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Climate Change
Global

HSBC Climate Change

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Stranded assets: what next?

How investors can manage increasing fossil fuel risks

Stranded assets are those that lose value or turn into liabilities before the end of their expected economic life. In the context of fossil fuels, this means those that will not be burned – they remain stranded in the ground. We believe the risks of this occurring are growing.

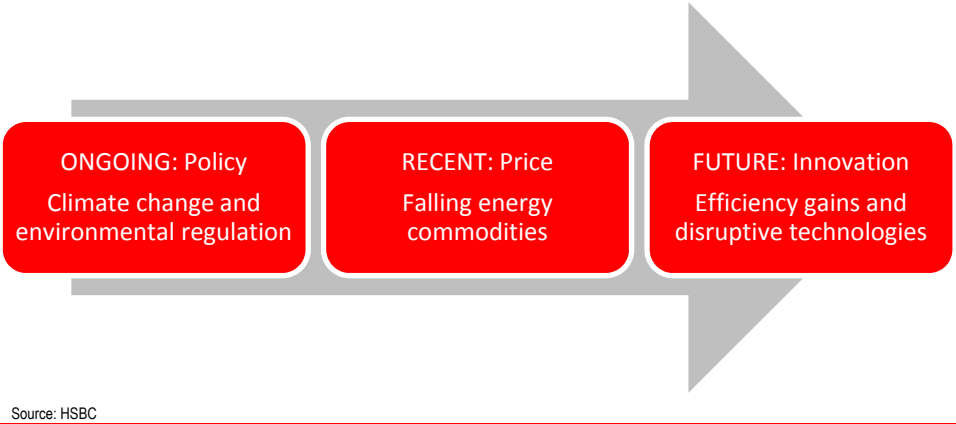
Stranded by climate change regulation: The stranded assets debate stems from the idea that, because burning available fossil fuels would mean breaching the 2°C globally-agreed temperature goal, regulation to tackle CO_2 would curb fossil fuel use. Coal assets face the greatest regulatory risks. The EU Plant Combustion Directive and US Clean Air Act, for instance, have targeted coal-fired power.

Stranded by economics: Oil price falls last year reinforced and widened the debate from coal to oil and gas by bringing an economic angle. Oil types such as oil sands and shale oil break even at USD80 per barrel or higher and assets have become loss-making. Globally, the market value of oil and gas companies has dropped by over USD580bn in the last nine months.

Stranded by energy innovation: Going forward, we think the risks of fossil fuel asset stranding could come from energy efficiency and advancements in renewables, battery storage and enhanced oil recovery. These drivers would impact demand for some fossil fuels, but while the timing of such structural events is difficult to predict, the challenge facing investors is to devise a strategy around the stranded assets theme that captures both climate commitment and fiduciary duty.

Devising an investment strategy: Identifying assets that are most at risk from stranding would be the first step in devising an investment strategy in our view. Thereafter, we see two options. Divesting fossil fuel stocks removes assets but dividend yields may suffer and portfolios become more concentrated. Holding onto stocks allows investors to engage with companies and encourage best practice, although there are reputational as well as economic risks to staying invested. Companies can cut capex but risks remain in maintaining exposure.

Figure 1: A brief history of stranding



Source: HSBC

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Contents

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Stranded assets: what next?

- Climate science and the launch of a carbon budget fuelled the first wave of discussion around the risk of stranded assets
- Oil price falls turned the debate from policy to economics
- We expect innovation in efficiency and technology advancements to change the energy mix and costs, potentially resulting in further stranding

From assets to liabilities

Stranded assets can be defined as those which have suffered from devaluations or conversion to liabilities prior to the end of their economic life. Fossil fuel companies, or some of their assets, may become non-viable or 'unburnable' because of a number of factors. Climate science and the launch of the carbon budget tool fuelled early debate and so one factor is a significantly increased cost of carbon, driven by regulations in different countries which tax carbon or create emissions trading schemes. The dramatic falls in energy commodities, in particular oil benchmarks, brought a second dimension to the debate, as the development of specific assets and reserve classes became increasingly unprofitable.

Looking ahead, we believe that stranding risks will become increasingly acute as efficiency gains hit demand and technology drivers increase supply and reduce demand. In this chapter, we discuss these three drivers for fossil fuel stranding.

Stranded by climate change regulation

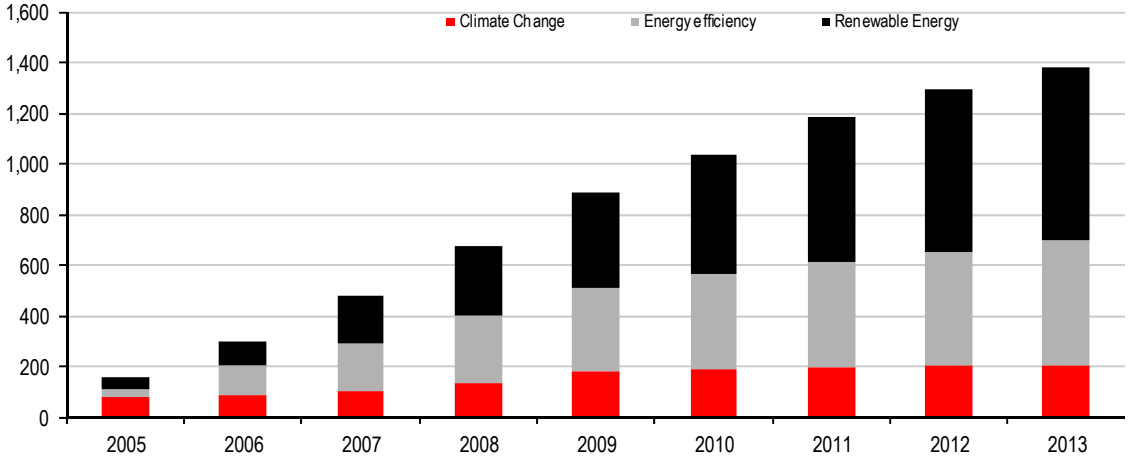
Burning fossil fuels releases greenhouse gas emissions, leading to dangerous levels of climate change. A central climate change focus is whether emissions are being kept in check at levels consistent with a temperature rise of less than 2°C, versus pre-industrial levels. Climate science and the launch of the carbon budget tool therefore catalysed the first wave of concern in capital markets that fossil fuels might be stranded.

The last twenty years has seen the emergence of policies aimed at mitigating climate change. Climate change policies pose regulatory risks to fossil fuel production, particularly those assets which are more carbon intensive. Chart 1 shows the number of climate policies which have been introduced since 2005.

Fossil fuels and the carbon budget

Scientists have developed a tool – the carbon budget – which allows tracking of atmospheric levels of carbon, and hence CO_2, levels against various probabilities of achieving the 2°C target. The carbon budget is an important tool to assess whether the world is on or off track to have a good chance of keeping temperature rises under 2°C. Chart 2 shows how much of the carbon budget remains to limit the world to warming of 2°C, with attached probabilities of less than 33%, of 50% and greater than 66%.

Chart 1: Total number of Climate policies since 2005



Source: IEA Policies and Measures Database

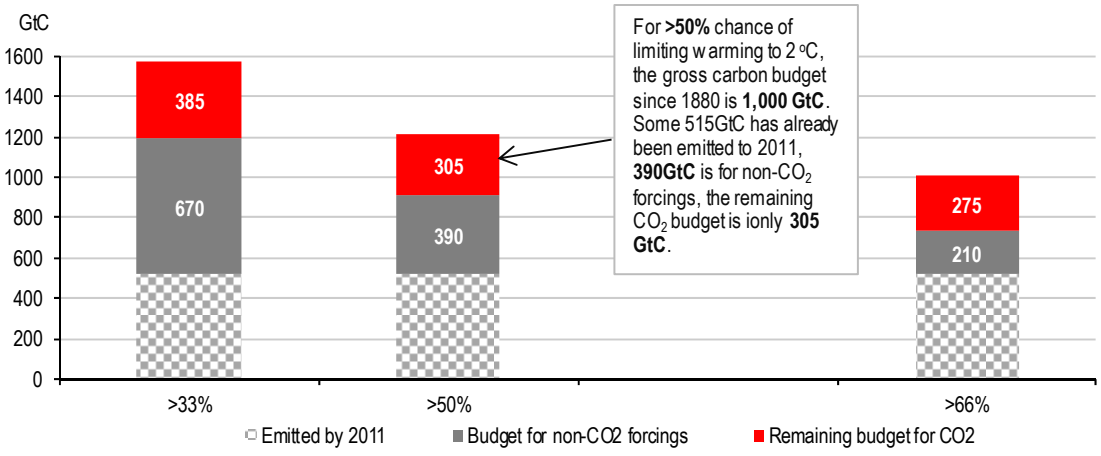
Text box 1: What are fossil fuels?

Fossil fuels are formed from the remains of living organisms, with the temperature, pressure, rate of decay and other factors during decomposition determining whether oil, gas or coal is formed. The sulphur content depends on exposure to either salt or fresh water during formation.

Gas can be found in many sources, including shale rock, sandstone and commonly in oil reservoirs and coal beds. It is mostly constituted of methane. Oil is 'heavy' if it has long hydrocarbon chains, or 'sweet' if low in sulphur. Oil includes the tar-like product found in oil sands. Coal ranges from lignite, considered low grade and used exclusively in power plants, through sub-bituminous and bituminous coal, used to make coke for steel making, to anthracite, high grade and high carbon, typically used to heat buildings.

The earth, via photosynthesis in forests, oceans and other natural processes, can absorb a certain amount of anthropogenic greenhouse gases without global warming, so zero net carbon is not implausible. The amount of total anthropogenic and non-anthropogenic emissions that can be absorbed annually by these natural 'sinks' varies. The US Department of Energy cites a range of between 31% and 79% of total emissions absorbed by natural processes over the period 1959-2013, with an average of 56%. (From a carbon budget expiry perspective, the absolute amount of non-absorbed carbon, rather than the percentage, is more important as the carbon budget is a fixed number. The net trend of absolute non-absorbed carbon is upwards over the period, which is a negative trend for climate change.)

Chart 2: The global carbon budget (CO2 & non-CO2) for given changes of meeting the 2°C target under RCP2.6



Note: 1tC = 3.67tCO2.
Source: WG1 (SPM) IPCC AR5.

Figure 2 shows how fossil fuels fit into the energy system and how they generate emissions. Oil provides 33% of primary energy, the largest single source. The majority of oil use is for transport, where 95% of energy consumed is oil. The power generation sector is the largest consumer of primary energy, accounting for 38.5% of total demand, much of which comes from coal and gas. The power sector is also the largest emitter of GHGs, which includes a 42% share of carbon dioxide emissions. The amount of CO_2 emitted each year, or 'CO_2 spend', is influenced by a variety of natural and man-made factors. Figure 2 also shows that 69% of greenhouse gas emissions are generated by extracting, processing and burning fossil fuels (the balance is from non-energy sources, including land-use change).

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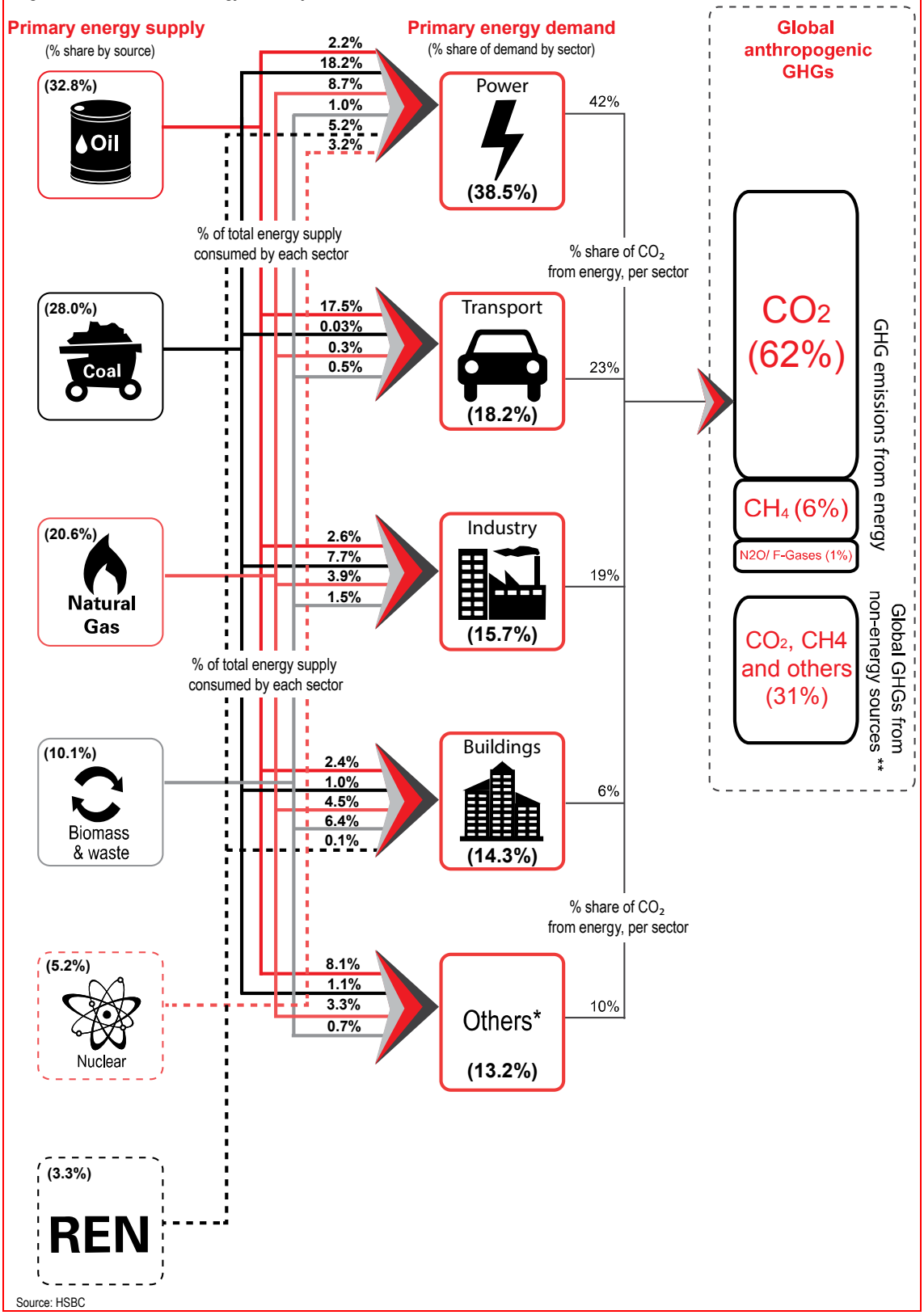
Figure 2: The Climate and Energy Economy



Source: HSBC

Pollution and safety regulation also pose stranding risks

As well as climate regulation, stranding can be caused by reactionary regulator drivers that tackle issues like health and safety and pollution. For instance, oil spills and explosions leading to loss of life can lead to some oil sectors becoming temporarily, or permanently, non-viable. After the Macondo oil spill, drilling in the Gulf of Mexico slowed for a while and we believe that the shadow of Exxon Valdez still hangs over attempts to develop Arctic offshore reserves.

In addition, fossil fuels may face stranding risks from regulation aimed at protecting and improving human health. Coal and oil are associated with high levels of non-GHG pollutants, in particular sulphur oxides and particulate matter, in urban areas. Coal faces more immediate regulatory risks, for instance through closing of power stations and smelters in cities, as has been seen in China. In the longer term, we believe the use of oil in transport may also face more widespread health-driven regulation. Shipping regulations designed to reduce SOx, NOx and particulate matter in urban areas and populated shipping channels is already being introduced.

In June 2014, President Obama announced new regulation which targeted coal-fired power generation in the US (see our report *USA: Climate boost for Paris 2015*, 3 June 2014). This has increased the stranding risk for US coal producers and coal-heavy utilities. The Clean Power Plan proposal from the EPA (Environment Protection Agency) framed climate in a health context and targeted a 30% reduction in carbon from power generation by 2030 from 2005 levels, now a national commitment in the country's submission ahead of the Paris talks. The EPA stated that it expects the plan to cut soot and smog by 25% and electricity bills by 8%, with overall health benefits estimated to be USD55-93bn by 2030. These followed 2013 regulations which targeted new coal power stations, effectively ensuring that none are built without carbon-capture-and-storage (CCS) (see our report *US: new rules cap coal emissions*, 25 September 2013). The implementation of the Mercury and Air Toxic Standards, which took effect last month, has increased pressure on coal fired power plant retirement. Coal-based electricity generation has already been falling as a share of the US energy mix; around 25% of coal based generation has been replaced with gas from 2005-2012 and we expect this trend to continue, particularly given the impact of shale gas in bringing US gas prices down.

Regulatory drivers still in place

New climate change regulation will continue, in our view, to have a restraining effect on GHG emissions - capping emissions and increasing the cost of emitting through taxes and emissions trading schemes - thereby posing further downside risks to more carbon intensive projects.

In 2015, the main regulatory event is the delivery of a universal climate agreement (UCA) in December (see our reports *2015: Dissect, Debate, Deliver'*, 7 January 2015 and *Geneva climate talks deliver'*, 18 February 2015), to come into force from 2020. Most countries are currently preparing intended nationally determined contribution schemes (INDCs) in preparation for a UCA. INDCs set out what countries plan to achieve through national legislation in terms of emission reduction and embedding resilience to the consequences of warmer temperatures. Table 1 lists INDCs released to date. So far, commitments made have been a positive surprise, from a climate standpoint, meaning regulatory stranding risks are greater. Further details can be found in our recent notes (*EU: No surprise en route to*

Table 1: INDC summary

Country	Pledge	Reduction by	Base year	Long term pledge	Comments
Switzerland	50%	2030	1990	Reduce emissions by 70-85% by 2050 compared to 1990. Reduce per capita emissions in Switzerland to 1-1.5 t CO_2 eq.	Carbon credits from international mechanisms will partly be used
EU	40%	2030	1990	Reduce its emissions by 80-95% by 2050 compared to 1990.	No contribution from international credits
Norway	40%	2030	1990	Achieve a low emission society by 2050.	Target is to be met through collective delivery with the EU International market credits will not be used to achieve the target, however it will continue to use CDM and JI
Mexico	25%	2030	2013	Reduce emissions by 50% by 2050 compared to 2000.	Net emissions peak starting around 2026, thereby reducing GHG intensity of GDP by 40% by 2030. Reduction ambition could increase up to a 40% subject to a global agreement. Adaptation goals mentioned.
USA	26-28%	2025	2005	Reductions of 80% or more by 2050.	Aim to reduce emissions by 28%. No contribution from international credits.
Russia	25-30%	2030	1990	Russia aims to use the 2030 target as a stepping stone towards developing a low-carbon long-term objective.	Commitment to the INDC will be based on the outcome of Paris. Emission reduction includes the absorption capacity of the Russian boreal forests.
Gabon	50%	2025	2000	Emergent Strategic plan 2010-2025 is to be extended to 2030, 2050, prior to COP21.	Includes land management, gas flaring reductions, energy efficiency and hydro power growth.

Source: UNFCCC

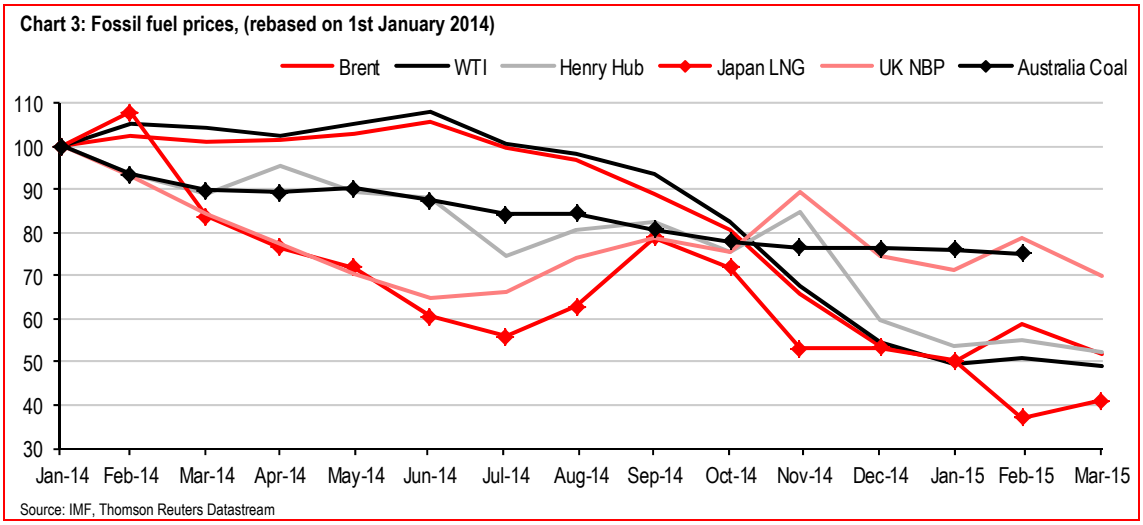
Paris, 12 March 2015, *Switzerland: a good opener*, 4 March 2015, *Norway and Mexico set out aims*, 31 March 2015 and *US and Russia set climate aims*, 1 April 2015).

The level of ambition put forward in future INDCs will be, in our view, at least partially dependent on the economic strength of the country and its dependency on fossil fuels for national income generation. We expect an agreement in Paris at the end of the year but are currently doubtful that the individual country emission reduction goals will be sufficient, when aggregated, to be consistent with the carbon budget set out for the 2°C goal. Although we expect a regulatory driven shift away from fossil fuel use overall, the main event this year in stranding terms is the fall in energy commodity prices, which we discuss in the next section.

Stranded by economics – the risk of today's lower energy prices

Fossil fuel companies, or some of their assets, may become economically non-viable in the future because of a number of factors. Until last year, the focus of investors concerned about stranding was on the risk that assets would be stranded by climate change regulation, as described in the previous section. Further reasons for the economics of fossil fuels to worsen include increases in the cost of production, greater taxes on earnings or the removal of subsidies. Increased supply (perhaps due to new discoveries, technological advances and political decisions) will also put downward pressure on prices where new demand does not match.

The most significant stranding dynamic to have emerged recently comes from the fall in the oil price and other fossil fuels. Chart 3 shows the falls in fossil fuel energy prices since the beginning of 2014, with falls in oil and gas prices more pronounced.



With lower oil prices, producers have a choice: continue to operate and take losses in the hope that prices will recover, or cut losses and shut down facilities. The ability and timeframe to withstand losses will depend on the type of producer (e.g. state owned or private) and diversification of reserves across the cost curve. Where the decision is taken not to produce from a proven reserve or to cease production which was underway, then the asset can be said to be economically stranded – non-viable given the current energy economy. Whether assets are stranded permanently or only in the short term depends on the costs of mothballing versus abandonment.

Stranded by energy innovation

The IEA has forecasted 50% total global energy growth over 2012-2040. So with this level of demand, are concerns that fossil fuels as an energy asset class could be stranded overstated? We don't think so. We think the third dynamic supporting the stranded assets paradigm will be innovation in energy systems, disruptive technologies and efficient processes. These represent a negative demand dynamic for energy use and a change dynamic for the energy mix.

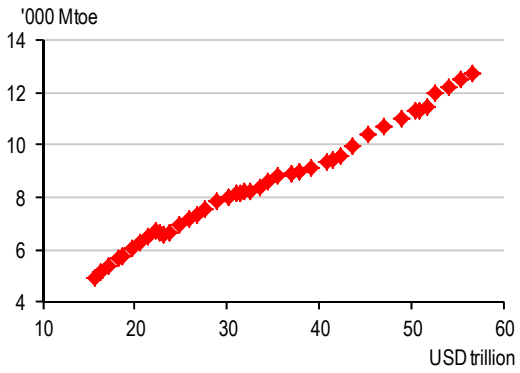
Efficiency drivers

Energy efficiency improvements mean the same outcome can be achieved using a lower amount of primary energy or power. Newly built and existing buildings allow considerable scope for efficiency improvements, through improvements to the building 'envelope' (façade, roof and windows) by insulation and double glazing. Industrial processes also allow considerable scope for improvements, via motors, variable speed drives and industrial heating. The transport sector allows for efficiency improvements via hybrid and electric vehicles as well as via improvements to internal combustion engine cars, via engines, tyres and lightweight components. This is a significant area of investment already. Our analysis in our report *Sizing energy efficiency investment*, 27 March 2014 showed a global expenditure of USD271bn in 2012 for buildings improvements, USD56bn for industrial improvements and USD27bn for efficiency in transport.

Greater energy efficiency has already been achieved in some economies. Chart 4 shows that, globally, energy use continues to rise with GDP growth. Meanwhile, chart 5 shows how the EU has begun to

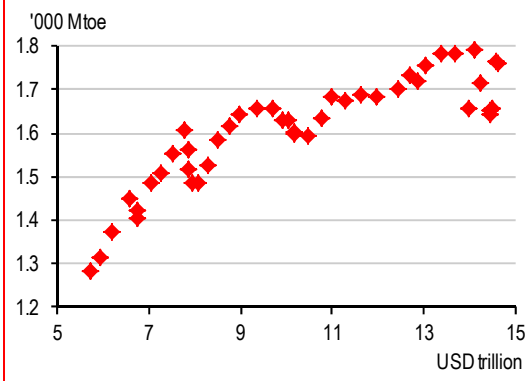
decouple energy use from economic growth in recent years, catalysed by a target adopted in 2009 to achieve efficiency savings of 20% by 2020 against 1990 levels. This demonstrates that greater energy efficiency can be achieved. We believe that the EU example can be emulated globally, which would reduce demand for primary energy including fossil fuels.

Chart 4: World: Energy use continues to rise with GDP



Source: BP Statistical Review 2014, World Bank; GDP is at constant 2005 price

Chart 5: EU: GDP decoupling from energy use



Source: BP Statistical Review 2014, World Bank; GDP is at constant 2005 price

Technology drivers

Advancements in technology have catalysed the supply and demand sides of the energy economy. An example is the rapid switch from steam to diesel and electric trains in the 1950s and 1960s. A second is the rise of nuclear in France's power mix in the mid-1970s, as the imported oil used in the majority of electricity generation became more costly following what is known as the first oil crisis, when OPEC ceased exports and oil prices rose by around four times in under a year.

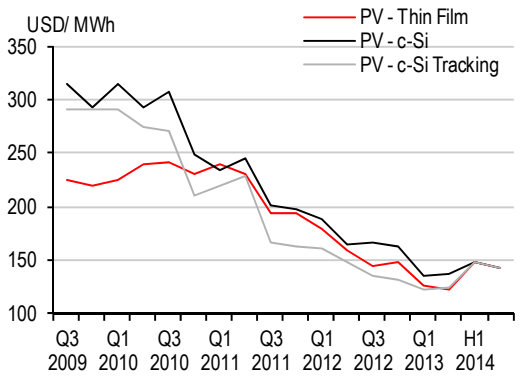
In our view, there are three key areas that could trigger future stranding, renewables, electricity storage and enhanced oil recovery.

Renewables: cheaper as well as cleaner

Renewable energy costs have come down over time. The trend of cheaper renewables contrasts with oil, where harder-to-access reserves are more costly to develop. If this trend continues or were to accelerate dramatically, this would trigger an economically-driven decarbonisation of the power sector, the section of the energy economy which contributes most towards carbon emissions.

Onshore wind is already competitive with fossil fuels in some regions. While offshore wind remains more expensive than coal or gas fired power on average, its cost is also coming down, driven by technological advances including size of turbines, cables and offshore substations. In addition, chart 6 shows that solar prices have fallen quickly in recent years. Further cost falls in renewables would be positive for more widespread adoption, in our view.

Chart 6: Falling cost of solar PV



Source: BNEF, Global LCOE xls, 14 August 2014

Many countries have adopted climate policy frameworks which explicitly support renewables via subsidies or feed-in-tariffs until the industry becomes established. The EU has a target of 20% renewables in the energy mix by 2020. In some countries, renewables also receive implicit policy support through decarbonisation targets. Further intended cuts in emissions which are announced in INDCs this year are supportive of renewables implicitly as, along with efficiency, solar and wind will be one means of achieving the cuts.

In our view, increasing the share of renewables in the energy mix also largely separates the cost of energy from the volatility of energy commodity markets, which is attractive to energy importing nations in particular.

Electricity storage

A dramatic advancement in battery technology, for instance via more efficient use of lithium or advances in aluminium battery technology, would transform the energy economy in our view. It would further catalyse the growth of renewables in the energy mix as the energy produced could be stored until needed. Storage also has important implications for the transport sector. Currently, batteries are an expensive and bulky component in electric vehicles (EVs). A step-change would clear an important hurdle in their ability to take significant market share from traditional petroleum-burning engines, would significantly change the demand profile for oil (the transport sector currently uses oil for 95% of its energy).

Enhanced oil recovery

Supply can be increased from reservoirs already in production. Primary recovery of oil from a reservoir typically yields approximately 10% of the total oil, while secondary techniques (injecting water or gas to create pressure and drive it to a wellbore) allow as much as 40% total recovery. Enhanced oil recovery (EOR) allows 60% recovery and possibly more. To date, enhanced recovery is technically possible, but has been expensive. The US Department of Energy catalogue three main categories of EOR employed to date – two (thermal and injection of different gases) which increase pressure and improve viscosity and also chemical injections using polymers and surfacants to improve volumes at well heads. One sub category of gas injections involves pumping CO2 from industrial processes into wells, which has added potential as a carbon-capture-and-storage method (albeit most EOR is energy-intensive in itself, hence the high costs). Should EOR become cheaper, i.e. should it become possible to significantly increase supply from existing wells, this would in turn increase the stranding risk for higher breakeven oil categories.

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Conclusions

Climate science and the launch of a carbon budget fuelled the first wave of discussion around the risk of stranded assets. The concern was that assets would be stranded by climate change regulation, which has already been witnessed to an extent, for instance with coal-fired power in some geographies.

Oil price falls turned the debate from policy to economics, as many unconventional oil sectors, such as oil sands, shale oil and Arctic drilling, have become loss-making in a relatively short period of time.

We expect innovation in efficiency and technological advancements, including in renewables, battery storage and enhanced oil recovery, to alter the energy mix and pricing in the energy economy, potentially resulting in further stranding of high carbon and high cost fossil fuels.

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Investors: Divest or Hold and engage?

- Investors should devise a strategy on how to manage exposure to high-cost and high-carbon assets in our view
- Investors can reduce exposure to fossil fuel companies in their portfolio by full or partial divestment…
- ..or maintain exposure and engage on climate and economic risks

Devising an investment strategy around fossil fuels

We believe that the three drivers set out in chapter 1, for why and how fossil fuel assets could become unburnable in the future, mean that investors should have a strategy in place for managing fossil fuel investments and in this chapter we set out various options. There is not one solution to mitigating stranded asset risk in our view, since the approach taken will depend on type of investor, size of assets under management, time horizon of investment and appetite for climate change alignment (i.e. owning an investment portfolio that is consistent with mitigating temperature rises).

We think investors can manage the risks of divestment through two mutually exclusive approaches. Divestment (selling fossil fuel investments) or hold-and-engage (holding assets but taking an active approach to minimising the associated downside risks) are the two options in our view, but both carry risks. For both of these approaches however, the first step is to identify which assets could potentially be devalued.

Which assets are unburnable?

In our view, to effectively manage stranding risks the starting point is to understand which assets have the potential to be devalued. The IEA stated in 2012 that no more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the 2°C target is to be met. Coal, oil and natural gas have very different emissions profiles and so coal would be likely to see a much higher proportion left unburned than natural gas. The table looks at reserves, which are proven and viable. Far greater amounts, categorised as resources, would remain in the ground unburned, limiting future project balance sheet growth for extractive companies.

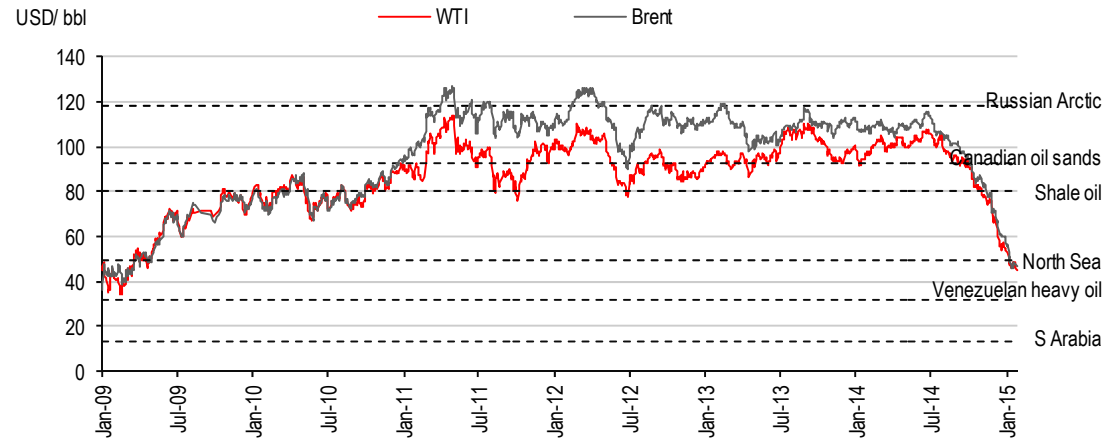
A number of studies have considered which assets are at greater risk of stranding.

Case study 1: A conclusion of our recent report, *Keeping it cool - Oil, CO_2 and the carbon budget*, 2 March 2015, was that, at **lower oil prices**, production from many oil reserves would be unprofitable. Chart 7 shows how this is the case, with the main oil benchmarks – West Texas Intermediate (WTI) and Brent – tracked over time against the break-even cost of production for extraction from the Russian Arctic, Canadian oil sands, US shale oil, the North Sea, Venezuelan heavy oil and Saudi Arabian conventional crude. Only the latter two are profitable at today's oil prices.

While expensive deepwater, US shale oil and risky Arctic ventures may be mothballed or abandoned, oil sands face the greatest stranding risks, in our view, given the combination of high breakeven price and higher carbon intensity of production.

Case study 2: The Programme for Stranded Assets at Oxford University studied **subcritical coal** fired power – that which is least efficient and most polluting, requiring more fuel and water to generate the same amount of power – accounting for 75% of global coal-fired power station capacity. Benchmarked against the most efficient power stations, subcritical uses 75% more fuel and 67% more water. As the most inefficient, they are most susceptible to climate and environmental regulation or, as they are typically the oldest stations in the fleet, to cost-efficient closure. Accounting for water scarcity and localised high particulate matter readings, **Indian and Chinese power stations** are most at risk of regulation. Oxford's research also highlighted the stranding risks to **Australian power**, where 50% of total power comes from subcritical coal fired power stations.

Chart 7: Project break-even and crude price



Source: Resources to Reserves, IEA, 2013, Thomson Reuters Datastream

Case study 3: Academics at University College London looked at the **total percentages of reserves** that should remain unused from 2010 to 2050 to meet a 2 degrees scenario. They found that 35% of oil reserves, 52% of gas reserves and 88% of coal reserves would be stranded under this scenario. The study also suggested that, under this scenario, there could be no development of the **Arctic** and no increase in **unconventional oil** production, such as oil sands. These assets would effectively be stranded. UCL also produced a **regional breakdown**, which shows that 75% of Canadian oil will not be burned, and over 95% of coal in the US, Middle East and Former Soviet Union countries.

Case study 4: A report from the Carbon Tracker Initiative described the risks facing producers of **Canadian oil sands**. They found that 92% of all potential projects require a market price of USD80/bbl in order to break even. This does not allow for contingencies (typically applied in the range USD5-15) or, of course, for profit and so a higher market price would be required for them to be sanctioned. The research also looks at which companies are exposed to Canadian oil sands and finds some companies have over 90% of capex in this sector and at this breakeven production level, while several of the international oil and gas majors have a few percent of capex at this level, which we think illustrates risks to investors exposed to these companies.

Divestment is one approach to managing the risk

Divestment is the first method by which investors can manage stranding risks in their portfolios. Selling down fossil fuel companies removes their risk and return profiles altogether. Screening out financial securities, (negative screening), is a long-used strategy within ethical investment. Examples employed by investors include negative screens of companies involved in tobacco, alcohol, deforestation, munitions, those associated with human rights abuses and those operating in countries with violent or undemocratic governments. An early example was the screen applied to companies operating in apartheid South Africa. Fossil fuel divestment is the latest in a line of such exclusions. In this section, we highlight practical considerations involved in divesting before discussing whether it can drive a lower carbon energy system.

Divestment has been endorsed as an approach to mitigating climate change by Ban Ki-moon, the United Nations Secretary General, and Christina Figueres, the head of the UN Framework Convention on Climate Change in speeches in 2014.

Investors in the US, and increasingly in Europe have already started divesting by limiting or selling down portfolio exposure. According to divestment advocates, 350.ORG, the list of institutions which have chosen, this approach now totals 130. Table 2 provides an indication of the types of institutions that have pursued a policy of divestment and the scope of the exclusion.

We think there are four approaches that investors can choose to adopt to implement a divestment strategy:

- 100% divestment from all companies producing fossil fuels
- Partial divestment (tilting) according to index classification, revenue criteria or breakeven prices
- Value chain analysis of the companies that are involved in fossil fuels
- Worst-in-class approach based on carbon intensity of individual companies

We look at these below.

100% divestment

Investors can choose to divest from all companies producing fossil fuels. This removes downside risks attached to coal, oil and gas companies from portfolios. The stated divestment rationale of investors makes clear that they are driven by concerns relating to stranding through climate change and through economics. The former of the two drivers has become something of a civil movement, led by NGOs, concerned activists and university fossil free campaigns.

Investors that have divested from all fossil fuel producing companies include the Guardian Media Group, the Dutch town of Boxtel and the Church of Sweden, as shown in Table 2.

Partial divestment (Tilting)

In our view, the main choice for investors to make is whether to sell all fossil fuel investments or to sell those which they consider to be higher risk.

We think there are three ways of assessing how to select stocks for a partial divestment strategy, sometimes known as tilting. The first, and most straightforward, but least easy to manage from an investment return perspective in our view, is to look at stock market index classification categories, which will allow a broad brush exclusion of all oil and gas companies, for example. The second is to identify the revenue generation related to fossil fuels by individual companies, before taking a view on what level of revenues related to fossil fuel is acceptable to allow investment in the company. The third is to assess individual project break even points to assess the likelihood of stranding.

Sweden's Second AP Fund divested from 12 companies deriving a majority of turnover from thermal coal and eight oil-and-gas production companies with substantial exposure to high-cost projects, such as oil sands. The Fund stated that it believes these companies face climate-related financial risks and that it is highly likely that projects may be stranded. Australia's Local Government Superannuation Fund divested from companies that make more than a third of their revenues from coal mining or coal-fired power.

Value chain analysis

Investors can also look along the value chain from producers to consumers of fossil fuels. We believe this strategy for divestment could be more effective because pressure is placed on a sector responsible for more emissions than any other and which can consider substitution to a low or zero carbon alternative. Norway's Storebrand Pension Fund divested from 13 coal producers, six companies with heavy exposure to oil sands and then from coal-heavy utilities. This screen extends the responsibility for greenhouse gas emissions along the supply chain, from primary producers of fossil fuels – coal in this example – to sectors that demand fossil fuels, in this case to power stations. Pragmatically, much coal is produced by diversified mining companies, meaning divestment of companies producing large amounts of coal will also lead to exclusion from the portfolio of exposure to many metals. Oil and gas companies are typically closer to pure play and therefore screening out these fossil fuels is simpler.

Table 2: Selection of institutions to have announced divestment from fossil fuel investments

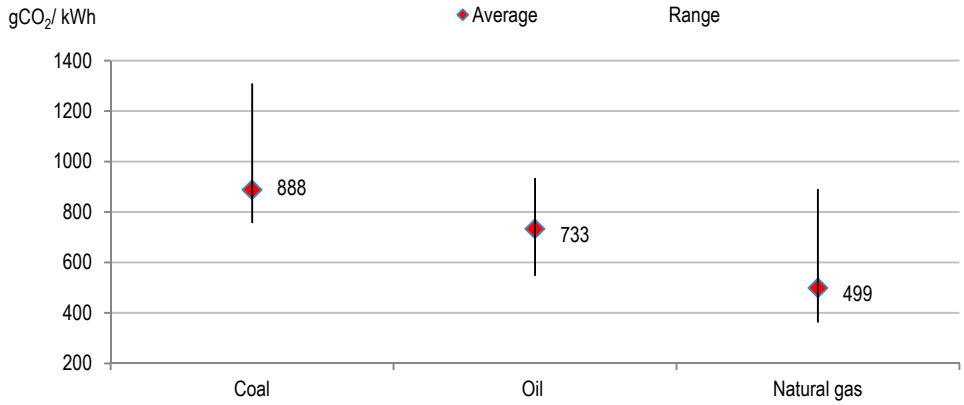
Investor	Country	Category	Strategy	Divestment	Date of announcement
Second AP Fund	Sweden	Pension	Partial divestment	12 coal and 8 oil-and-gas companies.	Oct-14
ANU	Australia	College	Partial divestment	Iluka Resources, Independence Group, Newcrest, Sandfire, Oil Search, Santos and Sirius, representing 5.1% of holdings.	Oct-14
Rockefeller Brothers Fund	US	Family fund	Fossil fuels	Initially, coal and tar sands. Ultimately, all fossil fuels.	Sep-14
Storebrand	Norway	Pension	Partial divestment	13 coal extractors and six firms that are heavily exposed to oil sands, later decision to divest from coal-heavy utilities.	Jan-14
Boxtel	Netherlands	Local authority	Partial divestment	200 fossil fuel companies that hold the largest coal, oil, and gas reserves.	Oct-13
Orebro	Norway	Local authority	Fossil fuels	All fossil fuels	Jun-13
Church of Sweden	Sweden	Religious	Fossil fuels	All fossil fuels	Sep-14
The University of Glasgow	UK	College	Partial divestment	Divested £18m from the fossil fuel industry and froze new investments	Oct-14
Green Mountain College	US	College	Partial divestment	200 fossil fuel companies that hold the largest coal, oil, and gas reserves.	May-13
Hampshire College	US	College	Fossil fuels	All fossil fuels	Dec-11
Peralta Colleges	US	College	Partial divestment	200 fossil fuel companies that hold the largest coal, oil, and gas reserves.	Dec-13
Prescott College	US	College	Partial divestment	200 largest fossil fuel corporations over the next 3 years	Feb-14
San Francisco State Univ	US	College	Partial divestment	Coal and tar sands companies, began process to look at fully divesting from the fossil fuel industry	May-13
Sterling College	US	College	Partial divestment	200 fossil fuel companies that hold the largest coal, oil, and gas reserves.	Feb-13
Stanford	US	College	Coal	Coal mining companies	May-14
World Council of Churches	Switzerland	Religious	Fossil fuels	All fossil fuels	Jul-14
The University of Sydney	Australia	College	Carbon	Cut its fossil fuel investments by reducing the carbon footprint of its portfolio by 20% over three years	Feb-15
Oslo	Norway	Local authority	Coal	Coal companies	Mar-15
Nordea	Sweden	Asset Manager	Coal	Up to 40 coal-mining companies	Jan-15
KPL Pension Fund	Norway	Pension	Coal	Companies that derive more than 50 per cent of their revenues from coal	Nov-15
Local Government Super	Australia	Pension	Coal	Companies that make more than a third of their revenues from coal mining or coal-fired electricity generation	Oct-14
Norges Bank IM	Norway	Sovereign Wealth Fund	ESG	22 carbon-intensive fossil fuel companies	Feb-15
The Guardian Media Group	UK	Media	Fossil fuels	All fossil fuels. Pledge to reinvest cash released in pro-environment/climate companies.	Apr-15

Source: HSBC, Company websites

Worst-in-class analysis

Beyond index classification categories, a revenue-based approach and value-chain analysis, a fourth approach is to identify and exclude the 'worst offenders' in any sector or subsector. Producing and consuming different fossil fuels results in different levels of carbon emissions. On a life-cycle basis – i.e. the emissions that result from extracting, processing and consuming (burning) fossil fuels – most emissions tend to be generated at the consuming stage. The consumption stage of oil accounts for 70-80% of CO_2 emissions. Studies have found that coal emits over 90% at the burning stage and gas over 85%. Chart 8 shows the lifecycle emissions for use of fossil fuels in power generation. Natural gas is the cleanest option. The chart also shows the ranges within each category, which are significant. Coal at the 'cleaner' end overlaps with gas at the 'dirtier', meaning a sensible approach to reducing carbon exposure could be to include best-in-class (lowest life-cycle emissions) coal and exclude worst-in-class gas.

Chart 8: Lifecycle GHG Emission for electricity generation (gCO2/kWh)



Sources: Comparison of lifecycle greenhouse gas emissions of various electricity generation sources, World Nuclear Association

Challenges with a divestment strategy

Reinvestment (or what to do with the freed up cash)

Divestment brings a degree of concentration risk. The amount depends on the scope of an investor's divestment – whether from all fossil fuel companies or a selection where risks outweigh returns. Table 3 shows the percentage of major indices which are constituted from oil and gas stocks. This in turn illustrates the concentration brought about by divestment, with notably higher risks for investors in the FTSE100.

Following divestment, investors must decide what to do with the cash freed up by selling fossil fuel assets. One option is to reinvest into the screened index. This affords slightly narrower exposure in an index without the upside and downside risks of oil and gas companies, but does not require an active buying decision. A further option is reinvestment into the low carbon economy. The Guardian Media Group's recently announced its decision to divest all fossil fuels from its USD1.2bn fund was accompanied by a pledge to reinvest funds in pro-climate stocks. Such an approach can be achieved through actively selecting stocks or through a proxy such as the HSBC Climate Change Index or a managed environmental investment fund.

Many fossil fuel companies are regular dividend payers. Table 3 shows both the significant weighting of oil and gas companies in major indices and that they offer a materially higher average dividend yield than the indices in which they sit. We think investors should consider lost yield from portfolios when divesting stocks and consider relative yields of investments made with cash released through divesting.

Table 3: Weights of oil & gas and coal companies in major indices

Index	Oil & Gas		Coal pure play		Index overall
	Weight (%)	Dividend yield (%, est.)	Weight (%)	Dividend yield (%, est.)	Dividend yield (%, est.)
FTSE 100	13.1	4.9	0	na	3.4
MSCI World	7.1	1.6	0.02	0.9	0.8
S&P 500	7.9	2.9	0.03	0.9	2.0

Source: Thomson Reuters Datastream; Note: dividend yield calculated based on 12m forward dividend per share estimate for individual stocks given in Thomson Reuters Datastream; sector weights are by market capitalisation; data as on 9 April 2015, na= not applicable

Performance

Clearly, the aim of investors is to generate positive returns, so how can investors expect their portfolios to perform with less or no allocation to fossil fuel companies? A recent report from HSBC's Equity Quantitative analysts, *Divesting from coal*, 23 March 2015, looked at the risks of divesting from Asian coal stocks by backtesting over a period of five years. Two options for re-allocation of capital from coal companies were offered – invest back into the screened index or into the HSBC Global Climate Change Index, which contains low carbon stocks. The analysis found that recent underperformance of coal companies meant outperformance of a divested portfolio over a five-year period. However, it also concluded that a number of downside portfolio risks remain, including to dividend and yield (very important to many university endowments and pension funds who need regular income from investments), growth, leverage and momentum.

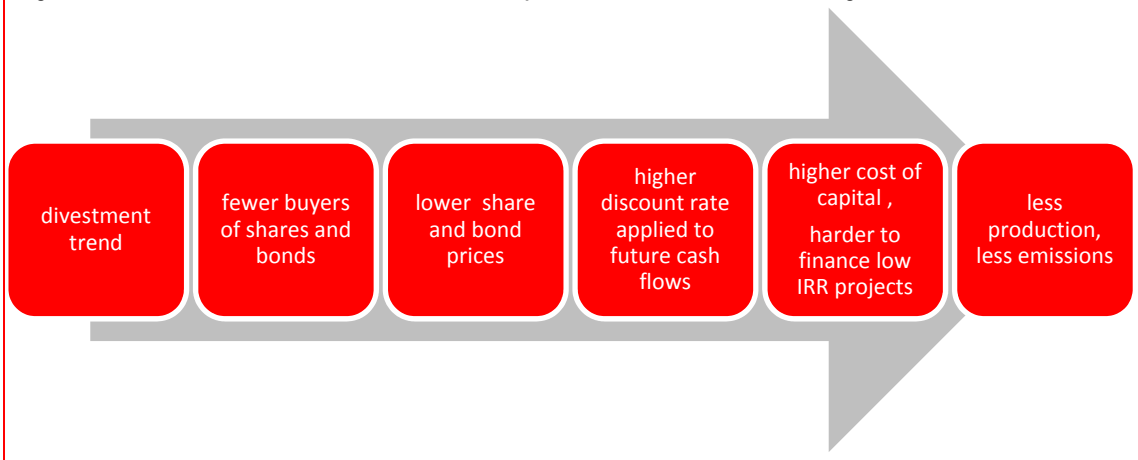
We believe that the risks of stranded fossil fuel assets have grown recently and will continue to do so. Stranding is an immature risk, which has intensified this year and which we expect to increase, meaning that backtesting is imperfect as a guide to future sector performance, i.e. the risks facing fossil fuels and derived energy today are different now to a few years ago and so to where they were at the beginning of any backtesting time series. Volatility and event risk, both material considerations in fossil fuel investment, may also not be adequately captured by backtesting over certain time frames.

Does divestment extend the carbon budget?

To the extent that climate goals can be achieved by a strategy of divestment, they are likely to be achieved via the leverage of publicity and reputational impact. A finding of the Oxford Programme for Stranded Assets is that, in every case reviewed, divestment campaigns stigmatised targets and ultimately were successful in lobbying for restrictive legislation. Oil and gas companies have been impacted by negative publicity on many occasions. The Macondo oil spill following the explosion on the Deepwater Horizon rig led to a substantial re-rating of the company's stock, large fines, an ousted CEO, lost revenue as operations were halted in the Gulf of Mexico and ultimately the sale of several divisions. Other major negative publicity events have been experienced by Exxon after the Valdez spill, Shell over a period of many years relating to environmental and social impacts of operations in the Niger Delta and Chevron following damage caused to Ecuadorian rainforest ecosystems.

In economic terms, divestment works theoretically as described in Figure 3, where less demand for shares and bonds ultimately increases the cost of capital to companies and limits the ability to finance expensive projects, which is particularly damaging in a sector where projects are inherently long term.

Figure 3: How substantial divestment could affect fossil fuel production and extend the carbon budget

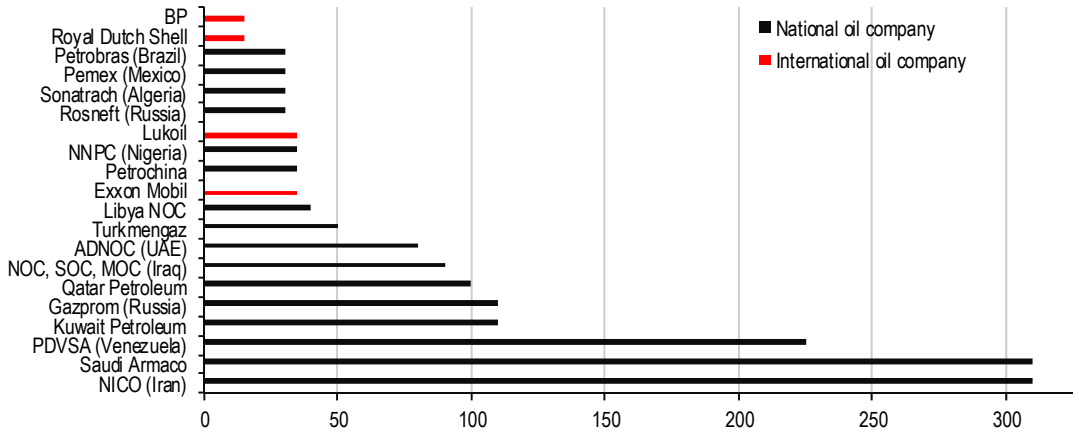


Source: HSBC

Table 2 on page 17 showed that the organisations that have committed to 100% divestment are relatively small investors in a global context. At this stage, we believe we are at the beginning of the *less production, less emissions* journey depicted in Figure 3. Nonetheless, we expect the divestment trend to remain a focus and believe that investors wishing to divest should consider which strategy of the four explained above is relevant for them.

The impact on total fossil fuel production also has some structural boundaries, given the proportion of proven reserves owned by unlisted, state-owned enterprises (SOEs). Chart 9 illustrates the fact that the bulk of the world's proven reserves is on the balance sheets of state owned enterprises, with NICO and Saudi Aramco the biggest owners. The red lines, representing BP, Shell, Exxon and Lukoil, are the only majority listed international oil companies in this top-20 list.

Chart 9: Proven oil and gas reserves 2010



Source: University of Oxford: smith school of enterprise and the Environment, Oliver Wyman and The Economist

Lastly, there is a risk with divesting that it may also result in shares being increasingly owned by disengaged investors (as those investors who are actively managing climate risks have decided to divest). This would mean the important leverage applied through investor engagement would disappear.

Hold and engage

Fossil fuel divestment is a less straightforward decision, ethically, than historical decisions to divest from other sectors or countries, in our view. This is due to the systemic place which fossil fuels have in the energy mix and, by extension, in our lives. Individuals may consume ethically, for instance by electing not to buy alcohol, uncertified wooden products or goods from certain countries. But to boycott all products derived from fossil fuels is extremely difficult. Coal, oil and gas are used for 75.6% of global power generation. Oil meets 95% of transport fuel requirements. Fertilisers, petrochemicals, construction materials are all highly dependent on fossil fuels, as are domestic heating and cooking.

Responsible investment is the integration of environment, social and governance risks into investment decisions. Investors unconvinced that divestment is consistent with either their climate targets or their financial aims may choose instead to continue to hold fossils and actively manage associated environmental and social risks on an ongoing basis. Remaining invested in fossil fuels retains an investor's position as a stakeholder and therefore able to contribute to governance of the company – a seat at the table alongside civil society, regulators and employees. A responsible investment policy relating to managing stranded fossil fuel assets risk could involve the following activities:

- Regular engagement on the regulatory and economic risks of standing of assets on company balance sheets. Companies should be asked to justify valuation of assets, capital expenditure and acquisitions given relative carbon exposures and breakeven oil price required.
- In engagement with fossil fuel producing and consuming companies, recommend diversification into lower carbon energy, such as through renewables, carbon-capture-and-storage or considerably more efficient fossil fuel technologies. Recommend also that projects are valued to include an appropriate carbon price.
- Integrating stranding risks into equity and debt valuation.
- Voting at shareholder general meetings. Investors could vote against management or executive remuneration where they believed risks were not being properly addressed. Specific resolutions relating to environmental risks associated with fossil fuels may also be tabled by shareholders at some companies, allowing others to show support.
- Broader engagement with other stakeholders, including clients, civil society, academics and regulators.
- A collective approach. Sign up to the Montreal Carbon Pledge, which commits investors to measure and publicly disclose the carbon footprint of their investment portfolios on an annual basis. Or join the Portfolio Decarbonization Coalition a community of institutional investors who will collectively disclose a carbon footprint of at least USD500bn of assets under management by December 2015.

A number of investors have publicly stated a considered decision to remain invested in and actively engage with fossil fuel companies, CalPers, Harvard and the Wellcome Trust are prominent examples.

Table 4: Oil and Gas majors' announcements on capital expenditure

Company	Announcement	Capital Expenditure					HSBC Commentary
		2013a	2014a	2015e	2016e	2017e	
BP (USDbn)	3-Feb	30.03	23.19	20.3	21.12	22.67	1)Organic capex to remain in the USD24–27bn range up to 2020 2)2015 guidance is now USD20bn, 12% y-o-y, 17% below previous guidance 3)The cuts have been made to exploration spend and deferral of projects 4)On 02 Feb 2015 HSBC revised the 2015e capex down by 12% compared to the 2014a
Y-O-Y (%)		-	-23%	-12%	4%	7%	
BG (USD bn)	3-Feb	12.17	9.41	5.91	6.68	6.74	1)Guidance midpoint is a cut of 31% y-o-y and 42% vs 2013 (USD11.2bn) 2)Spending in Brazil and on exploration are likely to stay flat 3)Expenses in Australia and on operations are likely to be halved 4)On 02 Feb 2015 HSBC revised the 2015e capex down by 37% compared to the 2014a
Y-O-Y (%)		-	-23%	-37%	13%	1%	
Statoil (USD bn)	6-Feb	15.56	16.58	17.15	17.79	18.47	1)Organic capex guidance was cut to USD18bn from the 2014-16 guidance of USD20bn and 2014's USD19.6bn 2)A further reduction of USD5-7bn p.a. of capex flexibility from onshore and non-sanctioned projects can be expected if need be 3)on 09 Feb 2015 HSBC revised the 2015e capex up by 3% compared to the 2014a
Y-O-Y (%)		-	7%	3%	4%	4%	
Total (USD bn)	2-Feb	31.5	27.27	23	23.74	23.49	1)Increasing capex flexibility in 2016 2)Capex will fall to USD20bn if Brent remains around USD60/bbl. 3)On 13 Jan 2015 HSBC revised the 2015e capex down by 16% compared to the 2014a
Y-O-Y (%)		-	-13%	-16%	3%	-1%	
Chevron (USD bn)	30-Jan	37.66	36.82	31	30.01	30.55	1)Capital and exploratory budget for 2015-USD35bn, 13%, lower than 2014 2)Spending could be flexible in and beyond 2015 if crude prices remain low 3)On 02 Feb 2015 HSBC revised the 2015e capex down by 16% compared to the 2014a
Y-O-Y (%)		-	-2%	-16%	-3%	2%	
Royal Dutch Shell A/B (USD bn)	29-Jan	41.15	33.28	32.88	33.64	33.77	1)Capex to stay high at little below the 2014 levels 2)Operating costs in 2015 to be reduced by over USD15bn over the next 3yrs 3)Cuts declared are relative to 2015's potential spend and not 2014's actual 4)Exploration spend to remain at USD40bn 5)Restructuring global resource in the North Sea and Asia 6)On 30 Jan 2015 HSBC revised the 2015e capex down by 1% compared to the 2014a
Y-O-Y (%)		-	-19%	-1%	2%	0%	

Source: Company websites, HSBC

How companies have responded

Companies are not, of course, oblivious to the risks that their assets will become stranded. Corporate reporting in the first quarter of the year gave some indication of future investment flows for projects and showed companies reducing spending on higher cost projects, which are more at risk of economic stranding. Table 4 shows company announcements on capex cuts from oil and gas majors under HSBC coverage. It is difficult to assess the root cause of cuts in capex announced by companies i.e. whether they are due to moth-balling existing projects or whether projects are shelved before they start. HSBC's Oil & Gas team believes that for the major oils, the easy area in which to make cuts is exploration spend, followed by new project sanctions.

The largest cuts amongst the majors to 2015 capex guidance were at BG, expected to be down 37% in 2015 from 2014, and at Total and Chevron, both down 16%. Illustrating sector-specific risks, Canadian oil sands producers Suncor, Cenovus Energy and NEG Energy announced cuts of 13%, 27% and 75% respectively. US shale oil producer, Continental Resources, announced a cut of 41%. In addition, a number of service companies to the industry have announced cuts in employee numbers and capital expenditure. In January 2015, Schlumberger announced its decision to reduce its overall headcount by approximately 9,000. Halliburton announced that, as a result of declining activity in the sector and the weakening outlook during the fourth quarter of 2014, the company took a USD129m restructuring charge. Chart 10 further illustrates the scale of cuts in capex from 2014 to 2015 for several categories of producer.

From a carbon budget perspective, decisions that result in a net reduction in CO_2 are positive, because they extend the time available to implement policy, invest in low-carbon energy infrastructure and scale up emerging technologies that facilitate a faster transition to a low carbon economy.

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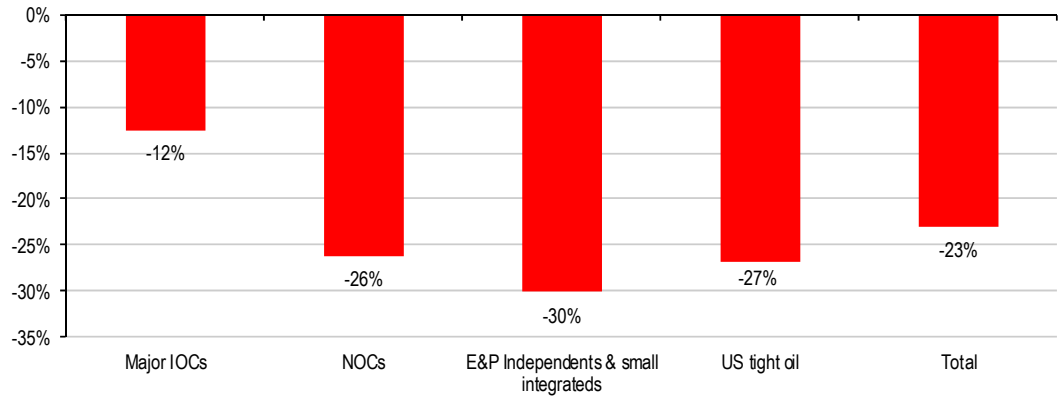
Chart 10: Quantum of cut in capex in 2015 vs 2014



Source: HSBC

Oil and gas majors have also invested in renewable energy forms including wind, solar and biofuels. Technologies such as carbon-capture-and-storage are further research priorities for several companies. Investor engagement should encourage them to continue and increase efforts to diversify their energy sectors and develop low carbon solutions as a hedge against stranded assets.

The risks to remaining invested

There are long-term and short-term downside risks associated with using a hold-and-engage investment policy to manage stranded assets risks.

Previously, climate regulation appeared the main stranding risk. Many investors and operators believed that, collectively, this would fall short of what is necessary to achieve the 2°C target, at least in the short to medium term, meaning risks were not that great or urgent. It was a tangible risk for truly longer-term investors such as insurers. The Governor of the Bank of England, Mark Carney, stated earlier in 2015, *"insurers, as long term investors, are … exposed to changes in public policy … One live risk right now is of insurers investing in assets that could be left 'stranded' by policy changes which limit the use of fossil fuels"*. There is also a reputational risk that non-divesters may one day be seen to be late movers, on 'the wrong side of history' to coin an increasingly common phrase, particularly if they get the downside risks wrong and make losses from fossil fuel investments. Tracker funds – which replicate indices – are also at risk of long-term regulation, obligated to own stocks in indices which their products tracked.

Sovereign wealth funds tend to be long term investors, mandated to grow savings either to provide future income when natural resources run out or to provide a stabilisation function during fluctuations in commodity prices or national income. For sovereign wealth funds whose capital comes from fossil fuels, with prominent examples including Norway, Venezuela, Kuwait, Abu Dhabi, Qatar and Saudi Arabia, a divested portfolio provides a natural hedge. For such funds, given inward capital flows come from fossil fuels, investing the capital in non-fossil fuels sectors diversifies sources of income and the overall value base.

But stranded assets are also a short-term risk. The speed of the collapse in energy prices over the past three quarters has taken the fossil fuel industry by surprise, in our view. As rigs are dismantled, capex is cut and operating assets quickly become unprofitable, stranding risks have become much more urgent for investors to address, including shorter term investors with positions based on a 12 month view or less.

In the shorter and longer terms, investors themselves become a target for negative campaigns and publicity, where once the oil companies were the targets of such campaigns. University buildings have been occupied by students following decisions by their colleges not to divest.

Conclusions

As discussed in the first chapter, we believe stranding risks for assets are relatively high this year and growing. To manage these risks, investors should first analyse what assets will be stranded and so where the risk lies in portfolios. Coal assets face the greatest regulatory risks, given the high associated emissions and substitution possibilities. Oil reserves with a high breakeven oil price are also at risk – oil sands, shale oil, Arctic and some offshore assets.

Next, investors should decide how to manage asset stranding risks, taking into account both their climate commitment and fiduciary duty. Divestment is one option, whether 100%, partial divestment by revenues or sectors, looking further along the value chain to fossil fuel consumers or by screening out worst-offenders. Divesting fossil fuel stocks removes assets but dividend yields may suffer and portfolios become more concentrated. Holding onto stocks allows investors to engage with companies and encourage best practice, although there are reputational as well as economic risks to staying invested. Companies have responded to asset stranding risks with capex cuts, although many productive assets continue to run at a loss.

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