

Lord Browne of Madingley
Menelaus Lecture
25th March 2009

Ladies and gentlemen, good evening.

As President of the Royal Academy of Engineering it gives me great pleasure to deliver the 49th William Menelaus Memorial Lecture.

The first Menelaus Lecture was delivered in 1927 by Sir William Bragg.

As a child I remember reading a war time print of a series of lectures delivered by Bragg at the Royal Institute; he inspired me to become a scientist.

I wasn't the only small boy he inspired – Sir William has the unique honour of being the only person ever to share a Nobel Prize with their son.

It is thanks to the work of visionary people like Sir William Bragg and many others that the scientific spirit continues to thrive in the UK.

It is also a great pleasure to be in Cardiff.

To paraphrase John F Kennedy, we meet tonight at a university noted for knowledge, in a city noted for progress, in a country noted for tenacity.

In uncertain times, we stand in need of all three.

As the financial crisis unfolds into a global recession governments have been presented with a rare opportunity to recast their economies.

Our host city has some experience of structural change.

The Cardiff docks used to thrive on the coal trade and heavy industry. Now the area has been transformed into a cultural hub, home to the Welsh Assembly and the Welsh National Opera.

The regeneration is an example of what can be achieved when political will is brought together with engineering vision.

A similar combination is called for in our response to my theme for this evening: climate change.

The problems caused by the changing climate are well understood but there's a frustrating sense of inertia when it comes to taking action.

The time for talking is now over; it's time to get things done.

I would like to make four points this evening.

First, the effects of climate change will be felt everywhere and it's crucial that we avoid tackling it in isolation from other social priorities.

Second, we have before us an opportunity to create a world-leading 21st century green industry in the UK. We should seize the moment.

Third, the UK's energy policy needs to be retooled to deliver new, more diversified infrastructure.

And fourth, we must strengthen international institutions to ensure that developing countries are tied into global climate change efforts.

[pause]

The fourth assessment report of the International Panel on Climate Change provides us with a clear call to action: by 2050 we must halve global emissions compared with current levels.

The Committee on Climate Change recommends that the UK's contribution to this goal should be an 80 per cent reduction in the same period – a target now enshrined in the Government's pioneering Climate Change Act.

I believe that both goals are appropriate and achievable.

A great deal of economic analysis and policy thinking has been done. There's a remarkable consensus on what it will take to get there:

- Taking energy out of global GDP, by revolutionising energy efficiency;
- Taking carbon out of energy, by deploying renewable, nuclear and CCS technologies;
- Preserving carbon sinks, through improved forest and land management;
- And helping vulnerable people to adapt to climate change.

The application of engineering solutions will be important. But the greatest challenges aren't scientific or technological.

Nor are they related to macroeconomic cost.

The greatest challenges are *political*.

My first point is that climate change must be placed at the heart of society.

The effects of climate change will be extensive – affecting everything from weather patterns to defence policy.

It's essential that we do not compartmentalise climate change as an issue. Environmental integrity should be made a tangible part of other social priorities, such as economic prosperity and national security.

This will require a new approach to policy across all levels of government and all government departments.

And it means making a much more determined appeal to hearts as well as minds. Environmental integrity isn't an option or a luxury: it's fundamental for society to flourish.

Of course there are tradeoffs between climate change and other social priorities – tradeoffs that are felt particularly keenly by some interest groups.

An example is the auctioning of carbon permits: essential in imposing a meaningful carbon price under the EU ETS.

Auctioning *will* impose an additional cost on fossil fuel intensive industries and their customers.

But this shouldn't affect industrial competitiveness.

Relatively few firms export carbon-intensive goods outside their trading blocs. For example, McKinsey estimate that as little as two per cent of US GDP is generated from such exports.

As carbon markets expand and link up, all players in an industrial sector will eventually be treated equally. The more exceptions that policymakers permit, the weaker those schemes are at delivering carbon reductions.

There are also other tradeoffs – such as the question of whether to build new coal-fired power plants, which would enhance energy security but harm the environment.

Fortunately, there are many areas of activity where economic prosperity, national security and environmental integrity come together

Building green energy infrastructure and improving energy efficiency are two examples.

This has been recognised in the United States, where President Obama has promised to double clean energy capacity as part of his plan to stimulate the economy.

A similar approach is called for by other governments. And this is my second point.

Here in the UK, a green revolution in our offshore waters is a prize waiting to be seized.

New wind turbine plants, transmission lines, installation vessels and substations would create thousands of jobs that might otherwise find their way elsewhere.

And enhanced clean energy infrastructure, coupled with the widespread deployment of smart meters and smart grids, would also bolster energy security.

The new industry would build on our world-class wind, wave¹ and tidal resources and our expertise in marine engineering.

The UK has already become the world's largest generator of offshore wind energy and has targeted 25GW by 2020.

And in the waters near Cardiff, the government is considering various tidal power schemes – the largest of which could provide five per cent of Britain's electricity needs.²

As a result of pioneering research, new low-carbon technologies are being created and the costs of proven technologies are falling.

And the business community has stepped up: signalling its willingness to take action in a flurry of new initiatives. Growing investment activity is a heartening sign that the green industry is at last beginning to take off.

Now there are signs that the government has recognised the opportunities.

Earlier this month, I chaired a low-carbon summit organised by Lord Mandelson and Ed Miliband and attended by the Prime Minister. The workshop was a good opportunity for industry stakeholders to engage directly with the government.

My overwhelming impression that day was that businesses are calling for two things: first, access to new sources of finance and second, policy which is clear, stable and predictable.

At that meeting I emphasised the parallels between our current situation and the strategic development of the North Sea.

The UK offshore oil and gas industry was created from virtually nothing during the 1970s and 80s.

I remember how, in the early days, companies like BP had to rely on hourly workers from America because the UK didn't have enough qualified technicians. Now, there are around 300,000 people resident in this country employed in the oil and gas industry.

High oil prices provided a strong market pull. But government also gave industry a helping hand: creating generous tax incentives and regulations, and helping to build strategic infrastructure.

There's even more cause for government intervention today. That's because energy security and climate change mitigation are public goods; they would not otherwise be recognised by the free market.

The alternative would be to leave new technologies to the vagaries of fossil fuel derived power prices before they can stand on their own two feet.

Which leads to my third point: we must fundamentally rethink the objective of energy policy in this country.

Competition has been the guiding star of UK energy policy since the 1980s and it worked well while there was a surplus of energy infrastructure capacity.

But price competition is now failing to deliver the new, more diversified infrastructure that we urgently need to bolster energy security and meet our climate change targets.

I remain convinced that the market is the most effective delivery unit available to society. But the market will need a new strategic direction, and a new framework of rules, laid down by government.

In the short-term, the combination of high capital costs, falling power prices and scarcer, more expensive debt finance is leading to inadequate returns for investors. There's a real risk that offshore wind projects will be cancelled.

One way to help mitigate that risk would be for the government to direct lending from state-controlled banks to green infrastructure projects, an approach similar to plans recently adopted in Ireland.

At the same time, governments should work with development banks, such as the EIB, to improve their capacity to disburse credit to low-carbon energy projects.

Policymakers must be frank – the cost of supporting renewable energy will be borne by consumers who pay a little more for their delivered energy.

But the impact may not be as large as some people think.

Recent analysis suggests that the cost to the consumer could be limited to just two or three per cent over the next twenty years.

By comparison, household electricity bills increased by *thirty* per cent between 2005 and 2007 as a result of rising fossil fuel prices.

And rising costs can be mitigated by improving energy efficiency.

This is another area where UK engineers are leading the way.

LED technology offers the possibility of producing light with only a quarter of the electricity.³ Fuel cells could one day replace gas boilers, paving the way for households to pay only for the delivery of *heat*, not gas.⁴

And in transport, thanks to the introduction of biofuels and strong lightweight materials, the efficiency of the internal combustion engine is constantly improving.

As engineers, we understand that reducing emissions is as much about improving old designs as it is making new ones.

Emissions from buildings are another good example.

With 80 per cent of current building stock likely to still be in use in 2050, reducing emissions from buildings will require retrofitting energy-saving technologies.⁵

This is an area where the government should lead from the front.

A retrofit programme for public buildings would reap carbon savings and simultaneously provide jobs in a flagging construction industry.

Harnessing the very large potential to improve energy efficiency is proving difficult, even though many of these savings would be at low or negative cost.

The solution will require a combination of fiscal incentives, targeted regulations and education programmes to change consumer behaviour.

It's clear that targeting energy efficiency, alongside renewable energy, should form the core of UK energy policy. As well as being essential to meeting climate change targets, these policies guide the path towards economic recovery and energy security.

However, the UK's broader goal – to limit global warming to two degrees – will not be achieved unless we concentrate as much, if not more effort on what happens beyond our borders.

This leads me to my fourth point: climate change is a global problem, and it requires a global solution – one which encompasses developing as well as developed countries.

It's estimated that the sum of national policies in the developed world is unlikely to achieve more than a third of required emissions reductions by 2020.

Developing countries contain by far the most material opportunities to reduce emissions in that time: two-thirds of the global potential, deliverable with a third of the cost.

Yet on every measure of equity, it's unfair to expect developing countries to shoulder the same amount of effort as developed countries from the start.

I believe the solution is twofold.

First, developing countries must do what they can, focusing on areas such as energy efficiency, that also enhance their economic prosperity and national security.

In parallel, policymakers must harness the power of the market, putting in place strengthened international carbon-finance mechanisms.

The Clean Development Mechanism, with its project focus, will be inadequate and difficult to scale up. It should be made less bureaucratic and expanded, with significantly enhanced carbon finance mechanism that apply across entire industrial sectors.

And it should be accompanied by a new financial framework for preventing deforestation and encouraging good land management in developing countries. These activities alone could contribute half the necessary reduction in global emissions by 2020.

Additional funds will also be needed to pay for adaptation efforts in developing countries, to build administrative and human capital, and to encourage the transfer of low-carbon technologies internationally.

This represents an opportunity for the UK's universities, alongside British business, to place themselves on the front line of global efforts to mitigate climate change.

Last year, rich nations spent more than a hundred billion dollars on overseas development assistance.

A recent analysis suggests that flows of carbon-related finance to the developing world will, in time, need to be of a similar magnitude.

This is hugely ambitious and will be impossible without dramatically strengthened international governance.

The answer is not to tear up existing institutions, such as the UNFCCC, and to start from scratch.

The evolution of GATT to the WTO suggests that, with the right support, institutions can widen and strengthen significantly over time.

I do, however, believe a new body – an international carbon fund – will be needed to act as a global central bank for carbon and to manage the exchange of multiple environmental “currencies” as national, regional and international schemes become linked together.

All that will require a great deal of diplomacy and the UK will have a critical part to play.

This country possesses a good deal of influence on energy and climate matters in the EU, which has spoken with a single and determined voice in recent negotiations.

Our relationship with the United States could be pivotal as Barack Obama's presidency heralds a new era of US engagement.

And we hold close friendships with many of the most important developing countries.

Several of those countries are in the G20, whose members are collectively responsible for 85 per cent of global emissions. With strong political leadership, the G20 summit next month could unlock a new global climate change agreement.

[pause]

Tonight I have set out a vision for the low-carbon future.

Just a decade ago this was a niche topic in politics.

Now it's widely recognised as fundamental.

It will require nothing less than a *revolution*: a revolution in the way we source energy; a revolution in the way we do business; and a revolution in the state's role in the market.

It will affect every sector of the British economy: from agriculture to finance, and from software management to civil engineering.

It may feel a lot like stepping into the unknown but humanity has thrived in exactly those moments when it has most pushed itself.

The words I quoted from JFK at the beginning of this lecture were delivered at Rice University in 1962, where the young President promised to put a man on the moon before the end of the decade.

He was not around to see it but his mission was a success.

The Apollo programme inspired a new generation of young people to become engineers, to discover new ways of solving life's challenges.

With political leadership and engineering vision, our very own low carbon programme can do the same again.

Thank you very much.

¹ Professor Whittaker FREng ran the team that developed the UK's first wave power station on the Hebridean Isle of Islay. Now with the company Aquamarine Power, he has developed the Oyster™ wave power system. This captures the energy in near-shore waves by means of a simple, highly

reliable, mechanism. The potential for exploiting wave power around our island is immense. To borrow from Darwin, Oyster is an example of one of the many different designs that are going to evolve to fill the niches around our coasts

² Professor Roger Falconer FREng of Cardiff University is advising on the possible schemes. The Welsh Assembly Government and Higher Education Funding Council for Wales are also investing in the Low Carbon Research Institute, based in Cardiff. Importantly, for the successful implementation of these technologies, Cardiff will also be the home for the new Centre for Integrated Renewable Energy Generation and Supply (CIREGS). In order to make Cardiff an even more attractive proposition for energy research, the School of Engineering has recently reorganised its Research Institutes and established an Institute of Energy.

³ Based at the University of Cambridge, Professor Colin Humphrys CBE FREng has found a way to grow the semiconductor gallium nitride cheaply, in order to produce LEDS that can be developed to emit useful white light. If these LED lights were to be installed in homes and offices, they could cut the percentage of UK electricity used for lighting from 20 per cent to 5 per cent, producing a significant impact on emissions levels. This would also radically cut electricity bills for both domestic and industrial users, helping to tackle fuel poverty and reducing overheads.

⁴ Work on solid oxide fuel cells is being led by Professor Nigel Brandon FREng at Imperial College. His work has led to the establishment of Ceres Power, a spin-out company which will develop research into fuel cells. Micro CHP of this type is likely to have too high a capital cost for ordinary householders to cope with, but a large corporation has the financial structures to discount high capital expenditure against future savings, so this particular technical innovation is leading business innovation as well. When your central heating boiler eventually expires, Ceres Power and its partners aim to offer you a fuel cell replacement which they will own and operate. Rather than buying gas, you will enter a contract with them to keep your house warm. This way, the consumer gets all the functionality they need, but Ceres Power and partners have every incentive to use energy more efficiently as they are selling warmth, not gas.

⁵ It's also important to recognise the power of holistic solutions. Peter Head OBE FREng – awarded the 2008 Sir Frank Whittle Medal by The Royal Academy of Engineering – has argued that changes in transport can bring with them changes to the built environment. For example, if transport is clean and non-polluting, natural ventilation can be used in buildings, thus improving their energy efficiency.