Finding Petroleum

- Why we don't have to worry about 'stranded assets'
- Why renewables growth could be exponential
- The growth of the lithium ion battery
- CCS - needing better cheerleaders from oil and gas?
- What its like complying with ETS offshore
- Tankers - can oil companies drive CO2 reductions?
- How to tell a better story

Event Report, Investing in petroleum under a carbon cloud, Nov 19, 2015, London

Special report

Investing in petroleum under a carbon cloud

Nov 19, 2015, London

Event sponsored by:

BERNSTEIN

bp

Petromall

Carbon Capture Journal

StrategicFit

Helping you make quality decisions

StrategicFit is a strategy consulting firm specialising in the upstream oil and gas industry.

We help companies, licence partnerships and stakeholders make difficult decisions they can be confident in.

Through decision analysis, a collaborative strategy process and sector expertise, we'll give you a clearer way forward.

www.strategicfit.co.uk

+ 44 (0) 20 7637 0324

Investing in petroleum under a carbon cloud

Finding Petroleum's London forum on November 19 2015, "Investing in Petroleum under a Carbon Cloud", covered topics including whether oil and gas companies have to worry about 'stranded assets', which oil companies will be hit hardest by carbon taxes, and will the industry all be shut down by renewables.

Also, how can investors steer companies to reduce emissions, how the industry can get carbon capture projects going, what institutional investors are thinking, and the threat of lithium ion batteries.

We covered developments with the oil major led 'Carbon Capture and Storage Project', how Premier Oil complies with the demands of the Emission Trading Scheme for offshore operations, how to reduce emissions from tanker shipping, and how the industry can tell a better story.

There wasn't any conclusion from the conference, except perhaps to say, oil companies are under increasing pressure to 'do something' about the climate, and perhaps getting involved in carbon capture is the best way they can respond to this pressure.

In his introduction, conference chairman and producer David Bamford said he had received a large amount of e-mail about the conference, of which around 80 per cent was negative.

The 20 per cent of positive replies contained comments like "very timely, about time, good for you".

The 80 per cent of negative replies contained comments like "since you're a geophysicist, surely you can't believe any of this [climate] modelling, the data is unconvincing".

"I have views of my own [on climate science] being a physicist," he said. "But actually that's not really an important point because the regulators and politicians of the world appear to believe the modelling and the data about the impact of fossil fuels on the climate and are proceeding to act on that belief."

"It seems that's the essential point, no matter what some physicists or geophysicists may say."

"That has led some people, such as John Browne (former CEO of BP) to say, the oil and gas industry faces an existential threat from carbon pricing, which is an interesting place for him to get to."

"This leads you down the track of, not all the oil that's been discovered can be produced, maybe the industry has a 10 year life."

Note: all presentations from the conference and videos can be downloaded from the event website
www.findingpetroleum.com/event/2d6fa.aspx

Also at the conference – Stuart Lodge, Process Engineer, carbon solutions with BP, gave a talk on the results of Phase 3 of the CO2 Capture Project (CCP). The talk is not included in this report, but the video and slides can be viewed on the event website

This is an Event Report from our forum in London on November 19, 2015, "Investing in petroleum under a carbon 'cloud'".

Event website
http://www.findingpetroleum.com/event/2d6fa.aspx

Report written by Karl Jeffery,
editor of Digital Energy Journal
jeffery@d-e-j.com
Tel 44 208 150 5292

Sales manager
Richard McIntyre
rmcintyre@d-e-j.com
Tel 44 208 150 5291

Conference produced by David Bamford

Layout by Laura Jones, Very Vermilion Ltd

Cover art by Alexandra Mckenzie

Finding Petroleum
www.findingpetroleum.com

Future Energy Publishing,
39-41 North Road,
London, N7 9DP, UK
www.fuenp.com

Don't worry about 'stranded assets'

There is nearly no need for listed oil and gas companies to worry about 'stranded assets', according to analysis by Bernstein Research

Climate models show that in order to limit temperature rise by 2 degrees, we must burn under 1455 gigatonnes (Gt) of carbon dioxide between 2014 and 2100, said Teng Ben, Senior Research Associate at investor research company Sanford C Bernstein.

For a temperature rise of 3 degrees, we can burn 3205 Gt by 2100, a big jump. This would allow all currently proven reserves of oil, gas and coal to be burned.

To achieve a 2 degree temperature rise means reducing global emissions by 25 per cent between 2000 and 2050, which is "very very unlikely," she said.

To illustrate this, Bernstein analysis shows that even if US and EU achieve their stated pledges of reducing emissions by 30 per cent by 2030 (US) and 40 per cent by 2030 (EU), China's pledge (to let its emissions peak by 2030), together with expected emissions growth from the rest of the world, will lead total emissions to increase 10 per cent from 2013 to 2030.

That would require a 50 per cent drop in emissions from 2030 to 2050, to get a 25 per cent drop over the period 2000 to 2050, Bernstein calculates.

If we want to keep atmospheric CO2 to under 450ppm, we can "double our efforts in energy efficiency, do more with the energy mix, and bring in energy technology improvements," she said.

Energy mix

One pathway is to use more gas, which emits less carbon when it is burned. However estimates vary as to how much is leaked into the atmosphere before being burned from pipelines and compressor stations, with natural gas being a much more potent greenhouse gas than CO2.

If we take the carbon intensity of coal as being 2-3 times gas for power generation, that means we can reduce CO2 emissions by 120 Gt (between 2014 and 2100) by substituting gas for coal and oil in power generation.

We can save a further 70 Gt CO2 (between 2014 and 2100) by substituting all coal use with gas (since not all coal is used in power generation, some is used in industry).

Emissions could be further reduced by using natural gas and LNG instead of oil for transport.

If there was a $40 / tonne carbon tax, this means that the gas price would need to be under around $6-7 MMBtu for it to be cheaper than coal, she said.

Spot LNG prices in Asia were $19.70 per MMBtu in February 2014 but the price has dropped to below $8 since then, although prices are predicted to drop further. US natural gas spot price is currently around $2/ MMBtu.

Solar has seen a massive increase in capacity over the past 5-10 years, having been helped by significant cost reductions and government subsidies, she said.

The subsidies have been gradually reduced around the world – this has led to a slowing in growth, with 2014 having the slowest growth since 2005.

Economically, a solar electricity system would cost 10 times more than the current one in the US, and 4 times more in Europe. "Economic wise, we're still not there yet for solar," she said.

Nuclear power is mainly only attractive in China, where construction costs are much less than in the US and Europe. The US has abundant gas supply so doesn't need nuclear.

"A global carbon pricing system will strongly favour the gas and LNG producers over oil producers," she said.

Stranded assets?

If we do manage to hit our 2 degree scenario, will this make oil and gas companies' reserves 'stranded' (unproduceable)?

If all current known reserves of fossil fuel (coal, oil, gas) are burned, that would emit 2514 GT of CO2, compared to 1455 GT which could be burned between 2014 and 2100 to keep temperature rise under 2 degrees (as described above).

Bernstein calculates that we can hit this 1455 GT limit by burning 40 per cent of our coal, and then we're free to burn 80 per cent of our oil and all of our gas, she said.

But also consider that the oil reserves most likely to be impacted first will be the high carbon ones (heavy oil) and the oil companies most likely to be affected are the ones which will still have their current reserves in the ground in 2060 based on current production rates.

Bernstein splits up the oil and gas industry into the largest 50 listed oil and gas companies, and the rest of the world.

The top 50 producers on average have reserves to last 23 years; the rest of the world has an average reserve life of 70 years. The rest of the world accounts for 70 per cent of oil and gas reserves.

This means that the reserves most likely to be hit by a 'stranded asset problem' will be the (non-listed) national oil companies (for example, if all oil use globally is finished from say 2060 onwards).

The countries with the longest oil reserves life are Venezuela, Libya, Syria, Iraq, Iran, Canada (with heavy oil), Kuwait, UAE and Saudi Arabia and Yemen.

For gas, it is Iraq, Turkmenistan, Iran, Venezuela, Qatar, Nigeria, Libya, Kuwait, UAE and Kazakhstan.

Looking at the companies, the companies with the longest reserves life are MEG Energy, Noble Energy, Continental Resources, Antero Re-

sources and Chesapeake Energy, and the companies with the highest carbon intensity are MEG Energy, Suncor Energy, Cenovus Energy, Canadian Natural, and Husky Energy.

There are many Canadian oil sands producers in those lists, which suggests that carbon prices might hit these companies the hardest, she said.

Carbon tax

Another threat to oil and gas companies is carbon pricing. The International Energy Agency (IEA) envisages a 'near term' carbon price of $40 a ton and by 2030, $100 a ton, although current price is around Eur 8.

Bernstein has done an analysis of the emissions data from many oil and gas companies, showing what the impact of a carbon tax would be (also including downstream operations and chemical processing).

At a carbon price of $40 a ton, the heavy emitters, led by Reliance, Anadarko and Santos, will see a hit to their Earnings Before Interest and Tax (EBIT) of 30 per cent, and the small emitters, led by Continental, Encana and Oil Search, will see a hit of about 5 per cent, Bernstein calculates. "It's really a range of numbers," she said.

What companies are doing

The CEOs of 10 large oil companies, including Saudi Arabia and PEMEX, but not any of the US majors, have called for a large carbon price. "They recognise there will be impact on the oil and gas industry from climate change policy and recognise they need to do more," she said.

Shell is currently planning for a $40 carbon price when weighing up new projects. It has been most vocal about developing gas and LNG as a future fuel. The company will be the largest LNG producer. "They are really taking actions," she said.

TOTAL has a 66 per cent stake in Sun Power, one of the largest solar panel producers globally.

Carbon capture

Bernstein did not include carbon capture technology in the analysis. "It's a relatively new area," she said. One CCS demonstration project makes equivalent CO2 reduction as taking 250,000 cars off the road, and compared to total global emissions, "that doesn't sound like a lot", she said.

Why renewables growth could be exponential

If the rate of renewables installation continues to rise, the amount of installed capacity would rise much faster, and it might not be long before it provides 40 per cent of our energy, said banker Howard Covington

If the rate of renewable installations continues to grow at 5 per cent per year until 2060, and plant life is 25 years, then the installed capacity will grow at 8 per cent a year, calculates Howard Covington, a founding shareholder and director of New Star Asset Management, and current Chairman of the Alan Turing Institute.

Mr Covington recently wrote a report together with Raj Thamotheram, CEO of Preventable Surprises, about the idea of 'forceful stewardship', how investors should take a more aggressive role in guiding the choices of companies they invest in. Preventable Surprises is a company which analyses and advocates for better investor pathways for reducing risk.

Renewables capacity could grow faster if installations follow an 'S' curve, as much technology adoption does (ie get adopted at an increasing rate early on and slows down later).

With this assumption, installations growing at 5 per cent a year long-term translate into the installed capacity increasing by 13 per cent a year in the early years, that means the amount of renewables is doubling every 6 years.

So the 5 per cent market share (of energy generation) which renewables have today would become 40 per cent in 20 years, by doubling 3 times.
"It won't go up that fast of course, but this kind of effect is what you have to look out for," he said. "That's why the renewables industry can see enormous growth."

This massive growth in renewables would come at the expense of other energy sources like oil and gas, he said. With wind growing at 3 per cent a year and solar growing at 6 per cent, we could see electricity generation from gas and coal halving between 2020 and 2040.

Similarly, oil use in transport could peak in 2030 and then drop rapidly.

This is based on an estimate of 15 per cent of vehicles being electric in 2030. "When I show that to fossil fuel companies, they say it won't happen anywhere near like that fast," he said. "Car companies say, it will be much more than 15 per cent."

"I deduce there is a scenario, which may or may not come into being, which says, fossil fuel in power generation will peak in 2020s, and fossil fuel prices will be permanently in decline thereafter. Oil in transport could peak in the late 2020s or early 2030s, and prices will be weak thereafter."

After the peak, fossil fuel will go into a 1-2 per cent annual decline. Large oil companies will be able to cope with that by making gradual adjustments to their portfolios, and small oil companies might go bust. "It may be faster or slower, but something like that."

It is interesting to compare predictions by BP and the renewables associations for how fast renewables and electric vehicles will grow, Mr Covington said.

BP's current growth predictions are 2 per cent for gas, 1 per cent for coal, nuclear and hydro (together) 1.6 per cent, renewables 6.5 per cent, oil for transport 1 per cent, and negligible growth in electric vehicles.

However studies by the Global Wind Energy Council, the European Photovoltaic Industry Association and bank UBS, point to growth in wind of 25 per cent a year, solar of 45 per cent a year, and electric vehicles of 40 per cent a year, a big difference.

Systemic risk

Investors might want to worry about damage climate change could cause to the entire economic system.

One school of economists, led by Willian Nordhaus, believes that a few degrees of average global warming won't make much difference, whereas others, such as Simon Dietz and Nicholas Stern believe that by the time you get to 8 to 9 degrees of warming, the damage to the economy will be more than 90 per cent (ie it will kill the economy). They think that 4-6 degrees of warming might reduce economic output by 50 per cent.

"Really serious economic damage is possible from high warming but we just don't know," he said. "That's why people are deeply concerned about the consequences of continued high emissions."

Current emissions targets by countries around the world are estimated to lead to a 2.7 degree temperature rise. With a Republican president in the US in 2016, these targets could be jeopardised and we could be back on track for 4 degrees.

"You can begin to use estimates like these to calculate what the damage to an investment portfolio is now from future warming," he said.

Mr Covington calculates that expressed in 2015 values, an investment portfolio has a 3 per cent probability of losing 10 per cent of its value, and a 17 per cent probability of losing 5 per cent of its value as a result of economic damage from future warming.

By 2035 the risks of investments losing their value will be around double.

The biggest risk for investors is the 'systemic' risk in the whole economy, the risk of economy-wide damage.

There is plenty of uncertainty in climate models, but the uncertainty is fairly well understood, he said. "A lot of the unknowns are known".

"The greatest uncertainly is we just don't know how the global economy will respond to 2 - 4 degrees of warming."

"There are perfectly sensible economists who think with 3 degrees warming we will lose 1 per cent per annum of growth. A change in growth expectations that large would take 30 or 40 per cent off share prices just like that. We just don't know whether this is likely.

"We don't have models of how global society and policies will respond to high warming."

Insurance companies are exposed 'on both sides of their balance sheet' because their investments would be affected by economy-wide damage, and they might have to pay out big sums to their clients for specific climate-related damage.

Managers of pension funds, which are a source of a large amount of investment, have a duty to manage risk, and a risk of losing 5 per cent of the fund's value is considered material, he said. So potential investments losses from future climate damage should be a real concern for them.

Other risks linked specifically to fossil fuel companies are 'stranded assets' – the risk that fossil fuel companies' assets include reserves they will never be able to produce or mine, and the 'carbon bubble' risk that fossil fuel companies are consequently overvalued.

Forceful stewardship

What is the best way investors can lead companies they own shares in, to reduce emissions?

A first step is disclosure, asking companies to count and publish their emissions. Although there has been much of this, the data shows that this is not leading to much actual emission reduction, said Raj Thamotheram, CEO, Preventable Surprises, a former director of investment management company AXA IM.

Preventable Surprises asked a group of investment professionals who take an active interest in climate change which methods they thought would be most effective in reducing emissions.

43 per cent thought that 'divesting from fossil fuels' was the least effective method, perhaps a surprising response given the amount of attention the idea of fossil fuel divestment has been given, he said.

Most respondents thought that the most effective method was to engage 'assertively' with governments and companies, asking governments to implement policies which lead to only a 2 degree temperature rise, and asking companies to change their core business strategies to align with a 2 degrees temperature rise.

Some investors try to get a balance right in their portfolio, to keep the amount of carbon being emitted by companies in it at a certain level, or 'portfolio carbon management' he said. This puts pressure on companies to also manage their carbon emissions.

Some investors hold private meetings with company executives.

A third method is shareholder resolutions at annual general meetings.
"'Show us your 2 degree plan' is a proposition we think will fly," he said. "This project has to be designed very carefully, to be easily understandable."

"BHP Billiton is the first major corporation to produce a 2 degree transition plan."

A shareholder resolution will raise the priority of climate issues from the company's head of environment to the in-tray of the chief investment officer, he said.

Having an environmental manager in charge of driving down CO2 emissions is like having a safety manager in charge of reducing safety in an oil company, he said. These are issues which need to be handled by the senior executives.

Investor stewardship should aim to get beyond 'tea and biscuits engagement', when a company meets some investors and tells them what it is doing, he said.

Investors often work with 'voting advisors', a company which acts on their behalf, and represents them at shareholder meetings. These people should be asked to vote for low carbon business plans, he said.

Some governments are seeking more active engagement, one example is ExxonMobil being subjected to a books and records request by New York attorney general, to find out if it was promoting a policy which was not consistent with its understanding of the risks of climate change.

We should get to the point where companies expect shareholders to require emission reductions, he said.

Mr Thamotheram advised the audience to read a report from fund managers BlackRock, "Pricing Climate Risk", which includes the sentence "Climate Change and its risks are going Mainstream".

What should companies do?

But what should oil and gas companies actually do, particularly at a time when boards are mainly focused on how they survive through to the end of 2018?

Companies could do a 'sensitivity analysis', to work out how their asset base could be impacted by climate change and climate change legislation, with a range of different scenarios, Mr Thamotheram said. "That's a significant step forward itself."

We're asking companies to "explain how they will make the transition to a world where warming is capped at 2 degrees, with a carbon price of $100 and a CO2 ceiling of 450 ppm," he said, "and to hit the target they find most challenging.""

"We've heard very senior people say that this has triggered a different culture of decision making within organisations."

For example, some insurance companies have said that if there is a four degree temperature rise, the claims could be so high and unpredictable that their business model just won't work, he said.

Companies which use fossil fuels should take steps to reduce their requirement for them, he said.

Fossil fuel companies and others in high risk sectors could take a similar scenario based approach.

However, oil and gas companies might continue to be good investments, Mr Covington said. If demand for fossil fuels comes down, large oil companies will just cut their capex and opex and continue to generate returns for shareholders, he said.

"If you think that oil company executives will eventually respond to emissions reductions by doing sensible things then oil companies are not high risk investments," he said.

The risk of investing in oil and gas may actually be higher if you invest on the basis that oil prices will continue to go up and up (as many investors did prior to the crash), because that makes for a much less predictable business.

Chris Davies – carbon capture needs industry cheerleaders

The carbon capture industry needs industry cheerleaders to come forward with proposals for taking CCS forward – perhaps starting with the 10 CEOs who signed up to the 'oil and gas climate initiative', said Chris Davies

In October 2015, 10 chief executives of major oil and gas companies signed up to the 'oil and gas climate initiative', with a short report devoting much attention to CCS.

"For people like me that's encouraging. Good stuff," said Chris Davies, the former leader ('rapporteur') for carbon capture and storage in the European Parliament and former MEP for North West England (1999 to 2014).

"But where's the beef? I've seen nothing yet. I don't think there is anything."

"We need cheerleaders. We need companies to come forward with proposals for taking CCS forward."

"I'm not asking them to part with money. I'm not here asking you to shove 500m euros in a black hole. I'm asking you to push the case to governments why they should find the money through levies on fossil fuels."

"We need oil and gas chief executives to start saying very loudly to the European Commission that they need the business case developing, in order to make the investments."

"If there's one overriding objective, it is to promote and encourage political will for carbon capture across Europe."

"It has been political will which has taken forward renewables, it has been political will which will take forward carbon capture."

Government and industry

Carbon capture and storage needs both industry and government to work, because without government support, "there is no business case for investing in CCS."

But also, "there is no business case for investing in renewables if you take away the subsidies."

"There's no business case for investing in gas fired power stations at the moment, which is why they are closing."
"If you want a business case, we know the mechanisms. First of all it's subsidy. Second, you put a price on carbon one way or another."

"Third, a mechanism which gives the certainty to investors."

"CCS has no purpose whatsoever apart from fighting climate change. It is up to politicians to create the business case which justifies the investment."

EU targets

The European Union set a target to reduce emissions by 40 per cent by 2030, building on a previous target to reduce emissions by 20 per cent by 2020. "That 2030 goal should be perfectly possible," he said.

It is important that the goal isn't achieved by moving heavy industry from Europe to China, which will lead to no benefit to the climate.

It may be possible to achieve even the 40 per cent emission reduction without using carbon capture and storage, he said. But to reduce emissions more than 40 per cent, we will have to find a way to handle emissions from gas power stations, cement plants, oil refineries and large energy intensive industry. "CCS is not going to be the whole answer but it is part of the answer."

"The Intergovernmental Panel on Climate Change (IPCC) and International Energy Agency (IEA) repeatedly say, if you want to achieve these things at lowest cost you're going to have to apply CCS," he said.

But so far very little progress has been made.

In March 2007, the European Council (a council of European Prime Ministers) set a goal of Europe having 12 CCS demonstration projects by 2015.

"It was European governance by press release. Prime ministers go into a room, they've got to say something, someone says, 'say something about CCS' They write it into the press statement and issue it, without any idea at all how they are going to promote construction of the CCS plants," he said.

"They relied solely on the Emission Trading Scheme driving up the carbon price to provide sufficient incentive, and meanwhile just threw money at renewables."

Now it's 2015, "we don't have a single demonstration plant in operation, and none approved. There are two in Europe, outside the EU in Norway, Sleipner and Snøvhit, which have now stored 20m tonnes of CO2 underground, perfectly safely and well measured and monitored."

In the US, 65m tonnes of CO2 are being stored every year entirely through EOR schemes, compared to 1m tonnes a year in the whole of Europe.

"At the moment many people across Europe are unaware of CCS technology.
There's outright hostility from some member state governments."

Renewables

Supporters of renewables have compared carbon capture with giving an alcoholic a bottle of port instead of whisky, in that it doesn't deal with the problem, it just pushes it back.

"I'm going to point to a little frustration with

the renewable sector," he said. "I like renewables, they have a huge role to play, but I wish they would tell the whole story."

A 2013 German study looked at the costs of renewables per ton of CO2 mitigated. It found that onshore wind required a subsidy equivalent to a Co2 cost of €40/tonne, which is "a good price", he said.

But solar power subsidies could amount to the equivalent of a CO2 cost of €500 a tonne. "You can see why subsidies are being curtailed. Carbon capture and storage could be developed for a fraction of that price," he said.

Also, "I wish the renewable sector would point to the advantage they have with preferential access to the grid," he said.

A carbon capture and storage plant would, similarly, "need guaranteed access to grid to ensure the investment was properly justified," he said.

Tree

Mr Davies' vision for how carbon capture can grow is like the way a tree grows.

Consider that the Dutch ROAD carbon capture project could (if approved) build a pipeline feeding CO2 from a power station into the North Sea.

It would be possible to connect many different Rotterdam industrial plants to this pipeline, also sending CO2 to the North Sea, where there is space for centuries of CO2 storage.

"Before long that pipeline becomes the trunk of a tree, with branches going down to Antwerp and the industrial complexes there, and up toward north Rhine Westphalia and industrial complexes of Germany," he said.

The US has already done it, with 4000km of CO2 pipeline. "You have the basis for all sorts of industries currently emitting CO2 to atmosphere, to store that CO2 permanently in the ground."

"The hard part is getting started, getting from here to there. That's where the political will comes in, the need for some vision, determination to win arguments, insist that progress is made, press for sufficient financial resources.

"At the moment that vision is missing. CCS is too often dismissed."

"If we were to secure some of the reductions in CO2 emission that are absolutely essential to stop temperatures rising, that will has got to be found."

Teesside

From a political point of view, the Teesside carbon capture project, collecting CO2 from heavy industry rather than power generation, could be much easier to sell to the 'green lobby', he said.

"Almost all environmentalists recognise you can't decarbonise industry without CCS because the CO2 is not caused by fossil fuels but with the processes of developing the product," he said.

"Teesside and Rotterdam are the two leaders in terms of developing a case for industrial CCS," he said.

But Teesside carbon capture also does not have any business case at the moment without government support. "It is very attractive but comes down to the need for governments to say, we're going to make this happen."

Enhanced oil recovery

A carbon capture plant in Aberdeen could be the start of a CO2 supply which could be used for enhanced oil recovery (EOR).

"I asked Shell, why have we never developed EOR in the North Sea. They say, 'because we haven't got a source of supply.' It's chicken and egg," Mr Davies said.

"At the moment oil prices don't encourage investment of that kind, but it's there for the future."

Prices

It is fair to expect carbon capture prices to come down. Consider that the team behind the Boundary Dam carbon capture project, in Canada, say they could build the next plant for 30 per cent less cost.

"They find the energy demand is lower than expected. The plant was also designed with methods to capture different trace chemicals, which are not proving a problem. The plant was also built bigger than it needed to be," he said.

"It's a classic case of learning by doing. In renewables everyone says the price will come down, and it will be the same with CCS."

Finding Petroleum

Allianz – climate change is high on investors' radar

In a recent meeting between Allianz and the CEO of a major oil company, "We spent a quarter of the meeting talking about climate change," said Chris Wheaton, Oil and Gas Portfolio Manager at Allianz Global Investors

Allianz Global Investors, part of Allianz, the world's largest financial services group, has a $130m fund for investing in energy.

When Chris Wheaton, Portfolio Manager and Analyst for the oil and gas sector at Allianz has meetings with oil industry CEOs, it is typical for a quarter of the meeting to be taken up talking about climate change, he said.

"I spend a lot of time thinking about this, to find the way out of the woods," he said.

Carbon tax

A carbon tax (or requirement to buy allowances for carbon emissions) is just one of the factors which may affect oil and gas companies, although it could be a major factor.

Mr Wheaton has studied how what the oil price needs to be for oil and gas companies to make a 'commercial breakeven' (considered a 10 per cent return on investment), if companies have to pay a $50 / tonne carbon cost on emissions from their operations.

This is emissions from operating oil and gas equipment, not emissions from combusting oil

and gas, where the tax would be paid by the consumer.

The study showed that Brazilian oil and gas producers could have a commercial breakeven with an oil price of $50 to $70, the shale producers would need an oil price of $75 to $85, and the heavy oil producers would need $90+.

The carbon price would basically make the current extremes more extreme. For example, Canadian oil sand operations is already in the fourth quartile in terms of cost of production; a carbon tax would make it 'even more fourth quartile', he said.

The whole industry would need an $80 a barrel oil price to maintain production, Mr Wheaton said. If the industry is going to grow, the oil price would need to be more than $80.

Also consider that financial returns at current oil prices, $50 to $60, are "low to mid-single digits", he said. Investors will not normally provide more capital to a project unless it is earning at least 10 per cent return.

Currently much North Sea oil has operating costs of $30 a barrel and incremental CAPEX (required to improve production) of $15. So at an oil price of $45, there isn't much going back to investors, he said.

Oil demand trends

Another factor to consider is oil demand.

Historically, oil demand increased a steady 1m bopd since the 1970s, and from 1985 the growth rate increased to 1.1m bopd. The 2008 financial crisis is barely visible in a graph of oil consumption.

"That's extraordinary steady trend of growth in what's been an extraordinarily volatile and uncertain period of time," he said.

But looking at predictions for oil demand for the next 25 years there is a wide spread, from the current upward trend continuing, to a range of predictions for a drop.

Mr Wheaton estimates that for every 1m bopd oil demand reduces, the 'equilibrium oil price' will fall by $5 to $8 / barrel.

Mr Wheaton estimates that oil demand could peak at 105 to 115mbopd, around 2030, but demand might only fall off slowly after that.

A change in industry

This will drive the oil and gas industry to take a very different approach. Instead of rewarding people who conquer new territories, making marginal plays slightly less marginal, it will reward companies which are more strongly driven by their accountants, making investment decisions based on return on capital invested.

It may be much more sensible to the health of the company to avoid marginal projects, he said.

This means that projects in the third and fourth quartile of economic viability will no longer get funding, he said.

If may be a good idea to limit growth to under two percent, focussing more on improving return on capital invested and cashflows per share, rather than chasing new opportunities, he said.

This does not mean oil will be a bad investment, he stressed. "Big oil can weather this crisis. Once they've done that, they can focus on longer term risks to the business."

Carbon capture

Carbon capture and storage could change the economic picture a great deal, particularly if used for enhanced oil recovery. "It would really improve a lot of the economics of mid and late life fields."

Consider that US operator Denbury Resources has an OPEX of $20 / barrel and CAPEX of $20 / barrel. However included in the OPEX is a charge of $3 to $7 for CO2, which the company purchases for enhanced oil recovery.

If a carbon capture and storage industry gets started, Denbury could be paid for taking away CO2, rather than paying for it. With an oil price of $40, this would make the company change from being breakeven to "quite attractive."

The problem with EOR is that the CAPEX cost to get there is really high, he said.

Mr Wheaton said he was very interested to learn what the economics of Shell's 'Quest' CCS project turn out to be. This project sequesters carbon dioxide from Shell's Scotford 'upgrader' plant (which converts heavy oil into something lighter), and uses the CO2 for enhanced oil recovery.

There isn't much economic incentive to invest in carbon capture projects, he said, "except in big consortia like White Rose."

There is a paradox in that investors still need return on capital, whether projects reduce carbon emissions or not, he said.

The stress which the oil and gas industry is currently under is good preparation for what is around the corner, he said. "This industry has been chasing growth uneconomically for far too long."

It was clear even before the oil price crash that the return on capital in the oil and gas industry was "not good enough", he said.

"This industry needs to decomplexify. The problem is that it took at $50 oil price to achieve that."

When it comes to carbon capture, Mr Wheaton said he would like to see more companies putting money into it. If the CO2 could be used for enhanced oil recovery, there could be big potential for the UK to improve oil production. It would beneficial to the UK economy, employment, tax revenues. "We are lacking the activation energy to get over the hump."

Long term demand

Mr Wheaton is very interested in the longer term aspects of oil and gas demand. Both transport and power are threatened by the lithium ion battery, he believes.

Perhaps the idea that gas is the fuel of the future needs to be 'stress tested,' he said.

Starting with transport, consider that if the cost of lithium ion batteries dropped as fast as the cost of solar has dropped, within 5 years electric vehicles could be cost competitive with internal combustion engines, he said.

Allianz made a forecast in 2012 for how fast battery prices would come down, and it reached the 2020 forecast price in 2015.

Some sceptics say that electric vehicles will not be adopted due to a lack of a charging infrastructure. But we may see more batteries in gasoline hybrid vehicles, which are charged by their engines, than in pure electric vehicles, he said.

There could be a big push to gasoline hybrid vehicles, driven by caps on vehicle fleet emissions, he said.

Looking at electricity supply, if the cost of batteries drops, then it will make renewable electricity much more viable.

We could see some developing countries skipping electricity from fossil fuel entirely, and going from no electricity to solar and batteries, he said.

So the battery could be a much bigger threat to the oil and gas industry than low oil prices, he said.

Mr Wheaton is currently trying to work out if there is enough lithium available. With a massive renewables growth rate, "you are going to need a lot of lithium. The numbers I've seen show there's enough for the moment. How much is controlled by China, that's an interesting question."

It will still be difficult for homes running on solar power to decouple from the electric grid, he said. A standard US household solar installation would generate 7 kWh peak, on a sunny midsummer day, and an average US consumer uses 10.9 kWh electricity. They would also need batteries to get them through a cloudy day.

Mr Wheaton noted that it isn't necessarily a good idea for many investors to invest in renewables. "If you have capital chasing a limited amount of opportunity, the return on investment will fall," he said. "That's exactly what happened in US shale, when too much capital chases the wrong kind of opportunities."

CEOs and carbon prices

Mr Wheaton was asked why the CEOs of 10 large oil companies called for a carbon price, if it isn't in their interests.

"The biggest issue shareholders have is uncertainty," he replied. "The CEOs were calling for certainty. It doesn't matter what the price is, as much as having a price and sticking to it."

Premier Oil – complying with ETS for offshore operations

The UK oil and gas industry already spends £20m to £25m a year on purchasing EU Emission Trading Scheme (ETS) allowances. Margaret Christie, Environmental Co-ordinator at Premier Oil, explained how it works

In 2014, the UK's upstream exploration and production industry paid £20m to £25m a year for EU Emission Trading Scheme allowances, said Margaret Christie, Environmental Co-ordinator at Premier Oil, quoting figures provided by industry body Oil and Gas UK.

The UK upstream industry includes 100 offshore installations and 26 onshore terminals, and together emitted 14.7 tonnes of CO2 equivalent in 2014, which accounted for 3 per cent of total UK greenhouse gas emissions.

If the carbon price rises to Eur 25 a ton, the annual payments will be above £100m, she said.

Like all industries, the UK offshore sector is given a number of free allowances and must purchase the rest. Free allowances are provided for 'emergency flaring'.

But it falls foul of UK legislation which says that nobody generating electricity themselves may receive free emissions credits. This rule was designed to encourage companies to connect to the National Grid, which can generate electricity more efficiently than using small generators.

But for offshore operators, connecting to the grid is not an option. And offshore platforms are big electricity users, since most compressors and pumps are electricity powered.

The £20m to £25m spending is a new development for the oil and gas industry, driven by efforts in Phase 3 of the EU Emission Trading Scheme to push up the cost of buying credits (in November 2015 the price was Eur 8.40, up from a low of Eur 4).

Phase 4, starting in 2020, is expected to be tougher still. "There's a lot of discussion going on about what phase 4 is going to have in it and what will be required," she said.

ETS covers industrial plants and power stations, and (from Phase 3 onwards) airlines. It includes offshore oil and gas operations, although not shipping.

If you under-report your CO2 emissions, you receive a mandatory Eur 100 / tonne fine, much more than the Eur 8.4 per ton you have to pay for your allowances. ExxonMobil was fined £2.8m under this regulation in 2010, believed to be the biggest ever fine in the UK. The fine was for underreporting in 2008.

There is a Euro 20 / tonne fine if you forget to submit a report on the right date, or make an error such as failing to include a turbine in your submission, she said.

CO2 emissions must be calculated to an accuracy of +/- 1.5 per cent, an equivalent accuracy to what is required in production fiscal reporting

(reporting how much oil and gas you have produced for financial accounting).

The data must be submitted by March 31st every year, and there are heavy penalties if the data is late or incorrect. The emissions also need to be independently verified.

Compliance

At the moment, for offshore oil and gas companies, ETS is seen more of a headache, making sure all the rules are complied with, than a direct cost (for purchasing emission allowances).

But in future, as the cost increases, the cost will be a bigger factor influencing behaviour.

It may not be clear from her job title 'Environmental Co-ordinator', but Ms Christie's role is mainly ensuring compliance with regulation, she said.

CO2 emissions is a major part of Premier Oil's environmental regulatory compliance workload, she said, although not the only part. "Everything we emit to air, discharge to water and waste to land is regulated. A lot of that regulation comes from EU."

The main sources of CO2 emissions are from running turbines to generate heat and power offshore, and from flaring surplus gas.

You can buy the allowances you need, or receive them through "investing in companies deemed to have approved energy saving projects worldwide," she said.

You need to understand all your sources of CO2, you need to meter them, and you need to have a clear understanding of where your data is coming from.

"This takes up a huge amount of my time, getting the data," she said.

It helps if you can automate your data management systems. "When you've got manual data entry you've got potential for people to make mistakes. People do it in their night shift at midnight".

There are other regulatory drivers relevant to emissions. Europe already has stringent regulations on flaring, which mean that flaring from oil and gas production is lower than anywhere else in the world. The flare volume is also expected to be either maintained or reduced year on year, she said.

There has already been a decline in emissions from the UK E+P sector, which could be attributed partly to declining production and decommissioning, and also measures to reduce CO2 emissions and improve energy efficiency, she said.

Premier Oil also measures 'emissions intensity' (total CO2 emitted vs total fuel produced), and this is published in corporate sustainability reports, she said.

Disciplines

Ms Christie is part of a team of five environmental advisors, working in Premier Oil's Aberdeen office, looking after 3 Premier Oil assets, its "Balmoral" floating production vessel, its "Solan" production facility West of Shetland to be producing by the end of 2015, and the "Catcher" leased FPSO, to be producing in 2017.

Many different disciplines need to be involved in providing ETS data and competent to do their role.

This includes production engineers and metering / allocation engineers, who have previously only been working on production reporting.

The company commercial managers have to make decisions about when to buy and sell allowances. The asset and project managers need to factor ETS costs into their overall budgeting.

Balmoral case study

Balmoral is a floating production vessel commissioned in 1986, connecting to a number of subsea tiebacks, with oil exported to the Forties pipeline system. Production is around 7,000 bopd.

There is no gas export facility, any gas produced needs to be either pumped back to the reservoirs for gas lift, or used as a fuel gas (to power turbines). Anything in excess of that needs to be flared.

The turbines on the platform can run on either fuel gas or diesel. The power demand is 6.5mW.

Last year the verified emissions were about 85,000 tonnes, a slight dip on the year before, she said. 2015 will be similar to 2014.

79 per cent of emissions are from combustion (to drive the turbines), 21 per cent is from flaring.

Like many North Sea facilities, Balmoral was not designed with reducing emissions in mind, including the idea of using gas as a fuel source.

There are not usually meters on fuel lines to pieces of equipment. "That wasn't thought as a requirement when they were designed and put in place," she said.

Another issue is that flowmeters are designed for certain flow rates, and as production declines, the amount of power required from the turbines will decline, which means that the fuel flow might decline to the point where it cannot be measured.

Before ETS, the main drivers on how the generators were operated were reducing diesel costs and maintaining reliability of power, she said. Now emissions are considered as well.

Using fuel gas rather than diesel has two benefits – one is there are less CO2 emissions from the combustion, the second is that less gas needs to be flared.

Another issue is the power redundancy. Offshore generators are built to generate more power than is needed, because any 'process upsets' could require large amounts of power. But this means that more power is being generated than is required.

"We recognised we can reduce the amount of redundancy in the system - that's what we mean by 'spinning reserve'" she said. "We moved from running 3 turbines all the time to 2 turbines.

The company also installed an energy management system, which can determine how much power is taken off each turbine. It can be set to take the maximum amount of power from the most efficient turbine, and the turbines which run on fuel gas.

If there was a gas export line, this could also be used as a gas import line, if there wasn't sufficient gas to run the turbine, rather than run it on diesel, she said.

Catcher

The Catcher project has a FPSO, currently being built in Japan, connecting to 3 subsea wells tied

back. It will have a gas export line, and when the wells become gas deficient, the FPSO will be able to import fuel gas via that line.

Oil will be exported by tanker. Loading tankers can be a big source of methane emissions, because the tanks can contain methane which evaporated from the previous cargo, which must be removed when the tanks are re-filled.

The oil wells will have both gas lift and water injection.

The FPSO will produce 47,000 bopd, and require 17 to 39 MW of power. It will emit 389,000 tonnes CO2 equivalent per year, which will cost Eur 3m a year, based on a Eur 8 / tonne CO2 cost.

Because Catcher is a new development, planning around CO2 can be made upfront, including methods for waste heat recovery.

The project team has already identified where the meters will need to be.

All of the flare lines need a means of taking a sample of fuel for analysis, and in the first iteration of the design, the sample points weren't in the right place, she said.

"I know these things sound simple, but people don't always understand the need for them," she said. "It's important that these things are picked up at the design stage."

"With a new asset, there's an opportunity to get data gathering automated from start to finish," she said. "That helps improve your data accuracy."

Catcher also has sophisticated production modelling systems. "For ETS it isn't enough to use your meter data and say, these are my CO2 emissions," she said. "You have to have a calculation. We use a theoretical gas mass balance. You can use production modelling software like HYSYS."

The energy management systems can flag up if you're not operating at your most efficient level.

Finding Petroleum

Can oil companies reduce emissions from ships?

International shipping causes 2.6 per cent of global CO2 emissions, and a large chunk of that is from (oil) tankers. Is there more the oil and gas industry can do to reduce them? Maritime expert Martin Shaw gave some perspectives

The oil tanker industry managed to reduce the number of oil spills (of over 7 tonnes) from around 120 in 1975 to about 2 a year now, said Martin Shaw, Managing Director of Marine Operations and Assurance Management Solutions Ltd and a former VP technical with BP Shipping.

"I believe a great deal of that was due to the influence of the oil companies," Mr Shaw said. "Oil companies made a big difference by saying to companies we're not going to use your ships if you don't meet the requirements."

"It's a wonderful story to tell about an industry."

"Is there some way oil majors can do something similar when it comes to climate change?"
Shipping bulk liquids is about 440 times more environmentally friendly than short haul air cargo, in terms of Kg CO2 emitted per tonne km transported.

It might be possible to reduce emissions by making sure ships do not travel faster than they need to (bearing in mind when their discharge berth will be available), using the latest technology for hull and propeller designs, and making sure the hull is free of fouling (weed) which causes resistance.

They could also look at LNG or methanol fuels, and perhaps more optimised routing strategies, looking at tankers as a world fleet rather than individually.

One important factor to note is that the emissions from the shipping industry are (in a way) nothing to do with the shipping industry, in that they are caused by a demand for shipping services.

Seaborne trade nearly doubled between 2000 and 2014, which would have led to a doubling of emissions.

Also listed oil companies do not have much power to influence shipping, because they do not directly charter most tankers. The two largest charterers in the world are Chinese. "If you're not controlling the chartering side of the business, how much influence are you going to have?" he asked.

Oil companies do not own many ships either. BP Shipping is the only oil major in the top 30 tanker owning companies.

Better co-ordination

One possible way to reduce emissions is more co-ordination around tanker shipments.

Currently each cargo is arranged individually by a broker, which could theoretically result in the same cargo being transported simultaneously from A to B and from B to A.

As an example, some years ago BP did a study of the shipping it was doing between three North Sea refineries it owned at that time, and found that, looked at holistically, the shipping could be done more efficiently. "We found one ship which was effectively circulating the North Sea with the same cargo on it," Mr Shaw said.

Speed and size

One option is to reduce speed. Fuel consumption goes up as a square function of speed, which means that "you can burn a lot of fuel without going much faster," he said.

A common feature of seaborne life is 'hurry up and wait', where the ship moves as fast as possible to the next port (something which is encouraged in the chartering contract), and then has to wait for a berth.

Currently the supply of oil is bigger than demand, which means that storage tanks are getting increasingly full, which means that tankers often have to wait for an available tank to discharge into.

Another option is to increase ship size. Having larger ships means a lower cost per ton moved. "Big is good as far as ships are concerned. For crude, you want the biggest ship you can get into the terminal."

But bigger ships mean more complex navigation restrictions, higher port costs, and an increase in working capital (because bigger ships are more expensive).

To make it easier to use larger ships, terminals could be located in deeper waters, and ports

should make sure they have enough jetties and enough tugs to accept them without delays, Mr Shaw said.

Ship design

There is a lot of interest in improving ship designs to improve fuel efficiency. A challenge is that it is very difficult to get a data set which shows you how efficient a certain change is, with the ship having different wind resistance on different days as the weather changes.

For example, "fouling", is basically "bits of weed grabbing onto the side of the ships," which can increase resistance, but this is very hard to measure.

"The answerer is you have to make a lot of subjective judgements," Mr Shaw said.

You can use more efficient propeller and hull designs, such as a bulbous bow and a bulbous stern.

Fuel

Heavy fuel oil, which most ships are powered by, is "the most horrible stuff in the world," Mr Shaw said. "It is black, thick probably not good enough quality to go on roads. It seems to be waste out of a refinery system."

It can contain catalytic ('cat') fines, which "make a terrible mess of engines." There are problems disposing of waste (unburnt oil).

You have to run the oil through centrifugal separators onboard, to remove impurities, so it can go through the engine without damaging it.

The oil needs to be heated and processed onboard. "So you carry your own refinery with you. You're turning a means of transport into a processing facility on legs."

The advantage is that heavy fuel oil is available anywhere in the world.

Environmental regulations are gradually phasing out the use of heavy fuel oil, because of its high sulphur content. When the fuel is burnt, it emits sulphur oxides ('SOx') which cause acid rain.

The sulphur limit in marine fuels was reduced from 4.5 to 3.5 per cent in 2013, and will be reduced further in 2020, forcing people to use distillate fuels.

There is a question about whether refineries can produce enough distilled fuels to run the global shipping industry. The International Maritime Organization is currently investigating this, and based on the investigation, will decide whether to force ships to use distillates from either 2020 or 2025.

There are already big areas around the UK and US waters with restrictions on SOx emissions and use of high sulphur fuels.

This is driving the US towards LNG fuelled ships, particularly on specific routes such as Florida to Puerto Rico, where a network of LNG fuelling stations can be set up.

A challenge is that it is very difficult to be sure what fuel a ship is using once it has left port. Container ship operator A P Møller "is creating a campaign to increase compliance in the EU - they are doing the right thing, they want to make sure everyone else does," he said.

Self-contained and networked

There are plenty of alternative fuels and propulsion methods, which Mr Shaw divides into 'self-contained' and 'networked', based on how much shore infrastructure is required.

'Self-contained' fuels include nuclear, wind and solar.

There have been experiments in nuclear powered merchant ships several decades ago in Germany, Japan and the US. "The problem is not many people are enthusiastic about you bringing your nuclear powered ship into a port alongside an oil refinery," he said.

There have been wind powered cruise ships, which are very effective.
There are designs for ships dragged by kites.

Many people have come up with designs for sail powered cargo ships and ships with solar panels on the deck. Not many of these designs have been built. "We tried solar panels on a tug and found they weren't particularly resistant to large mooring ropes being dropped on them," he said.

"Networked fuels" can include distilled petroleum fuels (like motor vehicle fuel), described above, methanol, LNG and biofuels.

LNG fuel (liquefied natural gas) has lower carbon emission for the same energy content. Mr Shaw chairs an annual conference on LNG fuelled ships. People said in 2011 that LNG ships were 5 years away, "and it's still 5 years away," he said.

LNG ships have a chicken and egg problem. "Why would you build a ship to run on LNG fuel if there wasn't a network of supply stations around the world to provide you with that fuel? Why would you build a network of LNG fuelling stations if there's no-one to use it?"

"Every year at the LNG Fuelled Ships conference someone says 'chicken and egg has gone' and by the end everyone says, 'no it has not,'" he said.

Shell is making inroads to the LNG fuel business, acquiring a company based in Bergen called Gasnor, which supplies LNG fuel to ships. Norway has created a fund to encourage conversion of ships to LNG fuelling, because LNG fuel leads to lower NOx emissions.

A small cluster of LNG shipping is developing in North West Europe, he said. "If anyone develops an LNG fuelling network , it will probably be Shell."

Methanol is another possible fuel, with one methanol fuelled ferry in operation between Kiel (Germany) and Gothenburg (Sweden). The methanol is supplied in Gothenburg by Methanex Corporation, the world's largest methanol manufacturer.

The chicken and egg problem can be solved by making ships 'dual fuel' while a distribution infrastructure for the new fuel is developed. An example is ships from the 1850s which had both sails and a steam engine (powered by coal), so they could use sail as a back-up in case they were in a part of the world with no coal supply. The transition to complete coal power took around 40 years, he said.

Taxes and emission credits

There have been discussions about the use of carbon taxes and emission trading in the shipping industry.

Currently, shipping is not included in the EU Emissions Trading Scheme (ETS). This is because of the complexities of working out when exactly an international ship would need to account for its emissions under ETS.

The European Union is supporting the International Maritime Organization (IMO) in is efforts to develop a global solution for charging for emissions, Mr Shaw said.

Having a carbon tax, a flat fee per ton CO2 emitted, would be easiest for shipowners to manage. But this will not be introduced by IMO, because the US delegation do not think IMO's role should include levying taxes, Mr Shaw said. So there may be a movement back to cap and trade.

Some kind of carbon charge will change people's decision making, Mr Shaw said.

War and Peace?

It's the oldest story in the world: the good guys fight the bad guys. Many have cast fossil fuel companies in the climate change story as the 'bad guys' and the renewables companies are naturally the 'good guys'. We need then to be at war with the fossil fuel companies, so goes the narrative. Belinda Perriman asked, "Is there a more helpful alternative narrative?"

As a society, "we've arrived where we have good guys and bad guys in the climate change story," said Belinda Perriman, Commercialisation Manager at Tees Valley Unlimited, formerly Senior Commercial Advisor, CCS and Oil & Gas with Shell.

The moves to push investors to divest from fossil fuels is like saying, "kill the monster", then life would be great, because the good guys would have won the battle," she said. "It's a dramatic script, slaying the dragon.

"Much as I love windmills, solar panels and my Tesla car, I haven't seen a single forecast from any Advising Body or NGO that shows we can meet the energy needs (even with increased energy efficiency) of a growing population based only on renewables in the next few decades."

"That growth in demand comes from very reasonable requirements for a washing machine, a refrigerator, or for transport that gets us further than a bicycle."

Also, energy systems take decades to develop. That unfortunately, doesn't fit the other script that someone charges in and saves everyone and the planet just in the nick of time."

Should supporters of carbon capture be telling the story in a different way, she asked, or find a way for the public to accept a more complicated story?

The 'monster' in the story, climate change, is not something caused by some nasty people who need to be killed, but something caused by ourselves, by society as a whole and our thirst for energy.

"Like so many deeper stories, the bad guy is sometimes within ourselves," she said.

"By meeting the energy needs and ignoring rules of physics that we understood as the industrial revolution kicked off, we have all created much of the problem of climate change."

The October 2015 announcement by 10 oil and gas industry CEOs, saying that they wanted to be part of the climate solution, was encouraging, Belinda felt. Not exactly the story of total reformation of character, but they did express a desire to change and to be working with society in fighting the climate change 'monster',

The CEOs may have been thinking of the skills their companies have, which could contribute to the climate solution by storing carbon back underground, where it came from, she said.

Sadly, many people just slotted their announcement in the existing 'good guy bad guy' story, she said.

Storage

One way to change the story would be if oil companies work with governments for a new business model around garbage collection, helping take society's waste product, carbon dioxide, for a fee.

Oil companies need an incentive to do work on complex projects, which take a lot of time and effort to deliver.

One incentive could be for a government to reduce or have no taxes on CO2 + EOR projects, she said. Having millions of tonnes of CO2 stored at no cost to society is better 'value for money' than paying all the costs.

The alternative means of dramatically reducing CO2 emissions into the atmosphere could be significantly more expensive.

A high carbon price would also serve as a good incentive for oil companies to develop CO2 storage projects, she said.

A carbon capture and storage industry, whether or not combined with EOR, could bring a new generation of people into the oil and gas industry.

Many people are still expecting carbon capture and storage to pay for itself or be 'economically viable' without subsidy. So it is important to note that it is still basically garbage collection, taking away huge volumes of unwanted waste. Even with small volumes being used, it is as likely to be economically viable by itself as your council garbage collection is likely to survive without funding.

Teesside

Ms Perriman currently serves as commercialisation manager for Teesside Collective, a group of heavy industrial plants in Teesside (North of England) that want to cut their emissions by over 90%, transporting and storing CO2 to geological stores deep below the North Sea.

The project is regrouping after the closure of SSI's Steelworks on Teesside earlier this year, with new members joining the Collective, and new solutions being explored. Emissions from Teesside are still some 7 million tonnes a year.

And a novel idea is being explored: carbon could be separated upstream of the industrial plants. This could use well known technology of steam methane reforming (SMR) of natural gas to form hydrogen, a clean burning fuel, and pure CO2.

The hydrogen could then be supplied to the plants as a clean burning fuel, instead of natural gas. This would require different burners, but the existing pipeline distribution network could be used. Teesside already has hydrogen production and hydrogen storage caverns, studied recently by ETI.

"And so Teesside Collective are leading the charge, as part of the solution to reduce emissions from heavy industry, in what is perhaps the most dramatic story of our time," she said.

Finding Petroleum: Investing in petroleum under a carbon 'cloud', The Geological Society, London, Nov 19 2015

Stuart Amor, Analyst
Hugh Ebbutt, Associated Director, A.T. Kearney
Alexandra Cass, Principal Consultant - hydrocarbons, Advisian (WorleyParsons group)
Feargal Murphy, ARKeX
Iain Poole, Barnett Waddingham LLP
Heidi Hellmann, Head of Strategy, BG Group
Stuart Lodge, Process Engineer, BP
Nick Wayth, VP Competitor Intelligence, BP plc
Robert Kennedy, Commercial Director, Caithness Petroleum Limited
Sean Barber, Business Development Manager, Cereno
Will Thornton, Geologist, CGL
John Glass, Consultant Geologist, Cloverfield Consulting Ltd
Belinda Perriman, Consultant
Micky Allen, Consultant
Peter Farrington, Geophysicist, Consultant Geophysicist
Dan Kunkle, Director, Count Geophysics
Meg Nicolaysen, Critical Resource
James Rosenshine, Industry Executive, Oil & Gas, Dassault Systemes
Alexandra McKenzie, Artist, Digital Energy Journal
Brian Donnelly, Consultant Geophysicist, Donnelly
Jane Wheelwright, Technical Application Specialist, Dynamic Graphics Ltd
Karl Jeffery, Editor, Finding Petroleum
Avinga Pallangyo, Conference Coordinator, Finding Petroleum
Nick Norton, Senior Energy Advisor, Foreign Office
Nikki Jones, MSc student, GeoExpro
Martine Davis, Senior Sales Executive, Getech
Chris Davies, Greenfield
Charlotte Grezo, Partner, Grezo & Co LLP
Faouzi Khene, GXT
Simon Berkeley, Principal, Halliburton
Wally Jakubowicz, Managing Director, Hampton Data Services
Norman Hempstead, Director, Hempstead Geophysical Services
Robert Ward, Advisor, HESS
Bauyrzhan Zhumabek, Production and Development team, Idemitsu Petroleum
Jasmin Kemper, IEAGHG
Peter Dolan, Chairman, Ikon Science Limited
Andrew Hopkins, Director/Seismic Interpretation Consultant, Inline Associates Ltd.
Bob Lambert, Founder, Ipex Energy Ltd
Ritchie Wayland, Exploration Manager, JKX Oil & Gas plc
Jonathan Bedford, Director, JXT
Peter Allen, Consultant, Layla Resources
Joseph Woodward, Graduate (MSc Petroleum Engineering), London South Bank University
Brian McCleery, Director, M2C Energy Advisers
Holger Schmid, MAVA
Martin Shaw, Managing Director, MOAMS Ltd.
Kristinah Samy, Senior Manager, Moore Stephens
Frances Morris-Jones, Non-Executive Director, OGA
Helen Turnell, Principal Consultant, NR Global Consulting Ltd
John Simmons, Director, ON Communication
Robert Parker, Consultant, Parker
Andrew Foulds, Director, Petrafiz Ltd.
David Russell, Consultant, Petromall
David Sendra, Associate Consultant, Petrophysical Consultant
Margaret Christie, Business Unit Environmental Adviser, Aberdeen, Premier Oil
Richard Lobeck, Corporate HSE Manager, Premier Oil
John Lewis, Head of Corporate Services, Premier Oil
Raj Thamotheram, Consultant, Preventable Surprises
Howard Covington, Preventable Surprises
Jake Leyland, Preventable Surprises
Olivia Stewart, Programme Coordinator, Preventable Surprises
Chris Wheaton, Director, RCM
Nick Bright, Retired
Robert Snashall, Consultant, RGSConsult
Alastair Bee, Partner, Richmond Energy Partners
Patrick Taylor, Director, RISC (UK) Limited
David Fishman, Chief Economist, Robertson
Brian Hepp, President, Rocky Mountain Limited
Robert Waterhouse, Director, Rosha Resources Ltd.
Elodie Grant Goodey, Managing Director, Saltus Consulting Ltd
Jerome Foreman, Principle Geoscientist, Sasol Petroleum
David Webber, Seismic Operations Supervisor, Sceptre Oil & Gas
Juliet Phillips, Campaigns Officer, ShareAction
Pete Nolan, Exploration Consultant, SHP
Irini Katsiani, Manager, Business Development, Statoil
Daniel Barnes, Consultant, StrategicFit
Richard Newton, Geoscientist, Tullow Oil
Alex Orbell, Geoscientist, Tullow Oil
Giles Watts, Consultant, Watts Geoscience Consulting
Bryan Moseley, Chief Geologist, White Rose
Chris Gumm, Business Development Manager, Automation Business Unit, Wood Group Mustang
Frank Drennan, Managing Director, Xodus Subsea
Steve Esau, Analyst, Xynteo

What did you enjoy most about the event?

Very stimulating
Bryan Moseley, Chief Geologist, White Rose

Stimulating input from investment professionals

The Bernstein presentation in particular was very good.

I thought the whole day was excellent - just a shame more people were not there to hear it. In particular I thought the presentations were (with very few exceptions) excellent and the discussion informing and informed. I also have to admit that it was expertly compered by Dave Bamford !
Giles Watts, Consultant

Although I could only stay for the morning sessions I really enjoyed the whole format. Both the talks and Q&A sessions were interesting and challenging. It's rare that a "working geoscientist" has a chance to step back and reflect on the bigger picture - and this was definitely one of these meetings.
Ritchie Wayland, Exploration Manager, JKX Oil & Gas plc

Good venue and a well structured day, and excellently chaired

Christopher Wheaton and Belinda Perriman's presentations.

Good mix of presentation subjects. Really liked the first few presentations e.g. how the financial forecasts are factoring in regulatory changes.