Chapter 11

Environment and Energy

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Introduction

Major transitions are needed in Ireland's energy systems.

Ireland's energy systems will face a major transformation in the coming decades. The key driver for this is international action to address and limit climate change. This transformation is supported by a range of policies at national and European levels,[1] including the White Paper on Energy (DCCAE, 2015), the National Policy Statement on climate change (DHPCLG, 2014)[2] and targets agreed under the EU's 2020 Climate and Energy Package and 2030 Climate and Energy Framework. These effectively envisage decarbonisation of national and European energy systems by 2050. They provide the longer-term vision of transformation and the shorter-term steps needed to achieve the vision. Large-scale public and private investments in energy infrastructures, efficiency and management systems will be needed.

An essential element of this required transition is the decarbonisation of Ireland's electricity generation system. This can be achieved with currently available technologies. However, significant and specific challenges exist for the buildings and transport sectors. Energy efficiency and innovation are essential in these areas, which are highly fossil fuel-based. Innovations include information provision and education, as well as new technologies. The transition to a fossil energy-free Ireland can provide short-, medium- and long-term benefits, including enhanced energy security and reduced costs, as well as significant co-benefits for human health, the environment and socio-economic development. However, considerable barriers to this transition exist and addressing these will be essential.

1 *www.unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf*

2 *www.housing.gov.ie/environment/climate-change/policy/national-climate-policy*

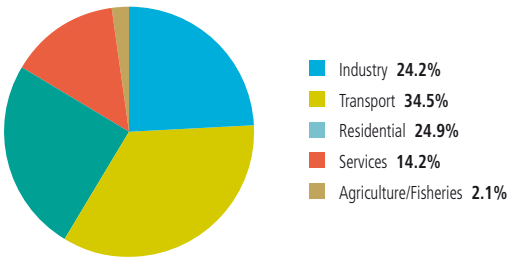
Current Position and Trends in Energy Use

As the economy improves the renewable sector needs to keep pace and the decoupling of economic growth from increasing energy use needs to be accelerated.

Ireland's total energy use in 2014 was 556 terajoules (TJ) (1.5 × 108 kWh). According to the Sustainable Energy Authority of Ireland (SEAI), the average household uses just under 50 kWh daily, of which 13 kWh is electrical energy.[3] European Environment Agency (EEA) data suggest that, at a European level, Ireland's household energy usage is the second highest, only below that of Finland.[4] Ireland had the fourth highest rate of energy import dependency (85.3%) among the European Union (EU) Member States in 2014, mainly in fossil energy. This dependency is both expensive (€5.7 billion in 2014) and environmentally unsustainable. However, overall energy use in Ireland has declined since its peak in 2008. While this was primarily linked to the economic recession, there is evidence of increasing energy efficiency. There was also an increased use of renewable energy in this period. As Ireland returns to prosperity, decoupling of economic growth from increasing energy use needs to be accelerated.

As shown in Figure 11.1, Ireland's principal energy requirements arise from transport, accounting for 35% of the total, and residential heating and electricity, accounting for 25%. Decarbonisation of energy use in the transport sector is a key challenge, which is addressed in Chapter 10.

Figure 11.1 Ireland's Energy Requirements by Sector (Source: SEAI, 2015)



Current Dependence on Fossil Fuels

Fossil fuel energy, especially oil, still makes up about 90% of Ireland's energy use profile, illustrating the extent of the decarbonisation challenge.

Figure 11.2 shows the sources for energy used in Ireland in 2014 (SEAI, 2015a). Fossil energy makes up about 90% of Ireland's energy use profile, of which oil (at 47%) remains the dominant fossil energy used, primarily for heating and transport. Overall trends in the use of various fossil energy sources vary, but there is a general decrease in fossil energy use and the use of renewable energy is growing, albeit from a very low base (currently approximately 8%).

Figure 11.2 Fuels Used for Energy in 2014 Based on SEAI Data (Source: SEAI)

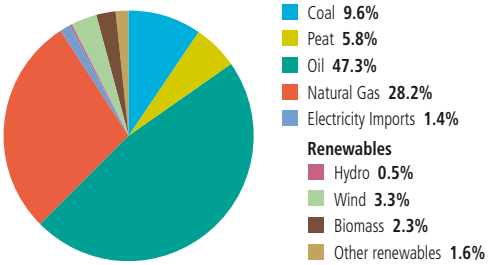


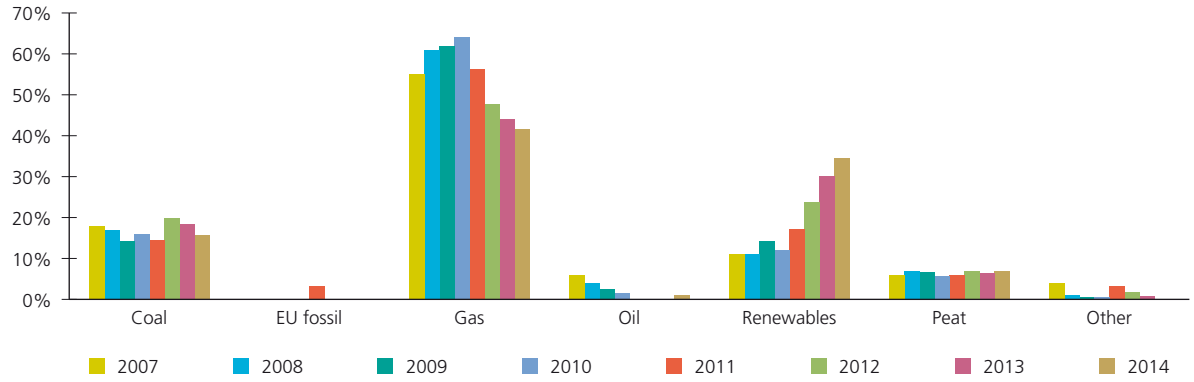
Figure 11.3 shows the changing nature of the fuels used for electrical power generation over recent years (CER, 2015). While there has been a significant increase in renewable energy generation, largely from wind, the data also show that gas remains the largest source of energy used. The increase in renewable energy use largely displaced gas rather than coal or peat, use of which has remained relatively stable. There are a number of compelling reasons why displacement of peat and coal would be preferable to displacing natural gas, including reducing greenhouse gas (GHG) emissions and improving air quality.

In Ireland, the electrical power generation sector accounted for 35% of energy used in 2014. Just over half of this energy is lost in the generation process and in distribution losses in the grid (SEAI, 2015a). The use of highly carbon-intensive fuels such as coal and peat has remained remarkably stable in this sector since 2007. Decarbonisation of this sector requires that coal and peat use is phased out rapidly, while a much greater use of renewables is required going forward. It is also essential that energy losses in transmission are factored into decision making on future energy systems.

3 *www.seai.ie/Publications/Statistics_Publications/Energy_in_Ireland/Energy-in-Ireland-1990-2014.pdf*

4 *www.eea.europa.eu/data-and-maps/indicators/energy-efficiency-and-energy-consumption-5/assessment*

Figure 11.3 Fuel Types Used for Electrical Power Generation in Ireland, 2007-2014 (Source: CER, 2015)



Renewable Energy

Energy derived from sustainable sources such as wind, sunlight, oceans, geothermal, biomass and biofuels is referred to as renewable energy. Ireland has considerable renewable energy resources, only a fraction of which are utilised to address our energy requirements. See *www.seai.ie/Renewables/* for information. The deployment of associated technologies, including wind turbines, solar panels (photovoltaic and thermal), has increased significantly in recent years.

Wind, ocean, solar, hydro and geothermal energy do not produce GHG emissions or emissions of air pollutants such as particulates, sulphur dioxide and nitrogen dioxide. Use of these renewable resources can have considerable co-benefits for human health and ecosystems. Meeting energy requirements from renewable resources can provide significant economic and employment benefits at local to national scales.

Bioenergy arises from combustion of various materials, including wood, animal wastes, and liquid biofuels such as biodiesels and alcohols. Historically, wood was the largest renewable energy source in Ireland; however, it was largely derived from unsustainable harvesting practices which led to Ireland's forest being steadily reduced so that just 1.5% of the total land area was under forest in the early 20th century (DAFM, 2008).

Sustainable bioenergy has the potential to replace some fossil fuels but a range of support measures will be required to incentivise this switch. *Ireland's Transition to a Low Carbon Energy Future 2015-2030* (DCCAE, 2015) includes measures to introduce a Renewable Heat Incentive from 2016 to reward each unit of renewable heat produced and used. Unsustainable bioenergy production can result in significant emissions of GHGs, while the biomass combustion process, particularly at a domestic level, and if not adequately regulated, can produce considerable emissions of air pollutants.

Use of solar energy in Ireland has been limited thus far to direct water heating. However, the improvement in efficiency of photovoltaic (PV) technologies and the remarkable decline in their costs mean that there has been an increase in the use of these technologies to provide electrical energy, with systems being installed in public, commercial and private buildings. If the trends in technological development and cost continue then PVs may become a major source of energy for Ireland.

The Residential Sector: the Second Largest Energy User (After Transport)

There are big opportunities for improvements in energy efficiency and cost savings for older homes.

The residential sector accounted for approximately 25% of energy used in 2014 (Figure 11.1). The profile of residential energy use is shown in Table 11.1. There has been a considerable shift from coal and peat to oil and particularly gas since 1990. Although electricity use has also grown, oil still dominates residential heating.

Residential energy use in Ireland peaked in 2010. Since 1990 there has been a move away from coal and peat to oil, gas and electricity. However, fossil based energy sources still predominate.

Table 11.1 Residential Energy Use in Ireland (Source: SEAI)

Residential energy use (GWh)	1990	2010	2014
Coal	7,277	2,957	2,546
Peat	8,430	2,948	2,325
Oil	4,528	14,690	9,967
Gas	1,364	8,253	6,229
Electricity	4,142	8,546	7,704
Renewables	520	631	754
Fossil fuels (total)*	21,598	28,848	21,068
Total	**26,260**	**38,024**	**29,526**

*Fossil fuel (total) is the sum of coal, peat, oil and gas use, while the final Total column also includes electricity and renewables use.

Significant improvements to the energy efficiency of housing have been evident since 2000 as a result of improved building regulations (e.g. the Building Energy Rating scheme – see topic box "Building Energy Rating" and Figure 11.4).

Building Energy Rating – Opportunities for Energy Efficiency and Cost Savings for Householders

The Building Energy Rating (BER) is a home energy rating from A to G. It is based on energy performance and CO_2 emissions. A-rated homes are the most efficient and will have the lowest energy use and costs.

Figure 11.4 shows the distribution of BER-certified homes in 2014. It can be noted that 50% of houses tested were rated D or lower. This represents both a considerable ongoing cost for these households and significant opportunity to improve energy efficiency.

Figure 11.4 Distribution of BER-certified Homes in 2014 (Source: SEAI BER data)

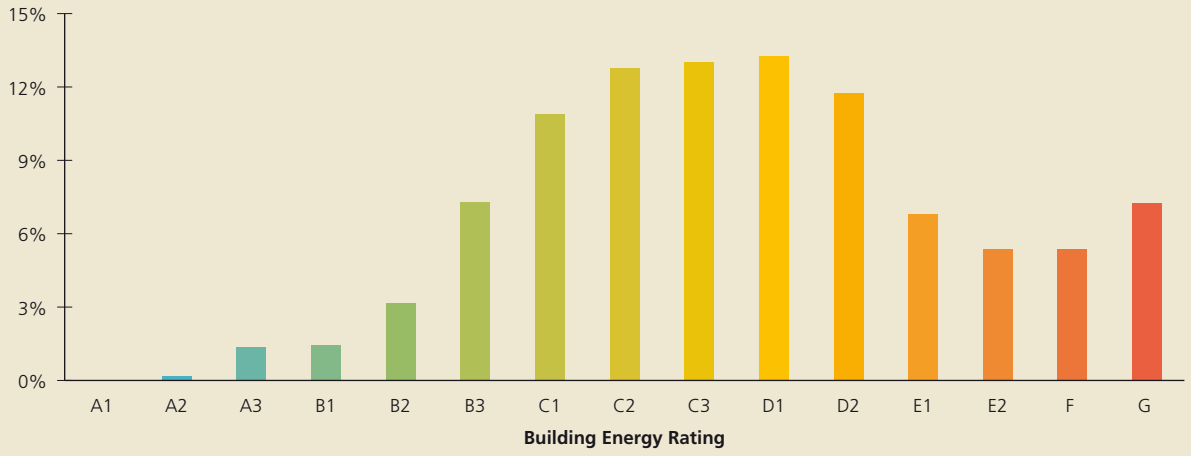
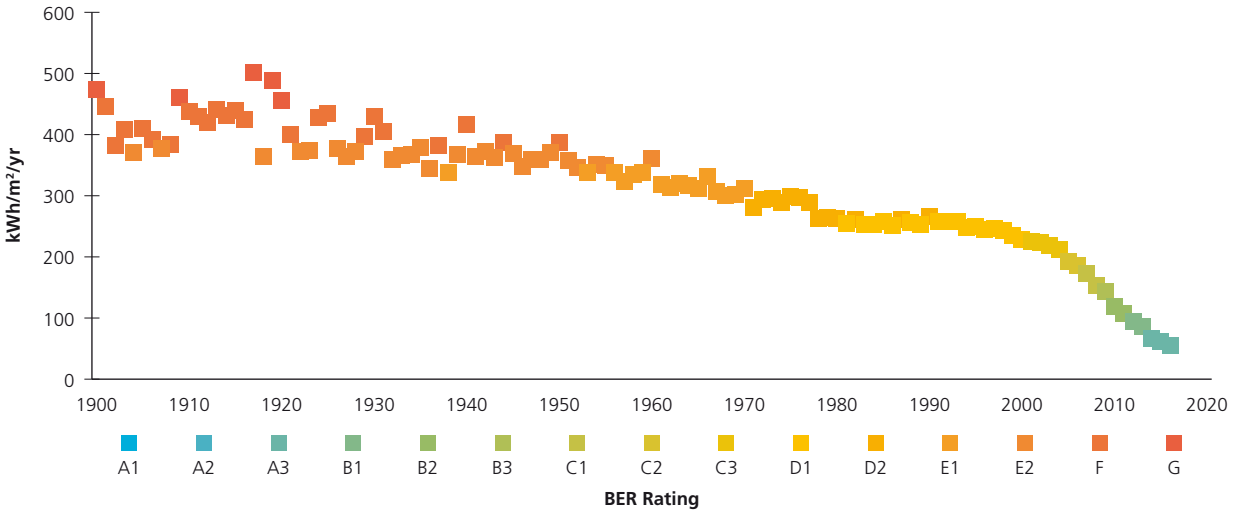


Figure 11.5 Average Building Energy Rating of Dwellings Constructed Since 1900 (Source: SEAI)



A Significant Increase in Retrofitting of Homes and Businesses is Essential

Approximately 75,000 homes and businesses will need to be upgraded for improved energy efficiency every year between now and 2020 if Ireland is to achieve the EU's 2020 energy efficiency target.

Retrofitting of the housing stock to reach BER grade A is an essential action to reduce GHG emissions. Upgrading a C-rated house to an A rating can reduce energy use from an average of 220 kWh/m² to 67 kWh/m² (TEP, 2015). This represents a major increase in comfort and long-term savings in energy costs. The "nearly zero-energy building" is a building standard that has a very high energy performance with the energy requirement being met to a significant extent by renewable sources. Recent (SEAI, 2016) data show that approximately 75,000 homes and businesses will need to be upgraded for improved energy efficiency every year between now and 2020 if Ireland is to achieve the EU's 2020 energy efficiency target. This is a very significant and immediate challenge.

Tipperary Energy Agency Warmer Homes Insulation Scheme

Since 2004, the Tipperary Energy Agency (TEA) has worked on a series of projects to support the retrofit of thousands of houses to bring these houses to grade D1 (from grades E-G) and to grade B3 standards, (from grades C1-C3) respectively. However, TEA determined that existing housing could be retrofitted to a better standard that virtually eliminates fossil fuel use.

In 2015, the TEA, under the SEAI Better Energy Finance Pilot programme, completed renovations of 10 private houses and achieved an average reduction of 153kWh/m²/yr, reducing energy consumption from 220 kWh/m²/yr on average (C3 standard) to 67 kWh/m²/yr on average (A standard). This near zero-energy building standard of retrofit (SuperHome Retrofit) included the provision of designed ventilation, air-tightness and an air source heat pump heating system. Retrofitting of a further 25–30 homes is due to be completed in 2016, leading to an estimated 60–70% reduction in household carbon dioxide (CO_2) emissions from these homes. This retrofit also resulted in a significant decrease in particulate emissions from open fires or stoves. See *www.superhomes.ie* for more information.

The Tipperary Energy Agency example shows how both learning and the effective use of incentives and innovative financing schemes can rapidly advance this retrofit process. Deep retrofits involving very extensive insulation and major energy efficiency measures, coupled with greater use of renewables on the electricity grid and the phasing-out of peat and coal over the next decade, can significantly lower CO_2 emissions from the domestic sector. Such approaches need to become central to the national discourse on actions to improve the quality of the national housing stock and the quality of life and health of communities.

What is Being Done (Energy Policy)

In 2014, renewable energy accounted for approximately 8% of all energy used, mainly from bioenergy and wind power; our target for 2020 is 16%.

The Renewable Energy Directive (2009/28/EC), which is incorporated into the EU 2020 Climate and Energy Package, requires Ireland to meet 16% of its energy needs from renewable sources by 2020. There are also specific national targets established under the National Renewable Energy Action Plan targets for electricity, transport and heating, for example that renewable energy should supply 12% of heating, 40% of electricity and 10% of transport energy requirements by 2020.

In 2014, renewable energy made up approximately 8% of energy used, mainly from bioenergy and wind power (SEAI, 2015a), which is some way short of our 16% target. Currently, 23% of electricity generation is from renewable sources (half of 2020 target): this has reduced annual energy imports by €255 million and avoided 2.6 Mt of CO_2 emissions. Renewable energy also supplied 6.6% of heating requirements and 5.2% of transport energy requirements.

A Bioenergy Strategy is, among other initiatives, expected to introduce an Exchequer-funded renewable heat incentive scheme in 2016, which will be aimed at larger commercial and industrial installations. In addition, enabling policies will address supply chain challenges through the establishment of a biomass feedstock planning scheme to optimise the supply chain in a sustainable manner.

There is a clear need for technological developments that would allow for energy storage systems to assist in the management of energy systems in Ireland. Significant innovations are anticipated in the United States of America (USA) and elsewhere, with local storage linked to local generation emerging as a model at household and community level. Such developments can have co-benefits for resilience and flexibility, as severe weather can cause significant network problems. Distributed and local storage, in combination with modern grid and energy management technologies, can be part of a robust and resilient energy system.

Energy efficiency enables achievement of the same or improved performance using less energy. Energy use in Ireland in all sectors is very inefficient, giving rise to increased energy costs, cold and uncomfortable housing, as well as emissions of carbon dioxide and other air pollutants. Increasing energy efficiency, through the insulation of buildings and use of efficient lighting and appliances, has multiple benefits inducing reduced energy costs and improved air quality.

The EU Energy Services Directive (2006/32/EC) provides the framework for energy efficiency policy. The National Energy Efficiency Action Plan sets out how Ireland will meet its energy efficiency goals. Ireland has a national target to deliver a 20% reduction in energy costs as a result of improved energy efficiency by 2020. Government bodies will lead in this process and have a higher efficiency target of 33%. According to the SEAI's *Annual Report 2015 on Public Sector Energy Efficiency Performance* (SEAI, 2015b), efficiency gains have been achieved through better energy management, building and facility upgrades, retrofit, and changes in transportation. By 2014, just over 50% of the required savings had been achieved.

Home Energy Storage Enters a New Era

Recent developments in residential solar power in the USA include a "Powerwall battery" for the home energy storage market, while another company has unveiled a "lightweight battery system" for homes and small businesses that offers a longer lifespan and does not require expensive cooling and ventilation systems. The growing popularity of residential solar panels is increasing interest in batteries that could store electricity from those installations. In the future, such storage systems could benefit homeowners by giving them more control over how and when they obtain the power they need, while helping utilities by shifting demand to off-peak hours and smoothing out the load on the system.

www.technologyreview.com/news/541336/home-energy-storage-enters-a-new-era/

The *Offshore Renewable Energy Development Plan* (OREDP) was published in 2014[5] and identifies the sustainable economic opportunity for Ireland in the period to 2030. The OREDP sets out key principles, policy actions and enablers that provide a framework for the development of the sector. The OREDP identifies opportunities for the

5 *www.dcenr.gov.ie/energy/en-ie/Renewable-Energy/Pages/OREDP-Landing-Page.aspx*

sustainable development of Ireland's offshore renewable energy resources. Its implementation will facilitate increased indigenous production of renewable electricity, thereby contributing to reducing GHG emissions, improving energy security and creating employment.

Ireland's position in the Atlantic Ocean gives it an almost unparalleled offshore energy resource, with suitable conditions for the development of the full range of currently available offshore renewable energy technologies.[6] Offshore wind is considered to be technologically mature, but regulatory and support systems will be needed to incentivise developments. However, given the levels of investment required, these are likely to be delivered by international consortia rather than local communities.[7]

The Energy White Paper – Ireland's Transition to a Low Carbon Energy Future

This White Paper sets the blueprint for a major transformation of Ireland's energy system, including elimination of fossil fuel use.

Ireland's Transition to a Low Carbon Energy Future 2015-2030

The Government's White Paper on Energy envisages a low-carbon future that will require us to take the necessary steps to:

- radically change our energy usage profile as citizens, industry and Government;
- become more energy efficient;
- generate our electricity from renewable sources of which we have a plentiful indigenous supply;
- move to lower emissions fuels (e.g. moving from peat and coal to gas);
- increase our use of electricity and bioenergy to heat our homes and fuel our transport;
- support the wide-scale deployment of renewable heat in the business, public and residential sectors.

The Energy White Paper *Ireland's Transition to a Low Carbon Energy Future 2015-2030*[8] sets out a framework for a major transformation of Ireland's energy system, including the elimination of fossil fuel use. The aim is to enable Ireland to realise the maximum potential of its renewable energy resources in a cost-effective and sustainable manner. The White Paper sets out our energy future and outlines three core objectives of sustainability, security of supply and competitiveness. It strives to strike a balance between these three pillars, whilst ensuring a low carbon future. The White Paper highlights the need for greater community and citizen engagement in this process, the opportunities for electricity in wider decarbonisation, and the need to improve grid links with Europe.

Sustainable Energy Communities

Community projects involving energy efficiency and renewable energy have a very important role in the energy transition.

Sustainable energy communities are those in which a community works together to develop a sustainable energy system to fit their own energy requirements. This exemplifies the transition process. It is generally a two-step process in which energy-wasteful activities and processes are identified and reduced or eliminated as part of an energy efficiency process. The second step is to replace fossil energy with renewable energy. This is largely carried out in a decentralised manner. A sustainable energy community can include a wide range of energy users, e.g. homes, businesses, sports clubs, community centres and churches, and a number of them are supported by the Sustainable Energy Authority of Ireland (SEAI), which aims to build capacity and share learning.[9]

6 *www.oceanenergyireland.com/*

7 *www.seai.ie/Renewables/* and *www.seai.ie/Publications/Statistics_Publications/Energy_in_Ireland/Energy_in_Ireland_Key_Statistics/Energy-in-Ireland-Key-Statistics-2014.pdf for more information.*

8 *www.dccae.gov.ie/energy/en-ie/Energy-Initiatives/pages/white-paper-on-energy-policy-in-ireland-.aspx*

9 *www.seai.ie/SEC/*

Case Study of the Aran Islands' Sustainable Energy Community

Over 350 homes and community buildings on the Aran Islands, two-thirds of the total, have undergone complete energy upgrades, involving improvements in insulation and installation of efficient heating systems, with support from the SEAI. This is resulting in more comfortable homes and lower energy bills, with total annual energy savings accruing to the islanders of €250,000. A trial of electric vehicles has also demonstrated how transport fuel needs can be dramatically reduced. Analysis shows that energy imports could be reduced even further by replacing heating systems with heat pumps powered by wind or wave energy in the future.

www.seai.ie/News_Events/Press_Releases/2015/Aran-Islands-Take-Action-to-Eliminate-Fossil-Fuel-Dependence-.html

Future Energy Distribution Systems

There needs to be a clear vision of the future: multifunctional and Smart energy management systems for Ireland.

Ireland's energy distribution systems need to be upgraded to ensure that they are fit for purpose for this century. Future energy distribution systems will need to be responsive to diverse user needs, flexible to new and emerging technologies, and resilient and robust in the face of increasing climate change impacts. The transition from centralised and fossil-based energy to more distributed and renewable-based energy systems poses challenges for existing grids and energy infrastructures which will need to be addressed.

It is also important that future grids are developed in a manner that enables positive community engagement. Further interconnectivity with the UK and Europe is also needed. The cross-border Renewable Integration Development Project is currently working to identify the optimum configuration of the electricity transmission grid in the north and north-west of the island to cater for renewable energy sources. Similar development and investment will be needed on an all-island basis to achieve the required decarbonisation of energy systems.

The transition process will be challenging for existing infrastructures and systems, significant elements of which are likely to need to be replaced. This process needs to be carried out in a manner that addresses the technical issues associated with the transition to a grid system that is fit for renewables, including microgeneration. Societal, institutional and socio-economic barriers also need to be addressed. Overall continued investment in the network and smart energy management systems is essential to meet customer and citizen needs. Clear information to inform consumer decisions over short, medium and longer timescales is needed. Future incentives and technical innovations in grid management systems are required to allow microgeneration to expand and to enable electrification of heat and transport. Central to this is a clear vision of the future multifunctional grid for Ireland.

Current plans for Ireland's future energy system include "Grid25". This is a high-level strategy outlining how EirGrid intends to undertake the development of the electricity transmission grid in the future, to support a long-term sustainable and reliable electricity supply. The

purpose of the upgrade is to allow the infrastructure to meet Ireland's future energy requirements, and aims to reinforce the transmission system. It also proposes an alternative for Grid West, which would include significantly less new overhead cable.

A "smart grid" is an electrical network in which power generators, electonic devices and distribution networks are interconnected via communication and smart processing technologies. Such a system could enable more distributed power generators such as combined heat and power (CHP), wind turbines, and micro-renewables (domestic wind turbines and photovoltaic systems), which could reduce electrical distribution losses and improve overall energy efficiency. A smart grid could also respond rapidly to emergencies (such as a power station failure) by reducing non-essential electrical loads in sequence to prevent the entire network from collapsing.

Carbon Lock-in, Outlook and Future Challenges

Transition to a carbon-free energy society and economy creates opportunities at a range of scales and will involve public and private investment.

With a 90% dependency on fossil energy Ireland is highly locked into carbon-intensive systems in electricity generation, transport and heating. This reflects infrastructure lock-in, as well as societal and cultural lock-ins. Investment, innovation, information, education and behavioural change are needed to overcome this damaging cycle and enable our society to embrace renewable alternatives. Renewable systems need to be backed up by information and education, as well as proper support structures so that individuals, communities and organisations can work together to take ownership of this complex challenge.

Transition to a carbon-free energy society and economy creates a new opportunity for many actors at a range of scales and will involve public and private investment in energy infrastructures, energy efficiency and innovative management systems. Approaches to and technologies used in transport and heating will also have to change, with electrification becoming a key option for both of these sectors. However, syngas (produced by the gasification of a carbon containing fuel) and other alternatives such as hydrogen power are also likely to have significant future roles. Investments need to be coupled to progressive policies and information provision in particular to enable engagement and ownership by citizens and other energy users.

Case Study of Aurivo Dairy Biomass Project

Aurivo Dairy Ingredients achieved a 70% reduction in oil consumption and a 50% reduction in carbon emissions when it installed a €5.25 million state-of-the-art biomass facility at its Dairy Ingredients plant in Ballaghadereen, Co. Roscommon. Aurivo was using 5.5 million litres of heavy fuel oil per year. This has now been replaced with 27,500 tonnes of wood biomass at 55% moisture content, and this fuel switch alone represents an annual saving of 17,160 tonnes of carbon.

www.seai.ie/Your_Business/Large_Energy_Users/LIEN/LIEN_Events/Events-2014/Biomass-Solution-for-Aurivo-Dairy-Ingredients-.pdf

Fossil Fuel Subsidies

There are calls at a global level to phase out subsidies for fossil fuels.

The Global Commission on the Economy and Climate's report, *The New Climate Economy: Better Growth, Better Climate*, calls for a phase-out of subsidies for fossil fuels as part of its 10-point Global Action Plan.[10] These subsidies are diverse and include those provided for exploration, production, distribution and purchase of fossil fuels including coal, peat, oil and gas. The International Energy Agency (IEA) latest estimates indicate that fossil fuel subsidies for consumers, in 2014, were US$493 billion. Those subsidies were over four times the value of subsidies to renewable energy.[11]

In Ireland, fossil fuel subsidies are estimated to be €386 million annually. This is made up of the share of the public service obligation (PSO) levy allocated to subsidising peat and securing gas supply, totalling €169.2 million in 2014, combined with elements of the fuel allowance payments to low-income households of about €217 million annually.

Energy Statements

Making information available to consumers promotes energy saving.

Key information on energy use is not readily available to households and businesses. It is recommended that multi-annual and detailed information on energy use is provided to users. The provision of such energy statements should become the norm for all centralised suppliers and enable users to assess where they are on the energy use spectrum

10 *newclimateeconomy.net/content/new-climate-economy-january-update*

11 *www.worldenergyoutlook.org/resources/energysubsidies/*

benchmarked against peers and best practice, e.g. with improved efficiencies. Such statements could include details on financing options to increase efficiency.

In this regard, the smart meter allows very accurate recording of an electricity consumer's true consumption, and it allows this data to be read remotely. This potentially allows consumers greater freedom in their choice of tariff and, in the future, may also enable consumers to know their exact carbon footprint from their electricity consumption.

Conclusions and Future Challenges

Key High Level Messages

Currently fossil fuels provide approximately 90% of Ireland's energy this is causing significant adverse effects on human health, ecosystems and our climate system.

The planned phase out of fossil fuel use and deployment of renewable energy resources will be central to a major transformation of Ireland's energy systems in the coming decades.

This will require large-scale public and private investment in energy infrastructure, energy efficiency and innovative management systems, including smart distribution and storage systems.

Information provision and positive engagement with citizens and stakeholders is essential for the success of this process, to include communities, public bodies, energy providers and users.

Significant investments in retrofitting existing public and private buildings to high energy efficiency standards is a priority and new building should meet the highest efficiency standards.

Meeting our energy targets and effectively transitioning towards a carbon-free society represents a huge economic and societal opportunity for the country. Clearly, the outlook for energy is very challenging. Fossil fuels make up about 90% of Ireland's current energy profile – as outlined in the Energy White Paper these need to be phased out and replaced with readily available renewable energy resources such as wind, solar and tidal. Already Ireland faces challenges in meeting its renewable energy targets. Significant ramping up of actions is required as well as much greater local involvement and input into the process.

The Energy White Paper sets out the blueprint and associated actions for Ireland's transition to a low-carbon energy future. It is clear that there are many specific challenges to address to achieve this vision, and regular reports on the status of the planned outputs would be a useful initiative to allow progress to be tracked and measured. Investment in clean and sustainable energy solutions is needed. Global energy systems will need to undergo a major transformation in the coming decades. Energy distribution and storage systems are also a factor to consider as part of the vision for energy saving, decarbonisation and community engagement.

Large-scale public and private investment in energy infrastructure, including energy efficiency and innovative energy management systems, energy distribution and smart grid systems, is required. Major investment is urgently required to transition to a multifunctional grid system that is fit for renewables including microgeneration. Sustainable energy communities could be supported to work together to significantly reduce energy-wasteful activities, and replace fossil fuels with renewable energy alternatives.

Progressive policies and information provision to support citizens to engage with the new energy future are required, as is envisaged by the White Paper. There are very clear wins for citizens in terms of energy savings by retrofitting older and less energy-efficient housing stock to reach higher energy ratings. Retrofits of the housing stock, especially older houses, as well as commercial and public buildings to reach BER grade A is a national climate change-related project that could be prioritised through more targeted action programmes. This project would also benefit householders in terms of comfort and savings on heating bills.

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