MAINSTREAM
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Lecture:
A Vision of a Sustainable Future

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Mr. Chairman, Ladies and Gentlemen,

I want to thank Liam Connellan for inviting me to give this lecture on “A Vision for a Sustainable Future”.

I am particularly grateful for the invitation because it is being hosted by three organizations I admire: Engineers Ireland, the Energy Institute and the Royal Dublin Society.

I am an engineer by training, and temperament.

I have been engaged in the energy sector all by career.

And I have frequented this vast RDS complex many times throughout my life; including being part of the Innovation Committee for a period in the late 90’s, the Spring Show, the Horse Show, the library, exhibitions, lectures, like this one, and not least, rugby matches at the week-end, cheering on Leinster.

Invitation to Think

But I admire the RDS for one reason more than any other. I just love its devotion to the promotion of science and industry, to the pursuit of best practice.

Above all, I admire its standing invitation to people, like you and me, to think, to be inquisitive, and to be adventurous. Even, to be visionary.

I remember that my father’s generation was influenced, indeed, you might say it was inspired, by a series of lectures given here over a century and a half ago.

Sir Robert Kane

I refer, of course, to Sir Robert Kane’s lectures on the ‘*Industrial Resources of Ireland*’, which took place before the Famine and were published later as a book, a very influential book, it should be said.

Kane was inspired by lectures he attended in the RDS and they stimulated him to carry out chemical researches at his father’s chemical factory in Henry St.

Kane had the audacity to suggest that this country need not be poor, that it had natural resources which could be developed and that industry, in its true sense, could turn those resources into riches.

In short, Mr. Chairman, ladies and gentlemen, he had a vision of a better, and realizable, future.

I stand here this evening as a beneficiary of that vision.

He pointed to the bogs of Ireland as a vast reservoir of energy, and not just as a picturesque waste land.

The new Irish state, under the leadership of Seán Lemass, acted on Kane's vision, and established Bord na Móna – of which I became Managing Director more than a century and a quarter after those lectures.

Starting Point

So, Mr. Chairman, ladies and gentlemen, you will not be surprised if, this evening, I present you with a vision. And, that I do so in the confident expectation that it too will be realized.

Let me begin by telling you what I won't be talking about.

I will not recite the science of climate change. I take it as a given that we humans have to contain the rise in global temperature to less than 2º Celsius by 2050. Otherwise, we will have triggered irreversible and catastrophic damage to the planet.

I assume that nobody here is a disciple of President Vaclav Klaus.

Neither will I recall the arguments underlying the concept of peak oil. My friend Colin Campbell, now happily based in Ballydehob, has well established that the production of oil will peak shortly and then began to taper off. In fact oil from traditional sources has been static since 2005 at 74mb/d.

Instead, I am going to take it as an absolute imperative that by 2050 we will have to reduce our Greenhouse Gas emissions by 80% at a time when the generation of electricity is expected to increase by 100%.

This is my starting point.

The first figure, of an 80% GHG reduction, comes from the UN Intergovernmental Panel on Climate Change.

The second, of a 100% increase in power generation, comes from the International Energy Agency, which is based in Paris as part of the OECD.

An 80% reduction in GHG emissions, while power generation is being doubled, is some challenge, Mr. Chairman, Ladies and Gentlemen.

But a sustainable future is one where these two targets have been met. That's a very simple definition of sustainability. Another definition is that we leave the planet no worse off than we found it.

My Vision

I want to offer a vision as to what the world would look like if we were to honour that obligation.

Quite simply, we would have shifted one hundred per cent from fossil fuels to renewable energy as the source of power. We would have weaned ourselves off hydrocarbons

We will be exploiting the power of the sun, the forces created by the rotation of the planet, the movement of the seas, and the heat locked just beneath the earth's crust.

Looking into the future here's what I see.

The sun and planet itself will be the source of sustainability. That strategy gives us the following forms of sustainable energy:

- Wind: both onshore and offshore;
- Sun: thermal, concentrated and photo-voltaic;
- Ocean: wave, tidal and currents;
- Hydro: dam and run of the river;
- Geothermal.

These forms of renewable energy will be harnessed to provide clean, cheap energy.

The new Economy

That clean, cheap energy will power a new economy, characterized by the omnipresence of electricity,

Electricity is a universal product. It is available everywhere, is used in every country and is the same around the world. It is the basis of our economy. It defines contemporary civilisation. As carbon based fuels run down use of electricity is reinforced.

It has released us humans from the tyranny of human and animal power.

It heats, cools, dries, turns motors, ignites sparks, creates X rays, creates magnetic fields; carries information in analogue or digital form.

It can be used to measure almost any human or inanimate variable. It computes the most difficult mathematical equations.

It powers ten thousand tonne cranes and it drives small pacemakers.

Most electricity is currently made in thermal devices such as boilers, turbines and rotating electricity generators. The average efficiency of these devices varies from fuel to fuel and from technology to technology but, in general, they are constrained by the thermodynamic cycle and the temperature limitations of metals.

Most energy locked up in the carbon based hydrocarbon molecule is wasted. About 60 to 70 % is dumped into the local environment, whether it is the river, the sea or the atmosphere.

Modern combined cycle natural gas turbines increase the efficiency to 50% or 55%but this still means that around half the energy gets wasted. Given the damage that fossil fuels do to the environment this level of wastage is completely unacceptable.

When we burn fossil fuels we take a beautiful structured molecule, something that has taken millions of years to perfect and we turn it into CO2. This is a ground state module, high in entropy, useless and indeed deleterious in the atmosphere which takes thousands of years to reintegrate into nature as a useful substance.

You could say that it is unethical.

That's why the electricity based economy of the future will be fuelled by renewables – where there is no wastage of energy.

A clean electric economy will allow us to reorganize society so that it is sustainable in terms of the power it generates, the goods and services it consumes and the lives it helps people to live.

Carbon Price

In my vision of a sustainable future there are no entry barriers preventing the deployment of renewables.

In the short-term, Mr. Chairman, Ladies and Gentlemen, a price will have been put on carbon, probably by a global emissions trading scheme.

The distortion in competition between brown and green power will have been eliminated by forcing brown power to internalize the cost it inflicts on the environment, and by reflecting that cost in the price of electricity.

This will have been a critically important departure from the past.

The incentive to reduce fossil fuels for power generation will be strengthened by these price signals. And it will have been re-enforced by EU and UN regulations limiting the supply of brown power to industrial and commercial users, as well as to households.

In the longer term, the transition from fossil fuels to renewable energy will be completed by 2050. No more fossil fuel plants will be built after 2020. And there will be no need for new nuclear plants.

The Energy Watch Group

The latest report from the Energy Watch Group vindicates that point about nuclear. In one scenario it forecasts that 30% of final energy demand throughout the world, and 60% of global

electricity, could be met in 2030 from renewables. In the OECD countries the figure would be 50% for final energy demand.

And that scenario, developed by this prestigious international network of scientists and parliamentarians, excludes hydro. So, the figures would be even higher.

They say that it is their strong conviction that nuclear power will **not** be needed if the world community takes the necessary steps to realize the full potential of renewables.

If I may quote: **"We contend there is no necessity to build new nuclear power plants, as proposed by the IEA, or to prolong the lifetime of existing ones".**

The key driver in reaching this nuclear free future is money. Everything depends on the scale of the investment we are prepared to make in renewables.

I agree with the Energy Watch Group that societies will respond to the climate change imperative, and the overriding need for oil independence, with a growing willingness to pay for a clean, secure and sustainable energy supply.

The annual investment behind their forecast of 30% of final energy demand by 2030 is estimated at € 125 per capita.

Now I find that figure interesting, indeed very interesting. It's the same as the world now spends on arms - in order to kill people, not to save them.

I do however believe that Governments around the world will be tempted by the promise of nuclear energy. Britain will I believe build enough nuclear plant to replace it's existing and aging fleet of nukes. China has said it would build 30 nuclear power stations and they have a habit of delivering on what they have said. I personally would prefer nuclear to further coal fired power stations. I see no prospects for carbon capture and storage, on any scale that can make a meaningful impact on CO_2 reductions. There is I believe no need to make this dubious choice between coal and nuclear. The technology exists now to build wind power stations to any level we choose, with other sustainable forms of generation coming along very soon.

Portfolio of Renewables

In a sustainable future, the technologies for generating clean power will be seen as part of a portfolio rather than as individual or separate ways of making electricity.

Wind and solar power will complement each other. Already this is happening in places like the States, and it will become commonplace throughout North Africa, and South America.

That is why Mainstream has, from the beginning, decided to go into solar energy.

Wind and hydro will work in tandem, as the Norwegians intend. They want to become the "Battery of Europe", as they call their vision. I am particularly interested in this piece of lateral thinking.

In the northern hemisphere I foresee almost limitless exploitation of wind at these latitudes. And most of it will be offshore.

Offshore Wind

Last year, more than 40% of new generation added to the European grid was wind.

The European Commission has just published a policy paper on Offshore Wind Energy. It says that the potential is literally enormous and that in 2020 there could be 30-40 times the current installed capacity.

In 2030, it could be up to 150 GW. There were those who thought I was over the top when I first proposed a 10 GW as a demonstration project for the Supergrid.

For offshore wind I anticipate that by 2050 we will long have stopped thinking of single turbines, or even wind farms, for commercial generation.

We will think in terms of "Wind Power Stations" – in modules of 500 MW, or more.

We will have solved the civil engineering problems of building in deep water.

Probably, we will have floating platforms by then, enabling us to go far out to sea. The potential, say in the Atlantic, is simply staggering.

The EU Commission states what I have long contended. There is sufficient off-shore wind to satisfy all of Europe's power requirements.

Just as there is enough wind in the middle US States to power the whole of the United States.

Supergrids

Off-shore wind power stations will be linked by High Voltage Direct Current interconnection. This HVDC technology already exists, and will be used to supply bulk energy on a continental basis to mass markets.

In the sustainable future we are discussing, national and state barriers will have been broken down. National and regional markets will have been integrated into huge continental markets, creating a functioning Internal Market as we Europeans call it.

All forms of ocean energy will be linked. Offshore wind power will feed into the same interconnectors as electricity generated by wave, tidal and current.

Energy from the sun, the wind and the ocean will be fused into one great power system. The sea will become a vast power plant.

There will be massive interconnection between these composite offshore power plants and the land based grids. This will enable us to capture energy, wherever and whenever, it is provided by the sun, wind and ocean.

Renewable energy is best understood if it is seen as a continental rather than a national phenomenon. With long grids the variability of wind is smoothed, as was shown in a paper published by the University of Kassel in Germany.

Supergrid Plans

Already, Supergrids are being planned for Baltic and North Seas. A Greenpeace study foresaw a North Sea supergrid of 68n GW serving 70million households. The latest Commission report has upped that to 150 GW.

I think that is not only realizable but errs on the low side. **Mainstream** will build massively in the North Sea as our plans come to fruition

Supergrids are also being planned for the Mediterranean to tap into solar.

The concept of the supergrid, which I first proposed six years ago, is on its way, and will be operable by 2020.

What I foresee is that we will finish up with a mega grid of supergrids. To the basic concept of the Supergrid we have added the essential concept of the Supernode, essential that is to creating a reliable grid in DC mimicking the traditional reliable high voltage AC transmission grids. The whole of Europe will be joined together in one single system linking off-shore wind and hydro from the north and ocean energy in the western ocean with solar in the south.

Furthermore, Europe will be linked with solar from North Africa, therby restoring an ancient economic link

A project on this scale was done before – it was done for gas in the North Sea. And, in fact, it is still is being done, involving land based pipelines crossing two continents.

What was done for gas will be done for renewables.

A Smart Grid

Allied to commercial generation of electricity I see micro and autogeneration becoming common place, so that homes, schools, hospitals, shopping centres, small businesses, individual factories and industrial estates, sport stadiums, and complexes like the RDS, will generate power on-site.

This will require a new sort of grid - a smart grid - new tariff schemes and a new grid code that enables the small generator to import and export power at will.

Smart grids will have replaced the dumb passive systems we have at present. Consumers will be able to manage their electricity consumption in real time, using the latest information technology.

Suppliers will be able to manage demand in real time by changing tariffs on a short-term basis and by modulating the power provided to end users depending on the time of day or the type of consumer.

The change I foresee in the grid is something analogous to the switch from the old point to point telephone lines to the mobile phone in your pocket or handbag which has in-built multi-functionality and universal networking.

Building the smart grid will be well underway by 2020, and will have been completed by 2030. The foundations for the new economy will have been laid.

Electric Vehicles

For most people, the really dramatic evidence of the shift from liquid fossil fuels to renewables will be in their own personal transport – the electric vehicle will replace the car powered by the internal combustion engine.

We now stand on the edge of a seismic shift, like that which occurred when the horse and buggy was replaced by the automobile.

As a sign of that shift, the US auto industry is calling for a federal bale out because it has been building the wrong cars and trucks. They have been looking backwards instead of forwards. Driving into the future with both eyes focused on the rear mirror.

The Japanese and European auto industries foresaw what was happening and are tooling up for the new era, that of the sustainable car.

By 2020, we will have about 10% penetration of electric vehicles in some advanced societies, like Denmark. Beyond that date few, if any, vehicles will be manufactured with an internal combustion engine.

By 2030, or 2040, at the latest, the transition will have been completed.

All these electric vehicles, Mr. Chairman, will be charged by renewable power.

Charging will take place mainly at night – leading to more efficient use of the generating assets and smoothing out the demand curve for electricity.

But the electric vehicle will be more than a means of transport. It will also be a means of storing power.

Distributed generation will be allied to distributed storage. And operators will be able to draw power from the vehicle fleet when needed.

The system will be a matrix of grid to vehicle, vehicle to vehicle, and vehicle to grid.

All public transport, trains, buses and metros will, of course, be electrified.

All movement of people and goods will be powered by electricity. And that electricity will be generated from renewables.

The Built Environment

But in a sustainable future the most notable change will be in the places where we live and labour, and in the appliances we use for work and recreation.

Heating, cooling and powering the built environment uses about half of the electricity we generate.

Make buildings more energy efficient and you take a step towards sustainability.

Turn buildings into power generators and you complete the journey.

By 2015 all new buildings will be built to specifications equivalent to passive house standards. By 2040, the existing stock of buildings will have been retrofitted so that they meet zero emissions standards.

All new buildings will be oriented towards the sun, to take advantage of the free solar energy that is available every day, even in Ireland.

New and existing buildings will be fitted for microgeneration – wind turbines, solar thermal panels, photo voltaic and, in many cases, for geothermal. Heat exchange pumps will be conventional.

I have this vision where power is generated virtually anywhere, from renewable sources, stored in buildings and vehicles, and distributed by smart grids, which micro manage generation and consumption in real time.

Appliances

But there is more to a sustainable future than that.

Virtually all the appliances we use in the home, office and the factory are energy inefficient.

They were designed for times when brown power was cheap and abundant.

Before we realized how dirty and dangerous it was.

Everything we use in the home will have undergone an energy revolution by 2030. The same in business. Energy management will be a key executive function, and a major responsibility for all CEOs and an index of corporate social responsibility for all businesses.

And energy managers will be part of every top management team. Energy management will become a whole new business sector, one of the most important in the economy.

Sustainable Communities

I have, by now, reviewed the sustainable future in terms of power generation, transport, the built environment, energy efficiency, micro and autogeneration, storage, appliances and energy management.

But a piece of the jig-saw is missing – the communities in which we live.

I foresee that the planning of neighbourhoods and towns will be revolutionized by 2020. And that we will be busy re-engineering our cities to meet our 2050 target.

Good spatial planning is the hallmark of successful civilizations. They understand the interplay between people and their physical environment.

The key requirements are contradictory - proximity and interaction on the one hand, privacy and intimacy on the other. The ideal, of course, is the Greek city state, or contemporary Italian cities, like Sienna. Compact, human in scale, yet sufficiently diverse to satisfy all our requirements.

That is not always possible in contemporary society but, at least, the suburbs will have been re-thought as a mode of living. More importantly, the ex-urbs, as the Americans call them, will have been reformed.

The idea of people travelling hours to work and then back home again will become as socially unacceptable as driving an SUV.

Sustainable communities will knit all the primary social activities together as a manageable core: schools and colleges, shopping, medical and other personal services, offices, eating and recreation, all within walking distance or immediately accessible by public transport, powered by renewables, of course.

Planners and developers will have undergone a conversion to the needs of the sustainable society.

The transition to a low carbon society, a sustainable future, will have been completed.

Mainstream Renewable Power

These are the basic elements of my vision, Mr. Chairman.

Let me say, I value the power of a vision.

It paints a picture of the future that can be so compelling that you already begin to believe in it, but, more importantly, you begin to live in the future before it actually happens.

People can believe in the power of change. That was the Obama message. Change you can believe in. Yes we can.

I believe in the vision I have just presented. I am already living it. That is why I founded a new renewable energy company earlier this year.

We deliberately called it "**Mainstream Renewable Power".** The name makes an association: renewable power is becoming mainstream. In a decade it will be mainstream.

And a decade on, people wont even think about renewables being mainstream. They will just be a conventional, everyday reality.

Go to our web-site and see the future translated into the present.

Here's what it says in the home page. Here's what I believe.

Our vision is of a future where economies can thrive, free from the restrictions of fossil fuels. We have the passion, the expertise and the resources to make that vision a reality.

Our core business is the development, construction and operation of wind, solar, thermal and ocean current plants.

Our aim is to deliver a successful business that accelerates global progress towards a sustainable future.

Already we have a staff of over seventy dedicated professionals coming from more than twenty different countries.

We have offices in Berlin, Chicago, Dublin, London, Santiago, Sydney and Toronto.

We have raised €72m in equity. This is only the very start, for renewable energy is a very capital intensive industry.

That's why we have developed a variant of the funding model we previously used.

The business is not reliant on the conventional business model of creating a market and then growing demand for a new product. It is in a completely different sort of market in which clean green power is replacing an unsustainable form of electricity and at the same time is ready to meet future global demand for electricity.

It is a business poised for the future.

Last week we announced a $ 1 bn investment in Chile. We are negotiating deals or making bids in the UK, US, Europe and the Mediterranean rim.

Five years from now, **Mainstream Renewable Power** will be the mainstream company in renewable energy.

Conclusion

Mr. Chairman, Ladies and Gentlemen.

I was so pleased, as I said earlier, to receive the invitation to address you. An invitation to think is always a challenge. It is an opportunity to re-examine your own beliefs, and plans, to conduct soul searching in public.

But it is also a spur to add new depths and insights to your own understanding of the present and to your vision of the future.

I hope I have responded adequately to your invitation and that I have repaid in some measure the debt we all owe to the RDS for its role over the centuries in promoting intellectual enquiry.

I know that I have gained personally from this exercise this evening.

And, I hope, that you have as well.

And, I hope, that we have commemorated Sir Robert Kane as he would have wished, by being visionary but realistic, by giving hope without illusions, by placing science at the heart of the possible.

Thank you for listening to me.