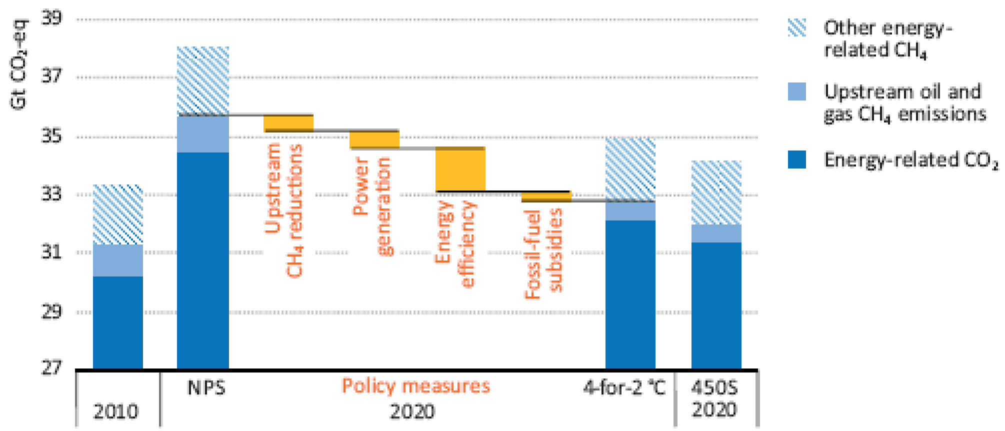


25. Including CH_4, energy-related emissions reach 34.9 Gt CO_2-eq in 2020.

Source: IEA, Re-drawing the Energy-Climate Map, 2013 (© OECD/IEA)

As shown in Chart 5, the 4-for-2°C scenario focuses on four main measures, namely 1) a much greater focus on mandated energy-efficiency measures (responsible for 49% of the savings under the 4-for2°C), 2) restricting the construction of new, low-efficiency coal plants (21%), 3) minimizing methane emissions from the upstream oil-and-gas industry (18%), and 4) partially phasing out fossil-fuel subsidies in both net-importing and net-exporting countries (12%). As can be seen, energy-efficiency measures are the most important in terms of the emissions reductions achieved. The IEA states that c. 60% of the total emissions-reductions achieved under the 4-for2°C scenario come from lower coal use, 25% from oil, and 17% from gas.

Chart 5: World energy-related CO2 emissions by scenario



Notes: Methane emissions are converted to CO_2-eq using a Global Warming Potential of 25. NPS = New Policies Scenario; 450S = 450 Scenario.

Source: IEA, Re-drawing the Energy-Climate Map, 2013 (© OECD/IEA)

Beyond these specific and largely mandated measures, a large part of the remaining 50% of reductions envisaged under the 450S comes from much greater deployment of low-carbon technologies in the power-generation industry, including renewables, nuclear, but also carbon-capture and storage (CCS).

Overall, aggregating all of the emissions savings achieved under the 450S relative to the NPS, we estimate that reduced demand for coal accounts for c. 70% of total CO2 savings from energy over the period, for oil c. 17%, and for gas c. 13%.

A daunting policy challenge, but what if …?

The 450S is primarily meant to inform policymakers in the run-up to the global climate negotiations in 2015, and in this respect, it offers them a hard-headed and practical path to achieving sustained long-term reductions in global C02 emissions. However, modelling a pathway and achieving a deal in global climate negotiations are two very different things, and in reality we think it will be extremely challenging to arrive at a deal in 2015 consistent with the measures outlined in the 450S.

However, this does not mean that fossil-fuel companies can carry on with business as usual without having to concern themselves with the implications of a 450-ppm pathway for their business models. On the contrary, we think fossil-fuel companies should be asking themselves the following question: what if a 450S or something like it were at some point to be implemented?

The revenues at risk in a 450-ppm world

The lower demand for fossil fuels under the 450S, together with higher and more widespread CO2 pricing, implies not only lower emissions compared with the NPS, but also lower fossil-fuel prices.

450S versus NPS: implications for fossil-fuel prices

Under the 450S, oil prices average USD109/bbl (in constant 2012 USD) out to 2035 versus USD120/bbl under the NPS, and coal USD87/tonne under the 450S versus USD105/tonne under the NPS. Gas prices are on average 9% lower under the 450S in North America, 13% lower in Europe, and 10% lower in Japan.

Fossil-fuel prices under the NPS continue to rise in real terms out to 2035

Table 5 shows the IEA's projections for fossil-fuel prices in real terms (constant 2012 USD) out to 2035 under the NPS. Given the rising demand for all fossil fuels over the period, and hence the need for the marginal unit supplied to come from ever higher up the respective industry's cost curve, the prices for all fuels are projected to rise over the next two decades.

Table 5: Fossil-fuel import prices under the NPS in real terms (constant 2012 USD per unit)

Fuel	Unit	2012	2035	2035 versus 2012
Oil	**bbl**	**109**	**128**	**17.4%**
Natural Gas				
US	*mmbtu*	*2.7*	*6.8*	**152%**
Europe	*mmbtu*	*11.7*	*12.7*	**8.5%**
Japan	*mmbtu*	*16.9*	*14.9*	**-11.8%**
Steam coal	**tonne**	**99**	**110**	**11.1%**

Source: IEA, 2013 WEO (© OECD/IEA)

Oil prices are projected to rise by 17% in real terms over the period, reaching USD128/bbl in 2035 compared with USD109/bbl in 2012. Gas prices, which unlike those for oil and coal vary greatly by region, are assumed to rise by 152% in the US, and by 9% in the EU, but to fall by 12% in Japan as the Asian market benefits from increasing supplies of LNG from the Middle East, Australia, and North America. Coal prices rise by a modest 11%, reaching USD110/bbl in 2035 versus USD99/bbl in 2012.

Fossil-fuel prices under the 450S are lower in real terms by 2035

Table 6 shows the projections for fossil-fuel prices in real terms (constant 2012 USD) out to 2035 under the 405S. Given the falling demand for oil and coal over the period, and the lower demand for gas than under the NPS, the prices for all fuels are projected to fall over the next two decades, except for gas prices in the US (these rise more modestly than under the NPS and despite falling prices in the EU and Japan are still lower than in both of these regions by 2035, albeit by a narrower margin).

Table 6: Fossil-fuel import prices under the 450S in real terms (constant 2012 USD per unit)

Fuel	Unit	2012	2035	2035
Oil	**bbl**	**109**	**100**	**-8.3%**
Natural Gas				
US	*mmbtu*	*2.7*	*5.9*	**118.5%**
Europe	*mmbtu*	*11.7*	*9.5*	**-18.8%**
Japan	*mmbtu*	*16.9*	*11.7*	**-30.8%**
Steam coal	**tonne**	**99**	**75**	**-24.2%**

Source: IEA, 2013 WEO (© OECD/IEA)

Oil prices are assumed to fall by 8% in real terms, dropping to USD100/bbl in 2035 compared with USD109/bbl in 2012. Gas prices are estimated to fall by 19% and 31% in the EU and Japan respectively by 2035, but to increase by 119% in the US. Coal prices fall by a quarter by the end of the period, reaching USD75/bbl in 2035 compared with USD99/bbl in 2012.

Lower volumes at lower prices: 450S implies substantially lower revenues

Given that the 450S assumes lower volumes of fossil fuels sold at lower average prices than under the NPS, it follows that the total revenues of the fossil-fuel industry over 2013-35 would be much lower under the 450S than under the NPS.

450S versus NPS: implications for fossil-fuel revenues

We calculate that the net impact of the volume and price effects assumed under the 450S would be to reduce the projected revenues of the global upstream fossil-fuel industry relative to the NPS by USD28 trillion (in constant 2012 USD) over 2013-35. This breaks down as USD19.3trn of lost revenue for the oil industry, USD4trn for the gas industry, and USD4.9trn for the coal industry (again, all in constant 2012 USD).

Oil industry most exposed, with USD19.3trn at stake

We calculate that the net impact of the volume and price effects assumed under the 450S would be to reduce the projected revenues of the global upstream-oil industry relative to the NPS by USD19.3trn (in constant 2012 USD) over 2013-35. This breaks down as USD13.8trn of lost revenue from the sale of conventional crude oil, USD2.8trn from the sale of natural-gas liquids (NGLs), and USD2.6trn from the sale of unconventional crude oil (again, all in constant 2012 USD).

We calculate global upstream-oil revenues at USD86.4trn under NPS…

Table 7 shows the actual volume of oil demand by category in 2012 and the projected volume of demand in 2035 under the NPS. The final column then shows our estimate of total cumulative demand over 2013-35 using a simple linear interpolation of the IEA's numbers for 2012, 2020 and 2035. On this basis, we calculate total demand for petroleum liquids over 2013-35 at 777bn barrels, comprising 566bn barrels of conventional crude oil, 128bn barrels of natural-gas liquids (NGLs), and 84bn barrels of unconventional crude oil.

Table 7: Global oil demand under the NPS, 2012-35 (mbd in 2012 & 2035, bn barrels over 2013-35)

	2012	2035	Total demand over 2013-35
Crude oil	69.4	65.4	565.8
NGLs	12.7	17.7	127.6
Unconventional	5.0	15.0	84.0
Total	**87.1**	**98.1**	**777.4**

Source: For 2012 & 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand over 2013-35, Kepler-Cheuvreux estimates based on IEA data

Table 8 shows our estimates for total revenues to the oil industry over 2013-35. To calculate these numbers we first take the volumes for 2012, 2020, and 2035 as given by the IEA, and then multiply these either by the oil price assumed in each of these years by the IEA (the case for crude oil), or by a price discounted to the IEA number (the case for NGLs and unconventional crude). For NGLs, we assume a price equivalent to 70% of the IEA's crude-oil price in each year, and for unconventional crude a price equivalent to 85% of the IEA's crude-oil price.

The reason we discount the price for NGLs is that NGLs contain less energy per barrel than crude oil. NGLs typically contain 4.4 Gigajoules of energy per barrel compared with 6.3GJ/bbl for crude oil. The reason we discount the price for unconventional crude is that much of the unconventional crude sold today – e.g. US light-tight oil or so-called shale oil, and Canadian oil sands - sells at a discount in the market to conventional crude for a number of reasons, for example because it is landlocked, or because it does not meet refinery specifications.

Accordingly, we derive annual revenues for the upstream oil industry of USD3.3trn in 2012, USD3.6trn in 2020, and USD4.2trn in 2035. The final column then shows our estimate of total cumulative revenues for the upstream oil industry over 2013-35 using a simple linear interpolation of our estimates for 2012, 2020 and 2035. On this basis, we derive total cumulative revenues of USD86.4trn, comprising USD67trn from conventional crude, USD10.7trn from NGLs, and USD8.8trn from unconventional crude.

Table 8: Global upstream-oil industry revenues (USDbn) under the NPS (constant 2012 USD)

Crude-oil price	2012 109/bbl	2020 USD113/bbl	2035 USD128/bbl	Total upstream industry revenues over 2013-35
Crude oil	2,761	2,792	3,055	66,891
NGLs	354	427	579	10,724
Unconventional	169	365	596	8,795
Total	**3,284**	**3,584**	**4,230**	**86,410**

Source: Prices for 2012, 2020, and 2035, IEA, 2013 WEO (© OECD/IEA); all revenue numbers are Kepler-Cheuvreux estimates based on IEA data

…but under 450S we estimate revenues USD19.3trn lower at USD67.1trn

Tables 9 and 10 show total oil demand and total upstream oil revenues over 2013-35 respectively under the 450S. As shown in Table 9, using the same methodology as in the case of Table 7 above, we calculate total demand for petroleum liquids over 2013-35 at 683bn barrels, comprising 505bn barrels of conventional crude oil, 110bn barrels of NGLs, and 68bn barrels of unconventional crude.

Table 9: Global oil demand under the NPS, 2012-35 (mbd in 2012 & 2035, bn barrels over 2013-35)

	2012	2035	Total demand over 2013-35
Crude oil	69,4	50,8	504,5
NGLs	12,7	13,6	110,4
Unconventional	5.0	11,3	68,4
Total	**87,1**	**75,7**	**683,4**

Source: For 2012 & 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand over 2013-35, Kepler-Cheuvreux estimates based on IEA data

As set out in Table 10, using the same methodology as in the case of Table 6 above, we derive annual revenues for the upstream oil industry of USD3.3trn in 2012, USD3.3trn in 2020, and USD2.5trn in 2035. Using our simple linear-interpolation method again, we derive total cumulative revenues of USD67.1trn, comprising USD53trn from conventional crude, USD8.1trn from NGLs, and USD6trn from unconventional crude.

Table 10: Global upstream-oil industry revenues (USDbn) under the NPS (constant 2012 USD)

Crude-oil price	2012 109/bbl	2020 USD113/bbl	2035 USD128/bbl	Total upstream industry revenues over 2013-35
Crude oil	2,761	2,614	1,854	53,076
NGLs	354	385	347	8,063
Unconventional	169	334	351	5,976
Total	**3,284**	**3,333**	**2,552**	**67,115**

Source: Prices for 2012, 2020, and 2035, IEA, 2013 WEO (© OECD/IEA); all revenue numbers are Kepler-Cheuvreux estimates based on IEA data

As shown in Table 11, this means that using our methodology the implied loss to the upstream oil-industry under the 450S in terms of revenues forgone would be USD19.3trn (in 2012 USD).

Table 11: Upstream-oil industry revenues forgone under the 450S vs. NPS (USDbn in 2012 USD)

	NPS	450S	Revenues forgone under 450S
Crude oil	66,891	53,076	-13,815
NGLs	10,724	8,063	-2,661
Unconventional	8,795	5,976	-2,819
Total	**86,410**	**67,115**	**-19,294**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

This breaks down as USD13.8trn of lost revenue from conventional crude oil, USD2.7trn from NGLs, and USD2.6trn from unconventional crude oil (again, all in constant 2012 USD).

As we explained in our introductory chapter (page 6), we find the IEA's assumption of rising unconventional production all the way out to 2035 even under the 450S counter-intuitive, a point we return to in our concluding chapter below.

Gas industry less exposed, but we see USD4trn revenues at risk

As already explained above, gas prices currently vary greatly by region, and although the differences between North American, European, and Japanese prices diminish somewhat over the IEA's forecast period, gas is still projected to be much cheaper in North America by 2035 than in Europe and Japan under both the NPS and the 450S.

The IEA does not give price assumptions for other regions under either the NPS or the 450S, which means that in order to estimate the impact of lower demand projected under the 450S in the rest of the world (ROW), we have to make much more speculative price estimates. As a result, here we first look at the implications of the 450S on the OECD countries (excluding Australia, New Zealand, and South Korea) in terms of the revenues at risk, and then attempt to estimate the impact of the 450S on the gas industry's revenues in the ROW.

Overall, we estimate that the net impact of the volume and price effects assumed under the 450S for the upstream-gas industry in the OECD (excluding Australia, New Zealand, and South Korea) would be to reduce revenues relative to the NPS by USD2.4trn (in constant 2012 USD) over 2013-35. This breaks down as USD900bn of lost revenue in North America, USD1.3trn in Europe, and USD300bn in Japan. For the ROW, our estimates are by their nature more speculative, but taking what we think is a conservative view we see a further USD1.6trn of revenues at risk for the gas industry over 2013-35.

In total, then, we estimate that up to USD4trn of revenues would be at risk for the upstream-gas industry over the next two decades under a global climate-policy framework consistent with a 450-ppm world.

We calculate upstream-gas revenues at USD11.5trn in OECD under NPS

Table 12 shows the actual volume of natural-gas demand between OECD and non-OECD countries in 2011, and the projected volume of demand in 2035 under the NPS. Global demand rises by 48% over the period from 3.4trn cubic metres (tcm) a year in 2011, to nearly 5tcm in 2035, with the OECD's share in the total declining from 45% in 2011 to 36% in 2035.

The third column shows our estimate of total cumulative demand over 2013-35 using a simple linear interpolation of the IEA's numbers for 2011, 2020 and 2035. On this basis, we calculate total demand for natural gas over 2013-35 at 96trn cubic metres, of which 40tcm (42%) is consumed in the OECD countries, and 56tcm (58%) in non-OECD countries.

Table 12: Global gas demand under NPS, 2012-35 (bcm)

	2011	2035	Total demand over 2013-35	Increase over period
OECD	1,597	1,885	40,043	18.0%
Non-OECD	1,773	3,086	55,879	74.1%
Total	**3,370**	**4,971**	**95,922**	**47.5%**
OECD % of total	45%	35.7%	41.7%	

Source: For 2011 and 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand and increase over 2013-35, Kepler-Cheuvreux estimates based on IEA data

Table 13 breaks down demand by region. The global demand increase of 48% disguises big regional variations, and not surprisingly it is the emerging markets that see by far the biggest growth.

Other Asia (comprising China, India, and other fast-growing countries in the region) is projected to increase its gas demand by 165% over the period, Latin America and Africa by over 80% each, and the Middle East by 75%. The OECD regions, by contrast, see much lower growth rates, especially Japan, whose demand barely grows at all over the period (annual demand of 124bcm in 2035 versus 120bcm in 2011).

Table 13: Global gas demand under NPS, 2012-35 (bcm)

	2011	2035	Total demand over 2013-35	Increase over period
North America	869	1,044	22,000	20.1%
Europe	525	605	12,995	15.2%
Aus/NZ	82	112	2,231	36.6%
Japan	120	124	2,806	3.3%
Eurasia	703	817	17,480	16.2%
Other Asia	410	1,088	17,227	165.4%
Middle East	399	700	12,639	75.4%
Africa	111	204	3,623	83.8%
Latin America	149	277	4,899	85.9%
TOTAL	**3,368**	**4,971**	**95,899**	**47.6%**

Source: For 2011 and 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand and increase over 2013-35, Kepler-Cheuvreux estimates based on IEA data

Table 14 shows the IEA's gas-price assumptions over 2013-35 for the three regions it makes projections for, namely North America, Europe, and Japan, but this time as priced per thousand cubic metres. As already explained above, gas prices currently vary greatly by region, and although the differences between North American, European, and Japanese prices are projected to diminish over the period, gas is still projected to be much cheaper in North America by 2035 than in Europe and Japan.

Table 14: Gas prices under NPS (constant 2012 USD) per thousand cubic metres (kcm) for OECD (excl. Aus, NZ & Korea)

	2011	2020	2035	2035 versus 2012
North America	99.1	187.2	249.6	**152%**
Europe	429.4	436.7	466.1	**8.5%**
Japan	620.2	521.1	546.8	**-11.8%**

Source: Kepler-Cheuvreux estimates for $/kcm prices based on IEA prices given in $/mmbtu in 2013 WEO (© OECD/IEA)

Table 15 shows our estimates for total revenues to the gas industry in the OECD countries (excluding Australia, New Zealand, and South Korea) over 2013-35.

To calculate these numbers we first take the volumes for 2012, 2020, and 2035 as given by the IEA, and then multiply these by the IEA's assumed gas price for each of the key OECD regions in each of these years.

Accordingly, we derive annual revenues for the upstream gas industry in the OECD countries of USD386bn in 2012, USD476bn in 2020, and USD436bn in 2035. The final column then shows our estimate of total cumulative revenues for the upstream gas industry in OECD countries over 2013-35 using a simple linear interpolation of our estimates for 2011, 2020 and 2035.

On this basis, we derive total cumulative revenues of USD11.5trn, comprising USD4trn from North America, USD5.8trn from Europe, and USD1.6trn from Japan.

Table 15: Upstream-gas industry revenues (USDbn) under NPS (constant 2012 USD) for OECD (excl. Aus, NZ & Korea)

	2011	2020	2035	Total revenues 2013-35
North America	86.1	179.1	162.1	3,986
Europe	225.4	234.5	217.9	5,835
Japan	74.4	62.0	56.3	1,636
Total	**386.0**	**475.7**	**436.2**	**11,457**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

450S implies OECD industry revenues USD2.4trn lower at USD67.1trn

Table 16 shows global gas demand over 2013-35 as projected under the 450S. In this scenario, demand still rises over the period, but by a more modest 20%. Total global consumption reaches 4tcm in 2035, with the OECD's share in the total again declining from 45% in 2011 to 36% in 2035.

The third column shows our estimate of total cumulative demand over 2013-35, again using a simple linear interpolation of the IEA's numbers for 2011, 2020 and 2035. On this basis, we calculate cumulative demand for natural gas under the 450S at 85.3trn cubic metres, of which 35.5tcm (42%) is consumed in the OECD countries, and 49.8tcm (58%) in non-OECD countries. Note that under the 450S, OECD demand is actually lower in 2035 than in 2011.

Table 16: Global gas demand under the 450S, 2012-35 (bcm)

	2011	2035	Total demand over 2013-35	Increase over period
OECD	1,597	1,493	35,535	-6,5%
Non-OECD	1,773	2,554	49,761	44,0%
Total	**3,370**	**4,047**	**85,296**	**20,1%**
OECD % of total	45%	35.7%		

Source: For 2011 and 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand and increase over 2013-35, Kepler-Cheuvreux estimates based on IEA data

Table 17 reveals that exactly the same pattern of growth holds under the 450S as under the NPS (albeit at lower absolute levels), with the main drivers of increasing global demand again being Other Asia (posting demand growth of 116%), Latin America (51%), Africa (50%), and the Middle East (43%).

Table 17: Global gas demand under 450S, 2012-35 (bcm)

	2011	2035	Total demand over 2013-35	Increase over period
North America	869	850	19,768	-2.2%
Europe	525	493	11,702	-6.2%
Australia/NZ	82	91	1,992	11.2%
Japan	120	101	2,541	-15.9%
Eurasia	703	665	15,734	-5.4%
Other Asia	410	886	14,901	116.0%
Middle East	399	570	11,142	42.8%
Africa	111	166	3,186	49.6%
Latin America	149	226	4,307	51.4%
TOTAL	**3,368**	**4,047**	**85,273**	**20.2%**

Source: For 2011 and 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand and increase over 2013-35, Kepler-Cheuvreux estimates based on IEA data

Table 18 shows the gas-price assumptions over 2013-35 for North America, Europe, and Japan under the 450S. Prices increase over the period in North America, but decline in Europe and Japan by 19% and 31% respectively. Nevertheless, prices in North America are still projected to be 40% land 50% lower than in Europe and Japan respectively in 2035.

Table 18: Gas prices under 450S (constant 2012 USD) per thousand cubic metres (kcm) for OECD (excl. Aus, NZ & Korea)

	2011	2020	2035	2035 versus 2012
North America	99.1	176.2	216.5	**119%**
Europe	429.4	422.1	348.7	**-18.8%**
Japan	620.2	491.8	429.4	**-30.8%**

Source: Kepler-Cheuvreux estimates for $/kcm prices based on IEA prices given in $/mmbtu in 2013 WEO (© OECD/IEA)

Table 19 shows our estimates for total revenues to the gas industry in the OECD countries (excluding Australia, New Zealand, and South Korea) under the 450S using the same methodology as in the case of Table 15 above.

Accordingly, we derive annual revenues for the upstream gas industry in the OECD countries of USD386bn in 2012, USD436bn in 2020, and USD399bn in 2035. This gives total cumulative revenues of USD9trn, comprising USD3.1trn from North America, USD4.6trn from Europe, and USD1.3trn from Japan.

Table 19: Upstream-gas industry revenues (USDbn) under 450S (constant 2012 USD) for OECD (excl. Aus, NZ & Korea)

	2011	2020	2035	Total revenues 2013-35
North America	86.1	162.1	184.0	3,107
Europe	225.4	217.9	171.7	4,567
Japan	74.4	56.3	43.3	1,354
Total	**386.0**	**436.2**	**399.1**	**9,028**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

As shown in Table 20, this means that using our methodology the implied loss to the upstream-gas industry under the 450S in terms of revenues forgone in the OECD regions would be USD2.43trn (in 2012 USD).

Table 20: Upstream-gas industry revenues forgone under 450S vs. NPS (USDbn in2012 USD)

	NPS	450S	Revenues forgone under 450S
North America	3,986	3,107	-880
Europe	5,835	4,567	-1,268
Japan	1,636	1,354	-281
Total	**11,457**	**9,028**	**-2,429**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

This breaks down as USD880bn of lost revenue from North America, USD1.3trn from Europe, and USD280bn from Japan (again, all in constant 2012 USD).

We estimate revenues forgone in ROW would be c. USD1.6trn

Estimating the revenues that the gas industry would stand to lose under the 450S in regions for which the IEA makes no price forecasts is by definition more speculative, but we can nonetheless make an effort. To do this, we begin by looking at the sales volumes forgone in the ROW outside the OECD regions already covered above (note, however, that although Australia, New Zealand, and South Korea are all in the OECD we have included them here rather than above as the IEA does not give separate gas-price estimates for these countries as it does for the US, Europe, and Japan).

Table 21 shows that the total sales volume forgone under the 450S relative to the NPS is 6.8trn cubic metres, which breaks down as 2.6tcm in Asia and Oceania, 1.7tcm in Eurasia, and 2.5tcm in the Middle East, Africa, and Latin America.

Table 21: Upstream-gas sales volumes forgone in ROW under 450S compared with NPS (bcm)

	NPS	450S	Volumes forgone under 450S
Asia/Oceania	19,458	16,893	-2,565
Eurasia	17,480	15,734	-1,746
ME, Africa, LatAm.	21,160	18,635	-2,525
Total	**58,098**	**51,262**	**-6,836**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

The next step is to identify which regions are net importers of gas at benchmarked international prices, or price gas in their domestic markets at benchmarked international prices. For Asia, China and India account for c. 70% of the total demand over the period (c. 53% and c. 17% respectively), and in these markets we estimate that 40% of total demand is imported. We assume that these Chinese and Indian imports are priced at an average level between the IEA's Japanese and European import prices over the period, which equates to an average price over the period of USD479/kcm (in constant 2012 USD).

The other countries either importing (South Korea) or pricing at or ever closer to international benchmarks over 2013-35 are Australia and New Zealand. For these countries we again assume an average price over the period of USD479/kcm (in constant 2012 USD). For the remaining ROW we assume prices average a much lower USD200/kcm, reflecting the large share of low-cost producers (especially the Middle East and parts of Eurasia) in this component.

Accordingly, we derive total revenues at risk in the ROW at USD1.6trn (Table 22).

Table 22: Upstream-gas revenues forgone in ROW under 450S compared with NPS (bcm)

	Sales volumes forgone	Assumed price (USD/kcm)	Revenues forgone (USD bn)
China & India imports	-651	479	-312
Australia, NZ, & Korea	-239	479	-115
Other ROW	-5,945	200	-1,190
Total	**-6,836**		**-1,617**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

Table 23 combines our speculative (but probably conservative) estimate for the revenues forgone in the ROW with the numbers we calculated for North America, Europe and Japan above.

Table 23: Gas Volumes and revenues forgone under 450S compared with NPS (USDbn in2012 USD)

	Volumes under NPS (bcm)	Volumes under 450S (bcm)	Difference	Revenues forgone under 450S
OECD (ex. Aus, NZ, SK)	37,801	34,011	-3,790	**-2,429**
Non-OECD (incl. Aus, NZ, SK)	58,098	51,262	-6,836	**-1,617**
Total	**95,899**	**85,273**	**-10,626**	**-4,046**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

As can be seen, on this basis we estimate that the total revenues at risk for the upstream-gas industry under the 450S relative to the NPS would be USD4trn (in 2012 USD).

Coal industry would have USD5trn to lose over 2013-35

We calculate that the net impact of the volume and price effects assumed under the 450S would be to reduce the projected revenues of the global upstream coal industry relative to the NPS by USD4.9trn (in constant 2012 USD) over 2013-35. This breaks down as USD4.2trn of lost steam-coal revenues, USD715bn of lost coking-coal revenues, and USD30bn of lost lignite revenues (again, all in constant 2012 USD).

We calculate global upstream-coal revenues at USD14.6trn under NPS…

Table 24 shows coal demand by category in 2011 and the projected volume of demand in 2035 under the NPS. The final column then shows our estimate of total cumulative demand over 2013-35 using a simple linear interpolation of the IEA's numbers for 2011, 2020 and 2035.

Accordingly, we estimate total demand over 2013-35 at 135bn tonnes, comprising 107bn tonnes of steam coal (also known as thermal coal), 21bn tonnes of coking coal, and 6bn tonnes of lignite (also known as brown coal).

Table 24: Global coal demand under the NPS, 2011-35 (mtce)

	2011	2035	Total demand over 2013-35
Steam coal	4,220	5,152	107,778
Coking coal	858	929	20,551
Lignite	313	246	6,429
Total	**5,391**	**6,327**	**134,757**

Source: For 2011 & 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand over 2013-35, Kepler-Cheuvreux estimates based on IEA data

Table 25 shows our estimates for total revenues to the upstream-coal industry over 2013-35.

To calculate these numbers we first take the volumes for 2011, 2020, and 2035 as given by the IEA, and then multiply these either by the steam-coal price assumed in each of these years by the IEA (the case for steam coal), or by a price at a premium to the IEA number (the case for coking coal) or a discount (the case for lignite).

For coking coal, we assume a price equivalent to 150% of the IEA's steam-coal price in each year (the kind of premium at which coking coal typically trades), and for lignite a much lower price of USD17/tonne in 2011, falling to USD15/tonne in 2020 and USD13/tonne in 2035 (there is no traded market in lignite, so we have taken the USD17/tonne price for 2011 from the US Energy Information Administration's website at http://www.eia.gov/coal/ and then assumed a falling price out to 2035 in line with the IEA's projection for falling demand over the next two decades).

Table 25: Global upstream-coal industry revenues (USDbn) under the NPS (constant 2012 USD)

Steam-coal price	2011 99/bbl	2020 USD106/bbl	2035 USD110/bbl	Total upstream industry revenues over 2013-35
Steam coal	418	497	567	11,322
Coking coal	127	158	153	3,228
Lignite	5	5	3	91
Total	**550**	**660**	**723**	**14,641**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

On this basis, we derive annual revenues for the upstream oil industry of USD550bn in 2012, USD660bn in 2020, and USD723bn in 2035. The final column shows our estimate of total cumulative revenues over 2013-35 using a simple linear interpolation of our estimates for 2012, 2020 and 2035. On this basis, we derive total cumulative revenues of USD14.6trn, comprising USD11.3trn from steam coal, USD3.2trn from coking coal, and USD91bn from lignite.

...but under 450S we estimate revenues to be USD4.9trn lower at USD9.7trn

Tables 26 and 27 then show total coal demand and total upstream coal revenues over 2013-35 under the 450S. As shown in Table 26, using the same methodology as in the case of Table 24 above, we calculate total demand for coal over 2013-35 at 104bn tonnes, comprising 80bn tonnes of steam coal, 19.2bn tonnes of coking coal, and 4.7bn tonnes of lignite.

Table 26: Global coal demand under the 450S, 2011-35 (mtce)

	2011	2035	Total demand over 2013-35
Steam coal	4,220	2,712	79,718
Coking coal	858	810	19,182
Lignite	313	97	4,715
Total	**5,391**	**3,619**	**103,615**

Source: For 2011 & 2035 numbers, IEA, 2013 WEO (© OECD/IEA); for total demand over 2013-35, Kepler-Cheuvreux estimates based on IEA data

As set out in Table 27, using the same methodology as above (but lower prices for lignite of USD12/tonne in 2020 and USD8/tonne in 2035), we derive annual revenues for the upstream coal industry of USD550bn in 2012, USD559bn in 2020, and USD295bn in 2035. Using our simple linear-interpolation method again, we derive total cumulative revenues of USD9.7trn, comprising USD7.1trn from steam coal, USD2.5trn from coking coal, and USD63bn from lignite.

Table 27: Global upstream-coal industry revenues (USDbn) under the 450S (constant 2012 USD)

Steam-coal price	2011 USD99/tonne	2020 USD101/tonne	2035 USD75/tonne	Total upstream industry revenues over 2013-35
Steam coal	418	411	203	7,144
Coking coal	127	145	91	2,513
Lignite	5	3	1	63
Total	**550**	**559**	**295**	**9,720**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

As shown in Table 28, this means that using our methodology the implied loss to the upstream coal industry under the 450S in terms of revenues forgone would be USD4.9trn (in 2012 USD).

Table 28: Upstream-coal revenues forgone under the 450S compared with NPS (USDbn in2012 USD)

	NPS	450S	Revenues forgone under 450S
Steam coal	11,322	7,144	-4,178
Coking coal	3,228	2,513	-715
Lignite	91	63	-28
Total	**14,641**	**9,720**	**-4,921**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

This breaks down as USD4.2trn of lost steam-coal revenues, USD715bn of lost coking-coal revenues, and USD30bn of lost lignite revenues (again, all in constant 2012 USD).

USD28trn of fossil-fuel revenues at risk in a 450-ppm world

Table 29 brings together our estimates for the revenues forgone by the upstream oil, gas, and coal industries under the IEA's 450S compared with the NPS. The total amount comes to USD28.3trn, of with oil accounting for 68% of this difference, gas 14%, and coal 18%.

Table 29:Fossil-fuel revenues forgone under 450S compared with NPS (USDbn in 2012 USD)

	Volumes under NPS	Volumes under 450S	Difference	Revenues forgone under 450S
Oil	100,844	88,378	-12,466	-19,294
Gas	79,419	70,656	-8,763	4,046
Coal	94,312	72,519	-21,793	-4,921
Total	**274,574**	**231,553**	**-43,022**	**-28,261**

Source: Kepler-Cheuvreux estimates based on IEA data from 2013 WEO

Oil demand is lower by a cumulative 12.5bn tonnes under the 450S, and with lower average prices as well this results in revenues forgone of USD19.3trn (in 2012 USD). Gas demand is lower by 8.7bntoe, and combined with lower prices, this results in lost revenues of USD4trn. Finally, for coal, lower demand of 21.8bntoe and lower average prices means that on our estimates the industry would stand to lose USD4.9trn of revenues under a global policy framework consistent with a 450-ppm world.

Risk is to high-cost, high-carbon producers

The point about the revenues under threat for the fossil-fuel industry under a 450-ppm policy framework is that the risks are not spread evenly across all players. Rather, the risks are concentrated on the marginal producers - the companies that are at the high end of the respective industry cost curves.

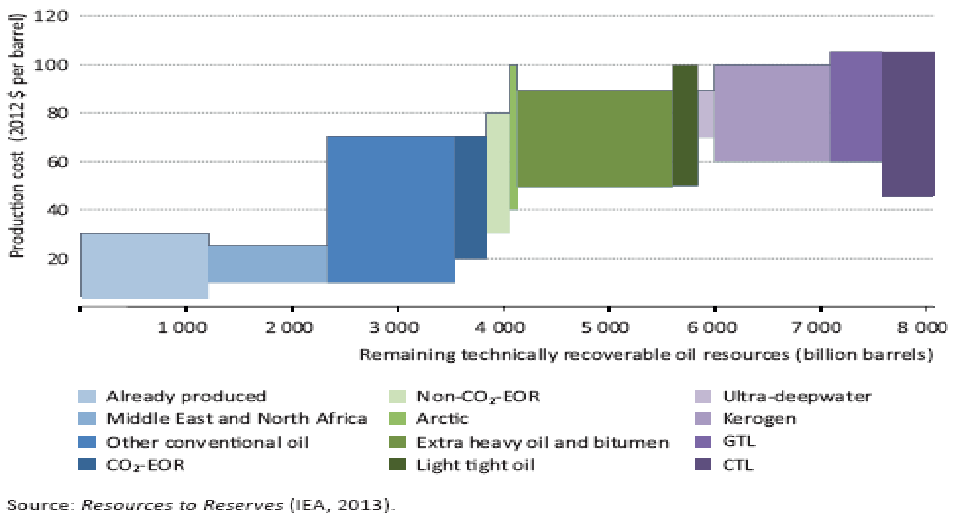
In this respect, it is also important to note that the high-cost sources of production tend to be the most carbon-intensive ones. This is because high-cost sources of production typically require more energy to be consumed in the extraction process, thereby leading to more CO2 emissions in the development of these resources than is the case for more easily extracted reserves.

This can be seen very clearly with reference to the oil industry, and as our analysis above has shown it is the oil industry that would stand by far the most to lose in terms of forgone revenues under a 450-ppm framework. Accordingly, and as a prelude to a more detailed analysis of the value at risk to the oil industry under a 450-ppm policy framework that we will offer in a forthcoming report, we here conclude with a quick look at the supply curve for the global upstream oil industry.

A quick look at the oil industry's cost curve

Chart 6 shows the IEA's estimate of the oil industry's long-run marginal cost curve (LRMC) as set out in the 2013 WEO published last November. Once again, all figures are in constant 2012 USD.

Chart 6: LRMC of petroleum liquids



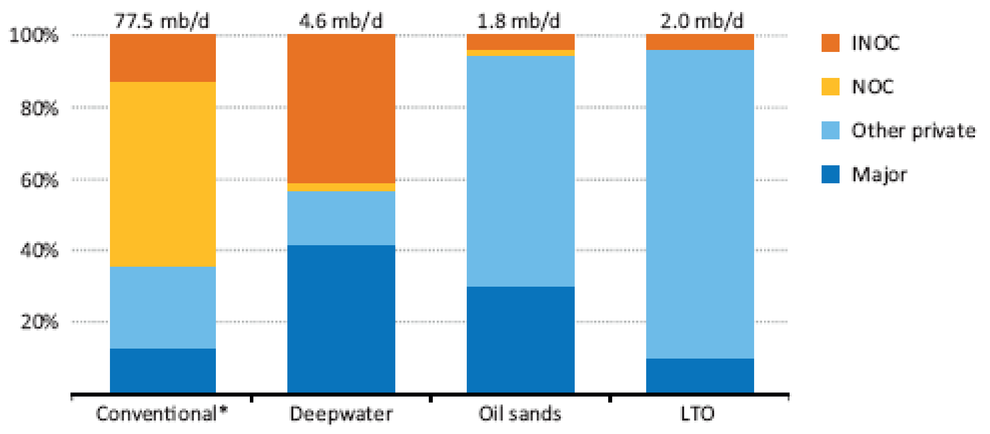
Source: IEA, 2013 World Energy Outlook (© OECD/IEA)

As can be seen, the world's lowest-cost remaining reserves are the conventional onshore reserves of Middle Eastern and North African (and mostly OPEC) countries, where the LRMC is in the range of USD10-25/bbl.

Other conventional oil (essentially onshore and shallow offshore) has a LRMC range of USD15-70/bbl, but beyond that it can be seen that the three main sources of unconventional oil already producing today – extra heavy oil and bitumen (Canadian oil sands), light-tight oil or LTO (also known as shale oil), and ultra-deepwater – all have much higher cost ranges. For Canadian oil sands the IEA estimates the range at USD50-90/bbl, for US light-tight oil USD50-100/bbl, and for ultra-deepwater USD70-90/bbl.

If we then look at the allocation of global oil production by company type (Chart 7), it can be seen that the IEA's numbers show conventional oil production dominated by national oil companies (NOCs, these being majority or partially state-owned companies with a monopoly or dominant share of production in their home country) and international national oil companies (INOCs, these being majority or partially state-owned companies with significant international interests relative to their domestic interests). Together, NOCs and INOCs accounted for nearly 70% of conventional oil production in 2012 on the IEA's numbers, with the international majors and independent private companies accounting for just over 30%. This means that the lowest-cost sources of production are predominantly government owned.

Chart 7: Oil production by selected resource and company type, 2012



* Excluding oil produced in deepwater.

Source: IEA analysis based on AS Rystad Energy.

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

If we then look at the higher cost, unconventional sources of production, it can be seen that while NOCs and INOCs together account for just over 40% of deepwater production, their share of oil sands and LTO production is much lower (less than 10% in each case).

This means that the high-cost, high-carbon sources of production are dominated by the international majors and independent private companies. Indeed, looking at the 8.4mbd of production from these sources in 2012, Chart 7 would suggest that c. 73% was owned by the international majors or private independents. This amounts to some 6.1mbd, or 2.23bn barrels per year. If we assume that the highest-cost, most carbon-intensive barrels would be the ones most at risk of not being produced under a 450-ppm policy framework, then on the face of it all of these barrels would be at risk under a 450-ppm global climate deal.

In reality, for the reasons already explained in our introductory chapter (pages 5-6), the production from *existing* unconventional fields would likely be safe even in a 450-ppm world. Instead, we think the production most at risk under a 450-ppm agreement would be potential future output from the proven unconventional reserves that are yet to be developed.

This is because if and when global climate policy were to tighten significantly, over time we think this would start to squeeze out the high-cost, high-carbon sources first. In particular, we think OPEC countries sitting on lower-cost, lower-carbon reserves would likely want to optimise their output in a 450-ppm world. Allowing for the time needed to upgrade infrastructures to enable higher levels of production, we think this would mean higher levels of lower-cost conventional output over 2025-35 than the IEA is assuming under its 450S.

Since lost revenues ultimately translate into lost earnings and hence lost value, this would suggest to us that it is the undeveloped deepwater, oil-sands, and LTO assets (which, based on the ownership of existing production from such sources, would be predominantly owned by the majors and private independents) that would be most at risk of stranding under a far-reaching global climate settlement.

Value risk to fall on high-cost, high-carbon producers

As our analysis throughout this report has shown, the risk entailed by a 450-ppm global policy framework for fossil-fuel companies is one of structurally lower demand and hence lower prices and lower revenues than under the trajectory the world is currently on.

Given that lost revenues translate into lost earnings and hence lost value, investors are becoming increasingly concerned about the risk of stranded assets associated with carbon risk. Indeed, in this respect, the agreement last month between Arjuna Capital and As You Sow on the one hand, and ExxonMobil on the other, can be seen as a landmark event. In exchange for the withdrawal of a shareholder resolution prepared by Arjuna Capital, Exxon agreed on 20 March to publish a report giving much more detail on how it is preparing for a more carbon-constrained world.

The press release issued by Arjuna Capital and As You Sow in response to their agreement with ExxonMobil made particular reference to the risk of stranding that faces *"unconventional 'frontier' assets"* such as deep-water plays and the oil-sands projects in Alberta, saying:

"These reserves are not only the most carbon intensive, risky, and expensive to extract, but the most vulnerable to devaluation. As investors, we want to ensure our Companies' capital will yield strong returns, and we are not throwing good money after bad".

And in our view, the fact that ExxonMobil's report published only ten days after its agreement with Arjuna Capital and As You Sow – entitled Energy and Carbon –Managing the Risks – then dismissed the idea that the company is facing any risk of asset stranding from its operations is beside the point.

What matters is that this has set a precedent for the world's major oil companies to engage with investors on the subject of the carbon risk in their asset portfolio and their preparedness for a more carbon-constrained world.

With this in mind, we will extend our analysis of the implications of a 450-ppm world for fossil-fuel revenues by looking in a forthcoming report at the value at risk for the oil industry of a more carbon-constrained world.

This forthcoming report will look not only at the value at risk under the IEA's 450S, but will highlight three other risks in parallel to this that should be of concern to ExxonMobil and any other companies in its peer group that think a global policy settlement consistent with 450-ppm world is essentially unachievable.

The first of these risks is tighter national or regional climate policy. In other words, whether a global policy framework consistent with a 450-Scenario is ultimately put in place or not, there is always also the risk of tighter legislation that could lead to stranded assets in certain markets.

A good example of such a risk at the moment relates to the ongoing debate over the Keystone XL (KXL) pipeline between Canada and the US. If President Obama ultimately decides to veto KXL, this could create stranded assets in the Alberta oil-sands plays both for Exxon and other oil companies.

Second, there is the risk that certain kinds of investments – notably high-cost, high carbon assets such as Canadian oil sands – could become socially unacceptable as investments for growing numbers of institutional investors over time. Indeed, this was one of the assets explicitly cited by As You Sow in its shareholder resolution that ultimately forced Exxon to write the report it published yesterday.

Third, we can also envisage a risk of stranded assets arising for oil companies under a scenario of *rising* oil prices. Specifically, if oil prices rise faster in future than currently assumed by the IEA in its base-case projections, we think this could lead to an acceleration of the policy incentives for, and deployment of, renewable-energy technologies and energy-efficiency measures, and hence a faster shift away from oil in the global energy mix over the next three decades than ExxonMobil assumes.

Research ratings and important disclosures

Disclosure checklist - Potential conflict of interests

Stock	ISIN	Disclosure (See Below)	Currency	Price
Exxon Mobil	US30231G1022	nothing to disclose	USD	100.50

Source: Factset closing prices of 23/04/2014

Stock prices**:** Prices are taken as of the previous day's close (to the date of this report) on the home market unless otherwise stated.

Key:

Kepler Capital Markets SA (KCM) holds or owns or controls 100% of the issued shares of Crédit Agricole Cheuvreux SA (CA Cheuvreux), collectively hereafter KEPLER CHEUVREUX.

1. KEPLER CHEUVREUX holds or owns or controls 5% or more of the issued share capital of this company; 2. The company holds or owns or controls 5% or more of the issued share capital of Kepler Capital Markets SA; 3. KEPLER CHEUVREUX is or may be regularly carrying out proprietary trading in equity securities of this company; 4. KEPLER CHEUVREUX has been lead manager or co-lead manager in a public offering of the issuer's financial instruments during the last twelve months; 5. KEPLER CHEUVREUX is a market maker in the issuer's financial instruments; 6. KEPLER CHEUVREUX is a liquidity provider in relation to price stabilisation activities for the issuer to provide liquidity in such instruments; 7. KEPLER CHEUVREUX acts as a corporate broker or a sponsor or a sponsor specialist (in accordance with the local regulations) to this company; 8. KEPLER CHEUVREUX and the issuer have agreed that KEPLER CHEUVREUX will produce and disseminate investment research on the said issuer as a service to the issuer; 9. KEPLER CHEUVREUX has received compensation from this company for the provision of investment banking or financial advisory services within the previous twelve months; 10. KEPLER CHEUVREUX may expect to receive or intend to seek compensation for investment banking services from this company in the next three months; 11. The author of, or an individual who assisted in the preparation of, this report (or a member of his/her household), or a person who although not involved in the preparation of the report had or could reasonably be expected to have access to the substance of the report prior to its dissemination has a direct ownership position in securities issued by this company; 12. An employee of KEPLER CHEUVREUX serves on the board of directors of this company; 13. As at the end of the month immediately preceding the date of publication of the research report Kepler Capital Markets, Inc. beneficially owned 1% or more of a class of common equity securities of the subject company; 14. KEPLER CHEUVREUX and UniCredit Bank AG have entered into a Co-operation Agreement to form a strategic alliance in connection with certain services including services connected to investment banking transactions. UniCredit Bank AG provides investment banking services to this issuer in return for which UniCredit Bank AG received consideration or a promise of consideration. Separately, through the Co-operation Agreement with UniCredit Bank AG for services provided by KEPLER CHEUVREUX in connection with such activities, KEPLER CHEUVREUX also received consideration or a promise of a consideration in accordance with the general terms of the Co-operation Agreement; 15. KEPLER CHEUVREUX and Crédit Agricole Corporate & Investment Bank ("CACIB") have entered into a Co-operation Agreement to form a strategic alliance in connection with certain services including services connected to investment banking transactions. CACIB provides investment banking services to this issuer in return for which CACIB received consideration or a promise of consideration. Separately, through the Co-operation Agreement with CACIB for services provided by KEPLER CHEUVREUX in connection with such activities, KEPLER CHEUVREUX also received consideration or a promise of a consideration in accordance with the general terms of the Co-operation Agreement; 16. UniCredit Bank AG holds or owns or controls 5% or more of the issued share capital of KEPLER CAPITAL MARKETS SA. UniCredit Bank AG provides investment banking services to this issuer in return for which UniCredit Bank AG received consideration or a promise of consideration; 17. CACIB holds or owns or controls 15% of more of the issued share capital of KEPLER CAPITAL MARKETS SA. CACIB provides investment banking services to this issuer in return for which CACIB received consideration or a promise of consideration; 18. An employee of UniCredit Bank AG serves on the board of directors of KEPLER CAPITAL MARKETS SA; 19. Two employees of CACIB serve on the board of directors of KEPLER CAPITAL MARKETS SA. CACIB provides investment banking services to this issuer in return for which CACIB received consideration or a promise of consideration; 20. The services provided by KEPLER CHEUVREUX are provided by Kepler Equities S.A.S., a wholly-owned subsidiary of KEPLER CAPITAL MARKETS SA.

Rating history:

We did not disclose the rating to the issuer before publication and dissemination of this document.

Rating ratio Kepler Cheuvreux Q4 2013

Rating breakdown	A	B
Buy	45.5%	0.0%
Hold	29.0%	0.0%
Reduce	21.0%	0.0%
Not Rated/Under Review/Accept Offer	5.5%	0.0%
Total	100.0%	0.0%

Source: Kepler Cheuvreux
A: % of all research recommendations
B: % of issuers to which Investment Banking Services are supplied

From 9 May 2006, KEPLER CHEUVREUX's rating system consists of three ratings: Buy, Hold and Reduce. For a Buy rating, the minimum expected upside is 10% in absolute terms over 12 months. For a Hold rating the expected upside is below 10% in absolute terms. A Reduce rating is applied when there is expected downside on the stock. Target prices are set on all stocks under coverage, based on a 12-month view. Equity ratings and valuations are issued in absolute terms, not relative to any given benchmark.

Analyst disclosures

The functional job title of the person(s) responsible for the recommendations contained in this report is **Equity Research Analyst** unless otherwise stated on the cover.

Name of the Equity Research Analyst(s): Mark C. Lewis

Regulation AC - Analyst Certification: Each Equity Research Analyst(s) listed on the front-page of this report, principally responsible for the preparation and content of all or any identified portion of this research report hereby certifies that, with respect to each issuer or security or any identified portion of the report with respect to an issuer or security that the equity research analyst covers in this research report, all of the views expressed in this research report accurately reflect their personal views about those issuer(s) or securities. Each Equity Research Analyst(s) also certifies that no part of their compensation was, is, or will be, directly or indirectly, related to the specific recommendation(s) or view(s) expressed by that equity research analyst in this research report.

Each Equity Research Analyst certifies that he is acting independently and impartially from KEPLER CHEUVREUX shareholders, directors and is not affected by any current or potential conflict of interest that may arise from any KEPLER CHEUVREUX activities.

Analyst Compensation: The research analyst(s) primarily responsible for the preparation of the content of the research report attest that no part of the analyst's(s') compensation was, is or will be, directly or indirectly, related to the specific recommendations expressed by the research analyst(s) in the research report. The research analyst's(s') compensation is, however, determined by the overall economic performance of KEPLER CHEUVREUX.

Registration of non-US analysts: Unless otherwise noted, the non-US analysts listed on the front of this report are employees of KEPLER CHEUVREUX, which is a non-US affiliate and parent company of Kepler Capital Markets, Inc. a SEC registered and FINRA member broker-dealer. Equity Research Analysts employed by KEPLER CHEUVREUX, are not registered/qualified as research analysts under FINRA/NYSE rules, may not be associated persons of Kepler Capital Markets, Inc. and may not be subject to NASD Rule 2711 and NYSE Rule 472 restrictions on communications with covered companies, public appearances, and trading securities held by a research analyst account.

Please refer to **www.keplercheuvreux.com** for further information relating to research and conflict of interest management.

Regulators

Location	Regulator	Abbreviation
Kepler Capital Markets S.A - France	Autorité des Marchés Financiers	AMF
Kepler Capital Markets, Sucursal en España	Comisión Nacional del Mercado de Valores	CNMV
Kepler Capital Markets, Frankfurt branch	Bundesanstalt für Finanzdienstleistungsaufsicht	BaFin
Kepler Capital Markets, Milan branch	Commissione Nazionale per le Società e la Borsa	CONSOB
Kepler Capital Markets, Amsterdam branch	Autoriteit Financiële Markten	AFM
Kepler Capital Markets, Zurich branch	Swiss Financial Market Supervisory Authority	FINMA
Kepler Capital Markets, Inc.	Financial Industry Regulatory Authority	FINRA
Kepler Capital Markets, London branch	Financial Conduct Authority	FCA
Kepler Capital Markets, Vienna branch	Austrian Financial Services Authority	FMA
Crédit Agricole Cheuvreux, SA - France	Autorité des Marchés Financiers	AMF
Crédit Agricole Cheuvreux España S.V	Comisión Nacional del Mercado de Valores	CNMV
Crédit Agricole Cheuvreux Niederlassung Deutschland	Bundesanstalt für Finanzdienstleistungsaufsicht	BaFin
Crédit Agricole Cheuvreux S.A., branch di Milano	Commissione Nazionale per le Società e la Borsa	CONSOB
Crédit Agricole Cheuvreux Amsterdam	Autoriteit Financiële Markten	AFM
Crédit Agricole Cheuvreux Zurich Branch	Swiss Financial Market Supervisory Authority	FINMA
Crédit Agricole Cheuvreux North America, Inc.	Financial Industry Regulatory Authority	FINRA
Crédit Agricole Cheuvreux International Limited	Financial Conduct Authority	FCA
Crédit Agricole Cheuvreux Nordic AB	Finansinspektionen	FI

Kepler Capital Markets S.A and Crédit Agricole Cheuvreux SA, are authorised and regulated by both Autorité de Contrôle Prudentiel and Autorité des Marchés Financiers.

For further information relating to research recommendations and conflict of interest management please refer to **www.keplercheuvreux.com**..

Legal and disclosure information

Other disclosures

This product is not for retail clients or private individuals.

The information contained in this publication was obtained from various publicly available sources believed to be reliable, but has not been independently verified by KEPLER CHEUVREUX. KEPLER CHEUVREUX does not warrant the completeness or accuracy of such information and does not accept any liability with respect to the accuracy or completeness of such information, except to the extent required by applicable law.

This publication is a brief summary and does not purport to contain all available information on the subjects covered. Further information may be available on request. This report may not be reproduced for further publication unless the source is quoted.

This publication is for information purposes only and shall not be construed as an offer or solicitation for the subscription or purchase or sale of any securities, or as an invitation, inducement or intermediation for the sale, subscription or purchase of any securities, or for engaging in any other transaction. This publication is not for private individuals.

Any opinions, projections, forecasts or estimates in this report are those of the author only, who has acted with a high degree of expertise. They reflect only the current views of the author at the date of this report and are subject to change without notice. KEPLER CHEUVREUX has no obligation to update, modify or amend this publication or to otherwise notify a reader or recipient of this publication in the event that any matter, opinion, projection, forecast or estimate contained herein, changes or subsequently becomes inaccurate, or if research on the subject company is withdrawn. The analysis, opinions, projections, forecasts and estimates expressed in this report were in no way affected or influenced by the issuer. The author of this publication benefits financially from the overall success of KEPLER CHEUVREUX.

The investments referred to in this publication may not be suitable for all recipients. Recipients are urged to base their investment decisions upon their own appropriate investigations that they deem necessary. Any loss or other consequence arising from the use of the material contained in this publication shall be the sole and exclusive responsibility of the investor and KEPLER CHEUVREUX accepts no liability for any such loss or consequence. In the event of any doubt about any investment, recipients should contact their own investment, legal and/or tax advisers to seek advice regarding the appropriateness of investing. Some of the investments mentioned in this publication may not be readily liquid investments. Consequently it may be difficult to sell or realise such investments. The past is not necessarily a guide to future performance of an investment. The value of investments and the income derived from them may fall as well as rise and investors may not get back the amount invested. Some investments discussed in this publication may have a high level of volatility. High volatility investments may experience sudden and large falls in their value which may cause losses. International investing includes risks related to political and economic uncertainties of foreign countries, as well as currency risk.

To the extent permitted by applicable law, no liability whatsoever is accepted for any direct or consequential loss, damages, costs or prejudices whatsoever arising from the use of this publication or its contents.

KEPLER CHEUVREUX (and its affiliates) have implemented written procedures designed to identify and manage potential conflicts of interest that arise in connection with its research business, which are available upon request. The KEPLER CHEUVREUX research analysts and other staff involved in issuing and disseminating research reports operate independently of KEPLER CHEUVREUX Investment Banking business. Information barriers and procedures are in place between the research analysts and staff involved in securities trading for the account of KEPLER CHEUVREUX or clients to ensure that price sensitive information is handled according to applicable laws and regulations.

Country and region disclosures

United Kingdom: This document is for persons who are Eligible Counterparties or Professional Clients only and is exempt from the general restriction in section 21 of the Financial Services and Markets Act 2000 on the communication of invitations or inducements to engage in investment activity on the grounds that it is being distributed in the United Kingdom only to persons of a kind described in Articles 19(5) (Investment professionals) and 49(2) (High net worth companies, unincorporated associations, etc.) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (as amended). It is not intended to be distributed or passed on, directly or indirectly, to any other class of persons. Any investment to which this document relates is available only to such persons, and other classes of person should not rely on this document.

United States: This communication is only intended for, and will only be distributed to, persons residing in any jurisdictions where such distribution or availability would not be contrary to local law or regulation. This communication must not be acted upon or relied on by persons in any jurisdiction other than in accordance with local law or regulation and where such person is an investment professional with the requisite sophistication to understand an investment in such securities of the type communicated and assume the risks associated therewith.

This communication is confidential and is intended solely for the addressee. It is not to be forwarded to any other person or copied without the permission of the sender. This communication is provided for information only. It is not a personal recommendation or an offer to sell or a solicitation to buy the securities mentioned. Investors should obtain independent professional advice before making an investment.

Notice to U.S. Investors: This material is not for distribution in the United States, except to “major US institutional investors” as defined in SEC Rule 15a-6 ("Rule 15a-6"). Kepler Cheuvreux refers to Kepler Capital Markets, Société anonyme (S.A.) (“Kepler Capital Markets SA”) and its affiliates, including CA Cheuvreux, Société Anonyme (S.A.). Kepler Capital Markets SA has entered into a 15a-6 Agreement with Kepler Capital Markets, Inc. ("KCM, Inc.”) which enables this report to be furnished to certain U.S. recipients in reliance on Rule 15a-6 through KCM, Inc.

Each U.S. recipient of this report represents and agrees, by virtue of its acceptance thereof, that it is a "major U.S. institutional investor" (as such term is defined in Rule 15a-6) and that it understands the risks involved in executing transactions in such securities. Any U.S. recipient of this report that wishes to discuss or receive additional information regarding any security or issuer mentioned herein, or engage in any transaction to purchase or sell or solicit or offer the purchase or sale of such securities, should contact a registered representative of KCM, Inc.

KCM, Inc. is a broker-dealer registered with the Securities and Exchange Commission (“SEC”) under the U.S. Securities Exchange Act of 1934, as amended, Member of the Financial Industry Regulatory Authority (“FINRA”) and Member of the Securities Investor Protection Corporation (“SIPC”). Pursuant to SEC Rule 15a-6, you must contact a Registered Representative of KCM, Inc. if you are seeking to execute a transaction in the securities discussed in this report. You can reach KCM, Inc. at 600 Lexington Avenue, New York, NY 10022, Compliance Department (212) 710-7625; Operations Department (212) 710-7606; Trading Desk (212) 710-7602. Further information is also available at www.keplercapitalmarkets.com. You may obtain information about SIPC, including the SIPC brochure, by contacting SIPC directly at 202-371-8300; website: http://www.sipc.org/

KCM, Inc. is a wholly owned subsidiary of Kepler Capital Markets SA. Kepler Capital Markets SA, registered on the Paris Register of Companies with the number 413 064 841 (1997 B 10253), whose registered office is located at 112 avenue Kléber, 75016 Paris, is authorised and regulated by both Autorité de Contrôle Prudentiel (ACP) and Autorité des Marchés Financiers (AMF).

Nothing herein excludes or restricts any duty or liability to a customer that KCM, Inc. may have under applicable law. Investment products provided by or through KCM, Inc. are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution, may lose value and are not guaranteed by the entity that published the research as disclosed on the front page and are not guaranteed by KCM, Inc.

Investing in non-U.S. Securities may entail certain risks. The securities referred to in this report and non-U.S. issuers may not be registered under the U.S. Securities Act of 1933, as amended, and the issuer of such securities may not be subject to U.S. reporting and/or other requirements. Rule 144A securities may be offered or sold only to persons in the U.S. who are Qualified Institutional Buyers within the meaning of Rule 144A under the Securities Act. The information available about non-U.S. companies may be limited, and non-U.S. companies are generally not subject to the same uniform auditing and reporting standards as U.S. companies. Securities of some non-U.S. companies may not be as liquid as securities of comparable U.S. companies. Securities discussed herein may be rated below investment grade and should therefore only be considered for inclusion in accounts qualified for speculative investment.

Analysts employed by Kepler Capital Markets SA, a non-U.S. broker-dealer, are not required to take the FINRA analyst exam. The information contained in this report is intended solely for certain "major U.S. institutional investors" and may not be used or relied upon by any other person for any purpose. Such information is provided for informational purposes only and does not constitute a solicitation to buy or an offer to sell any securities under the Securities Act of 1933, as amended, or under any other U.S. federal or state securities laws, rules or regulations. The investment opportunities discussed in this report may be unsuitable for certain investors depending on their specific investment objectives, risk tolerance and financial position.

In jurisdictions where KCM, Inc. is not registered or licensed to trade in securities, or other financial products, transactions may be executed only in accordance with applicable law and legislation, which may vary from jurisdiction to jurisdiction and which may require that a transaction be made in accordance with applicable exemptions from registration or licensing requirements.

The information in this publication is based on sources believed to be reliable, but KCM, Inc. does not make any representation with respect to its completeness or accuracy. All opinions expressed herein reflect the author's judgment at the original time of publication, without regard to the date on which you may receive such information, and are subject to change without notice.

KCM, Inc. and/or its affiliates may have issued other reports that are inconsistent with, and reach different conclusions from, the information presented in this report. These publications reflect the different assumptions, views and analytical methods of the analysts who prepared them. Past performance should not be taken as an indication or guarantee of future performance, and no representation or warranty, express or implied, is provided in relation to future performance.

KCM, Inc. and any company affiliated with it may, with respect to any securities discussed herein: (a) take a long or short position and buy or sell such securities; (b) act as investment and/or commercial bankers for issuers of such securities; (c) act as market makers for such securities; (d) serve on the board of any issuer of such securities; and (e) act as paid consultant or advisor to any issuer. The information contained herein may include forward-looking statements within the meaning of U.S. federal securities laws that are subject to risks and uncertainties. Factors that could cause a company's actual results and financial condition to differ from expectations include, without limitation: political uncertainty, changes in general economic conditions that adversely affect the level of demand for the company's products or services, changes in foreign exchange markets, changes in international and domestic financial markets and in the competitive environment, and other factors relating to the foregoing. All forward-looking statements contained in this report are qualified in their entirety by this cautionary statement.

France: This publication is issued and distributed in accordance with Articles L.544-1 and seq and R. 621-30-1 of the Code Monétaire et Financier and with Articles 313-25 to 313-27 and 315-1 and seq of the General Regulation of the Autorité des Marchés Financiers (AMF).

Germany: This report must not be distributed to persons who are retail clients in the meaning of Sec. 31a para. 3 of the German Securities Trading Act (Wertpapierhandelsgesetz – "WpHG"). This report may be amended, supplemented or updated in such manner and as frequently as the author deems.

Italy: This document is issued by Kepler Capital Markets, Milan branch and Crédit Agricole Cheuvreux S.A., branch di Milano, authorised in France by the Autorité des Marchés Financiers (AMF) and the Autorité de Contrôle Prudentiel (ACP) and registered in Italy by the Commissione Nazionale per le Società e la Borsa (CONSOB) and is distributed by Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.), authorised in France by the AMF and the ACP and registered in Italy by CONSOB. This document is for Eligible Counterparties or Professional Clients only as defined by the CONSOB Regulation 16190/2007 (art. 26 and art. 58).Other classes of persons should not rely on this document. Reports on issuers of financial instruments listed by Article 180, paragraph 1, letter a) of the Italian Consolidated Act on Financial Services (Legislative Decree No. 58 of 24/2/1998, as amended from time to time) must comply with the requirements envisaged by articles 69 to 69-novies of CONSOB Regulation 11971/1999. According to these provisions Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.)warns on the significant interests of Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.)indicated in Annex 1 hereof, confirms that there are not significant financial interests of Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.)in relation to the securities object of this report as well as other circumstance or relationship with the issuer of the securities object of this report (including but not limited to conflict of interest, significant shareholdings held in or by the issuer and other significant interests held by Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.)or other entities controlling or subject to control by Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.)in relation to the issuer which may affect the impartiality of this document]. Equities discussed herein are covered on a continuous basis with regular reports at results release. Reports are released on the date shown on cover and distributed via print and email. Kepler Capital Markets, Milan branch and Crédit Agricole Cheuvreux S.A., branch di Milano analysts are not affiliated with any professional groups or organisations. All estimates are by Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.) unless otherwise stated.

Spain: This document is only intended for persons who are Eligible Counterparties or Professional Clients within the meaning of Article 78bis and Article 78ter of the Spanish Securities Market Act. It is not intended to be distributed or passed on, directly or indirectly, to any other class of persons. This report has been issued by Kepler Capital Markets, Sucursal en España and Crédit Agricole Cheuvreux España S.V, registered in Spain by the Comisión Nacional del Mercado de Valores (CNMV) in the foreign investments firms registry and it has been distributed in Spain by it or by Kepler Capital Markets S.A and Crédit Agricole Cheuvreux, Société Anonyme (S.A.) authorised and regulated by both Autorité de Contrôle Prudentiel and Autorité des Marchés Financiers. There is no obligation to either register or file any report or any supplemental documentation or information with the CNMV. In accordance with the Spanish Securities Market Law (Ley del Mercado de Valores), there is no need for the CNMV to verify, authorise or carry out a compliance review of this document or related documentation, and no information needs to be provided.

Switzerland: This publication is intended to be distributed to professional investors in circumstances such that there is no public offer. This publication does not constitute a prospectus within the meaning of Articles 652a and 1156 of the Swiss Code of Obligations.

Canada: The information provided in this publication is not intended to be distributed or circulated in any manner in Canada and therefore should not be construed as any kind of financial recommendation or advice provided within the meaning of Canadian securities laws.

Other countries: Laws and regulations of other countries may also restrict the distribution of this report. Persons in possession of this document should inform themselves about possible legal restrictions and observe them accordingly.

Local insight, European scale

Amsterdam
Kepler Cheuvreux Benelux
Johannes Vermeerstraat 9
1071 DK Amsterdam
+31 20 573 06 66

Frankfurt
Kepler Cheuvreux Germany
Taunusanlage 18
60325 Frankfurt
+49 69 756960

Geneva
Kepler Cheuvreux SA
Route de Crassier 11
1262 - Eysins
Switzerland
+41 22361 5151

London
Kepler Cheuvreux UK
12th Floor, Moorhouse
120 London Wall
London EC2Y 5ET
+44 20 7621 5100

Madrid
Kepler Cheuvreux Espana
Alcala 95
28009 Madrid
+3491 4365100

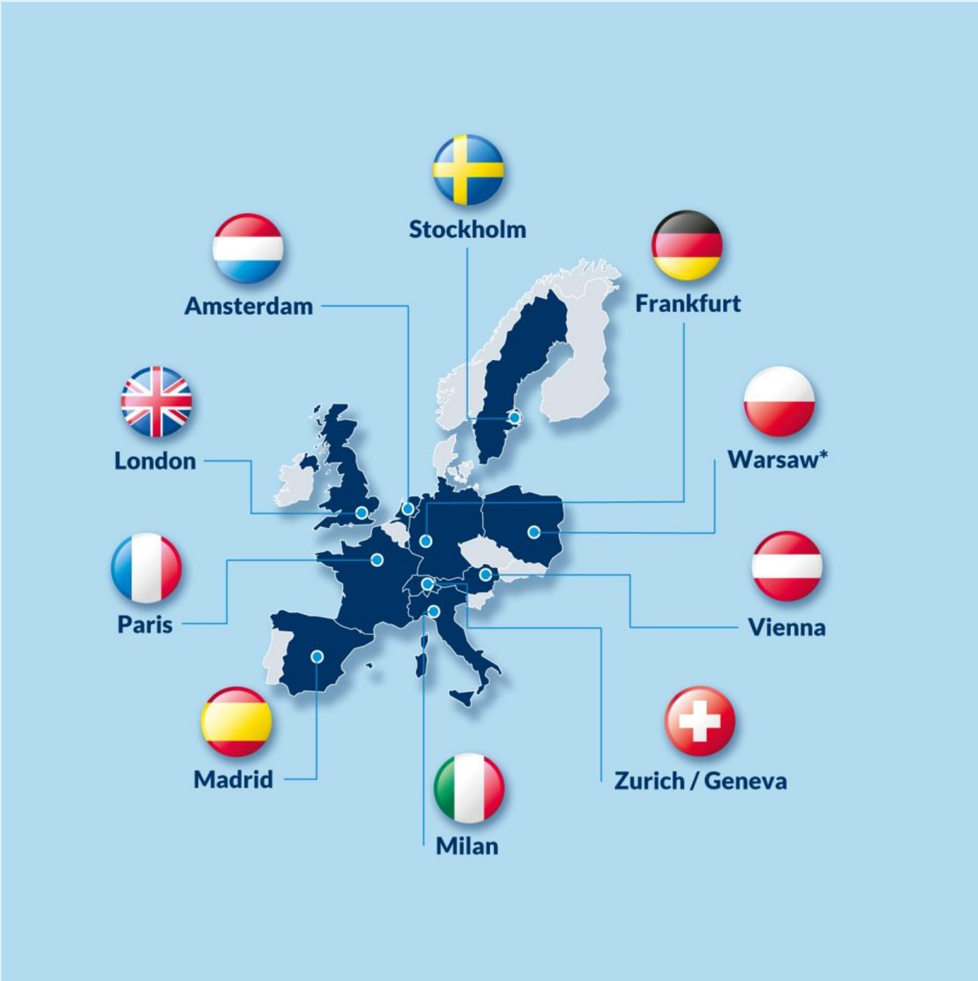
Milan
Kepler Cheuvreux Italia
Corso Europa 2
20122 Milano
+39 02 855 07 1

Paris
Kepler Cheuvreux France
112 Avenue Kleber
75016 Paris
+33 1 53653500

Stockholm
Kepler Cheuvreux Nordic
Regeringsgatan 38
10393 Stockholm
+468 723 5100

Vienna
Kepler Cheuvreux Vienna
Schottenring 16/2
Vienna 1010
+43 1 537 124 147

Zurich
Kepler Cheuvreux Switzerland
Stadelhoferstrasse 22
Postfach
8024 Zurich
+41 433336666



Kepler Cheuvreux has exclusive international distribution rights for UniCredit's CEE product.

North America

Boston
Kepler Capital Markets, Inc
225 Franklin Street, Floor 26
Boston, MA 02110
+1 617-217-2615

New York
Kepler Capital Markets, Inc.
600 Lexington Avenue, Floor 28
10022 New York, NY USA
+1 212-710-7600

San Francisco
Kepler Capital Markets, Inc
50 California Street, Suite 1500
San Francisco, CA 94111
+1 415-439-5253