28th November 2019

Thought Leadership & Public Policy

CLIMATE CHANGE SEMINAR WITH LORD BROWNE

We are pleased to send you a summary of our recent seminar led by Lord Browne of Madingley and moderated by Dr Eamonn Molloy of Pembroke College Oxford. It was sponsored by J. Stern & Co. and continued the series of events within our Thought Leadership & Public Policy programme. We brought together over 90 climate change experts and investment professionals, especially those focused on managing capital within an increasingly stringent ESG framework.

It is over 20 years since Lord Browne took to the podium at Stanford University and called for global oil companies to face the challenge of climate change. In the ensuing ten years as CEO of BP and in his subsequent involvement in the industry he has remained a highly authoritative voice in the climate change debate, seeking radical change at a pace that will not impact global growth significantly. During this period, and even more so today, he uses his knowledge of leading-edge technological advances in engineering to challenge policy-makers and the public to embrace faster and more ambitious change.

Lord Browne called for a two-pronged approach to address climate change and slow the rise in global temperatures. More than half of the necessary progress could be delivered by 'decarbonising hydrocarbons' through extracting CO2 from fossil fuel emissions, and by using more CO2 for CO2-derived products including hydrogen, chemicals and building materials. Secondly, he called for faster progress in new sources of energy - in nuclear fission, particularly in small reactors, in solar and wind energy.

Faster progress will require a judicious blend of regulation, tax incentives, compromise and investment. Lord Browne noted the change in public attitudes in many countries and called on policy-makers, leaders in the global industry, investors and Governments to take more determined action. With over 85% of global oil and gas production controlled by Governments, their commitment is critical to the whole process.

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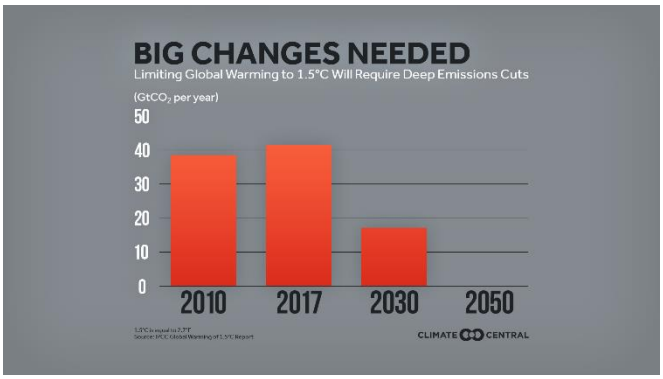
Unintended consequences

The fossil fuels which propelled global economic growth over the last 200 years have created unintended consequences of increasing scale in the shape of pollution, climate change and global warming. In 2019 global temperatures are ~1°C above the pre-industrial era and at the current rate of warming are likely to reach the 1.5°C threshold between 2030 and 2052 according to the International Energy Agency (IEA).

Even with the current pace of climate change initiatives, the extent of further growth in carbon emissions is likely to lead to an overshoot of the 1.5°C threshold into the 2-3°C range before falling back as carbon reduction efforts take effect. The impact of even a 0.5°C rise to 2°C on a permanent basis would be far-reaching. According to the IEA it would, for example, double the number of people affected by water scarcity and shrink the global fishing industry by ~50%.

CO2 emissions in many developed countries are now falling steadily, including in the UK, France, Germany and Japan; but this is not the case in countries like China and India due to strongly rising demand for electricity, increased car ownership and an entrenched attachment to coal-fired power stations, which in many areas have decades of potential use ahead.



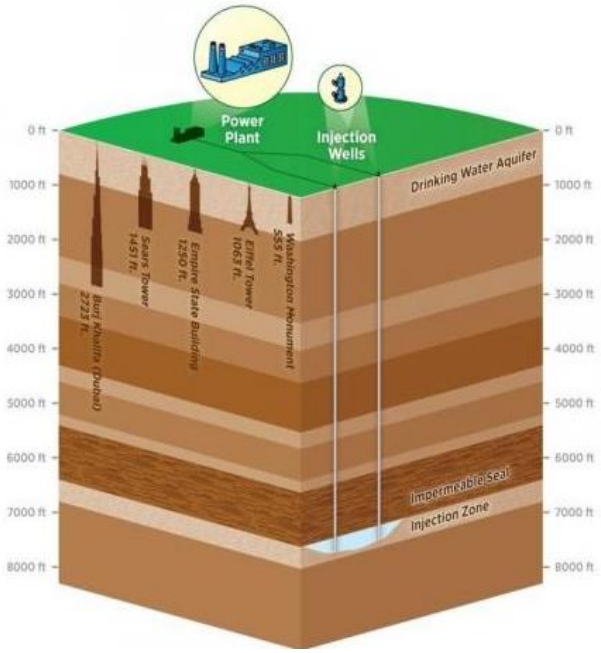
And unless more radical action is taken across the globe, it will be impossible to hit a target of a 1.5°C ceiling. For example, according to the IPCC, the pre-eminent climate science body, in its 2018 forecasts, it will be necessary for the whole world to be at 'net carbon neutral' by 2050 in order to remain below this ceiling on a sustainable basis.

This situation and the associated challenges were the instigation for our event, aiming to raise awareness and share insights and ideas within a sophisticated group of investors and experts.

Extracting CO2 from fossil fuel emissions

Lord Browne believes that across many sectors we already have the engineering and technical capability to decarbonise hydrocarbons on a much large scale than is currently being achieved. For example in electricity and heat generation, which accounted for over 40% of primary CO2 emissions globally in 2017 (IEA), he advocated extracting the CO2 and storing it in saline aquifers deep underground.

By their nature these saline aquifers are 'closed' and have not been blended with fresh water reserves underground. On current estimates there is scope to store well over 200 years of global emissions in these aquifers, in depleted oil and gas fields and deep coal seams. This process of 'geologic sequestration' of CO2 would be



Schematic of CO2 capture and sequestration, US EPA

complementary to terrestrial and biologic sequestration where the carbon is stored via agricultural and forestry practises.

In the diagram on page two the illustration uses a US power station, but a similar process could of course be used economically with large-scale industrial plants, or clusters of plants. Industrial plants generate another 23% of carbon emissions globally.

Reforming methane; expanding use of hydrogen

There is a growing international consensus that clean hydrogen will play a key role in the world's transition to a sustainable energy future. It is easily stored; it operates in a power system at ~80% efficiency compared to internal combustion engines at ~30%; and its only environmental impact is to produce water and heat.

The 'only' obstacles to its use, especially in transportation, is the need for a supply network, cost-effective hydrogen-powered vehicles, and the fact that the production of 'blue hydrogen' from methane generates CO2 as a by-product. And yet, according to sources such as Flogas, the world has sufficient proven and probable reserves of natural gas to last for 200 years at current consumption rates, with more being discovered.

Shell plan to expand their hydrogen refuelling network in California from 35 stations to 100 within two years

H-vision: blue hydrogen for a green future

Given that the world could become much more adept at handling CO2 emissions, Lord Browne pushed for greater use of hydrogen as part of the global climate change agenda. Earlier this year a large consortium 'H-vision', centred on the Port of Rotterdam has produced a feasibility study for large scale hydrogen production to help the Netherlands to become carbon neutral by 2050.

CO2-derived products

Lord Browne identified a series of industries where carbon emissions were being used to make CO2 derived products, and where greater investment would build scale benefits and boost the global decarbonisation initiative. In the chemical industry CO2 is combined with hydrogen, or hydrogen and ammonia to create methanol and urea respectively. Similar processes are used to manufacture CO2-derived plastics, fibres and synthetic rubber.

And a small Canadian company, Carbon Engineering, has started making liquid fuel from CO2 and hydrogen. This last example requires a substantial electricity supply, which is being sourced from an adjacent hydro plant. Carbon Engineering is being backed by Bill Gates, Chevron, BHP and Occidental.

Carbon Engineering

CE's Direct Air Capture technology removes carbon dioxide directly from the atmosphere.

Similarly in the UK, o.c.o. Technology has three plants producing 'carbon negative aggregates' [calcium carbonate or manufactured limestone] which can be used for low-strength applications in the construction industry such as pavement slabs and some masonry blocks. These replace traditional aggregates and also reduce the need for cement, which is a global industry with a very substantial carbon footprint, estimated to be up to 8% of global emissions.

Zero carbon energy sources

Whilst Lord Browne noted that the elimination of fossil fuel combustion in its entirety was unlikely, he stated that a very substantial increase in total energy derived from zero carbon energy sources was essential to meet growing energy demands in parallel with targets on emission reduction. He identified nuclear fission, solar and wind energy as zero carbon energy sources with the greatest potential.

With nuclear there is a step change in the industry away from non-standardized, large and expensive fission reactors towards small, modular reactors (SMR) which could be manufactured in volume and with substantial cost benefits. In the US for example, NuScale Power is the advanced stages of commercializing its SMR which can generate 60MW of electricity on a low cost and flexible basis.

NuScale's SMR

Technological development and economies of scale have dramatically decreased the cost of harnessing solar and wind energy. Although their contribution to the energy system is expected to increase, both are inherently intermittent in energy delivery and will require major advances in storage technology and capacity. However, one option would be to use surplus power produced during windy/ sunny periods to electrolyse water. Hydrogen produced in this way could be easily stored or transported in tankers and pipelines.

On a related point, Lord Browne suggested that the 'grid of the future' is likely to use a range of storage techniques in order to maximise its efficiency and minimize emissions. Delivering low-cost reliable and clean energy will require more innovation in carbon capture and storage (CCS) and carbon capture and utilisation (CCU).

Policy, incentives and investment

Lord Browne emphasized the potential redundancy of technological development if it is not supported by regulatory change, central and local government, and appropriate incentives for investors, producers and consumers. In the absence of a nurturing framework, major changes will be slow. He made an interesting comparison with the US Space programme and the semi-conductor industry, both of which were heavily supported by the US Government prior to a phase of private investment.

Although climate sceptics remain in many positions of power on a global basis, their influence is declining overall; and 'positive action' political agendas are now evident in many countries. For example, in the UK, all three major parties are committed to substantive targets on climate change in their manifestos. And in the USA, there are now 32 states pursuing a climate change agenda.

Lord Browne spoke with enthusiasm for an unambiguous and effective carbon tax sufficient to alter the behaviour of consumers and companies alike. On a personal basis such a tax would need to be progressive, not regressive, as households with a lower income spend a larger proportion of their weekly budget on energy costs.

He encouraged investors interested in climate change and promoting change to be active in a number of ways. To be more vocal in calling for incentives for the management of larger corporates; to be more determined in seeking out small innovative companies with a pro-change mindset; to have a long-term view; and to encourage policy-makers to be more robust in their own targets and actions. He believes we are moving closer to a tipping point of real accelerated change, stimulated by public opinion and the reality of the global position.

Acceptances		
All Souls College, Oxford	Earth & Atmospheric Sciences, Georgia Tech	RAF Central Fund
Ambrian Capital	Enhance Group	Rathbone Investment Management
Anglo Scientific	Hiscox	Redington
ARC	Homerton College, Cambridge	Royal Bank of Scotland Pension Fund
Arche Investments	Ishtar Advisory	Royal Embassy of Saudi Arabia
Aristata	JPM Private Bank	Rozental & Asociados
Aviva Investors	King & Wood Mallesons	Sainsbury Family Charitable Trusts
Barnardo's	King's College London	Sandaire
Bath University	L1 Energy	Sir Richard Sutton Limited
Bryan Cave Leighton Paisner LLP	Ledger Capital	Sirius Minerals PLC
BT Pension Scheme Management Limited	LSE	Smith & Williamson
Cambridge University	Lucy Cavendish College, Cambridge	Sompo Japan Nipponkoa
Canson Capital Partners	MacLean Securities	Stichting Droom en Daad
Capitalworks Investment Partners	Menhaden	Sustainable Future for All
Carduus Investment Advisors LLP	Mercer Investments	SWF Samruk-Kazyna JSC
Carillion Pension Trustees	MJ Hudson Allenbridge	Talisman Global Asset Management
Charles Stanley & Co	MM Energy	Tamsel UK
Christ's Hospital School	Murray Edwards College, Cambridge	The Prince's Foundation
CKA Capital Ltd	National Grid Pension Fund	The Royal Society
Close Brothers	Nest Corporation	Tri-Borough Treasury and Pensions
Consolidated Nickel Mines Ltd	New Amsterdam Group	UK Parliament
Coutts	OECG	Universities Superannuation Scheme
Credit Suisse	Oxford University Endowment Management	Wellcome Trust
Curzon Street	Pembroke College, Oxford	Weybourne Limited
Daiwa Fund Consulting	Pension Insurance Corporation	Yoke & Co
Department of Earth Sciences, Oxford University	PMCL Consulting	