Irish Corporate Leaders
on Climate Change

UNLOCKING OPPORTUNITY

THE BUSINESS CASE FOR TAKING CLIMATE ACTION IN IRELAND

A Report by the Irish Corporate Leaders on Climate Change

The Irish Corporate Leaders on Climate Change

The Irish Corporate Leaders on Climate Change brings together business leaders from a broad cross-section of Irish-based businesses to trigger a step-change in policy and action needed both to meet the scale of the threat posed by climate change, and to grasp the business opportunities created by moving to a low climate risk economy. Our vision is for Ireland to be a world leader among competitive, low carbon economies.

Through leadership, the Corporate Leaders use their position of influence to work with Government and consumers in making the vision of a sustainable, low-carbon society a reality.

The current members of the Irish Corporate Leaders on Climate Change are Bord Gáis, Bord Na Móna, Diageo, NTR, Siemens, Sodexo and Vodafone.

The secretariat of The Irish Corporate Leaders on Climate Change is hosted by Business in the Community Ireland.

This report was prepared for and with the Irish Corporate Leaders on Climate Change by Joseph Curtin

EXECUTIVE SUMMARY

The purpose of this paper by the Irish Corporate Leaders on Climate Change (Irish Corporate Leaders) is to identify the benefits and opportunities which decarbonisation will bring for Ireland in the period to 2050.

In a small open economy like Ireland, we have an opportunity to galvanise the development and deployment of new business models, processes, techniques, technologies and practices, which will be increasingly required to drive decarbonisation across the globe. There is significant potential for export growth in this area. But domestic deployment comes first. Countries that export cleantech have built their successes on deploying technologies at home – there are no shortcuts.

Throughout this paper we present the Irish Corporate Leaders experiences, which suggest that new challenges can unlock potentials within companies that would not otherwise be tapped. We substantiate our experiences with evidence from countries that have created jobs, exports and growth from taking ambitious climate action. In many cases the benefits of ambitious climate action are self-evident, yet they are generally underplayed.

To come to an understanding of the benefits of climate action for Ireland, we first identify what we describe as the seven pillars of Ireland's decarbonisation – areas of key strategic opportunity. In each case we then list, evaluate and quantify (where possible) the key benefits that decarbonisation will bring.

These include, but are not restricted to, creating tens of thousands of new jobs, driving competitiveness and exports, efficiency and productivity gains, innovation, supply chain development, energy security, health benefits, fuel poverty alleviation, boosting tax revenues, and regional development. The results are summarised below.

Decarbonised Ireland 2050

Pillar	Smartgrid	Wind	Zero Energy Buildings	Electrification	Interconnection	Climate Neutral Agriculture	Green Finance
Co-Benefits	Minimum 10,000 new jobs €2.4bn plus in fuel offsets Export market Attractive return on investment Exports	10,000 to 40,000 Jobs Regional Development Tax Revenues Provides Interconnection Energy Security Exports	10,000 to 30,000 Jobs Exchequer benefits Fuel Poverty Energy Security Health, comfort and asset values Exports	Oil Independence Consumer benefits Optomization of wind resource Local pollutants	Optimization of all generation assets Reduced curtailment of wind	Increased productivity Up to 8,000 rural jobs in bio energy Export potential Optimal use of marginal land	Attract funding Develop knowledge hub Export of skills
Costs	Up front Investment R&D	Price increase in low gas price scenario	Some exchequer & admin Construction	Charging Infrastructure	Risk of imported price increase Upfront cost	Forestry support Carbon auditing costs	
Natural Advantages	High level of deployment R&D and pilots	Wind resource Skills and expertise	Skills Leading policy initiatives	Network Skills Geographical		Skills Natural advantages	Skills Regularory environment
Case Study	Vodafone	Bord Na Mona	Siemens			Diageo	South Korea

We believe that these benefits and opportunities are sometimes neglected in the debate on climate action. This is to some extent because of limitations associated with the dominant analytical approach, which has tended to focus exclusively on cost. In cases where benefits have been considered, they are generally restricted to "damage costs avoided" in the distant future from curtailing emissions.

We find, however, that the assumption that decarbonisation must cost is just that – an assumption. There is a need to rebalance the narrative around decarbonisation, both in policy circles and in society.

We were struck by the sheer number of areas where there is a clear economic case for decarbonisation – from retrofit of buildings to growing more energy crops, to name but two. And yet despite some exciting initiatives and pilots, progress in these areas has been somewhat limited.

We uncover promising approaches that require further exploration. These include, for example: rolling out a carbon auditing scheme on all farms and the possible introduction of a bonus-penalty scheme for farmers; or developing Ireland's wind export opportunity in a manner consistent with delivering greater interconnection to the UK and European grids.

One of our key conclusions is that the calculus around costs and benefits are not a given, rather they are determined by how governments act. Above all, what is required from Government is the articulation of a coherent vision and strategy, one which learns from the positive experiences of other countries. A national strategy which leverages economic strengths and competitive advantages across sectors is a necessary first step. Sectoral concerns can more easily follow, rather than preceding or prescribing the national position.

This consistent strategy which aligns all key players and provides a clear signal of intent must be matched by supporting institutional arrangements and the commensurate allocation of administrative resources. These developments will provide the certainty and confidence that business needs to invest.

In many cases we find that the barrier is not cost per se. Neither then is the solution necessarily to provide increased government subsidy. The solution is often smart and targeted policy intervention, and willingness to trial and refine approaches. We find that public-private "lighthouse" financing initiatives – building on existing pilots – can play a central role in clarifying and reducing any risk associated with the necessary investments. We emphasise also the importance of consistent, persistent and coherent communication to the public as a key enabler of success. We must bring Irish citizens with us as we decarbonise the economy.

A key challenge for the analytical community is adapting future economic assessments of climate action to integrate more fully the co-benefits of climate action, which we identify provisionally in this paper. We must think about maximising Ireland's benefit, not just minimising cost. In this way Ireland can carve out a niche in a rapidly changing world, and ensure Ireland's economic vibrancy in decades to come.

We believe that tackling climate change is everyone's responsibility, across all sectors of society. We illustrate useful approaches and examples of best practice throughout this paper, with a view to promoting a spirit of cooperation, collaboration and information exchange between the public and private sectors.

INTRODUCTION

"Make no mistake: a new world order is emerging. The race for leadership has already begun. For the winners, the rewards are clear: Innovation and investment in clean energy technology will stimulate green growth; it will create jobs; it will bring greater energy independence and national security."
Josef Ackermann, Former CEO, Deutsche Bank

Rapid decarbonisation[1] is required to reduce greenhouse gas (GHG) emissions significantly in the period to 2050.[2] While there are precedents,[3] the scale of the challenge represents unchartered waters.

The narrative around this transition, both in policy circles and in civil society, has been dominated by considerations of "cost". This is in part because of limitations to the dominant analytical approach.

In this paper, the Irish Corporate Leaders on Climate Change seek to bring balance to this narrative. We see enormous opportunities for the business sector in responding to climate change. As is clear from the case studies we present, ambitious policy necessitates the development of technologies, skills and business practices which reduce the cost of attaining climate goals.

For a small open economy like Ireland, there is the potential to galvanise the deployment of new business models, processes, techniques, technologies and practices, which will be increasingly required to drive decarbonisation across the globe. There is significant potential for export growth in this area. But domestic deployment comes first. Countries that export cleantech have built their successes on deploying technologies at home – there are no shortcuts.[4]

We believe that the calculus around costs and benefits are not a given. Rather, in many cases they are determined by how supportive policies are shaped, how Ireland's response is structured, and the signals provided to the private sector therein.

The paper is structured as follows: we first identify limitations to the dominant analytical approach to decarbonisation. On the basis of key principles which we then set out, we present a strategy for Ireland's decarbonisation challenge built on seven key pillars. Finally we assess the potential benefits that can be captured in Ireland in each of these pillars of strategic opportunity. Examples of best practice from Group members and leading countries and regions are presented throughout. A brief conclusion follows.

THE BENEFITS AND COSTS OF DECARBONISATION

"Medium and long-term costs and benefits, as well as any co-benefits that may arise, will need to be taken into account in the development of all policy options."[5]

Review of National Climate Policy, Department of Environment, Community and Local Government, 2011

A great body of analytical work has focused on determining the costs of decarbonisation - for Ireland, Europe and the world. Where benefits are considered, they are generally understood in the terms of damage costs avoided (in the distant future) from limiting temperature increases.[6] Win-win outcomes can tend to be precluded by design.

According to the International Energy Agency (IEA), however, to keep global temperature increases within 2 degrees, investments in clean energy need to double by 2020. US$36 trillion is required by 2050 in total. But as the IEA point out "investing is not the same as spending". Total fuel savings add up to nearly three times the additional investment.[7]

New economic modelling approaches challenge the predominant focus on cost.[8] Modifying assumptions, sometimes only moderately,[9] gives rise to scenarios where economic growth and employment can be boosted while reducing emissions.[10] This tallies with the experiences of countries which are leaders in tackling climate change (See text boxes on Sweden and Denmark).

Sweden: Ambitious climate targets, spurring competitiveness and innovation

Sweden is perhaps the most ambitious economy in the world when it comes to mitigating emissions of greenhouse gases. Over the Kyoto period the country took on and achieved an emissions reduction objective which was significantly more ambitious than its legally binding EU target. In the period to 2020 it is required to reduce its non-ETS emissions by 17% on 2005 levels, and again, it has committed to doubling this rate of decarbonisation to roughly 33%.[11] Sweden has also announced that it will be carbon neutral by 2050, and will have a fossil fuel free transport fleet by 2030.

Significant decarbonisation has already been achieved. For example, emissions from the buildings sector were 81% decarbonised between 1990 and 2012;[12] economic growth has also been absolutely decoupled from emissions over the past decade.[13] All of this has been achieved while maintaining Sweden's position as one of the most competitive economies in the world.

The successes achieved are part of a government strategy to be a pioneer in climate and energy technologies. Climate is seen as "an opportunity to create new jobs and businesses, to boost export revenue".[14] Competitive advantages have been successfully leveraged through agreement of ambitious binding targets, delivered by a coherent combination of carbon pricing, targeted subsidies, and measures to promote technological innovation.[15] Sweden has the third highest number of patents in environmental technologies per capita,[16] and three of the most innovative cities in the world (Stockholm, Malmö and Gothenburg).

We can see the impact of ambitious regulation in the business environment. The majority of large Swedish companies, even those outside the traditional environmental technology sector, see themselves as proactive in environmental innovation, and are working actively to reduce their environmental impact and take advantage of business opportunities in the environmental technology field. Research from Sweden indicates that among the drivers of eco-innovation are tough government environmental regulation, as well as business opportunities and costs.[17]

The proposition that environmental protection and economic vibrancy are compatible is supported also by the OECD green growth literature, which sets out many of the channels through which "green" can create "growth".[18] Indeed thirteen EU countries (Germany, UK, France, Italy, Spain, Netherlands, Belgium, Portugal, Sweden, Denmark, Finland, Estonia and Slovenia) recently came together to call for a more ambitious climate policy, on the basis that it would boost investment, growth and employment.[19] The assumption that decarbonisation must cost is just that – an assumption.

Economic modelling work undertaken in Ireland tends to follow the dominant paradigm however. An emissions target is imposed on the economy (say, an 80 per cent reduction target for 2050). The model then determines the energy system that meets this requirement at least cost. Technologies are selected by the model on the sole basis of what they cost to purchase and operate, and what they are assumed to cost in the future.[20]

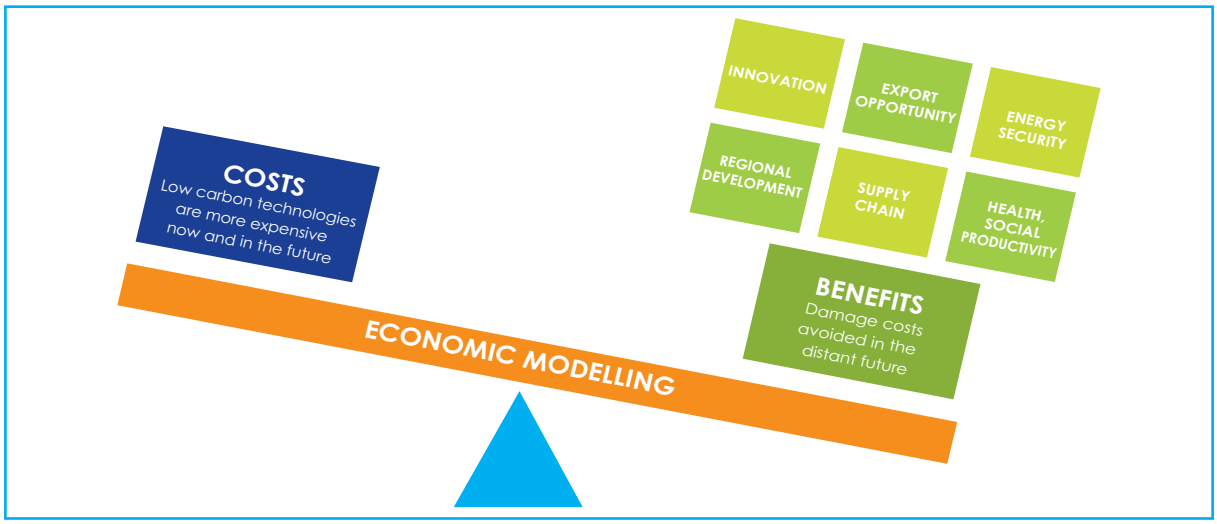
Co-benefits - difficult to model under the same analytical framework - are not considered.[21] For example, a solar panel manufactured in China with parts from Germany, would be selected ahead of a slightly more expensive[22] biomass CHP plant which is manufactured in Ireland, and which uses biomass sourced locally. The key issue of supply chain development is therefore not included in standard analysis. Nor are additional co-benefits considered, from innovation, to job creation, to energy security, to social or health benefits, to regional development, to compliance with legally binding regulations. Yet these benefits have been clearly evident in early movers such as Denmark and Sweden.

Crucially the cost of technologies is assumed to be independent of policy choice, whereas these technologies are highly dependent on how governments behave. The example of solar PV is a case in point – few economists or other analysts predicted that the cost of PV would decline by a factor of four over the past 5 years, in response to feed-in tariffs introduced in Germany and elsewhere (cost has declined by a staggering 99 per cent in thirty years).

The conclusion we draw is that the cost-benefit paradigm depends on what governments do – what short, medium, and long-term signals are provided to businesses; how credible these signals are; how business and government collaborate to identify and capitalise on key opportunities; and how cost-effective and efficient initiatives and programmes are.

The standard economic modelling work can also be used to provide insights into the overall cost to society arising from various decarbonisation pathways (by comparing to reference scenarios with no decarbonisation target). For example, one such analysis found that the additional costs of steep mitigation range from 0.7 per cent of GDP to 1.6 per cent of GDP.[23] It is often forgotten, however, that this is a gross cost, and should therefore be offset against benefits also arising. But these benefits are seldom the subject of analytical work.

Figure 1 The benefits and costs of decarbonisation



Let us be clear: we value this economic analysis; indeed, we rely heavily on various modelling, projections and scenario analysis in this paper. When interpreted correctly and used appropriately, the findings can be invaluable. They can, for example, provide insights into promising sectors and technologies for decarbonisation. Our point is not to discredit this valuable work; rather we find it does not provide the complete picture we need to inform our key strategic choices, as businesses and as a country. And in some cases, standard findings have been misunderstood to mean that decarbonisation will cost Ireland dearly.

Nor do not seek to disregard the costs associated with moving to a low carbon economy. We acknowledge the additional costs of some low-carbon technologies compared to fossil fuel-based alternatives.[24] We appreciate the difficulties of mitigating emissions from the agriculture sector, and transport to a lesser extent. We are aware of the dangers to businesses and sectors reliant on GHG-intensive technologies and processes.

What we are working towards is a more far-reaching analysis, which takes cognisance of the complexity of this field. Simple answers to extremely complex questions - expressed only in Euro per tonne of CO_2 mitigated – while useful, must be considered in a broader context. An overly reductionist framework which seeks to deny real world complexity will result in missed opportunities.

We must consider "maximum benefit", not just "minimum cost".

We believe, and have seen in our companies, how a new challenge can mobilise potentials within a company that could not otherwise be tapped. Similarly decarbonisation can unleash untapped opportunities and potentials within the Irish economy. These opportunities are far less discussed, understood and recognised, perhaps because they are diffuse, uncertain, and challenging to model in an integrated framework. But they are nonetheless real.

Our view is optimistic. It places a high premium on human ingenuity, the potential for innovation and capacity for problem solving. We have seen evidence of this ingenuity within our own organisations. Success is of course crucially dependent on how these issues are communicated to citizens, and the resulting public appetite for ambitious climate action.

THE SEVEN PILLARS

"The companies that survive longest are the ones that work out what they uniquely can give to the world"

Charles Handy, Management Scientist

As leading businesses, we know how important it is to agree and promote a strategic vision, and to devise and implement a strategy for delivery. We believe that the same is true of countries as they respond to climate change. A long-term vision, according to the OECD, is an important prerequisite for creating an "investment grade" policy framework necessary to underpin the transition to a low-carbon economy.[25]

Countries such as Denmark (see text box on Denmark below) and Sweden that have agreed a clear, long-term vision with ambitious targets, and a coherent and consistent implementation strategy, have proven the most successful in moving along the decarbonisation pathway, and exploiting the associated business opportunities.

Denmark: oil crisis to fossil fuel independence

When the 1973 oil crisis struck, more than 90% of all Danish energy supply was imported – among the highest dependency ratios of any country. In the midst of the crisis the Danish government launched a strategic response with the publication of several strategy response papers.[26] The culmination of this response was encapsulated in the recently announced vision to become fossil fuel free by 2050.

The overriding objective was to secure Danish energy security against the backdrop of uncertainty in international energy markets. A number of highly successful energy policy initiatives were launched to deliver this policy objective. Among the areas targeted were onshore wind power (at a time when the technology was not taken seriously by many), CHP production, improving the energy efficiency of existing and new buildings, strategic investment in energy R&D, as well as the ambitious use of green taxes.

The results have been dramatic. Since 1997 Denmark has become a net exporter of energy; energy efficiency improvements have meant that gross energy consumption has been stable for a long period despite solid economic growth, and Denmark now gets more GDP per unit of energy used than any other European country; renewables account for 18% of total energy needs and 28% of power generation chiefly due to the incorporation of wind into the power mix; and exports of Danish energy technology more than tripled from 1998 to 2008 and make up around 11% of total Danish goods exports.

The Danish wind turbine industry consists of more than 200 companies and manufactures 35% of all the world's wind turbines; the world's two largest producers of enzymes to bio-ethanol (covering a combined 70% of the world's market) are Danish; Denmark's Riso National Laboratory for Sustainable Energy is leading in hydrogen fuel cell research; and Europe's largest producer of thermal solar energy (SolarCAP) is located in Denmark.

Danish policy has given rise to a new industrial cluster, which is built around its natural competitive advantages and a coherent government strategy.

The Environmental Protection Agency (EPA) and the National Economic and Social Council (NESC) recommend that Ireland adopt a vision of a "GHG-neutral Ireland"[27] or "carbon-neutral"[28] by 2050. Speaking at the Oireachtas hearings on the Government's draft Climate Action and Low Carbon Development Bill, Minister for the Environment, Phil Hogan T.D. described a broadly similar objective, stating that Ireland aim for:

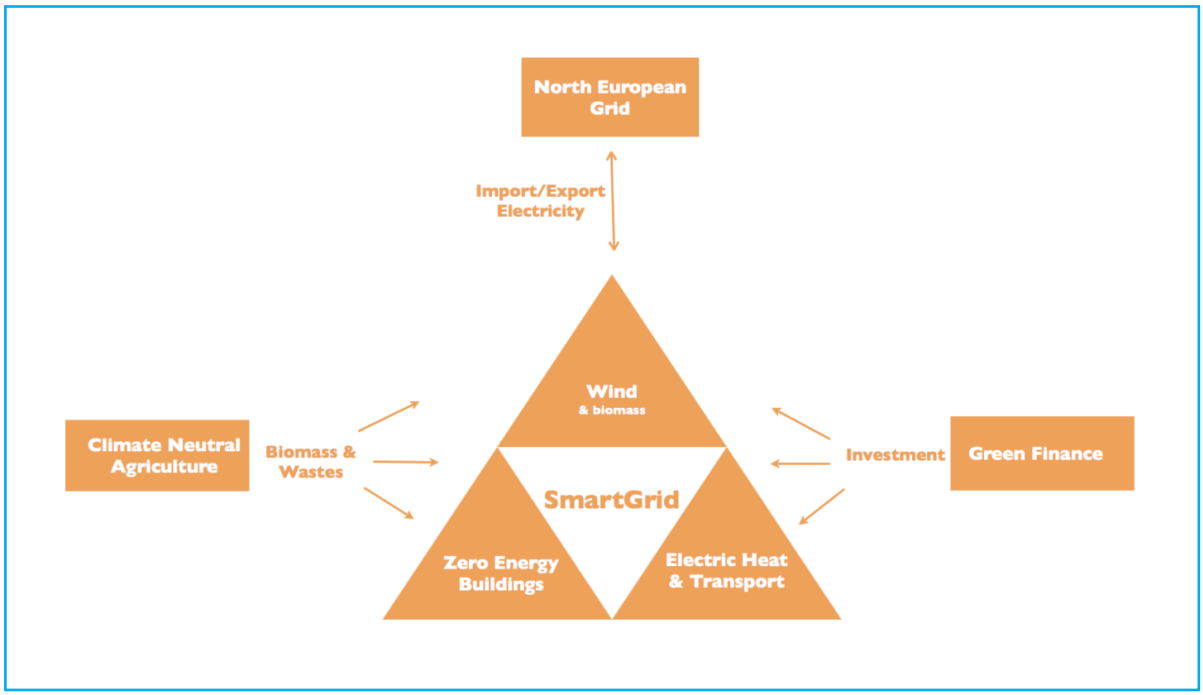
"Near zero carbon dioxide emissions by 2050 in the case of energy, buildings and transport, and carbon neutrality in the case of agriculture".[29]

Whatever precise formulation of words is chosen to encapsulate Ireland's 2050 objective, it must be operationalised. A coherent delivery strategy is required. We therefore present below what we see as the key pillars of Ireland's decarbonisation strategy. In the next section we use these pillars to explore the benefits of responding to climate change in each case.

In selecting these seven pillars (Fig 1), we have drawn extensively on the existing knowledge base.[30] In addition, we have attempted to ensure that our seven pillars:

- leverage the strengths and competitive advantages of the Irish economy (Table 1);
- are coherent and mutually reinforcing across sectors;
- build on successful existing strategies, programmes and initiatives;
- take account of the lessons from leading countries that have used the climate imperative to drive low-carbon growth; and
- are compatible with the principle of cost-effectiveness.

Figure 2 The Seven Pillars of Decarbonisation



The rationale for selecting these key areas is briefly set out in each case below. The competitive and natural advantages which each of the pillars leverage are set out in Table 1.

PILLAR 1 – THE SMART GRID

At the core of the Smart Grid is the integration of ICT onto the grid, to enable financial and informational (in addition to 'electrical') transactions among consumers, grid assets, and other authorised users. The roll out of the Smart Grid[31] is a critical lever for enabling and capturing green-growth possibilities across the economy. It is critical to managing variability of wind. Low-carbon power in turn can be used to decarbonise end-use sectors (through the electrification of heat and transport, see below), and allows for the more optimal use of generation assets through "demand response" (for example, decreasing electricity tariffs to households when the wind is blowing). Deployment of the Smart Grid therefore joins together three of the most important pillars of Ireland's decarbonisation: integration of wind, smart zero energy buildings, and electrification of transport and heat.

PILLAR 2 – WIND

Ireland has an abundant and cost-competitive on- and offshore wind resource. Wind will increasingly come to be the defining characteristic of Ireland's generation portfolio. It offers a significant export opportunity, and has the potential to generate enough electricity to exceed domestic demand by 2030.[32] According to various analyses wind could provide in excess of 60 per cent of electricity supply in 2050.[33] The variability of wind raises significant challenges, and development of the electricity and gas grids will be guided by the overriding priority to manage this variability. Biomass (including biogas) may emerge as a particularly important supplementary fuel to back up variable wind, with gas-fired generation used as a bridging technology.

PILLAR 3 - ZERO ENERGY BUILDINGS

There is a significant and cost-effective opportunity for Irish business in upgrading the existing residential and non-residential building stock. SEAI estimate that approximately 1 million houses could be brought up to an average C2 on the BER at an average cost of €7,600. Annual energy savings would be €690, offering a simple payback of 11 years. In the non-residential buildings sector, payback on investments can be even more attractive.[34]

Building regulations will mean that new buildings are built to near-zero energy standard. Advances in software for energy-management systems, and the installation of smart meters, means that these buildings will 'listen' to the price signal sent through a Smart Grid and will be able to make automatic decisions, such as changing thermostat set-points and reducing lighting, storing electrical energy for heat using smart-storage technologies or heat pumps, and drawing on micro-renewable technologies.

PILLAR 4 – ELECTRIFICATION

A low carbon economy will likely be increasingly dominated by the use of clean electricity, and increased demand for electricity is likely to offset efficiency gains.[35] The optimal use of electricity in end-use sectors, and the optimisation of grid resources, will be facilitated by the deployment of a Smart Grid (see above), allowing the heat and transport sectors to play a role in managing variable electricity production. Electric vehicles and plug-in hybrids will be key technologies, and smart electrical heating technologies and heat pumps are very likely to also play a significant role.[36]

PILLAR 5 – INTERCONNECTION

Interconnection of the all-island Irish electricity system with the UK (and possibly continental European) market is critically important to the Irish electricity system. Interconnection makes sense because it leads to the optimisation of generation assets. It is particularly important to the decarbonisation of electricity supply as it facilitates the integration of a greater share of variable renewables, and diminishes the likelihood of curtailment of these sources, making them increasingly economically attractive to investors.[37] Significant investment in interconnection with the UK and European grid is the primary way that seasonal heterogeneity of wind can be effectively managed in Ireland. In order to facilitate an optimal low carbon generational portfolio across Europe, as much as 13 GW of interconnection would be required between the UK and Ireland by 2030, which would require a very significant step up in investment.[38]

PILLAR 6 – CLIMATE NEUTRAL AGRI-FOOD AND FORESTRY

Ireland can become a world leader in the production, management and marketing of low-carbon, high-quality sustainable food.[39] Emissions from this sector are, however, unlikely to be eliminated entirely without significant technological breakthroughs. On the other hand emissions can be offset by absorption of emissions in forestry, grasslands and peatland restoration. This would require at least a doubling in the rate of afforestation,[40] which in turn would provide a greater supply of domestic biomass for use in other sectors of the economy, such as electricity, heat and transport. The bio-energy industry has a key role to play in sustainable rural development and employment.

PILLAR 7 – GREEN FINANCE

The global and domestic financing challenge is enormous. Trillions in low-carbon investments are required globally and billions domestically, if a transition to a low carbon economy is to be achieved. Yet pervasive market barriers prevent the capital from moving to what are perceived as risky investments. Those crying out for investment capital to invest in low-carbon technologies – homeowners, businesses and indeed government – find it hard to access. A better understanding of the investment proposition by the finance community can be delivered through the promotion of "lighthouse" projects. Pilot initiatives (such as the UK Green Deal) have the potential to drive transformational change over the coming decades. Ireland can become a world leader in the development and deployment of financial products and related advisory services which support the development, financing and promotion of a low carbon economy.

Table 1 Competitive Advantages of the Irish Economy

Pillar	Competitive Advantages and Strengths
Smart Grid	• Ireland has an advanced level of Smart Grid deployment by international comparison according to the IBM Smart Grid Maturity Model • A number of leading companies are involved in Smart Grid deployment in Ireland, and Ireland has a highly developed IT sector,[41] and stakeholder network (Smart Grid Ireland) supported by SEAI • North-South systems grid integration, and balancing a high level of variable wind, have developed a wealth of experience • Single electricity market, TSO and DSO which can facilitate rapid deployment of Smart Grid technologies • Excellent public-private research capacity: UCD Energy Institute Smart Grid Network Test Bed, and the EirGrid Smart Grid Innovation Hub[42] • World leading pilot programmes have been undertaken in several areas: smart meters, electric vehicles and self-healing networks[43]
Wind	• Excellent wind resource • Proximity to UK market • Skilled labour force and expertise from high level of domestic deployment • Low population density • Strong policy support (Feed-in tariff system, high-level dialogue with UK)
Zero Energy Buildings	• Poor quality residential and commercial buildings means that there is large pool of cost-effective abatement potential which can be used to build expertise domestically • Strong base of companies and skills with experience in relevant areas of hardware and software development and production • High number of certified Passive House consultants by international standards[44] • There is an increasing range of Passive-certified product manufactured in Ireland, including, for example, Munster Joinery • Supportive EU and domestic policy environment (Better Energy Programme and Energy Efficiency Fund) can be built upon
Electric Heat and Transport	• Leading companies in electric heat such as Glen Dimplex • Good base of relevant green ICT skills in workforce • One thousand public charging points for electric vehicles (EVs) installed by ESB networks • ESB/IBM project eCar is a useful pilot programme to build upon • Ireland's small geographical scale makes it an excellent test bed for EVs • Wind and EVs are highly compatible technologies

Climate Neutral Agriculture	• World class corporate sector including Kerry Group, Glanbia etc. • High sustainability and quality credentials to be built upon • Excellent national resource base in dairy sector in particular • High level of R&D capacity in Teagasc, Food for Health Ireland, and some funding available from the Department of Agriculture, Food and the Marine (FIRM, Stimulus & CoFoRD) • Irish researchers are involved in cutting-edge analysis focused on reducing emissions • Low-quality land availability for afforestation; high growth rates compared to Scandinavian countries
Green Finance	• World-class international financial services centre, with circa €2 trillion assets under administration • Ireland is already a centre offering green financial solutions for cleantech investment, with associated investment funds doubling in size over the past two years[45] • An emerging talent pool of green finance specialists and specifically tailored university programmes • Supportive policy environment and high level of public and private sector collaboration • Innovative public-private partnerships including energy efficiency fund and Better Energy Finance initiative • Many tax, legal and regulatory enablers are already in place[46]

We believe that Ireland's decarbonisation will be primarily driven under these seven pillars. We acknowledge, however, the many uncertainties. Progress in some cases is influenced by developments in the UK, EU and internationally, and a strategy must balance the requirement to provide direction and the requirement to work within this uncertain environment. Within this context, it is important to develop institutions and networks capable of assessing on-going progress, and adapting to new opportunities as they arise. A good example of managing uncertainty is to be found in the Danish strategy to become fossil fuel independent by 2050.[47]

OPPORTUNITIES FOR IRISH BUSINESS AND THE ECONOMY

"Today's business leaders increasingly realize that by leveraging both the cash and non-cash resources of their companies toward addressing important societal challenges, they can not only provide vital support to their communities, but also these activities, when done strategically, often lead to competitive advantage and sustainable profitability."
Douglas Conant, Former President and CEO of the Campbell and Nabisco Food Companies

Within companies, we know from our own experiences that environmental regulation galvanises innovation, both in-house and through our supply chains. This translates into new business opportunities, products or services, reduced costs of raw materials (through recycling or efficiencies), and higher staff morale, teamwork and productivity. The reputational benefits allow us to increase sales among environmentally conscious consumers.

We can see from countries like Sweden and Denmark how strong regulation, a supportive policy environment, and a coherent strategy based on exploiting national competitive advantages, translates into real benefits and opportunities for Swedish and Danish companies.

Ireland can follow. We identified in the previous section what we consider the seven key pillars of Irish decarbonisation to be. In this section we evaluate the benefits which could arise to the economy and society from the full exploitation of these opportunities. We also identify costs, as appropriate, against which these benefits must be considered.

PILLAR 1 - THE SMART GRID

There are many discrete aspects of the Smart Grid, each requiring significant investment, and each bringing unique opportunities and benefits. There are opportunities in software development, energy services, network technologies and energy system management. Ireland has a number of competitive and natural advantages in the area (Table 1), which can be built upon.

- SEAI estimate that more than 10,000 Irish jobs will be created by the implementation of Smart Grid infrastructure and its associated technologies; up to eight million tonnes of CO_2 mitigation could be derived directly from the implementation of Smart Grid; and a net reduction in energy imports of over 4.3 Mtoe, [equating to savings of €2.4 - 5.2bn in direct fuel offset by 2050] would also be delivered.[48]

- Many Smart Grid investments pay for themselves. For example, the CER concluded that smart meters could yield net benefits of up to €174 million over 15 to 20 years, taking into account customer bill reductions, efficiency, and environmental benefits. On this basis a decision was taken in 2012 to roll out a nationwide smart metering programme. Other aspects of the Smart Grid such as the self-healing network require significant investment, but can reduce and localise outages and save on repair costs, thereby paying for themselves over time.

The global Smart Grid market has experienced double-digit growth rates over the last five years and is expected to continue with growth rates of approximately 20 per cent per annum to 2020 according to various assessments.[49] The business opportunity in Ireland is to build on the leadership position and to leverage Ireland's natural advantages in this area, by hastening the deployment of aspects of the Smart Grid domestically. The Irish grid can act as a test bed for the deployment of Smart Grid technologies, thus attracting foreign direct investment,[50] and driving exports of skills, expertise and technologies. Engaging the strengths of leading companies who are leading the innovation charge in this space (see text box on Vodafone) can help develop a new Smart Grid cluster.

Vodafone: exploring new ways of working with technology

Vodafone is a thought leader in business innovation. It seeks to develop and deploy climate-friendly technologies and practices that boost operational efficiency in the workplace.

In 2011 Vodafone introduced 'New Ways of Working' at its headquarters in Leopardstown. All personal office space, desktop computers and landlines were removed. They were replaced with a new open-plan office space with 700 multi-person desk places provided for approximately 1,000 employees. The new work tools became a laptop, a smartphone and a locker to store a few essential items. The whole building was Wi-Fi enabled. The traditional silo approach to business organisation was overhauled, with everyone from the CEO down choosing where to sit on a daily basis.

The results have been dramatic. The office space requirement fell dramatically, and operational efficiencies included a dramatic drop in printer and other machinery use. These factors combined resulted in a 40% drop in overall energy use. Transport costs have fallen by 20% because of a more flexible interpretation of "the workplace" enabled by increased connectivity.

The traditional organisational approach was also found to be holding back innovation and new ideas by keeping communications within business units. Whereas this new approach has encouraged cross-functional collaboration through an informal and flexible structure for meetings. Increases in employee happiness, engagement, productivity, and teamwork have been reported across all business units. There has, for example, been a sizable increase in the number of employees recommending Vodafone products and services to family and friends.

Energy Data Management

Vodafone has also brought its innovation capacity directly to bear on the decarbonisation agenda. It has developed an Energy Data Management (EDM) solution, which consists of smart meters, data loggers and an online portal, enabling organisations to track energy use in real time at a granular level using Machine-to-Machine technology. 40,000 smart meters have already been deployed in-house across the globe.

Vodafone's experience suggests that technology-driven innovation is capable of delivering operational efficiencies and boosting profitability, while at the same time reducing the climate impact of doing business.

A key obstacle to Smart Grid deployment in many countries is that the regulator's primary objective is to protect the short-term interests of the consumer and prevent any unnecessary price increases.[51] It is therefore important to enable the regulator to take a benign view to extra expenditure on R&D or Smart Grid pilot projects, perhaps by establishing guidance which places more emphasis on the longer-term requirements of decarbonisation.

PILLAR 2 - WIND

The development of wind energy in Ireland for domestic and export markets has the potential to create significant benefits in Ireland. Evidence suggests that wind energy can lead to net job creation across a broad range of activities.[52] This is because the jobs created by renewables tend to be more labour intensive than those they replace. In Ireland net job creation will be far greater because much of the potential arises from the export opportunity, and no existing jobs would therefore be displaced.

Job creation estimates are notoriously difficult. Based on various analyses, we believe that **10,000 to 40,000** direct, indirect and induced jobs could be created in the period to 2020 in the wind sector.[53] The higher estimate reflects the potential to capitalise on localisation trends in manufacturing across the globe,[54] and attract local manufacturing. Currently in Ireland, 1.5 people are employed per MW installed, but this is less than 10 per cent of the total value chain according to the Global Wind Energy Council.

A key aspect of wind power deployment is that it can bring economic activity to some of Ireland's most peripheral and economically marginalised communities. Landowners can make an income through wind land lease payments, and new property tax revenue can accrue to local authorities which can be used to boost local communities. The extent to which communities gain will in fact be a key factor in achieving local acceptance for the projects, and should be a key focus of policy efforts.

Bord na Móna: clean energy hub

Bord na Móna was established in the 1940s to develop Ireland's peat resources. The company has committed to not draining or opening any additional bogs or peatlands and has begun a journey of transition under the guiding vision: 'A Contract with Nature'. It is transforming itself into a leading provider of climate-friendly products and services across several fields, including: renewable energy, clean air and clean water technologies, and resource recovery. A Key Performance Indicator for the generation business is to reduce the carbon intensity of the electricity by 70% in the decade to 2020.

A core aspect of this transition is the Clean Energy Hub concept. This involves the development of a number of wind farms on and adjacent to Bord na Móna's cutaway peatlands in the East midlands, which could be linked together to form an 'energy hub'. This hub could then be linked to the existing Irish network, to new cables designed to carry the renewable power for export, or to both. Bord na Móna hopes to lead the development of up to 2,000 Megawatts of wind energy capacity.

This would result in up to 4,000 construction jobs, hundreds of induced jobs in the locality, and long-term jobs in operation and maintenance. The national benefits include reduced liability from social welfare and increased labour and corporate taxes, regulatory charges and levies.

Bord na Móna will ensure that the benefits of this project are extended to the Midland local communities. This means more investment in local infrastructure; additional rates paid to the local authorities; and using peatland wind farms for nature, recreation and tourism.

The example of Bord na Móna illustrates how the climate challenge can provide an impetus for innovation, exports, job creation, and local community gain.

Billions in tax revenues could also accrue to the state through VAT, corporate taxes and taxes associated with increased economic activity. No state subsidy is required for facilitating wind exports. In fact, the Minister for Communications, Energy and Natural Resources (2012) has indicated that the State could impose a royalty of some kind.

The electricity highways which must be constructed to facilitate low-carbon electricity could potentially be designed in such a manner that they could (eventually) act as interconnectors, connecting the UK and Irish electricity systems. (See: Interconnection below).

A highly developed wind resource also has the potential to enhance national energy security, and to insulate the economy somewhat from the vagaries of fossil fuel price fluctuations. High gas prices have undermined the competitiveness of the economy in recent times. While the direction of future fossil fuel prices is uncertain, the deployment of wind and other renewables reduces Ireland's exposure and risk somewhat and therefore delivers systems benefits.

On the cost side of the equation, the extent to which using wind has increased costs for Irish electricity consumers has been debated at length. The general consensus is that wind has cost little, and assuming a medium to high gas price it will continue to be a cost-effective option in the future,[55] while at the same time delivering the enormous benefits outlined above. In other words, Ireland's feed-in tariff system has proven a highly cost-effective policy instrument.

PILLAR 3 - ZERO ENERGY BUILDINGS: RETROFIT

The payback on investment in retrofitting residential and non-residential buildings tends to be highly attractive. Unlocking these investments would deliver considerable benefits for Ireland and open up significant business opportunities for small, medium, and large companies, product manufacturers, raw material producers, as well as the tradespersons and professionals associated with the construction sector. New business models and financing arrangements are emerging around this opportunity (see text box on Siemens), supported in several cases by some ground-breaking Government initiatives (the Energy Efficiency Fund and Better Energy Finance) which can be built upon.

The primary benefit of retrofit work, particularly in the residential sector, is that it is labour intensive. Much like wind export, the jobs created would be entirely new rather than displaced from other sectors. The potential for employment opportunities in the residential retrofit sector alone has been estimated at between 10,000 and 30,000[56] sustainable jobs. The estimates vary according to the assumed number of homes undertaking a retrofit per annum, and the level of investment per retrofit. Jobs created in the (less labour intensive) non-residential sector are additional.

Government benefits through increased tax take, decreased health expenditure, and decreased liability for social welfare transfer payments to address fuel poverty. The case study (in Table 2) calculates the tax revenue to government from the installation of external wall insulation. Reduced social welfare and health spending are not considered making this a low-end estimate. Note, the tax take is significantly in excess of the grant provided for external wall insulation. This is not to suggest that the grant programme is the best available instrument available (see below), but that Government support in some form is justified.

Table 2 Tax take on installation of 123 m2 external insulation

	Taxable Amount (€)	Tax Rate (%)	Tax Take (€)
Labour Taxes (PAYE and PRSI) paid by installers	6,064	26.6*	1,618
Labour Taxes paid by materials distributors	3,178	15**	476
Relevant Contractors' Tax (relevant to cills/pressings, transport & shipping)	1,500	35	525
VAT (on materials + labour + margin 10%)	11,816	13.5	1,595
Corporation tax on net profit	537***	12.5	67
Total Tax Take			4,281

Source: Industry Case Study

* Combined weighted average of income tax and pay related social insurance
** The distribution margin is in the region of 30 per cent, 15 per cent assumed as tax take
*** Estimated at half gross margin

Broader benefits to society include increased productivity and competitiveness, fuel poverty alleviation, greater energy security, and reduced government health expenditure.[57] Investing in energy efficiency is also the most effective manner to reduce fuel poverty, and also therefore delivers social gains. Driving much greater levels of investment in residential (and non-residential) buildings would minimise Ireland's requirement for the purchase of carbon credits, and is, according to NESC, unquestionably the key to unlocking Ireland's near-term decarbonisation challenge (in the period to 2020).

Private benefits to homeowners include reduced energy bills, improved comfort in homes, health benefits, and increased property values.

Siemens: low carbon investments that pay for themselves

Siemens is one of the world's leading suppliers of a wide range of products, solutions and services in the field of energy technology. They are also involved in providing up front financing to help clients who wish to invest in saving energy and carbon emissions.

Modernisation work can often tie up capital that might be needed more urgently or could be put to better use elsewhere. Here, Siemens' energy performance contracting offers an answer. With this approach, modernisation work can be carried out without the need for customer capital expenditure or an immediate cash-out, because the investment costs are covered by the energy savings. Customers later benefit 100 per cent from the reduction in their

building's operating costs, and the modernisation work on their property can boost its value too.

Energy performance contracting begins by sitting down with the customer to define a project schedule. Siemens then identifies suitable buildings and conducts a preliminary study to estimate their potential energy savings. The latter are assessed in detail in a second study that also determines the measures required and their cost-effectiveness. An energy performance guarantee agreement is then signed with the customer, and the process of planning, delivery and installation can begin.

Once the work is completed, the efficiency guarantee comes into force. During this phase, reports on the energy savings achieved are prepared at regular intervals to ensure that targets are met. This requires precise monitoring of building installations so as to ensure that the savings guarantee is upheld and to enable installations to be fine-tuned for optimum operation.

With the energy savings achieved through energy performance contracting, Siemens and its customers are making an important contribution toward protecting the environment. In more than 1,000 such projects worldwide Siemens have helped customers to save around 15.9 TWh of energy.

By financing projects that reduce carbon emissions, Siemens increases the bottom line for its clients.

The benefits of retrofit to society are clear. They must be considered, however, against any costs to the exchequer which may arise. Although investments finance themselves over time through reduced energy bills, there are numerous barriers to investment to be overcome. A central issue surrounds the shortage of upfront funding, sometimes referred to as the financial barrier. This barrier interacts with a number of complicating behavioural, cultural, social, and informational barriers. According to NESC the primary requirement is for sophisticated and concerted policy attention on unlocking the intractable barriers. They cite the use of property taxes and stamp duty instruments to promote energy efficiency, and we agree that these types of instruments should be considered. We also believe that some level of government support must be sustained, and we favour market driven approaches such as Better Energy Finance, with the provision of favourable financing terms to early adaptors of "deep" retrofit. These costs are, however, far outweighed by the benefits for government itself, businesses and society.

PILLAR 3 - ZERO ENERGY BUILDINGS: NEW BUILDINGS

Turning to the new build sector, the re-cast Energy Performance of Buildings Directive (EPBD) requires that "all new buildings are nearly Zero Energy Buildings (nZEB)"[58] by the end of 2020, and that the energy required should be covered "to a significant extent" by renewable sources.

The primary benefit to the economy relates to capturing a share of a growing market for low carbon technologies, by building on its natural advantages (Table 1). Ireland could progress building regulations at a more rapid rate than required by the Directive, just as is being done in the Brussels Region (see text box on Brussels). This would encourage the deployment of necessary technologies and skills required for zero energy building construction.

The rationale is that green building is a major emerging trend in the global construction sector. A majority of firms view green buildings as a major business opportunity rather than a niche market.[59] Within the EU, the turnover in the building industry was about €1 trillion in 2009, divided evenly between new and existing buildings. Based on several market studies in the EU, investments in new buildings (for heat pumps, pellet heating systems, ventilation systems with heat recovery, triple glazed windows and insulation materials) are estimated to be €62 billion per year by 2020, €39 billion of which is attributable to the Recast EPBD. In other words, the Directive will lead to a trebling of demand for these goods and services.[60] The highest growth rates were identified for ventilation systems with heat recovery and triple glazed windows.[61] Irish firms who develop and deploy these technologies domestically will have an opportunity to export into these growing market places.

Brussels: Building Better Faster

The Brussels Capital Region requires all buildings to be nearly zero energy by the end of 2015, 6 years ahead of what is required by the Recast EPBD. Brussels' new regulation is based on the Passive House standard, making an equivalent standard of thermal efficiency mandatory for all new builds as well "major" renovations. New buildings (houses, offices and schools) must have a heat demand of less than15 kWh/m^2 year.

The opportunity must be considered against the costs of strong regulations in this area. It is estimated that it may be approximately 4 per cent more expensive to build to the highest standards of energy efficiency, with a range of 3-8 per cent given depending on the type of building.[62] These additional up-front costs are, however, more than repaid through reduced energy bills over a fraction of the lifetime of the buildings.

PILLAR 4 - ELECTRIFICATION

The electrification of heat and transport has the potential to provide a number of significant benefits to consumers and society in the period to 2050.

Electrification of transport (and heat to a lesser extent) has more potential than any other technology to reduce Ireland's dependence on the most volatile and scarce fossil fuel: oil. Electric vehicles alone are could reduce oil imports by up to 50% compared with 2011 by 2050.[63] Early adoption will minimise risks to consumers associated with highly volatile oil prices.

Electric vehicles are also reducing costs to consumers and bring significant benefits to society. According to SEAI estimates, based on projected cost reductions for battery production, EVs may offer cheaper 10 year cost of ownership than future ICE vehicles by 2019. Without financial incentives the cumulative savings to society could range from €2.3 billion to €12.4 billion by 2050.[64] Health benefits accrue from a reduction in local air pollutants from diesel engines in particular.

Electric heating and transport have the potential to optimise wind resources. The wind resource is greatest when it is least required: at night. EVs and smart storage heating technologies can charge at this time, bringing greater balance to electricity supply and electricity demand. EV charging can be managed (using the Smart Grid) to minimise grid development costs and enable EVs' demand to assist in managing wind variability.

While it is unlikely that we will have a role in the manufacture of EVs, there are manufacturing possibilities in the electric heat sector, where a number of leading Irish companies are active. Furthermore, there are significant enterprise opportunities for Irish companies around the infrastructure, management and payments systems, and software, which is required for the deployment of EVs.

On the cost side of the equation, the deployment of EVs requires the deployment of a charging infrastructure, which as a public good must be borne by society. While there are currently grants and tax reliefs available for EVs, they currently pose a relatively insignificant cost to the exchequer (approximately €1 million in 2013).

PILLAR 5 - INTERCONNECTION & INTEGRATION

A much greater level of investment between European electricity grids is considered a "no regrets" option.[65] Interconnectors of the all-island Irish electricity grid with the UK and European grids present multiple benefits for Ireland. It would enhance security of supply, promote competition in the electricity market, optimise use of generation assets, and facilitate the greater penetration of variable renewables.

Much of the benefit is delivered because interconnectors can reduce the curtailment of wind, leading to an optimisation of generation assets. However, the incremental benefit of each interconnector diminishes with each subsequent interconnector. Economic analysis of two current interconnectors between the island of Ireland and the UK suggests that these interconnectors deliver significant net economic benefits. A third interconnector will likely become economically attractive by 2020, and possibly a fourth by 2025.[66] Preliminary analysis also suggests that interconnection between the French and Irish market will be an economically attractive option in the near future, though due to the greater distances the capital costs are significantly increased.

Due to the high capital costs of interconnectors, further analysis is required to assess the extent to which electricity export opportunities in the UK market can be exploited in a manner which delivers enhanced interconnection. It has been suggested that because the anticipated capacity of export cables is very large, it may prove technically challenging for the Irish grid to connect in a manner which ensures stability. Nonetheless, in a medium-term perspective a potentially enormous level of investment is required to deliver sufficient interconnection for full decarbonisation (up to 13 GW in 2030). It would appear to make sense to explore the technical and economic feasibility of progressing these projects in a manner which delivers system benefits.

While some analysts have suggested that interconnection would lead to lower electricity prices in Ireland,[67] there is a danger that if electricity prices rise significantly in the UK market, this could negatively impact on electricity prices for Irish consumers.[68] In this scenario electricity producers could gain at the expense of Irish consumers. This danger can, however, be mitigated if rules on for the management of the interconnectors provide safeguards for Irish consumers. The rules which govern how interconnectors work and how electricity markets are integrated are as important as the physical infrastructure itself.

PILLAR 6 - CLIMATE NEUTRAL ARGICULTURE

There are a range of measures in the agriculture and land use sector which could reduce emissions and increase productivity and profits, which are cost-effective for farmers and the agri-business sector to implement.

On-farm, improving the genetic merit of the dairy herd, earlier finishing times, extension to the grazing season and reduced nitrogen use through use of clover, better manure management, and urea replacing Calcium Ammonium Nitrate (CAN) fertiliser, all have the potential to deliver higher profitability, while reducing emissions.[69] Delivering emissions abatement in agriculture is therefore not cost-prohibitive in these areas per se, but rather the challenges are cultural and behavioural.

Achieving 2020 bioenergy targets will create up to 8,000 net new jobs, mostly in rural locations.[70] The cultivation of bioenergy crops (including willow, miscanthus and winter wheat) is more economically attractive than beef farming in many cases. Another alternative is the use of grass for biogas. These crops could have a double dividend of displacing emissions from the beef herd, and emissions of fossil fuels from the electricity and heat sectors. Yet there remains inertia in the market place, and many farmers remain unconvinced by energy crops for a variety of reasons.[71]

While these barriers are formidable, they are not insurmountable. Enhanced measurement of performance, best practice and advice are needed, along with more proactive advisory services. This will require government support. There are positive signs that a world leading emissions measurement and reporting initiative could be rolled out on Irish farms, thanks to the efforts of leading Irish companies (see text box on Diageo). Were such a system to be linked to a system of economic reward, based on some form of pricing of the emissions in this sector, it could drive cost-efficient transformation in the sector. For example, a bonus-penalty (carrot and stick) scheme could be introduced where best practice is rewarded financially and inefficiencies are disadvantaged.

Diageo: enhancing the sustainability of its supply chain

Diageo is one of Ireland's leading companies, with a proud tradition of transforming premium Irish cream and barley into some of Ireland's most world-renowned brands, sold in more than 150 countries across the globe. Improving sustainability – from grain to glass – is at the heart of Diageo's business operations, and is key to its future success. To this end, Diageo has set challenging environmental goals and has made significant progress against key metrics including carbon, water, waste and packaging, and has actively promoted the importance of sustainable business practices among its employees and suppliers.

A key issue for the company is creating shared value for its brands and stakeholders, by ensuring the sustainability of its raw material supply chains. To this end, in 2010 Baileys approached its key cream supplier, Glanbia, with a view to piloting a new sustainable agriculture partnership. The idea was to develop and test new sustainable agriculture guidelines with ambitious sustainability indicators and timelines. In close collaboration with Glanbia, guidelines were developed in the areas of carbon, quality assurance, animal health and welfare, biodiversity, water, and health and safety, with a view to improving the sustainability of their 4,300 dedicated farms.

Glanbia began its audit programme in July 2012, which will take two years to implement. The programme includes a carbon audit which has been developed in the past year in conjunction with Bord Bia, Dairy Research Institute and the Carbon Trust. This work established an accredited carbon audit methodology and calculation for the dairy industry. Ultimately it is hoped that an awards scheme will be established, that will reward farms for continuous improvements, and to further develop 'best practice guidance' material.

Prompted by this initiative, other leading Irish milk processing businesses are now actively developing sustainability practices for their milk suppliers. Furthermore, a drive to establish a national sustainability initiative is currently being promoted by the Irish government.

This initiative will create value for both Glanbia and Diageo in terms of risk mitigation, and will deliver cost savings by boosting the productivity. Diageo recognise that this initiative will enhance its sustainability credentials and help grow the Baileys brand - while at the same time reducing emissions of greenhouse gasses.

It should be acknowledged that the impact of cost-effective measures to reduce agricultural emissions without impacting production is somewhat limited. A range of additional measures are not considered cost-effective. There is significant funding and scientific expertise in Ireland targeted at exploring new approaches to sustainable food production, and Ireland can be a frontrunner in this emerging field. Much like Denmark captured the opportunity associated with wind technology far before its importance was apparent, so too can Ireland in the area of sustainable food production. The knowledge, expertise and technologies which are developed here will be at a premium on the global market in years to come.

According to Bord Bia, international buyers are increasingly looking for more proof of Ireland's sustainability performance. The potential benefits to the Irish food sector of taking a proactive approach on the issue of sustainability might include an enhancement of our reputation and building market position over the medium to long term.

New forestry can play a key part in moving the sector towards climate neutrality by 2050. Meeting Ireland's future demand for biomass is also considered highly challenging.[72] An afforestation level approaching 15,000 ha per annum is required to provide a sustainable level of supply of forest-based biomass, which is double the current planting rate. The benefits of increased afforestation include the more productive usage of marginal land, providing the raw materials for various uses, and increasing farm profitability in the medium-term. Forestry can also offset an increasing quantity of agricultural emissions.

There are costs to government associated with rolling out a national quality assurance and auditing scheme, increasing funding for R&D, and disseminating knowledge and best practice. The sector itself might be expected to cover some of these costs, given the potential benefits which might accrue.

There is a cost to the Government of incentivising forestry which must also be considered. The current afforestation schemes typically include an establishment grant plus annual premium payments for up to 20 years of the 40-year forest rotation. Farmers with marginal or underused land, working independently or with private investors and Coillte, might be encouraged to consider increasing levels of afforestation on their land.

PILLAR 7 - GREEN FINANCE

Funding the decarbonisation opportunities is one of the key challenges. Innovative and smart financial products will be required to meet this challenge, often in collaboration with the public sector. Several promising examples in Ireland exist, which can be built upon, and much like technology, domestic deployment of "lighthouse" initiatives will enhance Ireland's reputation as a hub for bespoke low carbon finance products. There will be emerging opportunities for Ireland's green finance sector within the context of a growing market internationally. Estimated global investment in green funds and venture capital projects was US $214 billion in 2010, and could rise to $500 billion by 2017.[73]

The Green IFSC initiative is an attempt to capture these opportunities for Ireland. First-mover advantage is available in certain niche areas, and could provide the catalyst required to establish Ireland as a global Green Finance hub. Potential exists to develop a green IFSC cluster and brand incorporating green investment vehicles (e.g. investment funds of energy companies, banks and VCs), the administration of funds managed under green principles, and carbon trading and associated professional services. Government can play a role by encouraging the deployment measures to support the deployment of green financing solutions domestically (see text box on South Korea), which would increase Ireland's profile as an innovative hub for green finance solutions.

South Korea: Galvanising Green Finance

Since 2000, South Korea's growth had slowed after 60 years of rapid development. A new national vision, "Low Carbon, Green Growth", was launched in 2008, to guide the country to develop a competitive green-tech sector, with the objective of taking a large share of the world market.

It was established by the Government that there is a great risk that unsatisfactory financing of green tech companies could cause the green shift in South Korea to fail, due to the market uncertainty. South Korea therefore launched a number of policy measures to reduce the risk for financers.
These include:

- *State loans directly to green companies, or to commercial banks, which in turn lend to green companies;*
- *State loan guarantees for green companies who borrow from commercial banks;*
- *A deposit-lending programme where private customers are given tax deductions if they save in special green accounts – savings that the banks must then lend to green companies at favourable interest rates;*
- *State risk capital funds for investments in green companies; and*
- *Measures to facilitate financing in the capital markets.*

A supporting central government certification programme for green technologies, green projects and green companies, where certified companies have the potential to avail of these financing supports, was also launched. This is a policy approach which is often cited as best practice internationally.

RECOMMENDATIONS FOR GOVERNMENT

"Nations go to war, implement mass vaccinations of their populations and organise expensive insurance and security systems (such as anti-terror measures) to address much fainter threats [than climate change]. However, our societies seem to be willing to impose immense risks on future generations."
The Earth League (A voluntary alliance of leading scientists and institutions dealing with climate change)

Our first objective in this contribution is to challenge the predominant narrative on climate change. We do not believe that the benefits of responding to climate change have received equal attention to the costs. This is, in part, attributable to the existence of an established approach for estimating costs. The benefits, which are equally apparent, can be more difficult to model and quantify within an integrated framework. This predominant focus on costs is belied by the experiences of many of the most climate-ambitious countries and companies.

We have challenged this predominant narrative by first identifying what we see as the seven key pillars of Ireland's decarbonisation, with reference to competitive advantage and other considerations which we set out. In each case we have offered a preliminary analysis of the benefits available.

We were struck when making this analysis by the sheer number of areas where there is a clear economic case for decarbonisation – from retrofit of buildings to growing more energy crops, to name but two. And yet progress is limited. We uncover promising approaches that require further exploration. These include, for example: rolling out a carbon auditing scheme on all farms and the possible introduction of a bonus-penalty scheme for farmers; or developing Ireland's wind export opportunity in a manner consistent with delivering greater interconnection to the UK and European grids.

We therefore conclude that the barrier is not cost per se. Neither then is the solution necessarily to provide increased government subsidy. The solution is often smart and targeted policy intervention, and a willingness to trial and test approaches and practices. But this cannot be attempted in an entirely ad hoc manner; it must be done within a coherent strategic framework, it must be matched with commensurate devotion of administrative resources, and it must be sustained by on-going political support.

Above all, what is required from Government is the articulation of a coherent vision and strategy based on Ireland's key economic strengths and competitive advantages, one which learns from the positive experiences of other countries. A top-down perspective is required in order to leverage national economic strengths and competitive advantages, rather than sectoral concerns, which might be integrated later in the process.

This strategy must be matched by the institutional arrangements and devotion of scarce administrative resources to drive this agenda forward in a consistent manner across political cycles. In this way Ireland can carve out a niche for itself in a rapidly changing world, and ensure its economic vibrancy in decades to come.

A further crosscutting theme relates to "who pays?" In many cases, as we have argued the question needs to be reframed as "who benefits?" Yet we know that there will, in some cases, be an upfront cost of investment. This is where innovative public private financing initiatives can play a central role. Government can de-risk "lighthouse" initiatives, such as it has done already with the Energy Efficiency Fund. Once new models of financing have an established track record, the private sector will have no problem stepping up.

Our analysis of other countries also illustrates the importance of coherent communication. In Sweden, for example, a consistent narrative around climate change which combines environmental responsibility and business opportunity, has led to high levels of public understanding and support for ambitious strategy. What is required is not one communications campaign, but an on-going effort over decades.

We also pose a challenge for the analytical community. How can future economic assessments of climate action integrate more fully into their analysis the co-benefits that we identify in this paper? We must think about maximising Ireland's benefit, not just minimising cost.

We believe that tackling climate change is everyone's responsibility, across all sectors of society. We illustrate useful approaches and examples of best practice throughout this paper, with a view to promoting a spirit of cooperation, collaboration and information exchange between the public and private sectors in meeting this global challenge.

[1] We use the term "decarbonisation" in the broadest possible sense, to cover to all greenhouse gas emissions across the economy, i.e.: not just carbon dioxide, but also methane, nitrogen oxide and F-gasses.
[2] EU leaders have endorsed the objective of reducing Europe's greenhouse gas emissions by 80-95 per cent by 2050, and the EU Commission 2050 Roadmap sets out how this level of emissions reduction might be achieved.
[3] Countries like Sweden have shown that rapid rates of decarbonisation are feasible without damaging economic growth. Its commercial and residential sectors have become almost carbon free over the past two decades.
[4] Lewis, J., & Wiser, R. (2005). Fostering a Renewable Energy Technology Industry. Lawrence Berkeley National Laboratory.
[5] Department of Environment (2011) REVIEW OF NATIONAL CLIMATE POLICY. Available: http://www.environ.ie/en/Publications/Environment/ClimateChange/FileDownLoad,28328,en.pdf
[6] See, for example, Stern, N (2007) The Economics of Climate Change: The Stern Review. Cabinet Office - HM Treasury: London.
[7] IEA (2012) Energy Technology Perspectives, IEA Paris.
[8] See, for example: http://newclimateeconomy.net/about
[9] For example, those surrounding how expectations formation influences behavior
[10] PIK (2011) A New Growth Path for Europe: Generating Prosperity and Jobs in the Low carbon Economy. PIK: Berlin.
[11] Its domestic sector target is a 40% reduction on a 1990 baseline by 2020, which translates into a 33% reduction on a 2005 baseline. Some if the increased target may be achieved through the purchase of international carbon credits, though it will largely be met through domestic mitigation.
[12] See: http://www.naturvardsverket.se/en/News-and-press/Lower-emissions-of-greenhouse-gases-in-2012/
[13] Presentation from Swedish Ministry of Environment to OECD delegation, September 2013
[14] Swedish Ministry of enterprise, Energy and Innovation (2011) Environmental Technology – 13 Swedish Solutions. Stockholm: Government Offices of Sweden.
[15] See: http://www.regeringen.se/sb/d/17076/a/208672, last checked October 2013
[16] http://www.oecd.org/sweden/sti-outlook-2012-sweden.pdf
[17] Vinnova (2013) Eco-innovative Measures in large Swedish Companies". Stockholm: Vinnova.
[18] These include: driving efficiency, opening up new market opportunities, driving innovation, creating an environment conducive to investment, fiscal consolidation and reducing risks associated with resource shortages and bottlenecks. See OECD (2011b), Towards Green Growth, Paris: OECD. And: OECD (2012b), Towards a Green Investment Policy Framework, Paris: Organisation for Economic Co-operation and Development.
[19] The Green Growth Group (2013) Going for Green Growth: The case for ambitious and immediate EU low carbon action.
[20] Text Box: It is therefore necessary to make assumptions about future technology costs (and to assume that these costs are entirely independent from policy choices), future fossil fuel prices, etc. Projected future costs for technologies have already in many cases been found to be highly inaccurate, partly because they are dependent on policy choices, not independent of them. The example of solar PV panels is a good example of this. EU renewable targets and feed-in tariffs in Germany, Italy and Spain, among other European countries, has lead to a collapse in price in the price of solar PV panels throughout the world. They have declined by a factor of three since 2009, many times faster than even the most optimistic analysis of 2009 (http://cleantechnica.com/2013/01/22/chinese-solar-imports-drop-but-prices-continue-to-fall/#gP1m54ulow13lbiv.99), which again, has led to a renewed investment drive, which will drive prices down further.
[21] Energy and emissions savings are generally the only benefits included.
[22] Measured as the sum of capital and operational costs per unit of energy produced
[23] In one scenario, the energy system only is required to achieve at least an 80 per CO2 emissions reduction below 1990 levels by 2050, in another the 80 per cent GHG emissions reduction target would apply to the whole economy. See: UCC/EPA (2012) Irish TIMES Energy Systems Model (CCRP 2008 3.1)CCRP Report. Available: http://www.epa.ie/pubs/reports/research/climate/Irish%20TIMES%20Energy%20Systems%20Model.PDF
[24] Though this is certainly not the case for wind, either in Ireland or globally. See IEA (2013) Medium-Term Renewable Energy Market Report 2013 -- Market trends and projections to 2018. IEA: Paris.
[25] See: http://search.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2012)7&docLanguage=En
[26] See, for example, Danish Energy Policy 1976, which had the objective of securing Denmark against future crises in supply. This was followed by Energy 81, Energy 2000 and most recently Energy 21, which sets out an ambitious energy-policy agenda for the coming years.
[27] EPA (2012) Addressing Climate Change Challenges in Ireland, EPA: Dublin. Available: http://www.epa.ie/pubs/reports/research/climate/Addressing%20Climate%20Change%20Challenges%20in%20Ireland.pdf
[28] NESC (2012) Ireland and the Climate Change Challenge: Connecting 'How Much' with 'How To'. NESC: Dublin.
[29] See: http://oireachtasdebates.oireachtas.ie/Debates%20Authoring/DebatesWebPack.nsf/committeetakes/ENJ2013071000003?opendocument, last checked 17th September, 2013.
[30] In particular the modeling work of UCC and the NESC analysis.
[31] At the core of the Smart Grid concept is the integration of information and communications technologies onto the grid to enable financial, informational as well as 'electrical' transactions among consumers, grid assets and other authorised users. It allows for the optimisation of all grid assets, enables all generation, micro and macro-storage options to be integrated, and facilitates bi-directional power flow. It

will allow for the emergence of a 'prosumer' who not only uses electricity but also generates it. Supply companies will be in a position to aggregate consumers and influence overall demand using price signals, thereby creating a 'fifth fuel' or 'virtual power plant', which can be used to balance short-term variability in electricity supply. Taken from NESC 2012.

[32] SEAI (2011) Wind Energy Roadmap, available:
http://www.seai.ie/Publications/Energy_Modelling_Group_/SEAI_2050_Energy_Roadmaps/Wind_Energy_Roadmap.pdf

[33] Ó Gallachóir, B., Chiodi, A., Gargiulo, M., Lavigne, D. & Rout, U.K. (2012), Irish TIMES Energy Systems Model Final Report, Wexford: Environmental Protection Agency. The generation mix presented in the SEAI Smart Grid Roadmap also involved around two thirds of electricity coming from wind in 2050.

[34] NESC (2012) Interim Report

[35] Ó Gallachóir, B., Chiodi, A., Gargiulo, M., Lavigne, D. & Rout, U.K. (2012), Irish TIMES Energy Systems Model Final Report, Wexford: Environmental Protection Agency.

[36] See: NESC (2012) Ireland and the Climate Change Challenge: Connecting 'How Much' with 'How To'. Note, key areas that are expected to require energy beyond that provided by electricity in 2050 are freight transport, industrial processing and some share of heat in buildings. NESC also argues that the technology for natural gas-based vehicles (NGVs), particularly for goods vehicles (vans and larger trucks) and buses, is well established and should be further explored in Ireland.

[37] See, foe example, Diffney, S., FitzGerald, J., Lyons, S. & Malaguzzi Valeri, L. (2009), 'Investment in Electricity Infrastructure in a Small Isolated Market: the Case of Ireland', Oxford Review of Economic Policy, 25(3): 469-87; FitzGerald, J. (2011), A Review of Irish Energy Policy, Research Series, No 21, Dublin: Economic and Social Research Institute; Gorecki, P. K. (2011), The Internal EU Electricity Market: Implications for Ireland, Research Series No. 23, Dublin: Economic and Social Research Institute; Pöyry Energy Consulting (2009), Impact of Intermittency: How Wind Variability Could Change the Shape of the British and Irish Electricity Markets, Summary Report,Oxford: Pöyry Energy Consulting.http://www.poyry.co.uk/sites/www.poyry.uk/files/202_0.pdf.

[38] ECF (2011) Power Perspectives 2030: on the road to a decarbonised power sector. ECF: The Hague.

[39] NESC (2012) Ireland and the Climate Change Challenge: Connecting 'How Much' with 'How To'

[40] With current planting rates, by 2050 forests could sequester in the region of 1.8 Mt CO2. If the rate increased to 20,000 per annum, then the potential could be between 7 and 8 Mt CO2 sequestered in 2050.

[41] See: http://www.smartgridireland.org/

[42] http://www.ucd.ie/news/2013/09SEP13/230913-Taoiseach-launches-new-UCD-research-institute-to-focus-research-talent-on-energy-systems-integration.html

[43] Curtin, J (2012) Decarbonising Energy End Use Background Paper No.6Final Report from the NESC Secretariat. NESC: Dublin.

[44] See: http://passivehouseplus.ie/blogs/why-the-path-to-recovery-will-be-passive.html

[45] E&Y (2011) Cleantech Ireland: An Assessment of the Sector and the impact on the national economy; E&Y: Dublin.

[46] These include: "an OECD, EU, onshore, transparent low-tax environment for mainstream companies; a similar tax-neutral environment for Irish securitisation and structured finance companies; a similar tax exempt environment for Irish authorised investment funds; an efficient, responsive, progressive, globally respected regulatory regime for Irish authorised investment funds; a collaborative approach among advisers, industry
participants and government policy makers in connection with legislative and regulatory changes". See: Eleanor MacDonagh (2010) Presentation, available:
http://www.seai.ie/News_Events/Previous_SEAI_events/The_role_of_Smart_Cities_/Eleanor%20MacDonagh,%20McCann%20Fitzgerald.pdf

[47] Danish Government (2011) The energy strategy 2050: from coal, oil and gas to green energy. Available:
http://marokko.um.dk/~/media/Marokko/Documents/Other/GBEnergistrategi2050sammenfatning.pdf

[48] SEAI (2011) Smart Grid Roadmap

[49] PR Newswire (2012), Growth Opportunities in Global Smart Grid Market 2011-2016: Trends, Forecast, and Market Share Analysis. http://www.prnewswire.com/news-releases/growth-opportunities-in-globalsmart-grid-market-2011-2016-trends-forecast-and-market-share-analysisdecember-2011-138918124.html, 18/12/12 . See also: Kennedy, C. (2012), Investment in Smart Grid Technology to Reach $46 Billion, Oilprice.com. http://oilprice.com/Latest-Energy-News/WorldNews/Investment-in-Smart-Grid-Technology-to-Reach-46-Billion-by-2015.html, 18/12/12.

[50] E& Y (2011) Cleantech Ireland: An assessment of the sector and the impact on the national economy

[51] Eurelectric (2011), Regulation for Smart Grids, Brussels: Eurelectric

[52] See, for example: Michaels, R., & Murphy, R. (2009). Green Jobs - Fact or Fiction? Institute of Energy Research. Or: Ayee, G., Lowe, M., & Gereffi, G. (2008). Manufacturing Climate Solutions. Carbon-Reducing Technologies and U.S. Jobs. Chapter 11. Wind power: Generating electricity and employment. Duke University website: http://www.cggc.duke.edu/environment/climatesolutions/greeneconomy_Ch11_WindPower.pdf

[53] See; http://www.energyireland.ie/events/energybridge2013/brochure.pdf
SEAI estimate that the wind sector could create 20,000 direct installation and O&M jobs by 2040. Ernest and Young estimate that 10,000 direct and indirect jobs in Ireland by 2020. See Ernst and Young (2011) Cleantech Ireland: An assessment of the Sector and the impact on the national Economy. E&Y: Dublin. Based on IWEA (2009). SEAI (2011) Wind energy roadmap, available:http://www.seai.ie/Publications/Energy_Modelling_Group_/SEAI_2050_Energy_Roadmaps/Wind_Energy_Roadmap.pdf

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