Grantham Research Institute public lecture

A fractured future: climate change in an age of fossil fuel abundance

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When I had been the chief executive of BP for only a couple of years, I broke ranks with the rest of the industry.

In 1997, I stood under a blazing Californian sun at Stanford University, and explained that BP:

- acknowledged the risk posed by climate change;
- accepted that it was a result of human activity;
- and wanted to do something about it.

I was asked by other chief executives whether I had lost the plot.

The American Petroleum Institute accused BP of 'leaving the church'.

And some NGOs accused us of 'greenwash', assuming that we were trying to distract attention from our core business.

Ten years later, in 2007, I stood in the same place and reaffirmed BP's commitment to the fight against damaging climate change.

It was a matter of months before the beginning of the Great Recession, during which climate change seemed a more peripheral concern than ever.

That same year, production of shale gas in the United States would take off, turning North America from a major energy importer into a country considering the prospect of energy self-sufficiency, and postponing perhaps forever worries about peak oil or gas.

And just 4 days after that speech, I resigned from BP.

I said in 1997 that:

The time to consider the policy dimensions of climate change is not when the link between greenhouse gases and climate is conclusively proven but when the possibility cannot be discounted.

That time came for BP in 1997, and we started to take action. Some governments and businesses were already doing so, and by the time I reaffirmed BP's commitment in 2007, climate change was a key concern for almost all private and public policymakers.

That has led to some remarkable successes.

When it comes to the science, the level of uncertainty about mankind's influence on the climate is *decreasing*. Climate science will always be a study of probabilities, characterised by the scientist Stephen Schneider as 'system science, not test tube science'.

But where the IPCC once talked about merely a *discernible* human influence on the climate, it now has enough evidence to identify *clear human influences* as the *dominant cause* of recent warming.

As our understanding of man-made climate change has improved, so have the low-carbon technologies which could provide the solutions. Biomass is now a practical alternative to coal; the cost of wind and solar technologies has fallen dramatically; and the energy intensity of the world's GDP has continued to fall by an average of 1 per cent a year for the past two decades.

These improvements in science and technology have delivered measurable results. Global renewable energy capacity almost doubled over the 12 years that I was chief executive of BP, and it has *more than doubled* in the six years since I left. The growth in carbon dioxide emissions is slowing, and emissions in OECD countries are falling.

So our response to climate change has delivered real success.

But that success should not breed complacency. Global emissions are still rising, and concerns about the costs of decarbonisation are growing.

Any problem of risk management requires us continuously to update our responses in light of new information about what works and what does not work. We now have at least two decades of experience on which to draw. I think the time is right to re-examine, reassess and rejuvenate our attempts at tackling the existentially important question of climate change.

I think that means doing four things.

First, we need targets and commitment mechanisms which provide *stable and credible incentives* for action.

Second, we need to find *a new balance* in the way we support the development of low-carbon energy and technologies.

Third, we must devote more time and resources to the study of *human behaviour*, a mechanism for change which remains hugely underexplored.

And fourth, we need to pay greater attention to the public's *perception and understanding* of the energy mix.

Those four opportunities for change should be reflected in a modern set of energy and climate policies.

Let me begin with the need for clear and credible carbon reduction targets.

Whether in business or in public policy, it is the job of a leader to set the direction of travel. Targets are a critical part of that, because they provide a goal and a benchmark against which to measure progress.

The world *does not lack* emissions reduction targets. The Kyoto Protocol, for example, gave countries individual targets, and set up annual negotiations to renew them. The USA and the EU have set their own targets, and even China is aiming for ambitious reductions in energy *intensity*.

But to be effective, targets have to be taken seriously by voters, by consumers, but most importantly by the *businesses* which will invest in the solutions. That investment will only come from confidence, certainty and objectives which provide *clear mechanisms* to increase shareholder value.

Over the past two decades, the world has not always provided that sort of environment, and so we are not making full use of the enormous power and resources that businesses have to implement change.

Take the annual meetings of the United Nations Framework Convention on Climate Change. This year's meeting gave unprecedented prominence to the role that business can play, and the UK's climate change minister Greg Barker rightly stressed that decarbonisation will only happen with the support of business. But annual negotiations continue to seek consensus among almost 200 parties, and the incentives to adhere to targets are weak. With that in mind, the UNFCCC is unlikely to provide the stable and credible framework which businesses need to act.

Credibility also goes hand in hand with stability at the national level. If governments develop a track record of instability by changing the rules of the game, this will be reflected in the risk that businesses face and the cost of capital for low-carbon investors, making decarbonisation more expensive and less complete. I have seen the effects of instability first hand. My private equity firm is an investor in a solar power company in Spain, where the government has behaved recklessly by imposing retroactive tariff cuts and failing to adhere to the international Energy Charter Treaty, doing great damage to its reputation among investors.

Credibility also comes from consistency. Decarbonisation targets are questioned when it is clear that incentives exist both to remove carbon from the energy system, but also to produce and to consume it. In 2011, the UK spent over four billion pounds supporting the production and consumption of oil and gas, more than is spent to support renewable energy. In the US, production tax credits for renewable energy exist along 13 billion dollars of support for fossil fuels, and across the OECD region, around 80 billion dollars of public money is spent every year to support the production of carbon-based fuels. It's a bit like running both the heating and the air conditioning at the same time. These arrangements are neither sensible nor sustainable.

Targets and frameworks *do not need to be rigid or unchanging*, but they *do need* to remain credible over the *relevant timeframe* for low-carbon investors. Actions *or rhetoric* which create risk and instability will make decarbonisation a more distant goal.

My second point is about the use of public resources for decarbonisation. I think the experience of the last two decades shows that we need to find a new balance between public investment in technology, subsidies for low-carbon energy and market-based solutions to climate change.

In spite of its imperfections, the market remains the most powerful force for carbon reduction.

That force has been demonstrated with greatest effect in the United States, where the rising oil and gas prices of the past two decades created the incentives to both develop more hydrocarbons, and to use less of them. That eventually led to the commercialisation of vast reserves of unconventional oil and gas, and it contributed to huge improvements in energy efficiency, particularly in the transportation sector. The average new American vehicle is now *three times as efficient* as it was 40 years ago, and by 2025, they are required to be *65 per cent more efficient still*.

As a result, US oil consumption is declining, coal is being replaced by cheaper, cleaner and more abundant natural gas, and carbon dioxide emissions are back at levels last seen in 1994. Perhaps most significantly, almost all new US electric power generation capacity over the next decade is expected to come from gas or renewables.

Those developments were driven by market forces, but they were also *supported* by government regulation and investment. Stringent fuel economy standards provided a set of credible targets, and the US government contributed almost one hundred million dollars to critical research into the application of hydraulic fracturing. A combination of wise, enlightened regulation, public money *and market forces* created the conditions for change. Carbon dioxide emissions fell because dirtier fuels became more expensive, cleaner fuels became cheaper, and investment in energy efficiency offered attractive returns.

In contrast, carbon dioxide emissions in Europe are rising because the EU's Emissions Trading

Scheme has not provided the right market signals for widespread decarbonisation, and because the dirtiest fuels are the cheapest. In the UK, for example, coal is around 70 per cent cheaper than gas on an energy-equivalent basis. As a result, the portion of our electricity generated from coal is now at its highest since 1996, while the portion generated from gas is at its lowest since the same year.

A fully functioning *global* carbon market must remain the long-term goal. It would ensure that the true environmental cost of every fuel is reflected in its price *in all markets*, so that no country dents its competitive advantage by choosing to take unilateral action. But at the moment, that is a long-term aspiration which may not deliver results before it is too late. The damaging potential of climate change is too big for us to target the theoretically perfect at the expense of the practically possible.

We should therefore focus our efforts on an *intelligent combination* of public investment, technological improvement and market forces.

That should begin by using public money to support *technology* in preference to the production of energy. By some estimates, every pound of public investment in research and development stimulates up to five pounds of private funding. In the UK though, we will spend just over *3 billion pounds* this year on subsidising the generation of low-carbon energy, but around one tenth of that on support for long-term innovation and improvement in low-carbon technologies. Public funding programmes which extend beyond the next election are very limited.

Those priorities should be rebalanced. Subsidies which support the output of renewable technologies should continue to play a role, but without careful design they run the risk of prolonging inefficiencies, removing the incentive for technological progress, and diverting resources from more productive ends. They are also *powerless* to stop the substitution of coal for gas which has contributed to recent increases in European carbon dioxide emissions.

Investment in technology is not without risks, and it still requires the government to make practical choices which in a theoretical world would be made by the market. But investment in technology represents an investment in the economy's *productive capacity*, an investment which encourages low-carbon technologies to compete *without public support* in the future.

As co-head of a 4.5-billion-pound private equity renewable energy fund, the largest in the world, I have seen first-hand the power of technological improvement and the successes and failures of different renewable energy technologies. One of the most remarkable successes has come from solar power. The cost of solar modules has fallen by 80 per cent over the past five years, contributing to a 60 per cent fall in the cost of the electricity they produce, which is becoming competitive without subsidies. Solar panels require relatively little upfront capital expenditure before they start to produce electricity, and they are well suited to distributed electric power generation, meaning that they can provide electricity to many areas of the world.

Public support should go to a wide range of low-carbon technologies, including measures aimed at adaptation and geoengineering, which we should hold in reserve as a sensible last resort. But an approach focused on the low-carbon technologies with *proven potential* could achieve something really remarkable. For example, a grand global challenge aimed at stimulating research into solar generation *and electricity storage* technologies, *combined* with investment in infrastructure, could transform our journey to a low-carbon future.

Developments in energy supply must be matched by developments in demand. That will require a new focus on the understanding of human behaviour, my third point this evening.

At BP, we identified a huge desire among our staff to tackle the problem of the climate, and that became the driving force behind the changes we made. Those who worked at BP had lives not just within the company, but also as citizens and parents. Many of them were scientists and engineers, including some of the best applied scientists and engineers in the world. They read the evidence and they asked why as a company we were trying to ignore that evidence.

In my experience, the only way to reduce carbon dioxide emissions is to win the rational, commercial argument, and then to focus on the deeper motivations behind people's action. Of course, actions have to make commercial sense, but leaders also need to bring their people with them.

By 2001, we had reduced our carbon dioxide emissions by 10 per cent below their 1990 level not just because it saved us money, but because it was something which our people were proud to do.

An understanding of human behaviour was critical in the transformation of BP, and it should now play a key role in a modern public policy response to climate change.

Over two centuries ago, Stanley Jevons identified the implications of human behaviour for the energy industry. He argued that efficiency goes hand-in-hand with growing consumption, as we enthusiastically consume more for our money. By the same token, humans have a habit of rewarding their success at conservation with greater consumption. The installation of more efficient light bulbs, for example, might be met with the reward of a second refrigerator in the garage, or an extra degree on the thermostat.

Studies of human behaviour tell us that really smart technology needs to be able to *override* our consuming instincts.

It is well known that humans are not willing to make economically rational investments if they involve immediate costs or debt, followed by long-term and uncertain gains. If policies like the Green Deal are to be successful, we need to go beyond arguments based on probability and possibility alone.

A truly radical policy would award financial benefits to consumers who take *any sort of action* to reduce their carbon dioxide emissions. That might put a greater strain on public finances, and it would disproportionately reward those who have the money to invest. But it would be the most direct way of stimulating changes in the way we consume energy.

The behaviour of the 'irrational consumer' *has moved up the agenda*, and that is gradually leading to more intelligent approaches. Utility companies, for example, are beginning to realise that peer pressure can be just as powerful a force for change as price or technology. More government policies are now designed to exploit human behaviour, and that approach should now be extended to energy and climate change policies.

But our understanding of human behaviour really is in its infancy, and its transformative potential remains largely untapped. That is why I am working closely with the University of Cambridge to explore the opportunities for research, and to see how I can dedicate a portion of my own Foundation's annual spend to sponsoring a research Fellow in this field.

With greater support and attention, I am optimistic that the study of behavioural economics and psychology could make a real difference to carbon dioxide emissions, and bring huge benefits at next to no cost.

Human behaviour also plays a key part in the final point I want to make this evening.

It is not related to energy supply, demand or investment, but to *public perception and understanding* of the energy mix. Education, communication and credible persuasion must all play critical roles in new energy and climate policies.

Take nuclear power as an example. In spite of the accidents which loom large in our collective memory, it is in fact the safest form of energy, with fewer direct fatalities than any other energy source. In the developing world, coal has been around twelve times as deadly per unit of energy produced, a figure which rises dramatically if we look at China alone. Gas has been twice as deadly, oil almost twenty times as deadly, and perhaps surprisingly, hydroelectric power is more than *200 times as deadly* as nuclear power.

Even deaths caused over the long term from accidental radiation are estimated to be far fewer than those caused by the side-effects of fossil fuels. But in spite of that evidence, nuclear power conjures widespread fear and dread. And despite – or perhaps because – it is the safest, nuclear power is now one of the most expensive forms of energy. Its future looks bleak.

That sort of misunderstanding extends across the energy mix.

The IEA has recently noted that to prevent damaging levels of global warming, the world can only afford to emit another 900 gigatons of carbon dioxide between now and 2050, equivalent to one third of the world's proven fossil fuel reserves.

That has provided a powerful slogan for some campaign groups, who remind us that two thirds of the world's fossil fuel reserves must stay in the ground.

But that simple analysis fails to distinguish between the different types of fossil fuel.

We could in fact burn all of the world's proven gas reserves, and spend just 40 per cent of our carbon budget. Burn just half of the world's coal reserves, however, and we would emit over two thousand gigatons of carbon dioxide, or more than twice the carbon budget.

Not all hydrocarbons were created equal, and a failure to educate people about these differences threatens to distract us from the development of an affordable, reliable and environmentally sound energy mix.

I speak as Chairman of Cuadrilla, a firm at the forefront of shale gas exploration in the UK. I expect some people think I have left the church again, or that I have re-entered an old church.

But as long as wells are designed to keep methane leakage to a minimum, the cleanest hydrocarbon is natural gas, as it emits half the carbon dioxide of coal when burned to generate electricity.

The safe and cost-effective development of the world's vast gas reserves, including shale gas, must therefore be a critical part of the battle against dangerous climate change, providing that gas displaces coal and that it eventually gives way to a completely decarbonised energy mix.

Shale gas is already having a positive effect on the world's climate in the United States, where carbon dioxide emissions have fallen by more than 10 per cent over the past 5 years.

It clearly has the potential to do the same in Europe, where coal consumption is rising.

And most importantly, it could drastically reduce the carbon intensity of future economic growth in China in India, which could be decisive in limiting the rise in global temperatures to safe and manageable levels.

But misplaced fear and dread threaten to prevent this. Fears of water contamination, for example, are a prime reason for opposition to hydraulic fracturing. But there are in fact *no known cases* of groundwater contamination as a direct result of the hydraulic fracturing process.

Or take the value of local residents' houses. From Aberdeen to North Dakota, the evidence demonstrates that wherever the oil and gas industry leads to a thriving local economy, house prices go up rather than down.

But we have a tendency to focus on the perceived potential for catastrophe rather than the evidence.

Operators, regulators and credible third parties must therefore make a concerted effort to remind people of the *proven safety* and positive impact of technologies like hydraulic fracturing.

But we will then need to go *beyond the evidence*. Energy is also about vision, purpose and trust.

We know that a *radically new level of external engagement* is the only way to build the strong and sustainable relationships with local communities which the energy industry requires.

That means transparency about operations, consultation at every stage of a company's working processes, and supreme clarity of vision and purpose.

That sort of external engagement is the only way to earn the public's confidence. We must replace fear and dread with *education, communication, evidence and trust*.

In 1988, NASA scientist James Hansen testified before the United States Senate, telling the world that the greenhouse effect was changing the climate. The author Rupert Darwall labels Hansen's testimony the start of 'global warming as a political phenomenon', a 'turning point in the history of science and the start of a new chapter in the affairs of mankind.'

25 years later, it is time to begin writing the next chapter, with new authors, new energy, and a new sense of purpose.

That requires us to recognise what has worked and what has not worked, and to adopt a rational, *considered approach* to rebalancing the sources of energy which determine our carbon output.

There is no magic bullet. But consistent targets, investment in technology, changes to human behaviour and an approach based on evidence rather than impression will unlock a cost-effective route to a low-carbon future, and even a no-carbon future.

We must aim for an intelligent reassessment of the fight against dangerous climate change, a great *renewal and rejuvenation* of our efforts to battle this potentially existential threat.

Thanks to the potential of science, technology and engineering, I was not pessimistic in 1997. Nor was I in 2007.

For the very same reasons, neither am I now.

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