Carbon Risk and the Fossil Fuel Industry

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As calls for ambitious climate action intensify, questions arise concerning the resilience of the fossil fuel industry in a world ever more inclined to favour climate protection. This article will attempt to assess the extent of present risks and show how the strength of debate can affect practices and strategy employed by companies in this sector.

By refusing to play the role of "swing producer" in a context of falling oil prices, Saudi Arabia shows that it is determined to defend its market shares, even at the cost of seeing its oil revenues drop. Amongst many theories offered in explanation of such defensive action, there is one which can appear rather surprising. Such behaviour by Saudi Arabia might be in anticipation of a turning point in the battle against global warming, heralding the end of oil age. Driven by the logic of "a barrel sold at a reduced price is still worth more than the one not sold at all", Saudi Arabia is trying to sell off its goods before the climate constraints put an end to this source of income[1].

Whilst it is indeed unlikely that "climate risk" can be the only cause of the change in Saudi policies or that the end of the oil age is coming soon, one could not deny that such hypotheses are further justified by the glowing expectations from the next climate conference in Paris. In the first draft agreement, which is under discussion, the target of maintaining the warming curve of +2°C is reasserted, even referring to a possibility of a zero net emission target for the early 2050. This, of course, is only one of many possibilities proposed and there is nothing to guarantee it will figure in

[1] Hypotheses described by Elias Hinckley in the article entitled "Historic moment: Saudi Arabia sees End of Oil Age coming and opens valves on the carbon bubble" which appeared on the site Energypost.eu on 22 January 2015 and was also taken up by Deutsche Bank Research in the chapter "Peak carbon before peak oil" in the report "Konzept", published in February 2014.

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the final version of the agreement.

The complexity of the issue is clear; on the one hand, climate ambitions may compromise the future of fossil fuel unless large-scale CO_2 capture and storage technologies (CCS) are deployed; on the other hand, we can still not be certain how much credit should be given to the declarations of intent, and envisage a specific timescale for implementation of strong policies worldwide. Such underlying uncertainties feed speculations, like the one on Saudi strategy, causing further questions on the real extent of the carbon risk.

The debate, however, is no longer based on vague speculations. Accurate analyses have appeared in recent times, describing in details what ambitious climate policies could mean for fossil fuel extraction. Maps and models built on a batch of hypotheses are instigating an increasingly lively debate on the valuation of fossil fuel assets and, more generally, on the economic viability of investments in the development of new production sites. Investors are addressing the issue of carbon risk, seeking to limit their exposure, consequently urging the industry players to demonstrate and reinforce the resilience of their economic model.

I. What would be the impact on the exploitation of fossil fuels if the emission pathway was made consistent with the +2°C limit?

The commitment to limit the increase in temperature to +2°C compared to pre-industrial levels became official in 2009, in the Cancun agreement. The agreement was founded on the work of the Intergovernmental Panel on Climate Change (IPCC 2007), which showed that any increase above this level would bring about significant climate disruption. Since that time, this objective has been reasserted at every UN conference on climate. Indeed, the challenge for the Paris conference in December 2015 will be to formalise a global action plan for post-2020, consistent with the concept of maximum +2°C increase.

The limits of acceptability have therefore been set. Starting from this target, we can evaluate the corresponding efforts in terms of the emission reduction, always relying on the assumption that the promises made as a result of climate talks will be kept. This result can indeed serve as a starting point for a precise evaluation of the impact of such policies on the use of fossil fuels.

Fossil fuel energy as the key factor of global prosperity ... and the consequent emission of greenhouse gases

Since the industrial revolutions, energy in general and fossil fuels in particular have played a pivotal role in economic development throughout the world. Rapid growth in developing countries has confirmed this reasoning. The world's demand in energy grew by more than 50% between 1990 and 2012, whilst its gravity centre moved ever further towards non-OECD countries (IEA, 2014). With the share of fossil fuels in the total energy consumed in recent decades remaining stable at 80%, a strong link between fossil fuel and world prosperity cannot be denied.

Following the same trend, the annual emissions of greenhouse gases have increased by 80% between 1970 and 2010, with the rate of increase appearing more sustained between 2000-2010 (+2.2%/year) than it was in the previous three decades (+1.3%/year). Reliance on fossil fuels has been the main actuator of this increase; accumulated emissions of gases from fossil fuels have more than tripled between 1970-2010. Of the total of 49Gt of CO_2 equivalent discharged in 2010, 32Gt, or approximately 69%, were from the use of fossil fuel (IPCC, 2014), of which 14 Gt was in coal, the fossil fuel generating the most CO_2. In spite of reductions made in terms of energy intensity of GDP observed over the last decade, the effects of demographic and economic

growth remain strong, continuing to fuel the increase in fossil fuel emissions. Furthermore, recent times have witnessed an increase in the use of coal in the generation of world energy, reversing the reduction of carbon intensity in energy supply (IPCC, 2014).

With access to energy still representing a major problem, with 1.3 billion people without access to electricity to this date, (IEA, 2014), the greatest challenge is to reduce the proportion of gases from fossil fuels in GHG without affecting the dynamics of economic development and the elimination of poverty.

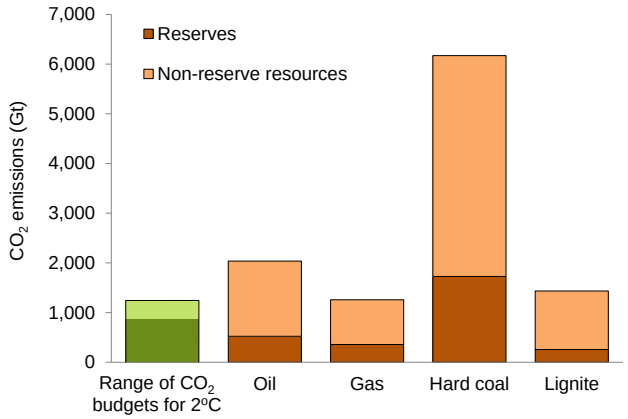
From "carbon budget" to "unburnable carbon"

Based on these historic considerations, the concept of "carbon budget" allows us to evaluate the target of +2°C in more practical terms, by calculating the amount of CO_2 which we will still be "allowed" to discharge until 2050. The first models were presented in 2009[2] and the concept of carbon budget has been repeatedly referred to since. The estimates of the IPCC (2014) indicate that, in order to have an approximately 50% chance of not exceeding the +2°C, humanity should not discharge more than 1100Gt of CO_2 between 2011 and 2050.

Based on these estimates and its main scenario of continuous development of the world's energy system (New Policies Scenario), the International Energy Agency (2014) stresses that the carbon budget might be used up by approximately 2040. The main objective of this concept is, indeed, to illustrate how the margin for manoeuvre is narrowing and consequently how urgent it is to reverse the current trends.

As a second step, the carbon budget was compared to the maximum total discharge from all fossil fuels assumed to be present in the subsoil. Such comparison was aimed at demonstrating that the exhaustion of the carbon budget is not consistent with unrestricted exploitation of coal, oil and gas. Consequently, a considerable part of these quantities was considered "unburnable". In other words, climate protection requires that a certain part remains in the ground, in the absence of large-scale deployment of GHG technologies.

Graphic 2: Comparison of the carbon budget and the maximum total discharge from the world's oil, gas, coal and lignite reserves and resources (source: Raupach, M.R. et al, 2014)



[2] See in particular Meinhausen, M. et al (2009), Greenhouse gas emission targets for limiting global warming to 2°C, Nature 458, 1158-1162.

Frame 1: Fossil fuel reserves and resources

The evaluation of the quantity of fossil fuel present in the subsoil is based on a classification system that takes into account the probability that these reserves could be subject to commercial production. Whilst criteria may vary from one institution to the next, the notion of reserves generally comes down to the volumes that can be exploited in the current technological and economic conditions, offering a certain degree of probability of being produced; the notion of resources, on the other hand, is wider-ranging, encompassing the quantities which could be exploited using both current and future technologies, without considering economic conditions.

The reserves therefore, are a sub-total of resources. Under this sub-total, there are three different resource groups, based on the probability of commercial exploitation: confirmed reserves with the highest chances of extraction (90%), probable reserves (50%) and possible reserves (10%). The term "P1" indicates confirmed reserves in general, the term "P2" the total confirmed and probable reserves and finally the term "P3" indicates the total of confirmed, probable and possible reserves.[3]

The extractive companies listed in the United States, both American and foreign, are required to report all confirmed reserves controlled by them on a yearly basis, referring particularly to the definition set by the *Security and Exchange Commission (SEC)*, which is judged very restrictive. There, confirmed reserves are referred to as *"quantities of oil and gas estimated with reasonable certainty, based on analysis of geological and technical data, as liable to be processed in a viable manner"*. Very specific criteria have been made available by the SEC, allowing for close interpretation of this definition of confirmed reserves, and consequently a rigorous comparison of the information published by all oil and gas companies. It is particularly required that all development projects should be subject to a final investment decision by the exploiting parties.[4]

Analysis of the geographical spread of unburnable reserves

The consequences only become really clear in the third stage of the reasoning, where an economically optimal scenario is built, based on a series of hypotheses, aimed at identifying precisely the type and location of fossil reserves considered unburnable[5] (McGlade C. and Ekins P., 2014). Using this approach based on maximising the social welfare, it has been proposed that the optimum solution would be abstention from using 80% of the coal reserves, one half of gas reserves and one third of oil reserves between now and 2050, which would give us a 60% chance of not exceeding +2°C. As far as this concerns CCS, the sensitivity studies proposed by

[3] See particularly Society of Petroleum Engineers, American Association of Petroleum Geologists, World Petroleum Council, Society of Petroleum Evaluation Engineers (2007), Petroleum Resources Management System.

[4] Refer to CFR 210.4-10 Financial accounting and reporting for oil and gas producing activities pursuant to the Federal securities laws and the Energy Policy and Conservation Act of 1975.

[5] The quantification and location of unusable reserves is defined based on a global energy system optimisation model, TIAM-UCL, which maximises the overall collective benefits using linear programming, based on specific constraints, which in the case in point are temperature curves. The hypotheses used take into account the scale of implementation of climate policies (moderate during the initial years and stricter beyond the initial period), development of the demand for energy, availability of technologies (notably CCS), the costs of production by type of fuel and country, the rate of production of the given resource in comparison to its availability and price in the region (generated based on the marginal cost of production, scarcity rent and transportation cost).

McGlade and Ekins suggest that the benefits would not be considerable since the cost of technology would be too great and their implementation timetable too slow. The scenario envisaging the introduction of CCS technology as of 2025 would only reduce the percentage of unburnable reserves by 2 points for oil, 3 points for gas and 6 points for coal. The results of the model are subsequently divided by region, particularly bearing in mind the cost of production.

Table 1: geographical spread of unusable oil, gas and coal reserves (source: McGlade C. and Ekins P., 2014)

	2°C with CCS			2°C without CCS		
	Oil	Gas	Coal	Oil	Gas	Coal
Africa	21%	33%	85%	26%	34%	90%
Central/South America	39%	53%	51%	42%	56%	73%
Other developing countries in Asia	9%	24%	34%	12%	22%	60%
Canada	74%	24%	75%	75%	24%	82%
China and India	25%	63%	66%	25%	53%	77%
United States	6%	4%	92%	9%	6%	95%
Europe	20%	11%	78%	21%	6%	89%
Former USSR	18%	50%	94%	19%	59%	97%
Middle East	38%	61%	99%	38%	61%	99%
OECD Pacific	37%	56%	93%	46%	51%	95%
Total	33%	49%	82%	35%	52%	88%

%, Unburnable reserves between now and 2050 in percentage of current reserves

Naturally, different geographical distributions can be envisaged but, according to the authors, they would all lead to a reduction of the social welfare. In the search for the best solution, substitution between fossil fuels inevitably plays a major role. For example, a study by UKERC (2014) emphasises that the development of the natural gas market would allow for an efficient transition to carbon-free energy, if the use of gas were to be increased between now and 2035 and if it is accompanied by a considerable reduction in the use of coal. In short, the objective of McGlade and Ekins's work is not to predict the future exactly, since other combinations may be advocated, but rather to demonstrate that seeking to maximise production wherever possible may not be relevant. During the last ten years, the upturn of non-conventional oil and gas or deep water offshore exploitation has led us to reconsider the issue of scarceness of fossil fuels. Today, models show us that climate constraints and the consequent limits of the carbon budget could force us to rationalise the worldwide production. By proposing their “economically optimal” distribution, McGlade and Ekins draw attention to the fact that a choice will probably have to be made between different fossil fuels and production zones.

II. Questions around the proper valuation of fossil assets

The climate-related topic takes on a financial aspect when it provokes questions about the relevance of current economic choices, pitched towards the further development of energy production from fossil fuels.

Most reserves are controlled by states or public companies (90% for oil). The first challenge would therefore be to diversify domestic economies. The idea that climate protection will lead to a loss of commercial opportunity for producing countries is constantly being asserted in international climate talks and reflected in recurrent requests for financial compensation, put forward notably by Saudi Arabia. So far these claims have fallen on deaf ears, probably because they have been judged too theoretic; however this argument is likely to recur as it has now found some firm foundations in the first unburnable reserve maps (Insight_e, 2015).

However, the resilience of producing countries attracts fewer comments than that of the coal, oil and gas companies, due to their predominance in stock market indexes. The capitalisation of the first 1500 oil and gas companies equals USD 4.9 trillion and USD 230 billion in the case of coal companies (Bloomberg, 2014). The concern is that these companies might be underestimating the "carbon risk", in view of the possibility of ambitious climate protection policies being implemented and curbing their activity. The investor community might be affected by similar self-delusion, whilst the world economy might be threatened by a "carbon bubble" burst. Financial losses could arise from belated and sudden acknowledgement of the inconsistencies between the value given to fossil assets and their true economic potential, in a world dedicated to protect its climate. Such calls to vigilance launched by NGO[6] and transmitted by the media[7] provoked a number of reactions and analyses by financial institutions[8], expert groups commissioned by governments[9], central banks[10], energy sector consultants[11] and even oil and gas companies[12]. There is evidently no consensus on the reality of carbon risk, however the vigour of the debate indicates that carbon risk considerations are gaining ground.

First question: can the proved fossil fuel reserves controlled by listed companies become stranded assets?

If fossil fuel companies listed on stock markets would be allocated a share of the carbon budget corresponding to the percentage of the world reserves they are holding (25%), admittedly one part of their assets (reserves) might not be able to generate a positive return. This is the key argument put forward by the NGO Carbon Tracker Initiative (2013) in order to demonstrate that the current value given to the reserves held by these companies is not consistent with the probability of their use, in view of climate constraints.

Stranded assets is a term used for investments which "*at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an*

[6] See particularly Carbon Tracker Initiative and the Grantham Research Institute (2013), Unburnable carbon: Wasted capital and stranded assets.

[7] See particularly the article by Bill McKibben that appeared in the magazine Rolling Stone on 19 July 2012, entitled "Global Warming's terrifying New Math".

[8] See particularly HSBC (2012), Coal and Carbon, Stranded Assets: Assessing the Risk, Citi group (2013) Global Oil Demand Growth – The End is Nigh, HSBC (2013), Oil and Carbon Revisited: Value at Risk from "Unburnable Reserves", Kepler Chevreux (2014), Stranded Assets, Fossilised Revenues.

[9] See particularly the report of the group of experts mandated by the Norwegian government: Slancke M. et al (2014), Fossil-Fuel Investments in the Norwegian Government Pension Fund Global: Addressing Climate Issues Through Exclusion and Active Ownership.

[10] Inquiry in course led by the Bank of England. Source : <www.parliament.uk/documents/commons-committees/environmental-audit/Letter-from-Mark-Carney-on-Stranded-Assets.pdf>.

[11] See particularly Rystad Energy (2013), Petroleum Production under the two degree scenario (2DS), IHS Energy (2014), Deflating the Carbon Bubble.

[12] See particularly Shell (2014), Letter to shareholders, 21 May 2014 and Exxonmobil (2014), Report: Energy and Carbon – Managing the risks.

economic return, as a result of changes in the market and regulatory environment" (IEA, 2013). In the case of fossil fuels, these non-anticipated changes may come in three different forms (Cambridge Associates, 2014). Firstly, they may concern public policies, whether in the form of an international agreement or several pieces of national or local legislation introduced in support of energy transition. A drop in the value of fossil assets could also be caused by a technological breakthrough, rendering clean energy more competitive and challenging fossil fuel supremacy in all forms of use. Finally, such a shift may also be brought about by social and political factors, such as aversion to fossil fuels, potentially leading to a change in consumer practices and strong local engagement against extraction projects.

While these changes are possible, the debate concerns more the timescale over which they are likely to occur. One of the criticisms of Carbon Tracker Initiative's calculations is indeed that, when referring to the percentage of global reserves controlled by companies, the type of reserves (confirmed, probable, possible) and consequently the probability of their being put to commercial use are not taken into account (IHS Energy, 2014). In addition, the country-level proved reserves estimates produced by the IEA incorporate volumes that are less likely to be produced than those controlled by companies, since companies tend to calculate their proved reserves applying the stricter definition provided by the American Securities and Exchange Commission (IPIECA, 2014). By the same token, some companies from the sector indicated that, based on the current rate of production, their proved reserves will be completely exhausted before any policies on climate could have a considerable effect (production/proved reserves ratio of 11.5 years in the case of Royal Dutch Shell and 16 years in the case of Exxonmobil). Beyond the valuation of proved reserves, the return on capital dedicated to prospecting and developing new proved reserves is being called into question. Capital expenditure in the oil, gas and coal industries has more than doubled since 2010, exceeding USD 950 billion in 2013 (IEA, 2014). Whilst the current proved reserves are not concerned by carbon risk, others are being developed and the probability of them becoming stranded assets cannot be completely excluded (CTI, 2014), according to the current hypotheses.

Second question: is carbon risk threatening the world economy?

The risk which is burdening the exploitation of proved reserves is causing concern for the financial soundness of the entities holding these reserves. When, in 2004, Royal Dutch Shell announced that they had overestimated their proved oil and gas reserves by 20%, the cost of their shares (Royal Dutch Petroleum Co.) immediately dropped by about 10%[13]. This case is often referred to when illustrating the importance of reserves in the evaluation of companies in this industry.

However, it is believed that 80% of the value of exploration/production companies is derived from the anticipated financial flows which are expected to be generated by proved reserves (McKinsey and Carbon Trust, 2008). If we consider it unlikely that the effects of policies on climate will outweigh those of demographic and economic growth within 10-15 years, the belief that the companies in this industry are correctly evaluated can be justified since a large proportion of proved reserves controlled by them will have been exploited by then. Besides, the energy sector depends on heavy infrastructures that cannot be transformed in a short period of time. We can thus assume that the change in approach will rather be continuous, allowing the investors and companies in this industry to adjust their strategies in order to avoid sudden losses (IHS Energy, 2014). In other words, if a carbon bubble is created, it is more likely to be deflated over time

[13] <www.bloomberg.com/bw/stories/2004-01-25/shell-the-case-of-the-missing-oil>

rather than to burst. Furthermore, the potential shock for financial institutions in circumstances involving a sharp devaluation of fossil assets would be strong but not to the point of compromising the stability of the financial system (GEF, 2014). Average losses would remain at around 3% of the total value of assets in European pension funds, 2% for European insurance companies and 0.4% for the big European banks (GEF, 2014). Financial institutions are significantly exposed to the fossil fuel industry, but much more to oil and gas companies than coal companies, whereas the latter are expected to be most affected by carbon risk.

A strict adherence to the carbon budget, therefore, does involve a risk, however it does not concern the use of proved reserves controlled by companies but the viability of future investments in development of new proved reserves. The current valuation of companies in the sector would only become exaggerated in circumstances involving a sudden change of direction occurring in the near future, which appears to be unlikely in view of the time factor described previously. Finally, a “carbon bubble” on its own would not appear able to create a systemic risk for world finance. In all, the debate on carbon risk is highly relevant in the context of a discussion on how energy balances are evolving and this debate is expected to grow as calls for ambitious climate action intensify; however, the talk of immediate threat that we hear today should be put in perspective.

III. Managing the carbon risk

Even if the debate is not clear-cut, it has obviously become topical, calling upon investors and the companies financed by them to react. In its latest analysis of trends to follow in the area of socially responsible investment, the financial services company MSCI (2015) identified the carbon risk control as a top priority for 2015.

Increasing transparency on the level of exposure to carbon risk

As the debate grows stronger, the calls for a better quantification of carbon risks are growing more frequent. In September 2013, an international coalition of 75 institutional investors, accounting for more than USD 3 billion worth of assets, confronted the companies with high carbon intensity, asking them to ensure greater transparency concerning the manner in which their carbon risk management is conducted. They particularly invited them to go beyond simply declaring their CO_2 emissions generated during the preceding year but to also state precisely the carbon stock contained in their reserves (CTI, 2013). In general terms, the companies are asked to analyse the consequences of a scenario of respecting the limit of +2°C on their business and performance (Kepler Cheuvreux, 2014).

Although such assessments of resilience to carbon risk are still not widespread (2°C Initiative), it is noted that, as of 2013, Bloomberg has provided its clients with a tool for measuring the potential impact of five decarbonisation scenarios on their profits as well as on share prices (Bloomberg, 2013). Furthermore, the majority of large companies have been since responding to the annual questionnaire of the NGO Carbon Disclosure Project, even though the total response rate in the industry was still only 24% in 2014 (CTI, 2014). Companies are essentially asked to single out the risks, as well as the financial and physical opportunities, which climate change is likely to create for them, as well as state which procedures they have implemented to take account of these.

Furthermore, in response to resolutions filed by some of their shareholders, Exxonmobil and Royal Dutch Shell respectively published a report in March 2014 and a public letter in May 2014 in which they argue that carbon risk will not have a significant impact on their assets, especially

in light of their world fossil fuel demand outlooks. They also describe the strategies implemented in order to face these potential risks. Some, however, judged these steps insufficient, precisely because they focus on the global picture and do not assess the impact of various decarbonisation scenarios on the different types of assets they own (Kepler Cheuvreux, 2014). Even though reassurance of the investor would evidently be in the companies' best interest, these calls for greater transparency might put them in conflict with the need to refrain from disclosing commercially sensitive information, particularly in terms of the viability of individual projects. Nevertheless, practices are changing, as seen from the recent decision of the management of Royal Dutch Shell and BP to back stakeholders' resolutions requiring the firms to include details on carbon risk in their annual reports as of 2016[14].

Divesting from fossil fuels?

As seen in the past with the tobacco industry or the apartheid regime in South Africa, 2012 saw the launch of a fossil fuel divestment campaign. Supporters of this campaign are calling on investors to withdraw from the fossil fuel sector and not contribute to materializing a climate scenario where the +2°C would be exceeded. The campaigners' arguments are founded primarily on ethical principles but those arguments are now further supported by financial concerns. In December 2014, 181 organisations, mainly universities, religious organisations and local government bodies, constituting USD 50 billion in assets – which, compared to the asset values mentioned previously, is rather low - joined the movement, according to NGO 350.org. Even though the campaign is gaining momentum, the direct consequences remain limited, mainly because of the importance of large investors in the sector (Bloomberg, 2014). At the same time, this type of campaign attracts media attention as it gains support from high-profile supporters, such as that of the Rockefeller brothers' foundation, announced in 2014. The effects are therefore primarily indirect; the divestment campaign can fuel a stigmatisation process (Ansar et al, 2014).

However, the dual approach "invest or divest" seems to suit the fossil fuel industry less well than it did tobacco or apartheid since the question of ethics and finance arising from the use of fossil fuel invite more nuanced responses (Younger, 2015). This is why some investors have preferred a selective approach, dissociating themselves only from the high-emission industries, in particular coal. In October 2014, MSCI responded to the request of their clients by launching a new index named *MSCI Global Fossil Fuels Exclusion Indexes*, the first to provide information on the market's global performance while excluding all fossil fuel companies, and a similar index which only excludes coal companies, often judged to be the most at risk. A new decision-making tool is offered to investors, allowing them to gauge their involvement in industries with a high carbon intensity. Such disinvestment "à la carte" was precisely the preferred option of a group of experts mandated by the Norwegian government to rule on the basic strategy regarding the Norwegian sovereign fund. In their report, published in December 2014, the experts estimated that climate change was an important parameter in fund management for ethical and financial reasons, but that a withdrawal from the whole sector would not constitute a viable strategy and that a case-by-case approach should be favoured (Skancke M. et al, 2014). In line with these recommendations, the manager of the Norwegian fund stated that 32 coal processing companies had been removed from its portfolio in 2014 (NBIM, 2015).

Consolidating companies' resilience

[14] <www.reuters.com/article/2015/01/29/climatechange-investor-shell-idUSL1N0V82IE20150129> <www.reuters.com/article/2015/02/05/us-climatechange-bp-idUSKBN0L92GK20150205>.

Another way for the investors to protect themselves from carbon risk would be to open a dialogue with company managers, encouraging them to better incorporate the concept of carbon risk into their corporate strategy (IIGCC, 2014). The better prepared the company for the eventuality of regulatory, technological or socio-political changes, the less costly it will be for the company to finance them. In early 2015, 180 financial institutions were noted as betting on shareholder engagement to put forward their concerns about carbon risk (Novethic, 2015).

With respect to the issue of resilience assessment, the main requirement seems to be to use carbon pricing hypotheses when making decisions on investment. The idea here is to calculate the theoretical cost of emissions generated by each project during its economic lifetime and integrate the resulting data into the viability assessment. Many large energy companies have already adopted this approach (CDP, 2014), incorporating the cost of carbon into their viability calculations. Logically, this should immediately result in the exclusion of those extraction projects which are highly emitting, costly and have a long lifetime, probably reflecting the unburnable reserves map by McGlade and Ekins mentioned in the previous text.

Furthermore, companies in the sector will find themselves encouraged to reduce the causality link between use of fossil fuels and CO_2 emissions. The work will primarily consist of developing new CCS technologies, the potential of which has so far not been fully demonstrated. More precisely, the implementation of existing pilot projects should be accelerated, of which only twenty two were implemented by late 2014 (Global CCS Institute, 2014). Besides, even if emissions are mainly generated by combustion of fossil fuels rather than their production, companies in the sector should be looking to reduce their own carbon footprint, limiting the flaring of gas or methane discharge, whilst increasing the energy efficiency of their processes such as refining.

Global industrial initiatives

Aware of the stakes, the industry has strongly increased its efforts to improve carbon performance, primarily through international cooperation. In January 2014, a worldwide partnership was created, named *Oil and Gas Climate Initiative*, which should provide an exchange platform for oil and gas companies with the view of boosting and coordinating their actions in the fight against global warming. Originally supported by Saudi Aramco, BG Group, Eni, PEMEX and Total, and recently joined by Sinopec, the initiative aims to enrol as many participants as possible and to keep a regular tally of their operations[15]. By the same token, creation of a new partnership was announced during the New York summit on climate in September 2014, for the reduction in methane emissions in the oil and gas sector. The *Oil and Gas Methane Partnership* brings together companies (ENI, PEMEX, Southwestern Energy, Statoil, BG Group and PTT), NGOs (Natural Resources Defense Council, Environmental Defense Fund) as well as the producing countries (Mexico, Nigeria, Norway, Russia and the United States)[16].

Finally, a company will [from now on] be considered less risky if its activity portfolio is sufficiently diversified and, as a whole, less carbon intensive. Consequently, the perception of carbon risk

[15] Oil and Gas Climate Initiative, Action Statement of September 2014 : <www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/09/INDUSTRY-oil-and-gas-climate-initiative.pdf>

[16] CCAC Oil and Gas Methane Partnership, Press Release, 23 September 2014: <www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/05/INDUSTRY-PR.pdf>

will incite fossil fuel companies to widen their original activity scope and become “energy companies” (Kepler Cheuvreux, 2014). The first step would be to favour those fossil fuel projects with reduced emissions, investing for instance in natural gas. The second phase would be to engage in industries whose growth is linked to the advancement of energy transition, such as energy efficiency services and renewable energy. Diversifying strategic development axes will reassure investors, showing them that the company is capable of maintaining high performance regardless of the situation with climate ambitions.

Conclusion

December 2015 is approaching and the recent announcements by China and the United States lead us to believe that the prospect of an international agreement on climate might not be a mere illusion, or at least that it is more likely that it has ever been. This situation will give a decisive stimulus to the question of the constraints which might influence the future of fossil fuels and the resulting financial risks.

While concerns regarding the valuation of fossil assets do appear uncertain, the very existence of this debate and its continuous echoes is liable to provoke a change in the perception of risk and its integration into the strategies applied by the investors and companies in this sector. The fossil fuel companies are well accustomed to managing all kinds of risk but will from now on have to deal with yet another requirement, whereby they will have to demonstrate coherence of their strategies with the possibility of a large shift towards climate preservation.

It can be seen that certain companies are already considering these issues, slowly changing their business lines and practices. It remains to be seen whether these events will trigger wide ranging changes in the fossil fuel energy sector or, indeed, whether a gap might start to appear between those who refuse to engage before seeing proof of the validity of the arguments and those accepting the transparency game and deciding to give themselves a clear role in the transition towards a low-carbon energy system.

Reference:

- 2°C Initiative (2014) *Carbon Risk for Financial Institutions – A Perspective on Stress Testing and Related Risk Management Tools*
- Ansar A., Caldecott B., Tilbury J. (2014) *Stranded assets and the fossil fuel divestment campaign: what does divestment mean for the valuation of fossil fuel assets?*, Stranded Assets Programme, SSEE, University of Oxford
- Bloomberg New Energy Finance (2014) *Fossil fuel divestment: a $5 trillion challenge*, White Paper
- Bloomberg New Energy Finance (2013) *Bloomberg Carbon Risk Valuation Tool*, White Paper
- Cambridge Associates (2014) *The Fossil Fuel Divestment Discussion*, Research Note
- Carbon Tracker Initiative (2012) *Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?*
- Carbon Tracker and the Grantham Research Institute (2013) *Unburnable Carbon 2013 : Wasted capital and stranded assets*
- Carbon Tracker Initiative and Ceres (2014) *Carbon Asset Risk Initiative Fact Sheet*
- Carbon Tracker Initiative (2014) *Recognizing Risk, Perpetuating Uncertainty. A baseline survey of climate disclosures by fossil fuel companies*
- Carbon Tracker Initiative (2015) *Responding to IHS/IPIECA on Oil&Gas Capex*
- Carbon Trust (2008), *Climate change – a business revolution?*
- Citi Group (2013) *Global Oil Demand Growth – The End is Nigh*
- Clingendael International Energy Programme (CIEP) (2014) *Transition, What Transition?*, Study for the Dutch Ministry of Infrastructure and Environment
- Carbon Disclosure Project (CDP) (2013) *Use of internal carbon price by companies as incentive and strategic planning tool*
- Deutsche Bank Research Haus (2015) *Peak carbon, before peak oil*, Konzept Magazine January 2015
- Exxonmobil (2014), *Energy and Carbon – Managing the Risks*
- Generation Foundation (2013) *Stranded Carbon Assets: Why and How Carbon Risks Should Be Incorporated in Investment Analysis*
- Global CCS Institute (GCCSI) (2014) *The Global Status of CCS*
- Green European Foundation (2014) *The Price of Doing Too Little, Too Late*
- HSBC Global Research (2012*), Coal and Carbon, Stranded Assets: Assessing the Risk*
- HSBC Global Research (2013) *Oil & carbon revisited – Value at risk from "unburnable" reserves*
- International Energy Agency (AIE) (2014) *World Energy Outlook*
- IHS Energy (2014) *Deflating the "Carbon Bubble"*, Special Report
- IMPAX Assessment Management (2013) *Beyond Fossil Fuels: The Investment Case for Fossil Fuel Divestment*
- Institutional Investors Group on Climate Change (2014), *Investor Expectations: Oil and Gas Company Strategy*
- Intergovernmental Panel on Climate Change (GIEC), (2014) *Drivers, Trends and Mitigation*, in: *Climate Change 2014: Mitigation of Climate Change*, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
- IPIECA (2014) *Exploring the concept of unburnable carbon*, IPIECA Factsheet

- Intergovernmental Panel on Climate Change (GIEC), (2014) *Energy Systems,* in: *Climate Change 2014: Mitigation of Climate Change*, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
- Kepler Chevreux (2014) *Stranded assets, fossilized revenues*
- Kepler Chevreux (2014) *Toil for oil spells danger for majors*
- McGlade C., Pye S., Mathieu C., Juric Z., Matosovic M. (forthcoming publication) *Unburnable Fossil Fuels in a 2C World*, Insight_e Hot Energy Topic
- McGlade C. and Ekins P (2015), *The geographical distribution of fossil fuels unused when limiting global warming to 2°C,* Nature Vol 517
- McGlade, C., Bradshaw, M., Anandarajah, G., Watson, J. and Ekins, P. (2014), *A Bridge to a Low-Carbon Future? Modelling the Long-Term Global Potential of Natural Gas*, UKERC Research Report
- Meinhausen M., Meinhausen N., Hate W., Raper S., Frieler K., Knutti R., Frame D., Allen M. (2009) *Greenhouse-gas emission targets for limiting global warming to 2°C*, Nature April 2009, Vol 458
- MSCI (2015) *2015 ESG Trends to Watch*
- Norges Bank Investment Management (NBIM) (2015) *Responsible Investment in 2014*
- Novethic (2015) *Les investisseurs mobilisés sur le changement climatique*
- Raupach M.R et al (2014) *Sharing a quota on cumulative carbon emissions*, Nature Climate Change Vol 4
- Royal Dutch Shell (2014) *Letter to Shareholders dated 21 May 2014*
- RystadEnergy (2014) *Petroleum Production under the two degree scenario (2DS)*, Final Report
- Slancke M., Dimson E., Hoel M., Kettis M., Nystuen G., Starks L. (2014) *Fossil-Fuel Investments in the Norwegian Government Pension Fund Global: Addressing Climate Issues Through Exclusion and Active Ownership*, A report by the Expert Group appointed by the Norwegian Ministry of Finance