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Skills for Zero Carbon

The Demand for Renewable Energy, Residential Retrofit and Electric Vehicle Deployment Skills to 2030

National Skills Council

Expert Group on Future Skills Needs

An Gasra Saineolaithe um Riachtanais Scileanna sa Todhchaí

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Acknowledgements

The Expert Group on Future Skills Needs would like to record its appreciation to the members of the Steering Group established for this study, for contributing their time, valuable knowledge and expertise. The membership of the Steering Group is set out in Appendix II.

Special thanks are also due to the many industry executives, academics and staff in expert organisations and State agencies who gave their valuable time and insights through interviews and at workshops.

The Expert Group on Future Skills Needs would also like to acknowledge the high-quality work and expertise of AECOM Ireland Limited, who were commissioned to undertake this study on behalf of the EGFSN.

Introduction to the Expert Group on Future Skills Needs

The Expert Group on Future Skills Needs (EGFSN) advises the Irish Government on the current and future skills needs of the economy and on other labour market issues that impact on Ireland's enterprise and employment growth. It has a central role in ensuring that labour market needs for skilled workers are anticipated and met.

Specifically, the EGFSN:

- Carries out research, analysis and horizon scanning in relation to emerging skills requirements at thematic and sectoral levels. Steering Groups comprising of experts from relevant enterprise sectors and the education and training sector may oversee sectoral research studies to be undertaken or commissioned by the EGFSN. Drawing on statistical input and analysis from the SLMRU and consultation with the enterprise/education experts as part of the study, draft reports setting out the projected needs are prepared by the EGFSN.
- Engages with the HEA, SOLAS, QQI, the Regional Education Fora, and education and training providers in the course of its research.
- Engage with DFHERIS, the HEA, SOLAS and other relevant bodies to produce agreed action plans to address the skills needs identified.
- Submits the findings of its research and agreed Action Plans to the National Skills Council prior to publication.
- Disseminates its findings to the Regional Skills Fora and other relevant groups.

The Enterprise Strategy, Competitiveness and Evaluations Division within the Department of Enterprise, Trade and Employment provides the EGFSN with research and analysis support.

Foreword

This Expert Group on Future Skills Needs report seeks to support the delivery by 2030 of some of the key enabling actions in the Government's Climate Action Plan- the ambitions to boost onshore and offshore wind energy generation, an increase in solar energy generation, the energy efficient retrofit of the existing housing stock, and the uptake and maintenance of electric vehicles on Ireland's road network.

At both a global and domestic level, the need to urgently accelerate the transition to a Zero Carbon Economy is reflected in binding targets for emissions reduction over the next decade and, ultimately, carbon neutrality by 2050. In the Irish context, this will be driven by the Climate Action and Low Carbon Development Act, and its associated system of sectoral carbon budgets, which seek to achieve steep reductions in Ireland's carbon emissions by the 2030 deadline.

By identifying the nature and scale of the skills required across wind, solar, retrofit and electric vehicle deployment, the report seeks to support this level of emissions reduction through significantly enhancing the role of renewables in energy generation, the built environment sector's energy efficiency performance and the electrification of road transport. The report recognises that this transformational change for the economy and society will lead to changes in sectors and occupations, the phasing out of existing roles, but also demands for new skills and competencies, as well as employment opportunities, in the new Zero Carbon economy.

The development of this report involved comprehensive engagement with stakeholders across Ireland's wind and solar energy, residential retrofit and electric vehicle sectors, as well as insights from international experience of the Zero Carbon transition. The report sets out to define the Zero Carbon Economy- the challenges involved and existing employment levels; to understand its core occupations and skills; seeks to identify best international, as well as domestic, practice for the development of Zero Carbon skills; and identifies a range of broader issues related to skills development in Zero Carbon activities.

On the basis of this analysis, as well as quantitative occupational demand forecasts in the key areas of focus, the report makes 30 recommendations across six themes- (1) Renewable Energy, (2) Retrofit, (3) Electric Vehicles, (4) Promotion of career pathways in Zero Carbon economy activities, (5) Alternative sources of skills supply for Zero Carbon economy activities, and (6) Public Sector Programme Management and Carbon Accounting skills- in order to secure the necessary level of skills supply in the years to 2030.

I would urge the National Skills Council, as well as Zero Carbon Economy stakeholders across the public and private sectors, to urgently consider these recommendations and facilitate their implementation.

On behalf of the EGFSN, I would like to thank all of the contributors to this report who so generously gave of their time and expertise. I would also like to express my thanks to the members of the project steering group, in particular its chair, Conor Minogue, for their insights and support in finalising the report. Finally, I wish to acknowledge the EGFSN Secretariat, based in the Department of Enterprise, Trade and Employment, for managing and leading this study to a successful conclusion.

Tony Donohoe

Chairman

Expert Group on Future Skills Needs

Executive Summary

Across the globe, it has become increasingly clear that the transition to a zero carbon economy must urgently accelerate. In Ireland, in the context of an ambition for carbon neutrality by no later than 2050, as set by the Climate Action and Low Carbon Development Act, the Climate Action Plan and Programme for Government (2020) have set ambitious targets to substantially reduce emissions by 2030; the most significant targets that have been set, and on which this report focuses, are those relating to the significant public and private investment in renewable energy, electric vehicles and the retrofit of the housing stock.

This requires a transformational change of how the economy and society operates, which in turn, brings about changes in sectors and occupations, with resultant demands placed on workforce skills and competencies. The economy's future competitiveness will be tied to its ability to decarbonise. The labour market must adapt to the changing need, as enterprises and employers source the appropriate level of skills for the Irish workforce, while employees in certain 'sunset' sectors face uncertainty as their roles are phased out. The message is clear – there is much work to be done to transition to a zero carbon and resilient economy and this report identifies the biggest challenges in terms of distinguishing between a skills shortage within certain occupations and an overall labour shortage within other occupations required for the renewable energy, retrofit and electric vehicle transformation.

Learning from the Past

While many countries find themselves in unprecedented times, facing new sets of climate change related challenges and requiring a switch in behaviour to the transition pathway while developing different and emerging skillsets, there is little doubt that there will be significant change in 'how' workplaces and society function. This study explores the new and emerging skills, but also casts back, and reflects on lessons learnt from past initiatives that have been undertaken to facilitate the zero carbon transition. Most significant are the skillsets required at a societal level, to manage the transition. We have termed these Programme Management skills, reflecting the need to coordinate a very complex transformation.

Stakeholder and Industry Engagement

A process of industry and key stakeholder engagement, which was undertaken between January and April 2021, underpins this report. This comprised of 20 key stakeholder interviews, 40 interviews with businesses and enterprises operating in the retrofit, renewable energy and electric vehicle markets and two workshops, attended by a mixture of government, training providers, industry bodies, employee representatives and businesses. The section on 'preparing for the future' presents a synthesised summary of this engagement, which underpins the labour market analysis.

Labour Market Analysis

The greatest skills challenges for the transition to a zero carbon economy relate to achieving the housing retrofit targets, specifically the imperative to ramp-up the number of houses with completed deep energy retrofit by mid-decade. It was determined in a recent Expert Group Future Skills Needs report on the Built Environment (2020) that there are shortages in a number of construction occupations, and the requirements of the Climate Action Plan targets will exacerbate this. Overall, a shortage in craft occupations associated with retrofitting is likely by the middle of the decade, particularly those with the necessary skills to work on domestic retrofits. Measures are needed to address the provisioning of these skills, through upskilling existing craftspeople, while also continuing to attract new entrants to the sector to address the shortfall.

Achieving the allocation of skills required to attain the renewable energy targets is not without its challenges. For professional engineering occupations associated with renewable energy, there is a shortage of skilled people with relevant experience, rather than necessarily a shortfall in the overall number of engineers entering the profession- although there may be shortfalls within some specific disciplines. This points to upskilling requirements in emerging and niche engineering occupations. An existing overall shortage in construction occupations may constrain activity in the renewable energy sector, while additional training to prepare for working in an offshore environment will be required. The upskilling in energy renovations/retrofits will need to be flexible in terms of timing/scheduling of training, given that the industry is very busy, particularly with the pipeline of work that was suspended during COVID-19 workplace closures.

The analysis undertaken on the transition to electric vehicles showed less labour market friction, although a clear switch away from mechanical skills to working on high-voltage electric vehicles will occur over the next decade. While this will require upskilling within the motor repair industry, the reduced maintenance and repair requirements for electric vehicles compared to conventional internal combustion engine vehicles may create new challenges in terms of sustaining current levels of employment in the sector.

The table below summarises the Labour Market Analysis conclusions for each main occupational group, along with relevant supply strategies to inform the recommendations.

Occupation	Labour Market Analysis Summary	Relevant Supply Strategies
Engineering	Other than Electrical and Retrofit Engineers/Designers, there does not appear to be a significant gap in FTE Labour Demand relative to overall HEI supply. There does appear to be a shortage of engineers with the necessary skills and experience to work in the sector.	– Boost availability of / capacity in Electrical, Energy and Building Services engineering courses – Increase exposure to Renewable Energy topics in third-level engineering courses – Provide more upskilling and CPD opportunities for engineers in topics relevant to the Zero carbon Economy
Environment, Planning, Legal and Professional	There does not appear to be a labour shortage relative to overall HEI supply. There does appear to be a shortage of professionals with the necessary skills and experience to work in the sector.	– Provide more upskilling and CPD opportunities professionals topics relevant to the Zero carbon Economy. – Explore measures to attract skilled professionals to Ireland
Construction	While formal labour supply indicators are not available for many construction occupations, there are likely to be labour shortages among general construction occupations relative to the projected increase in demand.	– Continue to implement recommendations of the Building Future Skills report to boost supply in construction occupations
Other Emerging and Niche Renewable Energy Occupations	A number of new occupations will be required in the Renewable Energy Occupations. Given their novelty, most currently lack direct and obvious routes for new entrants, which acts as a barrier to stable supply.	– Consider the creation of direct entry routes into Emerging and Niche occupations
Electric Vehicles	Current levels of training for EV technicians appears to be sufficient in the short-term, while the inclusion of EV training within the existing Motor Mechanic apprenticeship would likely ensure stable supply for most of the decade.	– Fully integrate EV training within the existing Motor Mechanic apprenticeship programme – Monitor developments in the overall labour demand for Vehicle Mechanics, and explore potential re-training pathways if necessary.
Craft & Retrofit	There appears to be significant labour and skills shortages among most craft & retrofit occupations relative to current supply indicators. This shortage will be particularly acute in the middle of the decade, when retrofit targets are expected to reach their maximum output. There is also a disparity in the numbers completing apprenticeships, and the low numbers subsequently undertaking further training to work in the retrofit sector (e.g. heat pump installation training for plumbers).	– Increase the provision and uptake of training for Retrofit occupations – Fully integrate Retrofit Occupations within relevant apprenticeship programmes

Recommendations

The list of recommendations arising from this study are presented in the table below. The recommendations resulted from collecting and collating ideas in the interviews and workshops that were held with industry and stakeholders. Once the labour market analysis was undertaken - which identified the demand for labour over the next decade while also considering the supply pathways for that labour - a long list of recommendations was drawn up. These were presented to the EGSFN Steering Group in a draft report. The recommendations were refined, identifying those with responsibility for implementation. The 30 recommendations are divided into six categories:

1. Renewable Energy
2. Residential Retrofit
3. Electric Vehicles
4. Promotion of career pathways in zero carbon economy activities
5. Alternative sources of skills supply for zero carbon economy activities
6. Public Sector Programme Management and Carbon Accounting Skills

Renewable Energy	
1.	Coordinate planning for training and upskilling within the renewable energy sector, including through establishment of training partnerships or responses for projects between Government, industry and education and training providers.
2.	Prioritise training provision for emerging occupations in Onshore and Offshore Energy and Energy Systems.
3.	Facilitate the expansion of existing offshore and maritime training to meet the increasing demands of the offshore energy sector.
4.	Engage with the fishing and other relevant sectors, such as the oil and gas industries, to source skills for offshore work.
5.	Upskill existing engineering, environmental and legal professionals, electrical workers and electricians in zero carbon skills, including through micro credentials and other Continuous Professional Development opportunities.
6.	Maximise alignment with industry needs and increase exposure to the Renewable Energy sector at third level for undergraduate engineering, environment and planning students.
7.	Increase the availability and capacity of electrical engineering programmes to meet demand from zero carbon activities, in particular Renewable Energy projects.
8.	Explore the creation of direct pathways into Emerging and Niche occupations in the Renewable Energy sector, such as Specialised engineering professionals, specialised ecology and environmental experts, legal and financial experts, project managers, Solar Technician and Marine equipment and ROV operatives, to stabilise supply. Also promote participation in the forthcoming Wind Turbine apprenticeship programme.
9.	Extend the skillsets of the existing zero carbon economy workforce into areas including commercial skills, electricity trading, adaptability, digital and technology skills, health and safety, problem solving and effective communication.

Residential Retrofit	
10.	Support job stability and longevity of careers in the retrofitting sector, by providing clarity on budgetary allocations for retrofit and by developing retrofit grant schemes that facilitate year-round activity.
11.	Ensure that the required number of retrofit training places in nZEB Centres of Excellence, as well as other providers of retrofit training, are properly resourced and available to meet the level of retrofit demand in the coming years.
12.	Improve the availability and flexibility of retrofit programmes in order to incentivise and facilitate employers in releasing staff for training.
13.	Increase training for Retrofit Engineers/Designers, including through an increase in the availability and capacity of Energy Engineering or Building Services Engineering degree programmes, postgraduate programmes and CPD training.

14.	Engage with and encourage the urgent upskilling of existing plumbers in the installation and servicing of heat pumps.
15.	Explore the full integration of retrofit occupations within relevant apprenticeship programmes.
16.	Continue to promote and improve the accessibility of apprenticeships to young people, including their role in addressing climate action.
17.	Facilitate adult participation in apprenticeships and traineeships, in particular for general operatives within the Construction sector.
18.	Enhance stakeholder engagement skills across the Retrofit sector in order to build awareness and trust in the benefits of retrofitting and to drive homeowner adoption.
19.	Assess the benefits of developing a register of workers who have upskilled in retrofitting, in order to underpin consumer confidence and demand for residential retrofit.
20.	Explore the utilisation of public procurement processes to incentivise participation in retrofit training.
21.	Upskill the existing Built Environment workforce in life cycle environmental assessment and sustainable renovation. Also increase the emphasis on life-cycle environmental assessment/'sustainable renovation' in undergraduate and post-graduate construction professional programmes.

Electric Vehicles	
22.	Engage the existing pool of motor mechanics and encourage and support their upskilling to work on Electric Vehicles, in particular through digital skills training, to improve the attractiveness of the sector overall, retain the existing labour force and attract new entrants.
23.	Progress the incorporation of Electric Vehicle material into relevant Apprenticeship Syllabuses to secure longer term Electric Vehicle maintenance skills supply.
24.	Provide and promote mandatory Electric Vehicle Safety Training to the existing mechanic labour force.
25.	Explore the introduction of recognised certifications as a requirement to work on Electric Vehicles and to foster consumer demand.

Promotion of career pathways within Zero carbon Economy Activities	
26.	Define and promote career opportunities, and associated education and training pathways, in the zero carbon economy to school leavers, in particular females, career guidance professionals and parents through industry and government outreach and promotional activities.
27.	Provide work experience opportunities for students and young people in zero carbon economy activities, including at TY level and through the new Work Placement Experience Programme for the young unemployed.

Alternative Sources of skills supply for Zero carbon Economy Activities	
28.	Promote career opportunities and skills mobility for zero carbon activities from other sectors of the economy through exploring opportunities for career pathways from or within sectors negatively impacted by the transition from fossil fuels or, where feasible, other factors such as the Covid 19 pandemic.
29.	Engage in a communications and outreach campaign to attract skills for zero carbon economy activities from the Irish diaspora and the broader pool of international talent

Public Sector Programme Management and Carbon Accounting skills	
30.	Develop programme management and carbon accounting skills within Government to support change and the transition to a zero carbon economy

Given the urgency of meeting Ireland's climate action goals, it is crucial that these recommendations are prioritised within national skills, labour activation and inward migration policy, and be centrally driven by Government, through a High-Level Implementation Group, working in close collaboration with industry and the education and training system in the years ahead.

1

Introduction

1 Introduction

There is emphasis on the urgency and immediacy of addressing climate change, which in turn places pressure on the labour market as it adapts to the changing needs. Ultimately, challenges are faced by enterprises and employers to find the appropriate level of skills as Ireland transitions to a zero carbon economy, and on employees in certain 'sunset' sectors that face uncertainty as their roles are phased out. There is a need to coordinate the upskilling and training response: in terms of activities required by education and training providers to ensure that skills needs are met, while also ensuring that there are no shortages of unskilled/ general labour that may be required.

The functioning of the Irish economy is predicated on continuous processes of innovation and change, and dominant drivers of change are the switch to zero carbon dependent processes and increased digitalisation. The transition to a zero-carbon economy massively affects all economic activity, and all industries and sectors will form part of the future zero carbon/net zero economy. The future competitiveness of the economy will be tied to its ability to decarbonise. It is acknowledged that the effects will be transformative across communities, workplaces and all aspects of the economy.

This will encompass a range of measures such as climate action within agriculture, enterprise or industrial heat decarbonisation, the bioeconomy, the circular economy, and non-electric vehicle sustainable mobility- the skills implications of which will require their own analysis. The lens of this particular study, however, is focused on the most substantial targets, and therefore core enabling measures contained within the Government's (2019) Climate action Plan to Tackle Climate Breakdown (henceforth the Climate Action Plan) i.e., those related to wind and solar energy generation, the energy efficient retrofit of the housing stock, and the deployment of electric vehicles.

1.1 Rationale and Objectives of the Study

In order to facilitate the reorientation of Ireland to a zero carbon economy, there is a need for concerted action by both public and private sector stakeholders, to deliver the nature and scale of skills and expertise across the enterprise base necessary to enable this transition.

The Climate Action Plan sets out the measures through which the magnitude of long-term climate change is to be mitigated through actions to reduce greenhouse gas emissions and decarbonise all sectors of the economy. The aim by 2030 was to reduce emissions levels by 30 per cent relative to 2005 levels – although the Programme for Government Our Shared Future (2020) and the Climate Action and Low Carbon Development (Amendment) Act have now embedded a commitment to 51 per cent reduction by 2030, with the ambition to reach zero targets by 2050. This also includes a commitment that 70 per cent of electricity needs will come from renewable sources by the end of this decade.

The ultimate objective is to transition to a competitive, zero carbon, climate resilient and environmentally sustainable society and economy by 2050. To achieve this objective, Ireland will require a change in its overall emissions trajectory of the order of a 7 per cent decline each year from 2021-2030, transitioning to zero net carbon emissions by 2050.

Emissions from energy used in transport, energy associated with using and heating domestic buildings and emissions associated with electricity production accounted for 47 per cent of Ireland's greenhouse gas emissions in 2019. Hence the ambitious targets set for these three sectors:

- **Energy efficient retrofit of buildings and installation of Heat Pumps and other renewable heating options:** Increase the cumulative number of residential buildings retrofitted to B2 BER to c.500,000 by 2030; and install c.600,000 renewable energy heating sources in residential buildings, including c.25,000 in commercial premises
- **Development of onshore and offshore Wind and Solar power energy generation:** The targeting of 5GW of offshore renewable wind energy, an increase in onshore wind capacity of up to 8.2GW, and generation of up to 1.5GW of grid scale solar energy
- **Rollout of a comprehensive Electric Vehicle (EV) fleet and charging infrastructure:** Development of a pool of mechanic skills and fast charging network (across key locations on national road network, new and existing non-residential buildings and garage forecourts) to support an ambition of having 840,000 EVs, including 95,000 electric vans and trucks, on the road by 2030.

Although many of the skills required for this transition exist in various occupations and workplaces, there is a need to identify emerging skillsets and the changing landscape in different occupations to facilitate the transition to a zero carbon economy.

This study:

i. Consisted of a labour market analysis to identify the nature and quantify the scale of the skills needs of enterprises supporting the transition to a zero carbon economy in the coming years. This included the development of skills demand forecasts based on a number of assumptions, including the targets set out in Irish Government and EU strategies

ii. Identified pathways to ensure the relevant skills are available, to facilitate the transition to a zero carbon economy, over the next decade

iii. Incorporated the perspective of stakeholders in each of the transport, electricity generation and construction sectors to gain a deep understanding of the skills required to move to a zero carbon economy

iv. Developed a suite of recommendations that can be drawn upon to ensure that the future skills needs of activities supporting the transition to a zero carbon economy are fully addressed by stakeholders through the education and training system and any other relevant sources of skills supply.

1.2 Methodology

- This study was conducted using a combination of primary and secondary sources, using both quantitative and qualitative data. In summary, these include:
- Twenty interviews with key informants to gather the views of significant government and non-government stakeholders
- Forty interviews with enterprises and industry bodies, to obtain the opinions of industry
- Two Virtual Workshops attended by trainers, education providers, policymakers and industry representatives to discuss and corroborate the future of skills in the zero carbon economy
- Development of a forecasting model to estimate future skills needs, using a bottom-up approach using the current labour input required to attain the targets set in the Climate Action Plan.

1.3 Scope of Evaluation

This report delivers a set of recommendations to anticipate labour supply shortfalls in the zero carbon sectors (retrofitting, electric vehicles and renewable energy) for the period 2020-2030. Recommendations are aligned with the EGFSN's remit and are limited to:

- Higher Education and Further Education and Training
- Upskilling/Reskilling
- Professional Development
- Net Migration
- Alternative Supply.

1.4 Structure of the Report

The report is structured as follows.

- **Section 2** introduces the zero carbon economy, in particular highlighting the scale of change that the climate targets require. It lists the significant policy changes that have occurred since 2015, a period that has seen an acceleration in planning and responding to the climate crisis. Although there is no agreed sectoral definition of what the zero carbon economy encompasses, this section reviews initiatives, data and emerging methodologies in this respect. It also presents a framework to understand the challenges of the skills switch into zero carbon activities, recognising that the timing and time constraints impose additional constraints on the transition.
- **Section 3** introduces the methodology used in this study to identify the zero carbon economy, in the Irish context of attaining our Climate Action Plan targets. As with any newly emerging sector, or reclassification of a sector given changing focus of activity, people working in that sector may be classified as working in other sectors, or their occupations may be required across a number of industrial sectors. Section 3 introduces the 'Core', 'Emerging' and 'Niche' occupations that are associated with the zero carbon sector.
- **Section 4** presents insights from initiatives, case studies and other sources to identify success factors (or failures) in terms of skills for the zero carbon economy. There is no blueprint available or a set pathway that all countries should follow, to transition to a zero carbon economy. There are some lessons that can be learned however, recognising that every country has a unique set of circumstances that need to be considered. Three international case studies (from the UK, Norway and the Netherlands) are used to show the importance of governance policy, leadership and programme management to facilitate the move into employment in zero carbon sectors and the development of the skills required. The UK is considered an early adopter in developing offshore wind energy, Norway is an early adopter in the switch to electric vehicles, while the Netherlands pioneered a Programme model for housing retrofits. Section 4 also presents case studies of selected initiatives undertaken to date in Ireland.
- **Section 5** presents findings and common themes from the stakeholder engagement undertaken for this study. Structured interviews were undertaken with over forty enterprises and companies working in the zero carbon sector, and a further twenty interviews with key informant stakeholders, including representatives from Government, education and training providers, semi-state organisations and industry organisations. Two workshops were also undertaken in February and March 2021, with approximately 40 participants in both workshops.

- **Section 6** presents the Labour Market Analysis, which contains estimates of both the additional demand for labour and occupations from the Zero carbon Economy, as well as indicators of existing supply through education, training and immigration. The Labour Market Analysis is based on a bespoke labour demand model developed for this project, which uses a 'bottom-up' approach to forecast the labour (both the quantity and types) required in order to achieve Ireland's renewable energy, electric vehicles and retrofit targets.
- **Section 7** presents recommendations on tailored measures to build up the supply, both domestic and international, of skills required to enable the zero carbon economy. Interviewees from industry and key informant stakeholders were asked to share their solutions to 'in an ideal world, what would you change to match skills with the task that is required?'. While some of the recommendations were directed at overcoming the constraints rather than being specifically skills related, the recommendations include a breadth of solutions for consideration by policymakers, industry and the education and training system.

2

Understanding the Sector

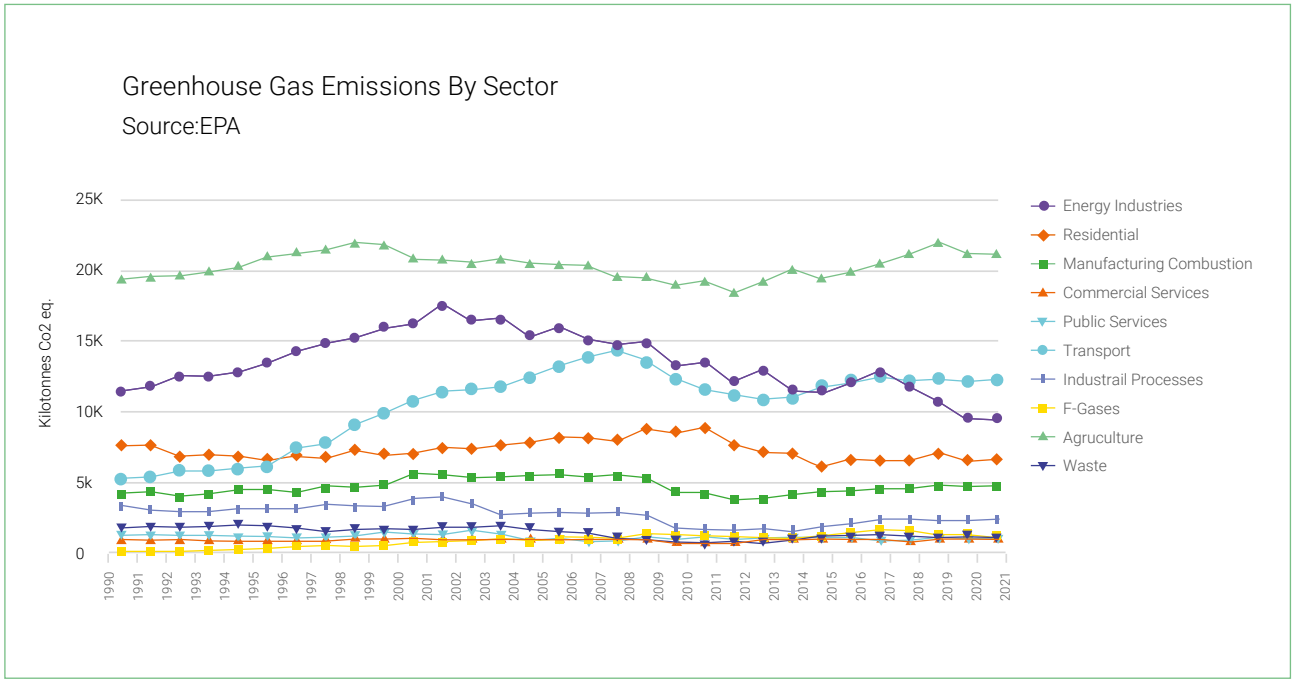
2 Understanding the Sector

2.1 The Challenge of transitioning to a Zero carbon Economy

The challenges facing people and society in switching activity away from economies and societies dependent upon fossil fuels is not unique to Ireland. Transitioning to a zero carbon-based economy requires transformational change across all sectors and indeed changes to how society operates across the globe. There are displacement effects on workers in 'sunset' sectors, and an increased demand for skills in the emerging zero carbon sector. This report addresses the challenges and constraints experienced in Ireland in transitioning to a zero carbon economy, from a people, employment and skills perspective, with a focus on renewable energy generation, energy-efficient retrofit of buildings and switching to an electric vehicle fleet and charging infrastructure.

The sectoral profile of Ireland's greenhouse gas emissions (in Figure 2.1) displays marked changes since 1990. Emissions from the energy industries have decreased since 2000, reflecting both growth in the renewable energy sector and the switch away from burning peat and coal for electricity generation. Transport emissions have more than doubled since 1990, reflecting the accompanying movement of people and goods when an economy and population is growing, as well as the patterns of settlement and urban development. Emissions from the residential sector (buildings and home heating) have remained relatively constant between 1990 and 2019, with peak emissions during certain years corresponding to cold winters when more home heating is required. The OECD (2021) note that Ireland's progress in delinking the economy from environmental pressures was uneven in the last decade, with emissions and waste generation rising with strong economic growth. While the climate, circular economy and biodiversity policies are identified as gaining a renewed emphasis, the OECD ibid. caution that these need to be swiftly implemented to alleviate the growing pressures from intensification of agriculture, demographic development, urban sprawl and road traffic.

Figure 2.1 Historic Emissions by Sector

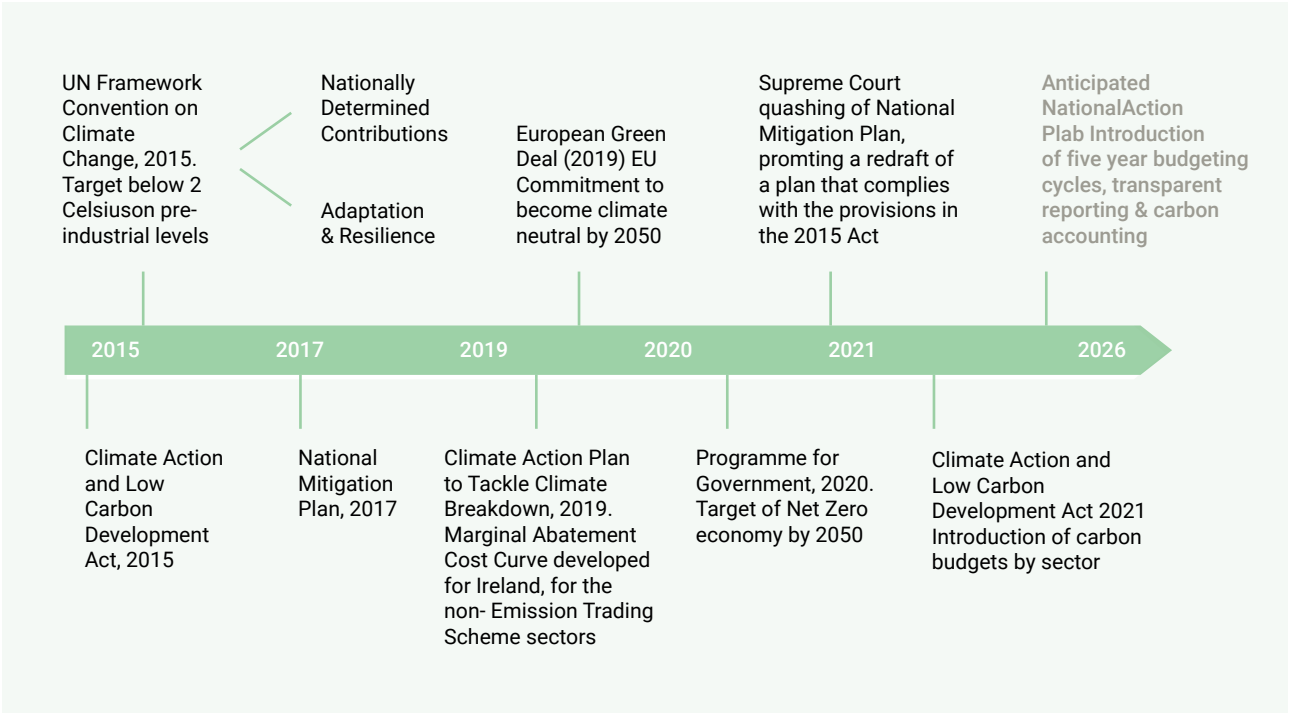


Source: Environmental Protection Agency, 2020

Ireland's national policy position to reduce CO2 emissions was prompted by international obligations under the United Nations Framework Convention on Climate Change, and the 2015 Paris Agreement that is legally binding for signatories. Figure 2.2 traces the more recent (i.e. since 2015) policy response to Climate Change, which also coincides with the adoption of the Sustainable Development Goals (SDGs) by the United Nations General Assembly. Since 2015 there has been a significant acceleration of the transition to a zero carbon economy, with the introduction of the Climate Action and Low Carbon Development Act in 2015, the National Mitigation Plan in 2017, and the publication of the Climate Action Plan in 2019. Concurrently, the EU published the European Green Deal in 2019, committing Europe to become climate neutral by 2050. This ambitious target was echoed in the newly formed coalition Government's Programme for Government in 2020, which sets out the Irish Government's commitment to an average 7 per cent per annum reduction in overall emissions from 2021 to 2030; and to achieving net zero emissions by 2050.

The Supreme Court ruling on the National Mitigation Plan in 2020 prompted the introduction of a Climate Action and Low Carbon Amendment Act in 2021, and a redraft of the National Climate Action Plan. Similar challenges have occurred elsewhere in Europe, such as the Urgenda case that was heard in the Dutch Supreme Court in 2019, and more recently in April 2021, Germany's Supreme Constitutional Court ruled that the government's climate protection measures were insufficient to protect future generations.

Figure 2.2 Recent Timeline of Policy Response to addressing Climate Change



Three sets of targets guide climate change policy in Ireland. Two of these targets were set at an EU level, and these are called the EU Effort Sharing Decision (ESD) and the EU Effort Sharing Regulation (ESR). These set Greenhouse Gas reduction targets for 2020 and 2030, respectively for all EU member states, with Ireland assigned a 20 per cent and 30 per cent CO2 equivalent reduction target, respectively, from 2005 emission levels. The ESD and ESR targets apply to non-Emission Trading Scheme (ETS) emissions only, including those arising from agriculture[1], transport, built environment and small industry. Irish emissions for the non-ETS sectors totalled 47.844 metric tonnes of CO2 equivalent in 2005. By 2019, this had dropped only 4.5 per cent from 2005 levels, to 45.711 metric tonnes of CO2 equivalent.

1 Agriculture is required to "approach carbon neutrality" and only where it does not compromise capacity for sustainable food production.

The third set of targets were laid out in 2014, in the National Policy Position for 2050. The Irish Government's plan to meet these targets were published in the Climate Action Plan to Tackle Climate Breakdown (2019), many of which were recommitted to in the 2020 Programme for Government.

The Climate Action and Low Carbon Development (Amendment) Act was passed by the Houses of the Oireachtas in July 2021, with a new 'National Climate Action Plan' published in October 2021. The previous aim to reduce emissions levels by 2030, by 30 per cent relative to 2005 levels was replaced in the Programme for Government and Zero carbon Amendment Act to a 51 per cent reduction. This will include the introduction of sectoral carbon budgets, and it is expected that five-year budgeting cycles will be introduced, along with transparent reporting and carbon accounting requirements.

While the targets may change, the delivery of three key elements of Ireland's Climate Action Plan will require additional skills and labour input. These are:

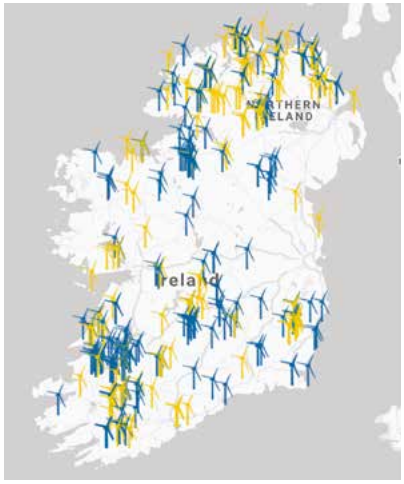
- Development of onshore and offshore wind and solar power energy generation
- Energy efficient retrofit of buildings and installation of heat pumps and other renewable heating options
- Rollout of a comprehensive electric vehicle fleet and charging infrastructure.

Renewable Energy Targets

The targets set in the Climate Action Plan 2019 related to the development of onshore and offshore Wind and Solar power energy generation. Specific targets were 3.5 Gigawatts (GW) of offshore renewable wind energy[2], an increase of onshore wind capacity of up to 8.2GW, and generation of up to 1.5GW of grid scale solar energy.

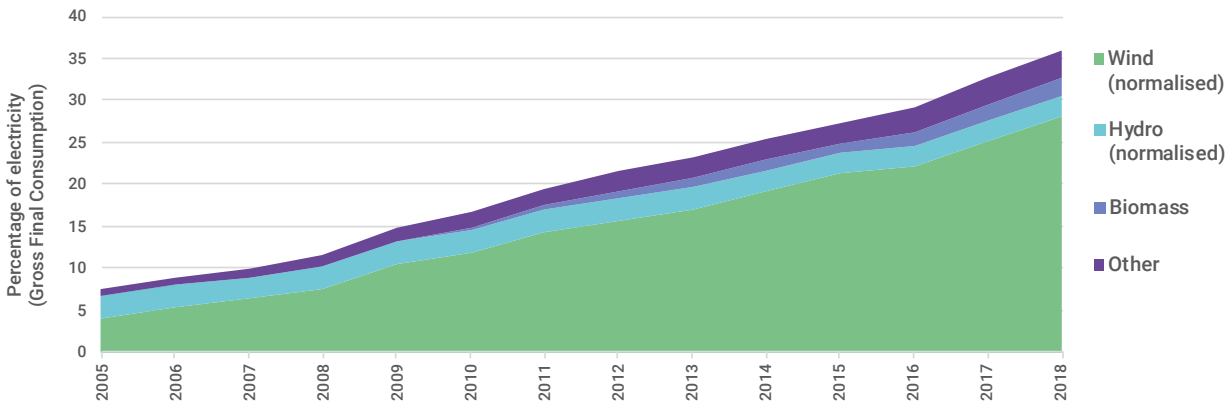
The Programme for Government 2020 set the target to deliver at least 70 per cent renewable electricity by 2030, with additional targets of prioritising the development of microgeneration, letting people sell excess power back to the grid by June 2021; ensuring that community energy schemes are included (with a community benefit fund and community category within the auction for supplying electricity); and to develop a Solar Energy Strategy for rooftop and ground-based photovoltaics, to ensure that a greater share of electricity needs is met through solar power.

Figure 2.3 Location of wind farm



Source: windenergyireland.com April 2021

Figure 2.4 Renewable Energy Share of Electricity Generation



Source: SEAI, 2021

2 Later increased to 5 GW under the 2020 Programme for Government

Figure 2.4 shows the considerable growth in renewable energy from 2005, largely due to the development of onshore wind energy. Electricity generated from wind accounted for 32 per cent of the total in 2019, which amounted to 10,019 GWh of electricity. There is 4,235MW (or 4.235GW) installed capacity in the Republic of Ireland, and as is evident from Figure 2.3, with large concentrations in the northwest, south and south west of the country. The Climate Action Plan target of 8.2GW is nearly double current capacity.

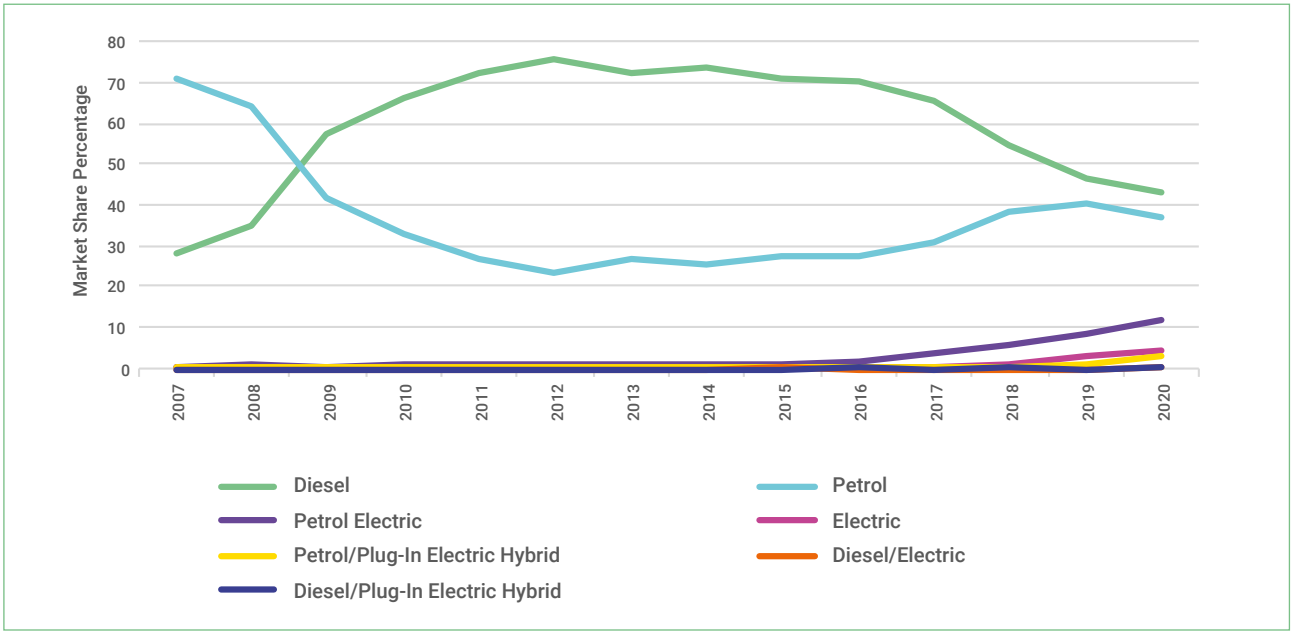
Solar accounted for only 21GWh of electricity generated in 2019[33], revealing that solar capacity is in its nascency in Ireland. Although the solar target in the Climate Action Plan was 1.5GW, the solar industry expects to deliver 5GW in the next ten years[44].

Overall, renewables' contribution to the electricity inputs increased by 13 per cent in 2019. Renewables accounted for 26 per cent of the inputs to electricity generation in 2019 but they were responsible for 38 per cent of the electricity generated. This is because non-combustible renewables such as wind, hydro and solar are considered 100 per cent efficient, and so no energy is lost in generating electricity, unlike traditional thermal generation such as coal or peat.

Electric Vehicle (EV) Targets

The Irish Government set a target of 936,000 EVs on Irish roads by 2030. However, the current market share of EVs is still low, accounting for only 4.5 per cent of new car sales in 2020, sitting slightly above the EU average of 3.6 per cent. This equates to 4,013 EVs sold in 2020. EV hybrids are also included in the EV target and combined with EV market share made up 19.8 per cent of new car sales in 2020, or 17,491 cars sold. On average, between 2016 and 2020, 120,000 cars were sold annually. Figure 2.5 and 2.6 shows the dominance of diesel and petrol vehicles in the Irish fleet. In order to reach the Climate Action Plan target, 83 per cent of cars sold within the next nine years will have to be EVs or hybrids; or 100,000 EVs / hybrids will need to be sold annually from now until the end of the decade. Figure 2.7 shows the concentration of electric vehicle home chargers in the two largest urban areas – Dublin and Cork, accounting for half of all the home chargers that SEAI supported.

Figure 2.5 Market Share of Vehicles by Fuel Type

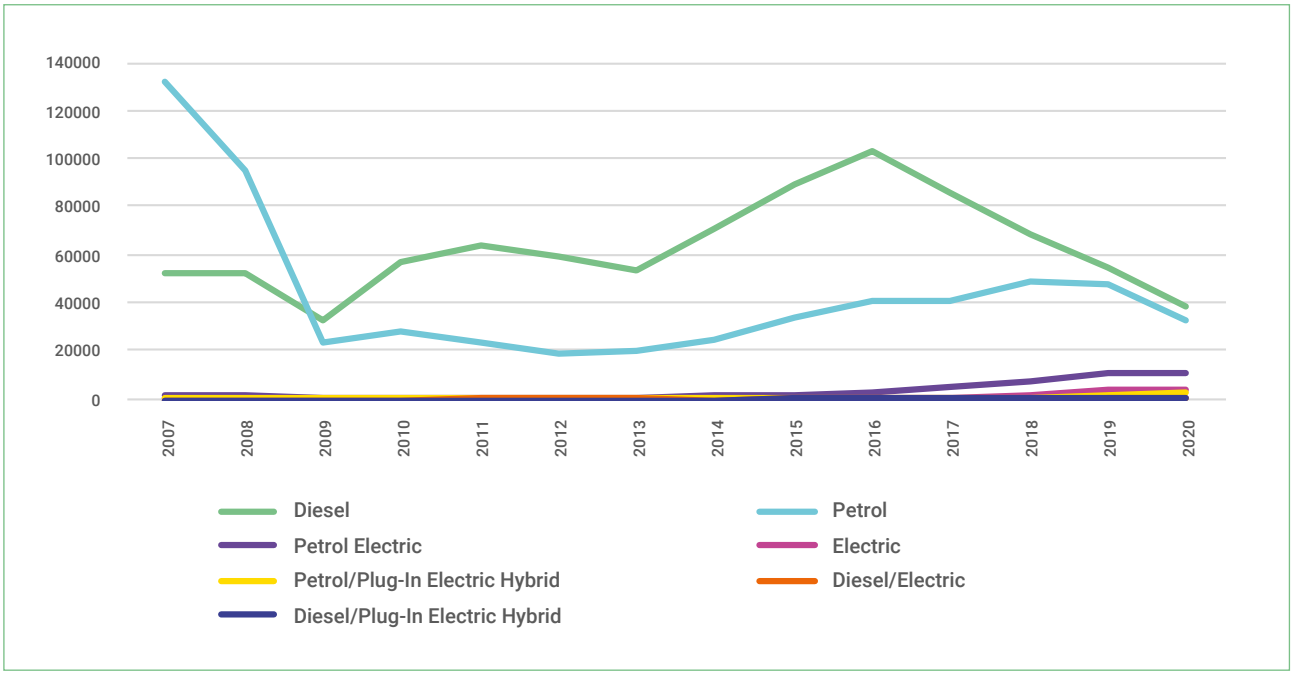


Source: SIMI, 2021

3 SEAI, 2020. Energy in Ireland 2020. https://www.seai.ie/publications/Energy-in-Ireland-2020.pdf

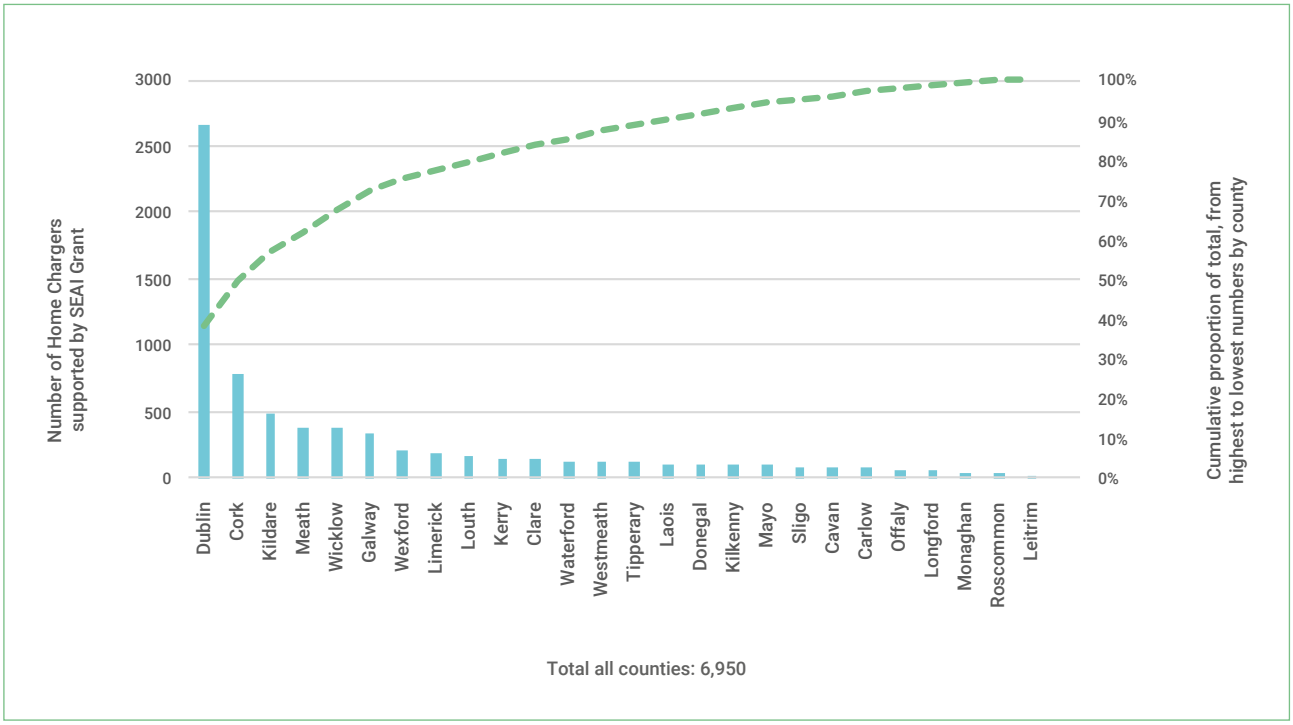
4 Note that gigawatts (GW) refers to the capacity of the energy or electricity, whereas gigawatt hours (GWh) refers to the amount of electricity that is produced over a period of time (one year), noting that solar energy is available only during daylight hours, and wind energy is available throughout the day and night.

Figure 2.6 Number of Vehicles Sold by Fuel Type



Source: SIMI, 2021

Figure 2.7 Home Chargers Installed, with support of SEAI



Source: SEAI Home Charging infrastructure grant data

Building Upgrade (Retrofitting) Target

In the Climate Action Plan, the Government set a target of increasing the cumulative number of residential buildings retrofitted to BER B2 to 500,000 by 2030, and to install 400,000 renewable energy heating sources in residential buildings, and 25,000 in commercial buildings. The Programme for Government signalled developing a new area-based and one-stop-shop approach to retrofitting, with plans for grouping homes together to lower cost, starting in the Midlands area.

In 2017, SEAI launched the Deep Retrofit Pilot Programme, to address homes with poor insulation and inefficient heating systems. To date, 526 homes have been completed in the Deep Retrofit pilot programme. All have achieved a BER A rating. In 2019, approximately 2,000 homes were retrofitted via the Government schemes to a BER B2 level, while 3,000 homes were retrofitted in 2020.

In 2021, SEAI launched the National Home Retrofit Scheme (One Stop Shop Development Call), aimed at engaging groups of households, registered Housing Associations and Local Authorities and Energy Utilities or other organisations to participate in delivering a 'One Stop Shop' type of service for energy efficiency works. It is expected that over 5,000 homes will be upgraded to a minimum B2 BER rating, with most of the homes installing a heat pump.

2.2 Making Sense of the Challenge

The challenge of transitioning to a zero carbon economy is significant, and the magnitude of work that is required to attain the targets for renewable energy, electrifying the transport fleet and retrofitting houses is enormous. The scale and ambition of the targets are transformative for the economy, and although Ireland is incrementally moving toward a zero carbon economy, the targets are 'tipping points' for climate action. Tipping points are conditions that, when crossed, cause system behaviour to radically change performance. The term tipping point is frequently used to describe bio-geophysical conditions in the climate change discourse, but is also applied to social and economic systems[5]. Rather than stitching the future into what was done in the past, tipping points require a new normal, a change to institutions (both formal and informal), and change across all aspects and sectors of society.

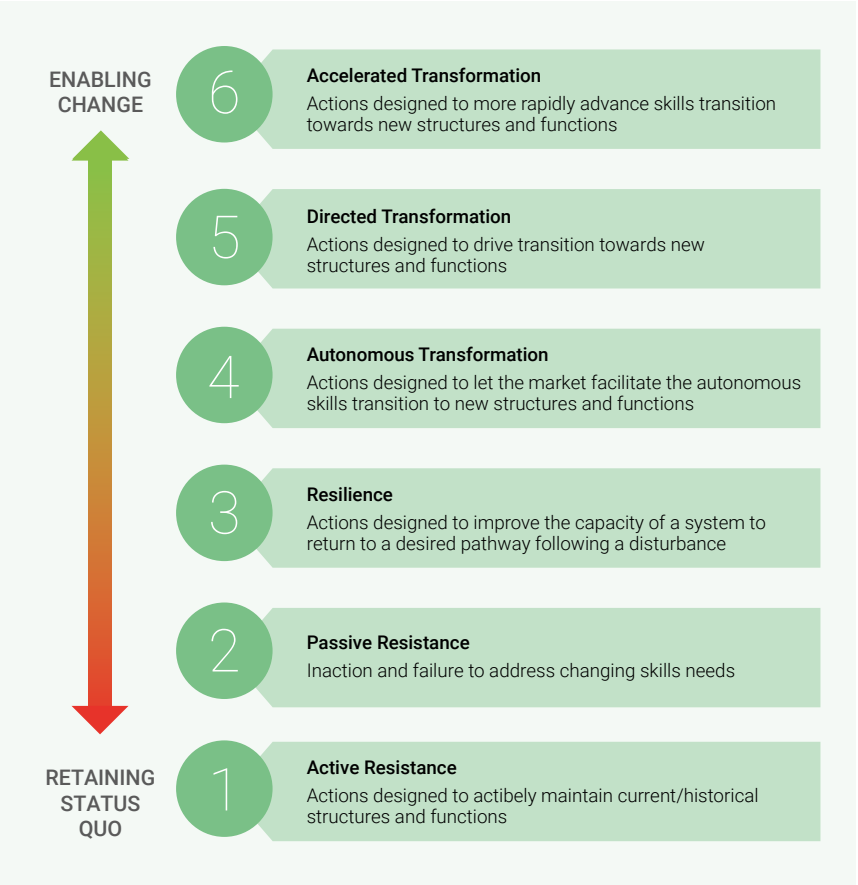
The challenge of the Climate Action Plan targets and skillsets required is a challenge that will be encountered in many workplaces and occupations across all sectors, in terms of what work is done and how it is done. While this report sets out the likely labour market scenario if Ireland transitions to a zero carbon economy though the Climate Action Plan targets, it is important to acknowledge resistance to change. There are forces and biases that operate to retain the status quo[6], which are important to acknowledge and plan for. The challenge for skills planning is to identify the enablers of change with regards to skills provisioning.

5 Folke et al. (2010).

6 This is at an individual, organisational and societal level, and is acknowledged in the literature on resilience, as people want to 'return to normal' after a significant change. See Kahneman, D. et al. (1991) and Li, C.et al. (2018)

Figure 2.8 shows a scale of resistance – resilience – transformation on a spectrum. This is relevant in understanding the challenge, as through the stakeholder engagement there was explicit recognition that there is 'Directed Transformation' in the training content and delivery in response to the zero carbon skills challenge, while there is also 'Passive Resistance' within some occupations (for a variety of valid reasons), to retain the status quo. We consider the recommendations of this report will/should concentrate on actions that will lead to 'Accelerated Transformation', actions designed to rapidly advance the skills transition. It is of particular relevance given the urgency of the Climate Action Plan and the short timeframe available to make the transition/transformation to a zero carbon economy[7].

Figure 2.8 Resistance – Resilience – Transformation Scale of Changing Skills



If the Climate Action Plan targets are attained it would signify Ireland's transition to a new set of institutions, or a 'new normal'. Resistance to change relies on sets of institutions to keep them in place. From an organisational and systems theory perspective, the principle of resistance to change is of direct relevance when attempting to accelerate a transformation of skills in the zero carbon economy.

There is a whole Programme Management skillset associated with managing change itself, not just the management of construction or building programmes that is required by the actions in the Climate Action Plan. During the stakeholder interviews and workshops undertaken for this study, much of the discussions steered away from skills and training per se and onto barriers and challenges faced by industry and Government that need to be addressed before people are deployed into the zero carbon activities. Stakeholders identified that there is a need to create both skills and occupations to make the transition happen, that this process will not be an 'Autonomous Transformation'. Stakeholders commented on the need to meld 'softer' skills such as adaptability with technical skills already required in occupational training. In addition to the labour market forecasting that was undertaken for this study, on calculating for example how many plumbers will be required for retrofitting, there are skills required to manage the complex change.

This complexity results from the speed of change, and the constraints or resistance to change. To articulate the competing rates of change in the context of the zero carbon skills challenge, different levels are presented in Figure 2.9, which shape the targeted recommendations of this study.

7 Otto, I. et al. (2020)

Figure 2.9 Economics of Institutions

	Framing the Skiills Challange		Transformation Scale	Core Focus	Significance in context of analysing Skills Needs
Level 1: Embeddedness	**Social Theory**	Slow Change ↓ Continuous Change	Active or Passive Resistance to Change	Informal Institutions such as Customs, Traditions and Accepted Social Norms. Customs could take 100 to 1,000 years to change	Legacy skillsare important, and have roots in culture and 'how' work is done 'footing the turf' for home open-fire heating. Traditional skills are important in the context of the built enviornment. Recognition that there is resistance to institutional change, even informal institutions
Level 2: Institutional Environment	**Economics of Property Rights and Political Theory**		Resilence in legal systems and active resistance in the case of vested interests	International binding obligations Spctial planning and what is permissible at a local level	Programme Management Skills within Government and skills of governacnce (ingovernment agencies) Skills within enterprise to navigate the institutional enviornment
Level 3: Institutional Arrangement	**Contract Theory**		Directed Transformation	Governance of contracts, Planning and establishing confidence and certanty on the pipeline of work	Governance of contacts for maximum efficiency Low carbon economy requires collaboration and integration of technical and commercial skills Importance or Programme Management
Level 4: Resource Allocation	**Conventional market economics: labour within production theory**		Accelerated Transformation	Instantaneous market exchanges, facilitated by digitalisation, effeciencies and optimising resources	Increasing demand on skills to be interdisciplinary and flexible. Commercial focus, particularly with respect to renewable energy markets

Source: Adapted from Williamson (1998)

The level of embeddedness recognises traditional practices, traditional skills and cultural norms of how people work. This can be the most challenging level to effect change, as there can be active resistance to change, particularly depending on the age of people and stage they are at in their lives, and will be encountered by the retrofit programme. Numerous stakeholders highlighted the challenge of the skills required to communicate/ educate the general public on the imperatives of the targets, particularly with regards to homeowners during a retrofit.

The second level, the institutional environment relates to the set of formal rules and legislation in operation at any particular time. There is resilience in legal and legislative systems, and typically it can take between 10-100 years to change the rules at this level. The transition to a zero carbon economy is placing pressure on this level, to enact change at an accelerated rate, which requires significant programme management skills. This second level relates particularly to the Government and planning agencies.

The third level relates to the institutional arrangement or the shorter-term contracts that enterprises and firms enter. There are changing skillsets required at this level to transition into a zero carbon economy, particularly what was referred to as 'softer skills', or collaboration, communication and melding technical and non-technical skills in various occupations. The fourth level is resource allocation, or what happens within 'the market' or firms/enterprises. The labour market analysis presented in Section 6 specifically measures the skills changes that are required at this level. Overall Figure 2.9 shows that there are changes in skills required at all levels, not just within firms and enterprises who are physically building the transition. Feedback from enterprise, stakeholders and key informant interviews identified some of these changes that need to occur to ensure the Climate Action Plan targets are achieved.

2.3 Employment in the Zero carbon Economy

The 'Zero carbon Economy' is not a defined sector or occupational group in the Irish economy, but a term that refers to a loose collection of economic activities that are aimed at protecting and alleviating negative pressures on the environment. For instance, Eurostat defines the 'Environmental Goods and Services sector' (EGS) as "activities to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, goods and services that reduce environmental risk and minimise pollution and resource use". [8]

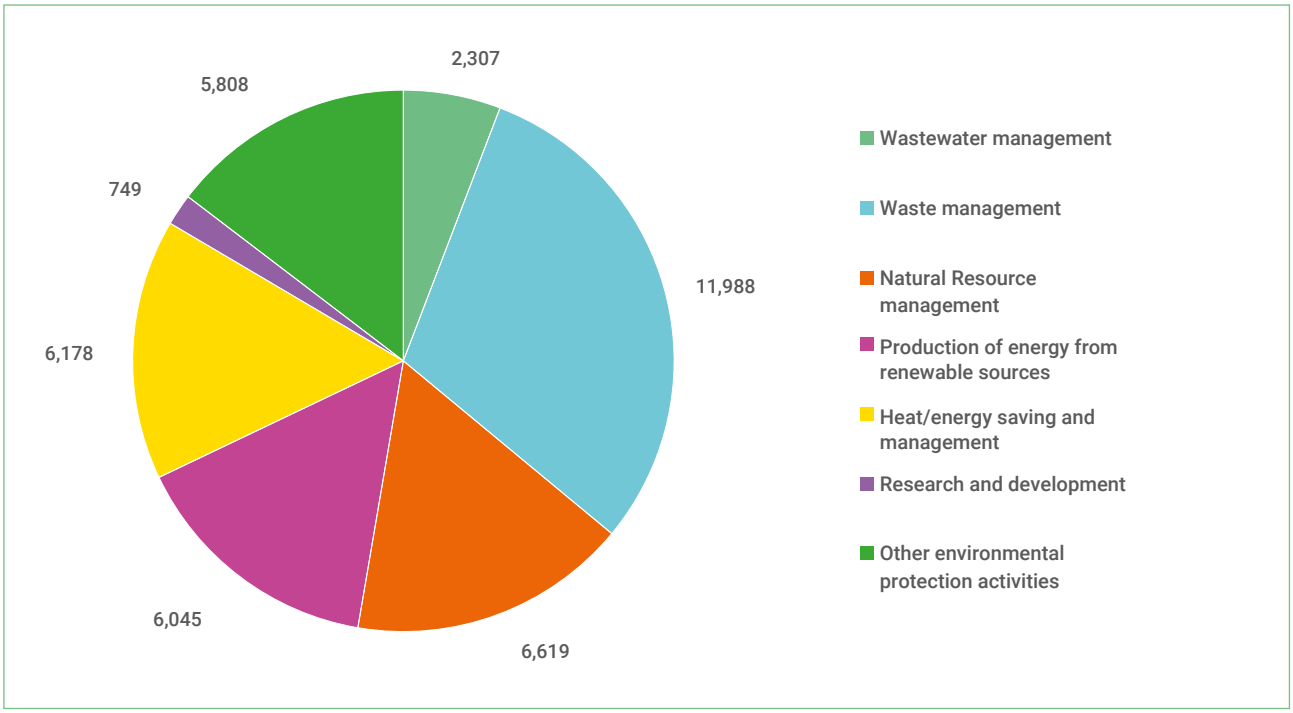
Based on this definition, Eurostat is collecting and develops estimates of output and employment in the sector. Its most recent estimate for employment suggests that just under 40,000 people were employed in EGS activities in 2017 in Ireland, compared to just 16,171 five years earlier. A breakdown of these activities (shown in Figure 2.10) shows that 'Waste management', 'Natural resource management', 'Heat/energy saving and management' and the 'Production of energy from renewable sources' are the largest sectors. The latter two activities correspond to retrofits and renewable energy respectively, suggesting that approximately 12,000 people were employed by these sectors in 2017.

Defining "Zero carbon"

"Decarbonisation means reduction of carbon. What is meant is the conversion to an economic system that sustainably reduces and compensates the emissions of carbon dioxide (CO_2). The long-term goal is to create a CO_2 free global economy.
A low-carbon economy, low-fossil-fuel economy, or decarbonised economy is an economy based on low-carbon power sources that therefore has a minimal output of greenhouse gas emissions into the atmosphere, specifically carbon dioxide. The low-carbon economy can be seen as a step in the process towards a zero-carbon economy".

Source: EPA website

Figure 2.10: Eurostat environmental goods and services employment by activity, 2017



Source: Eurostat, 2020

8 Eurostat, 2009.

Separate to Eurostat, estimates have been produced by industry bodies to estimate the employment in their own sectors. A recent report commissioned by the Wind Energy Ireland (WEI) estimated that approximately 4,770 people are directly employed by the Irish Wind Sector[9], while the Sustainable Energy Authority of Ireland estimates that around 3,500 were employed as a result of energy efficiency measures it supports in Irish homes and businesses[10]. However, while these statistics are all useful for understanding the economic and employment impacts of these activities, they do not reveal much about the types of skills and occupations required by a transition to a Zero carbon Economy.

There are a number of taxonomies for jobs in the zero carbon economy. The United Nations (UN) Environment Programme and the International Labour Organization (ILO) (2011) defined 'Green Jobs' as those in the key economic sectors of renewable energy, buildings and construction, transportation, basic industry, agriculture and forestry. 'Green jobs' can include occupations that are already defined within the wider economy, such as engineers or construction workers; as well as occupations that are based on new tasks and activities, such as Wind Turbine Technicians. 'Green Jobs' have an element of quality associated and include occupations that contribute substantially to preserving or restoring environmental quality, while also providing decent work in the sustainable zero carbon sector. This concept was further developed by the UN and ILO through the 'Just Transition', an explicit recognition that there is a displacement in the labour market, particularly from carbon-intensive occupations. A major concern with transitioning to a zero carbon economy is ensuring a fair distribution of the associated costs across businesses and households, particularly if there is a concentration of affected communities in 'sunset' industries in one town or county. A core focus of a just transition relates to jobs and livelihoods.

The European Union introduced the Just Transition Mechanism to alleviate the socio-economic impact of the transition to a zero carbon economy. The Irish government has emphasised the need for a Just Transition, meaning that the government is committed to making changes while ensuring that no member of society gets left behind. The ESRI (2019) undertook an analysis of the likely change in employment demand across all counties[11], as Ireland transitions to a zero carbon economy, providing an evidence base for the Just Transition process in Ireland. The main driver for the scenario was the phasing out of fossil fuels from the electricity production process. Key findings of the ESRI study are that government-based sectors like education, health services and public administration will have positive labour demand impacts, while the mining (including peat production) and transportation sectors will have negative impacts. The ESRI study found overall that there were positive labour demand impacts across the country, with the exception of two counties due to their relatively larger share of workers in negatively impacted sectors.

9 KPMG, (2021).

10 Department of Jobs, Enterprise and Innovation, (2013).

11 The scenarios were developed using the I3E model, which is a fully dynamic CGE model, that is, it enables transitions through time, rather than more traditional CGE models that are 'static equilibria', meaning that there is uncertainty as to when equilibrates, or when the effects manifest.

3

Understanding Zero carbon Occupations and Skills

3 Understanding Zero carbon Occupations and Skills

The transition to a Zero carbon Economy – and the realisation of Ireland's targets in terms of renewable energy, electric vehicles and domestic retrofits - will require an expansion in the range and number of Occupations and Skills available in the Irish economy. A 'Skill' is defined as someone's ability to carry out certain tasks, while an 'Occupation' refers to a role/job carrying out a similar set of tasks and duties. While it is important to note the distinctions between the two concepts, in many cases, identifying key Occupations for the Zero carbon Economy can also reveal much about the skills that will be required, as these occupations are generally based on common combinations of knowledge, skillsets and qualifications necessary to carrying out the work in question.

Occupations in this report are mostly based on the 'Standard Occupational Classification (SOC) 2010'[12] system which was the CSO's basis of reporting in Census 2016 – the most recent occupational data available. SOC is a hierarchical system of classifying occupations by both skill level (levels within the same job type – e.g. managers and operatives) and specialisation (different job types – e.g. Engineer and Plumber). SOC is based on 840 detailed occupational groups, although only 329 of these are included in the 2016 Census results. Relevant SOC occupations to the Zero carbon Economy were identified through a literature review and engagement with industry/stakeholders, and these occupations are outlined in Section 3.1. Occupations based on the SOC classification system are referred to as 'Core Occupations'.

It is important to note that occupational data cuts across numerous sectors. As an example, Project Managers work across the construction industry, financial services and health amongst others. Occupations are not exclusive to any particular sector, meaning that occupational data alone does not reveal whether particular areas of the economy are experiencing shortages. The zero carbon economy includes activities that have not been undertaken at scale before in Ireland, such as offshore wind, Solar Photovoltaic (PV) installation or domestic retrofits, meaning that it may require new or highly specialised occupations that are not yet defined in Irish statistics. As these niche and emerging occupations are still important to this transition, Section 3.2 section will aim to identify and define these separately to the SOC system. It may also be the case that new skillsets are required within or across occupations, and these are also identified where relevant in Section 3.2 and 3.3.

3.1 Core Occupations

The following tables detail the core occupations that were identified as being relevant to the three sectors examined: renewable energy, electric vehicles and domestic retrofit. Core occupations include the main occupations involved in the planning, design, construction and operation of renewable energy developments, as well as those involved in electric vehicle maintenance, charging infrastructure installation and domestic retrofits.

The core occupations are based on key job profiles identified through a literature review and interviews with enterprises and stakeholders, which were subsequently matched to the equivalent occupational code in the SOC 2010 system of occupational classifications, as used in Census 2016. Matching these job profiles to Census occupations, allows for existing employment and training levels to be estimated and aligned with the forecasting/modelling process that was undertaken as part of this study. However, while the Census data

12 Office for National Statistics, 2020. Standard Occupational Classification 2010. Volume 1 Structure and descriptions of unit groups. Available at https://bit.ly/3twUBSM, accessed April 2021.

includes 329 separate occupations, in many cases these occupational classifications are still quite general, and do not always reflect the skills and specialisations required by the zero carbon sector. Further work was done to disaggregate and explore key specialisations within these categories, and details of these niche or emerging occupations are contained in Section 3.2.

The tables (Table 3.1 to 3.7 below) include a general definition of each occupational group, an overview of the typical entry route or qualifications required, and identifies any other relevant job titles. Descriptions of each occupation were compiled from several sources, including:

1. The SOC 2010 database as used in the Census. However, while the Census data includes 329 separate occupations, in many cases these occupational classifications are still quite general, and do not always reflect the skills and specialisations required by the zero carbon sector;
2. ESCO Database, or the European classification of skills database (European Skills, Competencies, Qualifications and Occupations);[13]
3. The 'Wind Career Map' from the US Department of Energy;[14]
4. Interviews and consultation with industry and stakeholders.

The tables include estimates of the number of Full-Time Equivalents (FTE) employed in each occupation 2019 (in the right-hand column). This figure was developed by updating the 2016 employment levels (as per Census 2016), with annualised growth and FTE factors as indicated by the SOLAS National Skills Bulletin 2020[15] and Labour Force Survey. It should be noted however that these employment estimates are across all sectors of the economy, meaning that the true figure for the zero carbon sectors is likely to be significantly lower. It is of use to identify where constraints within the existing workforce, or occupations where it is clear that the number of people is insufficient to meet additional demand from zero carbon activities (e.g. where redeployment across sectors is not possible). Tables also include a SOC code. This is for identification purposes only, and of relevance in the future if these tables are updated.

3.1.1 Engineering

Table 3.1 displays the main engineering occupations identified for this analysis. Engineers are one of the most important occupational groups to the design, construction and operation of wind and solar energy developments. The main disciplines required are Civil, Mechanical and Electrical engineering, along with more specialised areas such as environmental, energy and marine engineering. In addition to the typical design and supervisory role of an engineer, engineers in Ireland (especially Civil and Environmental Engineers) tend to play an important role in the planning and Environmental Impact Assessment process, often in a project management role for wind and solar developments

Universities and institutes of technology are the primary entry route for engineers, with postgraduate qualifications (Level 9 on the NFQ) and professional experience also required to achieve chartership status. While undergraduate degree programmes generally cover the main engineering disciplines (for example Civil, Mechanical etc.), postgraduate qualifications are generally required for more specialist subject areas. Knowledge of renewable energy issues, including wind and solar technologies, planning and policy, is also an important prerequisite for entering the sector.

13 The ESCO system describes, identifies and classifies professional occupations and skills relevant for the EU labour market and education and training. ESCO provides descriptions of 2,942 occupations and 13,485 skills linked to these occupations. The aim of ESCO is to support job mobility across Europe and therefore a more integrated and efficient labour market, by offering a "common language" on occupations and skills that can be used by different stakeholders on employment and education and training topics. ESCO is a European Commission project, run by Directorate General Employment, Social Affairs and Inclusion (DG EMPL).

14 US Dept of Energy (undated) Wind Career Map. Available at https://www.energy.gov/eere/wind/wind-career-map

15 SOLAS (2020a).

Table 3.1: Core Engineering occupations

Occupation	Code	Description	Entry Route	Other relevant titles / specialisations	2019 FTE Estimate
Civil engineer	2121	Civil engineers undertake research and design, direct construction and manage the operation and maintenance of infrastructure.	Civil engineers usually possess an accredited three or four-year degree (Level 7/8 NFQ) in civil engineering or engineering science or an accredited Higher National Diploma or Certificate. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution. For specialist disciplines, postgraduate qualifications and/or relevant work experience are generally required, although some undergraduate courses are available for environmental engineering.	Environmental engineer, Structural engineer	9,300
Mechanical engineer	2122	Mechanical engineers undertake research and design, direct the manufacture and manage the operation and maintenance of engines, machines, aircraft, vehicle and ships' structures, building services and other mechanical items.	Mechanical engineers usually possess an accredited three or four-year degree (Level 7/8 NFQ) in mechanical engineering or an accredited Higher National Diploma or Certificate. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution. For specialist disciplines, postgraduate qualifications and/or relevant work experience are generally required.	Naval/Marine engineer	5,200
Electrical engineer (incl. Electronics Engineer)	2123	Electrical engineers undertake research and design, direct construction and manage the operation and maintenance of electrical equipment, power stations, building control systems and other electrical products and systems. Electronic engineering is a sub-discipline focused on smaller-scale electrical components, circuits and appliances.	Electrical and electronic engineers usually possess an accredited three or four-year degree (Level 7/8 NFQ) in electrical/ electronic engineering. Qualified electricians can also qualify by completing a two-year apprenticeship in Industrial Electrical Engineering. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution.	Electronic engineer, Computer engineer	8,900
Production and process engineer	2127	Production and process engineers advise on and direct technical aspects of production programmes to ensure cost-effectiveness and efficiency. This unit group incorporates industrial engineers, who work to find ways to eliminate wastefulness in the wind turbine production processes.	Production and process engineers usually possess an accredited three or four-year degree (Level 7/8 NFQ) in production, process or manufacturing engineering or an accredited Higher National Diploma or Certificate. Apprenticeship routes are also available in Manufacturing and OEM engineering. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution.	Industrial engineer	3,600

Occupation	Code	Description	Entry Route	Other relevant titles / specialisations	2019 FTE Estimate
Engineering professionals n.e.c.[16]	2129	This occupational group includes engineering professionals not elsewhere classified, such as Energy Engineers or Wind Engineers. Many of these are highly specialised or new occupations within the renewable energy sector.	Entry routes vary, but generally involve an accredited three or four-year degree (Level 7/8 NFQ) in a base engineering discipline (e.g. Civil, Mechanical, Electrical), followed by a postgraduate qualification in the specialist area. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution.	Energy Engineer, Wind Engineer, Material Engineer	8,300
Quality control and planning engineer	2461	Quality control and planning engineers plan production schedules, work sequences, and manufacturing and processing procedures to ensure accuracy, quality and reliability.	Quality control and planning engineers usually possess an accredited three or four-year degree (Level 7/8 NFQ) in a relevant engineering discipline or an accredited Higher National Diploma or Certificate. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution.		2,600
Telecommunications engineer	5242	Telecommunications engineers install, test, maintain and repair public and private telecommunications systems and cables. In practice, this occupation can often overlap with Electrical Engineers or Electricians.	Entry routes can vary significantly depending on the job level. Engineering degrees are available in HEIs, often as joint programmes with electronic, IT or computer engineering. Apprenticeship routes and other non-engineering electrical qualifications are also available. The status of 'chartered engineer' (NFQ Level 9) is achieved through the completion of postgraduate training and full membership of a chartered engineering institution.		4,800

3.1.2 Environment, Science and Humanities

The 'Environment, Science and Humanities' occupations are primarily subject-matter experts involved during the planning and design phases of wind and solar developments. This category includes planners, environmental scientists, ecologists and social scientists, as well as highly specialised technical experts within these occupations. Environmental Impact Assessments in particular, which are regularly required for wind farm developments, need input from a range of specialist experts, including ecologists specialised in ornithology and marine biology (for offshore wind), acoustic scientists, geologists, hydrologists and archaeologists. While solar farms tend to have less stringent EIA requirements than wind farms, input is often still needed from ecologists, environmental scientists, and some specialist subject-matter experts, such as in 'Glint and Glare Assessment'.

While the initial entry route to most of these occupations is through the third-level system, as many of these tasks are carried out by specialist experts, often with postgraduate degrees, undergraduate qualifications alone may not be sufficient for many roles. As well as ensuring that there is a sufficient number of graduates coming through the system, it is also important to ensure that these graduates are equipped with the right skills/ knowledge to work in the zero carbon sector.

16 n.e.c. = not elsewhere classified

Table 3.2: Core Environment, Science and Humanities occupations

Occupation	Code	Description	Entry Route	Other relevant titles / specialisations	2019 FTE Estimate
Physical scientists	2113	Physical scientists study relationships between matter, energy and other physical phenomena, the nature, composition and structure of the Earth and other planetary bodies and forecast weather conditions and electrical, magnetic, seismic and thermal activity. Depending on their area of expertise, they provide technical support to the design, planning and environmental impact phases of energy developments.	Depending on the specialist subject area, scientists generally have a base Level 7/8 degree in science, physics, geography etc. Experts in specialist subjects generally require evidence of their expertise, such as a postgraduate qualification and/or relevant expertise.	Geologist, Meteorologist, Acoustic expert, Shadow Flicker expert, Glint & Glare expert	750*
Social and Humanities Scientists	2114	Social and humanities scientists study and analyse human behaviour; undertake research in areas such as sociology, economics, politics, archaeology, history, philosophy, literature, the arts; organise the collection of qualitative and quantitative information, and perform subsequent analyses.	Entry is most common with a degree or equivalent qualification but is possible with other academic qualifications and/or relevant experience. Postgraduate qualifications may be required for some jobs. Archaeologists are required to have a degree, as well as obtain a competency-based license when carrying out any excavations.	Archaeologists, Economists	650, incl. approx. 200-250 archae-ologists[17]
Conservation professionals	2141	Conservation professionals are responsible for ensuring that landscapes, habitats and species are protected and enhanced via appropriate management and conservation. They promote public understanding and awareness of the natural environment and help to develop and implement appropriate policies to achieve these objectives.	Depending on the specialist subject area, conservation professionals generally have a base Level 7/8 degree in ecology, natural resource management or related fields. Experts in specialist subjects (e.g. ornithology) generally require evidence of their expertise, such as a postgraduate qualification and/or relevant expertise.	Ecologists, Ornithologists, Marine biologists	600
Environment professionals	2142	Jobholders in this unit group investigate, address, and advise on a variety of terrestrial and marine environment and resource management issues, including the development and implementation of environmental policies and remedies that address the impacts of human activities and industrial processes on the environment.	Environment professionals generally have a base Level 7/8 in environmental science or similar fields, along with relevant experience and/or postgraduate qualification.	Environmental scientist, Site Environmental Clerk of Works, Carbon Accounting experts	1,700
Architects and town planners[18]	2431-2432	Town planning officers direct or undertake the planning of the layout and the co-ordination of plans for the development of urban and rural areas. For energy developments, planners prepare planning documents for planning applications and environmental impact assessments.	Entrants generally hold an accredited degree or postgraduate degree, before attaining chartered status with their relevant professional body following a period of professional experience.	Planner, Landscape Architect, Quantity Surveyor	6,500, incl. approx. 3000 architects

17 Based on the Institute of Archaeologists of Ireland Public Members Register

18 Although the main occupation of interest are planners, census data combines Architects (2431), Town Planning Officers (2432), Quantity Surveyors (2433) and Chartered

3.1.3. Construction and Technical

Construction and technical occupations are generally involved in various construction, maintenance and repair tasks during the installation and operations stages of renewable energy developments. This includes general construction occupations involved in building wind and solar farms, such as elementary workers, crane drivers and building supervisors, as well as more specialised electrical and technical occupations for the operations phases. Some of these are outlined in greater detail as Emerging or Niche occupations.

Entry routes vary considerably, although formal academic qualifications are generally not a prerequisite. Safety certifications are generally required to work on site (i.e. Safe Pass), while certain non-craft operatives, such as crane drivers or excavator operators, may require additional training and a corresponding Construction Skills Certification Scheme (CSCS) card to work in the sector.

Table 3.3: Construction and technical occupations

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Construction and building trades supervisors	5330	Construction and building trades supervisors oversee operations and directly supervise and coordinate the activities of workers in construction and building trades.	Generally no formal academic entry requirements or qualifications, although experience (usually 5+ years) is essential for most medium and large sites. Health and safety certifications are also mandatory.	Foreman	4,600
Construction Project Managers and related professionals	2436	Job holders in this unit group manage and oversee major construction and civil engineering projects and major building contracts for quality of work, safety, timeliness and completion within budget. They also forecast travel patterns and develop strategies for managing the impact of traffic-related demand.	Project Managers generally hold a qualification in a relevant discipline to the project (e.g. Civil Engineering, Planning) as well as significant experience in the sector. Postgraduate project management qualifications are also advantageous.	Project Manager	2,000
Crane drivers	8221	Crane drivers supervise and undertake the operation of cranes, jib cranes, power driven hoisting machinery and power driven stationary engines to lift and move equipment, materials, machinery and containers.	No formal academic requirements, although entrants are required to undertake short training courses and hold a CSCS card along with any other necessary health and safety requirements.		750
Mobile machine drivers and operatives n.e.c.	8229	Job holders in this unit group supervise and undertake the operation of machines to transport, excavate, grade, level, and compact sand, earth, gravel and similar materials, drive piles into the ground and lay surfaces of asphalt, concrete and chippings, and operate other mobile machines not elsewhere classified.	No formal academic requirements, although entrants are usually required to undertake short training courses and hold a CSCS card along with any other necessary health and safety requirements.	Excavator / Dumper / Tractor Operator	7,000

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Elementary construction occupations	9120	Job holders in this unit group perform a variety of general labouring and construction duties to assist building, civil engineering and related trades workers in the performance of their tasks.	No formal academic requirements, with training typically provided on the job.	Labourer, Construction Worker	13,800
Electrical and electronics technicians	3112	Electrical and electronics technicians perform a variety of miscellaneous technical support functions to assist with the design, development, installation, operation and maintenance of electrical and electronic systems. This category includes wind and solar technicians, who maintain and repair wind turbines and solar equipment.	Entry requirements vary considerably depending on the specific role, although generally take the form of a third-level or apprenticeship qualification. Additional industry-specific training may also be required.	Wind Turbine Technician, Solar Technician	3,300
Building and Civil Engineering Technicians	3114	Building and civil engineering technicians perform a variety of technical support functions to assist civil and building engineers, including the preparation of drawings, maps and plans using specialist software.	Entrants can secure qualifications in the HEI (generally at Level 6) and FET Sector. The status of chartered engineering technician is obtained after a period of further training at work and upon gaining the membership of a professional engineering institution.	Draughtsperson, CAD Technician, GIS Technician	7,600
Health and safety officers	3567	Health and safety officers counsel employees to ensure and promote health and safety in the workplace and coordinate accident prevention and health and safety measures within an establishment or organisation.		EHS Officer	3,400
Energy plant operatives	8124	Energy plant operatives operate and maintain equipment which produce electrical energy from wind, solar and other power sources. They monitor measuring equipment to ensure the safety of operations, and that the production needs are met. They also react to system problems, and repair faults.	There are generally no formal academic requirements. Training is typically by apprenticeship, incorporating technical training and practical experience.	(Power) Plant Operator	1,000

3.1.4 Legal and Professional Services

In the context of the Zero carbon Economy, this group includes occupations that provide specialist legal and financial advice and services to developers of large-scale renewable energy infrastructure, such as solicitors, accountants, tax experts, and investment analysts. They are heavily involved in the early stages of projects, providing advice in relation to financial feasibility, contracts, land and regulation.

The typical entry route into most of these professions is through the third-level system, followed by a relevant postgraduate qualification and chartership with a professional institution. Similar to the Environment, Science and Humanities occupations, knowledge of and experience in the sector is another important prerequisite, and likely more relevant to addressing capacity issues in the sector than third-level alone.

Table 3.4: Legal and Professional Service occupations

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Managers and proprietors in other services n.e.c.	1259	Job holders in this unit group perform a variety of managerial tasks in other service industries not elsewhere classified. This includes overseeing staffing, organising day-to-day maintenance activities, and monitoring of safety and performance.	Entry requirements can vary, but generally include a relevant qualification in engineering, electrical, mechanical or related disciplines, as well as experience in the sector.	O&M Manager	4,500
Solicitors	2413	Solicitors with relevant expertise in energy regulation, real estate, planning, and commercial matters advise and act on behalf of organisations developing renewable energy projects.	Solicitors generally qualify with a law degree, before taking the Law Society's entrance (FE-1) exams. This is followed by a Professional Practice Course and a training contract with an experienced solicitor for at least two years. Legal services for energy developments are generally provided by specialised practices.	Legal experts	12,000
Chartered Surveyors	2434	Chartered surveyors conduct surveys related to the measurement, management, valuation and development of land, buildings, and infrastructure; and provide advice in relation to legal and commercial matters.	Entrants generally hold a Level 7/8 degree in Quantity/Land/Building Surveying or construction economics. The status of chartered surveyor is obtained following specialisation and several years of experience in a chosen field (Land, Construction or Property), and membership of a chartered body.	Quantity / Land / Property Surveyor	4,800
Accountants and tax experts	N/A*	Accountants and taxation experts advise on tax matters and assess tax liabilities	Entrants generally hold a degree in business, finance, accountancy or similar fields, before obtaining a professional qualification in accountancy. Relevant experience with energy developments is also necessary.		36,500

*Occupation title based on SOLAS National Skills Bulletin, rather than SOC Classification

3.1.5 Transport and Logistics

Transport and Logistics occupations are mainly required for the procurement and construction phases, and are responsible for transporting and coordinating the materials and equipment for renewable energy developments. In the case of offshore wind, ship and aircraft (usually helicopters) are also necessary to transport workers to and from the site during all project phases, as well as carrying out aerial and marine surveys.

Table 3.5: Core Transport and Logistics occupations

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Managers and directors in transport and distribution	1161	Managers and directors in transport and distribution plan, organise, direct and co-ordinate the activities and resources necessary for the safe, efficient and economic movement of passengers and freight by road, rail, sea and air transport.	No particular entry route or academic requirements. Experience in the sector is an important prerequisite.	Logistics Experts	7,100
Aircraft pilots and flight engineers	3512	Aircraft flight deck officers check, regulate, adjust and test engines and other equipment prior to take-off, navigate and pilot aircraft and give flying lessons.	Entrants must pass a medical examination, before training with an Approved Training Organisation to obtain a pilot's license.	Helicopter Pilots	1,500
Ship and hovercraft officers	3513	Ship and hovercraft officers command and navigate ships and other craft, co-ordinate the activities of officers and deck and engine room ratings, operate and maintain communications equipment on board ship and undertake minor repairs to engines, boilers and other mechanical and electrical equipment.	In Ireland, qualifications are available through degree programmes at the National Maritime College of Ireland.	Navigation Officer, Chief Engineer	400
Large goods vehicle drivers	8211	Large Goods Vehicle (LGV) drivers (formerly HGV drivers), collect, transport and deliver goods in rigid vehicles over 7.5 tonnes, articulated lorries and lorries pulling trailers.	No formal academic requirements, although a Road Haulage Operator's License is required.	Lorry Driver, HGV Driver	21,500
Marine and waterways transport operatives	8232	Marine and waterways transport operatives supervise and carry out a variety of deck duties and operate and maintain engines, boilers and mechanical equipment on board ships, boats and other marine vessels.	Requirements can vary depending on the base country of each vessel, although formal academic qualifications are generally not necessary. New entrants generally require a medical examination, before undertaking short training courses at a nautical college or other training bodies.	Ship Crew, Seamen	600

3.1.6 EV Maintenance and Infrastructure

The main occupation of relevance to EV maintenance is vehicle mechanic- details for which are summarised in the table below. This occupational group is assumed to include EV Technicians, although the specific requirements of an EV Technician is considered in the next section under emerging and niche occupations.

Table 3.6: Core EV Maintenance and Infrastructure occupations

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Vehicle technicians, mechanics and electricians	5231	Vehicle technicians, mechanics and electricians accept calls for help and repair and service the mechanical parts and electrical/electronic circuitry and components of cars, lorries, buses, motorcycles and other motor vehicles, and repair and service auto air-conditioning systems.	Typical entry is via a Level 6 Craft Apprenticeship in Motor Mechanics.		16,200

The main occupations identified as being involved in the installation of EV charging infrastructure have been listed in other tables, but include Electricians and Electrical fitters (5241), Civil Engineers (2121), Electrical Engineers (2123), Elementary Construction Occupations (9120), Mobile machine drivers and operatives n.e.c. (8229) and Construction and Building Trades Supervisors (5330).

3.1.7 Retrofit

The occupations in this category in mainly consist of craft occupations, such as plumbers, electricians and carpenters, as well as some general elementary construction occupations involved in domestic retrofits. For these craft occupations, the apprenticeship system is the main entry route, while most elementary construction occupations do not need formal academic qualifications.

In addition to these existing craft occupations, several niche and emerging occupations for domestic retrofits are listed in the next section, reflecting the additional skills or qualifications needed to carry out certain Retrofit tasks. These include Heat Pump Installers, Insulation Operatives, and Retrofit Engineers.

Table 3.7: Core domestic retrofit occupations

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Electricians and electrical fitters	5241	Electricians and electrical fitters assemble parts in the manufacture of electrical and electronic equipment and install, maintain, and repair electrical plant, machinery, appliances and wiring.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ.		17,500
Roofers, roof tilers and slaters	5313	Job holders in this unit group cover roofs and exterior walls with felting, sheeting, slates, tiles and thatch to provide a waterproof surface.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ.	Solar PV Installer	1,800

Occupation	Code	Description	Entry Route	Other relevant job titles	2019 FTE Estimate
Plumbers and heating and ventilating engineers	5314	Jobholders in this unit group assemble, install, maintain and repair plumbing fixtures, heating and ventilating systems and pipes and pipeline systems in commercial, residential and industrial premises and public buildings.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ. Installers with a level 6 qualification can complete domestic heat pump systems training course covering design, installation and commissioning. For retrofit grant aided works registration with SEAI is required.	Heat Pump Installer	11,300
Carpenters and joiners	5315	Carpenters and joiners construct, erect, install and repair wooden structures and fittings used in internal and external frameworks and cut, shape, fit and assemble wood to make templates, jigs, scale models and scenic equipment for theatres.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ.		12,300
Glaziers, window fabricators and fitters	5316	Job holders in this unit group install pre- glazed wooden, metal or PVC framework, and cut, fit and set glass in windows, doors, shop fronts, and other structural frames.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ.		3,200
Plasterers	5321	Plasterers apply plaster and cement mixtures to walls and ceilings, fix fibrous sheets and cast and fix ornamental plasterwork to the interior or exterior of buildings.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ.		6,000
Painters and decorators	5323	Those working in this unit group apply paint, varnish, wallpaper and other protective and decorative materials to the interior and exterior walls and surfaces, paint designs on wood, glass, metal, plastics and other materials, and stain, wax and french polish wood surfaces by hand.	Typically through an apprenticeship or traineeship approved by SOLAS corresponding to a Level 6 on the NFQ.		8,900

3.2 Emerging and Niche Occupations

While CSO data and the SOC system formed the basis of the occupational analysis shown above, there were instances where key occupations did not neatly correspond to these existing classifications. This was often the case where an occupation represented a relatively new job (such as a Wind Turbine Technician), a highly-specialised discipline within an existing occupation (such as an energy or marine engineer), or where additional qualifications or training are necessary to carry out a certain activity (such as a Heat Pump Installer or EV technician). As simply using the existing occupational classifications would not give a full picture of the necessary qualifications and skillsets, and as these occupations are likely to experience the greatest growth over the next decade, it was necessary to explicitly identify and define these emerging and niche occupations in the context of the zero carbon economy.

The following tables identify and define these 'niche' or 'emerging' occupations, including a description of the role and an outline of the typical entry route into the occupation. It is notable that many of these niche occupations do not currently have a direct entry route into the profession, with prospective workers often required to have a basic qualification before choosing to seek additional training or qualifications in the specialist area. This requirement creates additional time and cost barriers, that could potentially make the zero carbon economy sectors less attractive for workers and businesses compared to other sectors of the economy.

Renewable Energy

Table 3.8 displays profiles of emerging and niche occupations within the renewable energy sector. Broadly speaking, these occupations can be summarised as three main groups, each with distinct skills requirements and entry routes. These are:

- **Specialist and experienced professionals** – Many industry stakeholders identified particular shortages of experienced professionals, including engineers, environmental/planning experts, solicitors, accountants and project managers with the necessary experience and knowledge to allow them to work on large energy developments. While they may be required at all stages, they are especially relevant to the planning and development stage, and input heavily into the consenting, EIA, design and commercial processes. As outlined previously, although the initial entry route to most of these occupations is through the third-level sector, the specialist nature of these roles in renewable energy developments often means that additional postgraduate qualifications and/or professional experience is a necessary prerequisite.
- **Renewable Energy Technician**s – This primarily includes Wind Turbine and Solar Technicians, who are primarily involved in servicing and repairing renewable energy developments. Solar Technicians also play a significant role in the installation of solar farms. Entry routes to date for these occupations have been relatively informal and ad-hoc, and are typically comprised of a mixture of technical qualifications and on-the-job training. However, formal entry routes are emerging through the apprenticeship system for Wind Turbine Technicians, reflecting the maturity of the sector and the increased attractiveness of the sector as a career option.
- **Marine operatives** – This includes ship crew, officers and operators of marine equipment and remote-operated vehicles. It is reasonable to expect that marine careers will be a significant growth area with the expansion of offshore wind, and new roles will be required in operating the vessels and equipment required during the planning and construction phases. To date, it has been reported that the sector typically relies on vessels and ship crew from outside Ireland to meet the demand for marine operatives, suggesting that there is a gap in existing education and training provision for these occupations.

Table 3.8: Profiles of emerging and niche occupations in the renewable energy sector

Occupation	Description	Typical Entry Route
Specialised engineering professionals	Highly-specialised engineering professionals, including naval engineers, wind energy engineers and energy engineers, who work on the design, construction and maintenance of renewable energy developments.	Typical entry route is to qualify with a Level 7 or 8 degree in one of the main engineering disciplines (e.g. Civil, Mechanical, Electrical), before undertaking a post-graduate qualification in the specialist area. Some HEIs offer direct undergraduate degrees in these areas, although options are relatively limited in Ireland.
Specialist ecology and environmental experts	Highly-specialised ecological and environmental professionals, who are involved in the planning and EIA stages of (mainly) wind developments. They carry out surveys, monitoring, and impact assessments to predict the likely impact of developments on species and habitats. Specific subject areas of demand include: Ornithology Marine biology / ecosystems Carbon accounting	Entrants generally hold a Level 8 degree in environmental science, ecology, biology, zoology or similar, before undertaking a post-graduate qualification in the specialist area. This is generally accompanied by several years of research or professional experience. Those contributing to EIA reports are generally required to describe and demonstrate their experience in the subject area.
Legal and financial experts	Highly-specialised legal and financial professionals, who provide advice relating to legal and commercial matters, including planning, contracts, taxation, auctions and energy regulation.	Experts are generally fully-qualified solicitors (legal) or chartered accountants (financial) with specialist knowledge in legal/financial aspects of energy and wind developments.
Project Managers	Project Managers manage the development of wind and solar energy developments, and are responsible for coordinating the feasibility, environmental impact assessment, and planning stages. They also may manage the project during construction, depending on the exact development model in place.	Entry routes vary considerably, but Project Managers are generally managers, engineers or planners with at least 5 years of experience, and a good understanding of the commercial, environmental and regulatory characteristics of energy developments. While generally not sufficient in the absence of experience, Level 9 qualifications in project and construction management are also available in most Irish universities.
Wind Turbine Technicians	Wind turbine technicians maintain and repair wind turbines by performing diagnostic inspections, analysing faults, and performing repair duties. They ensure the wind turbines operate in compliance with regulations, and assist the wind engineers in the construction of wind turbines. Wind turbine technicians may also test and install hardware and software components of wind turbines.	Technicians generally have electrical/mechanical qualifications (Level 6-8), before undertaking training directly within the industry or through dedicated programmes. Training programmes are now available in Ireland via Green Tech Skilllnet, and a Wind Turbine Maintenance Technician apprenticeship is currently pending validation, with a pilot expected to commence in 2021.
Solar Technician (grid)	Solar energy technicians install and maintain systems that collect solar energy. They prepare the necessary fixtures, install and mount solar panels, and plug them into an electronic system including an inverter to connect the solar energy systems to the electricity lines.	No formal academic requirements are required, although Solar Technicians often have an electrical background or qualifications.
Marine equipment and ROV operatives	Marine equipment or ROV operatives generally pilot underwater remote-operated vehicles and machinery for tasks in the construction of offshore wind farms, including trenching, preparing foundations or laying cables. They may also be involved in carrying out planning and pre-construction surveys.	Generally require a Level 8 degree in engineering, electronics, computers or related disciplines, although time in the industry is also appropriate in some instances. ROV Operators generally undertake short training courses to become qualified to operate an ROV[19] or other marine equipment.

19 Marine Institute, 2015.

Electric Vehicles

The main emerging/niche occupation for electric vehicles is an EV technician, which is a mechanic with the appropriate training and certification to work on maintaining and repairing electric vehicles. While EVs generally require less frequent maintenance than ICE vehicles, the more stringent safety requirements for working with high voltage means that EV mechanics must be appropriately trained and certified to work with electrical systems. While the additional safety considerations of using EVs will likely require upskilling, the additional health and safety training is noted, but considered out of scope of the current study.

Table 3.9: Profiles of emerging occupations in the electric vehicles sector

Occupation	Description	Typical Entry Route
EV Mechanic	EV mechanics are vehicle mechanics who are trained to maintain and repair electric vehicles. EV mechanics carry out diagnostics, and repair electrical, mechanical and digital systems.	Mechanics become fully qualified after a four-year apprenticeship, with a QQI Level 6 Advanced Certificate Craft in Motor Mechanics. After this, mechanics can undertake short (generally 2-3 day) courses provided by the FET sector to become certified to work on EV systems.

Another occupation that was noted as requiring additional training in EV systems are paramedics and first responders at road accidents.

Retrofit

Finally, Table 3.10 contains profiles of the niche and emerging occupations for domestic retrofits, which cover all stages of the retrofit process.

Emerging occupations identified on the design and engineering side of the domestic retrofit process include BER Assessors, Retrofit Engineers / Designers, and Retrofit Coordinators. These occupations are responsible for providing the necessary engineering, design and project management support to bring the retrofit from design through construction. In addition to these three formal occupations, several organisations have emphasised the important role of a 'Renovation / Retrofit Advisor' within the residential retrofit process. IGBC defines Retrofit Advisors as "building professionals who have upskilled in energy renovation (…) and can provide independent advice on a full renovation project"[20], while the SEAI also refer to the importance of "a trusted source (…) perceived as likely to act in [the customer's] best interests and to provide impartial advice"[21]. While it is not yet clear whether Retrofit Advisors will emerge as distinct occupations or whether the role will be filled by one of the other occupations listed here, it still represents a necessary role in the retrofit process and one that is important for building confidence in customers regarding their retrofits.

In future, it is important to note that retrofit will require the integration of digital design tools and analysis that are used in the new commercial build sector- some One Stop Shops are already looking at this area. Examples include: the digital surveying of property using LiDAR and drones- this is used in the commercial sector, where the building is surveyed and works monitored; Building Information Modelling and integrated design software, to design and monitor retrofit works, drive down costs and reduce on site errors; Standardisation of designs; and analysis, through the creation by engineers and software developers of products like Retrofkit and BERWoW. The main One Stop Shops all have online homeowner retrofit tools now. SEAI is also interested in the BER research tool.

On the contracting side, the main niche and emerging occupations are generally installers of new technologies, such as Heat Pumps, Solar PV systems, and insulation. These occupations are generally existing contractors who have completed additional training to become certified/qualified to carry out the task in question.

20 Jammet and O'Brien (2020)

21 SEAI (n.d.)

Table 3.10: Profiles of niche/emerging occupations in the residential retrofit sector

Occupation	Description	Entry Route
BER Assessor*	Residential BER Assessors carry out Building Energy Rating assessments for clients, and provide advice as to retrofit requirements.	In order to become a registered Domestic BER Assessor, candidates require an NFQ Advanced/Higher Certificate in construction studies (or similar) or a recognized equivalent, and are required to complete a BER training course to register with SEAI.
Retrofit Engineer / Designer*	Retrofit Engineers / Designers are responsible for planning and designing domestic retrofits. They carry out BER surveys and perform heat loss calculations to identify necessary works, prepare plans and drawings for contractors, and certify that works have been completed to the required safety and operational standards.	Retrofit Designers are generally architects, surveyors or engineers (with a Level 7/8 degree in Civil, Energy, Building Systems engineering or related disciplines), that have upskilled or specialised in energy renovation.
Retrofit Coordinator*	Retrofit Coordinators generally project manage the retrofit process on behalf of the client, and help to ensure that projects are safe, high quality and performing to their maximum potential. In some lower-risk projects, they may also fill other roles in the retrofit process.	Retrofit Coordinators generally have similar qualifications to Retrofit Engineers / Designers or Assessors, but should generally have the necessary experience or qualifications to project manage large projects.
Heat Pump installer	Heat Pump installers design, install, service and repair air-source and ground-source heat pump systems in domestic and commercial premises.	Heat Pump installers are generally fully-qualified plumbers who undertake additional training courses with an accredited training provider to become a SEAI registered installer. Additional short training courses are also often provided by equipment manufacturers.
Domestic Solar PV installer	Domestic PV Solar installers design and install domestic solar systems, often on rooftops.	Domestic PV installers are generally roofers or electrical professionals who undertake additional training courses to become a SEAI registered installer. Additional product specific short training courses are also often provided by equipment manufacturers.
Insulation Operatives	Insulation operatives install insulation by hand or by using machinery in order to reduce heat loss in buildings, including through internal (dry-lining), external, cavity wall, attic and underfloor insulation.	No academic qualifications are required, although operators of External and Cavity Wall Insulation equipment require certification from the NSAI. Training is typically provided on the job or in the FET sector.

*Adapted from 'The Retrofit Academy' (2021).

3.3 Skillsets

In addition to the core occupations and emerging and niche skillsets that may be new to Ireland, several overarching skillsets were identified through the literature review and stakeholder engagement process and were considered relevant to the zero carbon economy. These are broader skills required of many jobs, so are not exclusive to the zero carbon economy, but are necessary for the transition.

- **Customer and stakeholder communication** – The scale of the change envisaged in the CAP not only requires buy-in from industry and policymakers, but also from households and communities. While the science of climate change and the risk associated with changing global temperatures is uncontested, the ability to navigate through complex scientific concepts and communicate solutions to customers in terms that they understand/value is a skill that many enterprises are facing.
  Many of the firms interviewed for this study noted that it is important for workers in the sector, particularly those with front-facing roles, to be able to seamlessly communicate and sell the benefits of the zero carbon transition to potential customers and community members. This is most relevant to the domestic retrofit sector, where reaching the targets will mostly rely on individual homeowners making a decision to undergo a retrofit. The mix of technical skills and business acumen (while understanding the budgetary constraints of households) is considered crucial for many firms.

- **Commercial skills** are increasingly sought by the renewable energy and the retrofit firms, as many projects are joint venture partnerships and/or involve sourcing funding for the projects. There are commercial, contractual structuring and procurement skills required for large programmes.
- The **behavioural capabilities** of the existing workforce in the renewables sector were discussed by a number of enterprises as being equally important as technical skills. These skills, such as leadership, strategic orientation for the enterprise, commercial awareness, customer service focus, performance and innovation, are critical skills that are sought by firms in the sector. The technical skills in renewable energy generation are necessary, but not the only skill, as firms are operating in highly competitive markets, where participation in RESS auctions requires meeting technology, financial and community eligibility.
- Required **Health and Safety Skills** were identified, especially for people with technical skills but working in new environments (e.g. off-shore wind). The safety risks for working with electric vehicles were also identified, as there are additional hazards that people working in motor vehicle repair are exposed to, due to the high voltage components and cables capable of delivering a fatal electric shock.
- **Digital Skills** are ubiquitous across many jobs, and also in the zero carbon sector economy. Mechanics are increasingly required to undertake diagnostics and require digital literacy. Turbine technicians increasingly control the renewable energy systems remotely, and techniques and processes such as drone use are becoming part of a technician's job.
- **Problem Solving Skills** were discussed as being important, with an ability to have a broad spectrum of knowledge and experience in the renewable energy sector
- A key behavioural skill that was identified was the **adaptability** of the renewable energy worker, which is more of a cultural attribute of workforce resilience. The skills used in the renewable sector are sourced from established or traditional disciplines – such as mechanical and electrical engineering, information technology systems and electricians. Multidisciplinary skills were considered ideal, which would imply new entrants into the sector having a number of years' experience, with an ability to work in multidisciplinary teams.
- **'Soft Skills'** such as communication, customer care, psychology and collaboration skills were identified by RENO-NUC and the Irish Green Building Council as required by construction professionals who undertake deep retrofits.

4

Learning from the Past

4 Learning from the Past

Throughout the twentieth century, the process of innovation and new technologies prompted the economist Joseph Schumpeter to coin the phrase "creative destruction", to describe a process which radically changes the economic structure from within, making certain skills and capabilities redundant and creating new ones concurrently. This is the basis for understanding how humans and societies progress and develop throughout history and cautions about the negative impacts on people and livelihoods when skills within occupations change significantly. Transformations originating from technological innovation can take a lot of time – diffusion of new technology faces many barriers. However, addressing climate change requires much more than incremental change, and OECD (2012)[22] research has shown that the rate of innovation has accelerated in selected climate change mitigation technologies that are linked to key policies. Governments have a central role to play in the transitioning process. Transitions require management and coordination, as people's livelihoods may be threatened.

Moving from agrarian to the industrial organisation of society transformed communities and the economy. While undoubtedly societies are in a digital transformation phase, this is a process that began in the 1950s and was accelerated throughout the 1990s with the advent of the internet, meaning that although it is transformative of how society functions, it is relatively incremental, with little or less risk of catastrophic societal disruption if the change does not occur (although there are dependencies between addressing digitalisation and transitioning to a zero carbon economy, particularly with respect to renewable electricity generation and "Smart" systems design). Ireland underwent radical change throughout modern history, facilitated by "big government" projects, such as the Shannon hydroelectric scheme at Ardnacrusha in the 1920s, the electrification of the country in the 1940s and the completion of significant transport infrastructure project in the 1990s and 2000s. These "big government" projects are characterised as complex adaptive societal systems, used by many people for different purposes that transform how society functions. As an example, the engineers for Ardnacrusha were 'imported skills', coming from Germany. The rapid deployment of a workforce of over 5,000 people at Ardnacrusha was not without its problems[23]. The Ardnacrusha Scheme signifies the first exposure of the Irish economy to the flow of technology from outside and the dissemination process associated with it. The management of transformational change requires significant consideration and programme management, skills that are required within government and their agencies.

4.1 Learning from Global Leaders

This section presents short case studies of transformational initiatives, and draws out lessons learned from how other countries have managed transformational change, before switching to a focus on Ireland, and what lessons can be learned from activities undertaken to date in the development of skills in the zero carbon sector. These Irish examples are not necessarily transformational, but focus on initiatives that have worked, and that are considered good practice.

22 OECD (2102) Energy and Climate Policy Bending the Technological Trajectory. Paris OECD: Studies on Environmental Innovation.

23 Seanad Éireann debate 14th December 1925. https://www.oireachtas.ie/en/debates/debate/seanad/1925-12-14/4/

Case Study 1: The United Kingdom's Offshore Renewable Energy Transformation

The United Kingdom (UK) is a world leader in the development of offshore wind. In 2019, wind generated power accounted for 20 per cent of the UK's electricity, half of that coming from offshore wind farms. During the 1990's, policy institutes in the UK began to promote an environment for development of offshore wind, through socio-economic and political spheres.[24] It was promoted as a suitable method within the UK to address climate change issues and achieve emission reductions. Wind energy was recognised as an indigenous power source that would strengthen the UK's energy security, whilst providing jobs to people. It was also a reprieve to public opposition to the further development of onshore wind farms.

These key supportive narratives were successful in presenting a credible and appealing image of offshore wind to investors, policy makers and the general public, and in particular, it had support from the Crown Estate, established by the UK government in 1961 to manage Crown owned land. The Crown owns almost the entire UK seabed where the offshore wind farms are located. The Crown Estate provided additional certainty for the offshore renewable industry, as it identified suitable sites and began to co-invest in projects. The opportunity to develop offshore wind energy was facilitated by this governance arrangement, as the Crown Estate is a statutory corporation run on a commercial basis and allowed for an expedited foreshore licensing process.

Despite these favourable factors, the UK offshore wind industry experienced significant setbacks. The UK was a market leader in developing offshore energy but faced the initial high costs of installation. It was expected that installation costs would decrease over time, but costs continued to increase. In order to maximise cost competitiveness, larger companies such as Siemens and Vestas were sought after to develop offshore windfarms. As a result, small indigenous companies in the UK struggled to break into the market[25]. This hindered the development of the homegrown labour force skills required to carry out such projects and to maintain the turbines once completed. However, in recent years supports have been put in place in the form of apprenticeships. In 2017, Grimsby Institute of Further and Higher Education and Furness College in Barrow created a wind turbine technician apprenticeship scheme in the UK. Wind turbine company, Ørsted, has been utilising this apprenticeship programme and it has seen a total of 33 apprenticeships join the company, working on UK based wind farms.

Ireland can learn many lessons from the trajectory the UK took to develop its offshore wind industry. Ireland has a skilled labour force with a maritime background, and this could be utilised, unlike in the UK, where overseas contractors (Vestas and Siemens) were used primarily to build and maintain the initial offshore wind farms. Developing the skilled labour force early in the process would also allow for the support of indigenous companies to progress in the sector, unlike in the UK. Although the UK used foreign contractors to be cost competitive, Ireland can take advantage as a 'technology taker' and avoid the risk of trialling new technology and processes that were forged by the UK. Taking advantage of the costly research and development that the UK carried out, Ireland could fully utilise these cost competitive prices whilst building up a skilled offshore renewable energy labour force.

Case Study 2: Electric Vehicles Norway

An Electric Vehicles (EV) initiative in Norway began in the 1990s as a scheme to assist the national electric vehicle producers, Think and Buddy. The Norwegian parliament created incentives for citizens to use EVs, starting with import tax exemption for EVs. This helped boost the domestic industry for producing EVs, and the parliament created further incentives for EV users; EV owners availed of free public parking, reduction in the annual licensing fee (motor tax), and by the end of the 1990s EVs were exempt from road tolls. By 2000, EVs were permitted to use bus lanes and consumers were exempt from paying VAT on the purchase of an EV.

Due to these incentives, demand for EVs grew rapidly and the domestic producers could not meet the demand. More EV models became available on the Norwegian market. Although these EV models were less advanced in terms of comfort and safety, consumers were willing to trade these for the economic incentives of owning an EV combined with the access to bus lanes. As a result, EVs became a political priority and setting new incentives and measures to support the domestic production industry were placed on political agendas. However, the global financial crisis ended most of these plans as the domestic EV producers went bankrupt. Although no additional incentives or measures were put in place as a result, the existing scheme continues to operate providing potential EV owners with incentives.

In 2011 the Norwegian government set up Transnova as an instrument to advance the use of low emission transport technologies. Transnova became responsible for setting up a network of charging stations. The development of this network further incentivised the ownership of EVs and represented the only incentive the government put in place after the global economic crash. The sale of EVs began to rise dramatically even though no further incentives were put in place. This can be explained as a result of the market opening up and more EV models becoming available. Although the incentives put in place previously helped to develop the market, the lack of variety of EV models kept a portion of the population from buying them. As a variety of EVs became available to consumers, more began to purchase them.

24 Barthelmie. and Pryor (2001)

25 Kern (2014)

Case Study 2: Electric Vehicles Norway

From 2012 onwards the development of the EV market share rapidly progressed. Starting from a 2012 market share of 3 per cent, by 2015 it had increased to 23 per cent. In 2020, Norway became the first country in the world where the sale of EVs was greater than the sale of ICE vehicles, accounting for 54 per cent of all new cars sold. In comparison, Ireland's EV market share was 3 per cent in 2020. This places the Norwegian market approximately eight years ahead of the Irish market. As the market share increased, mechanics had to rapidly adapt to be able to handle high-voltage batteries and other diagnostic tools required to repair and maintain the vehicles. The car manufacturers in Norway were instrumental in this process, by internally certifying Norwegian mechanics. But outside of the main dealerships, the Norwegian EV Association facilitated workshops for service and repair on EV, by providing both the necessary tools and certifications. Erik Lorentzen, head of analysis and consultancy at the Norwegian EV Association stated that this training was an important step as it also led to increased competition in the mechanic industry, which has benefitted all EV owners.

There are valuable lessons that Ireland can take from the case of Norway. To develop the skillset that will be required by mechanics, Norway has provided a clear indication that training and appropriate certifications are required for EV maintenance and repair work. Although some of the training was provided for in the main dealerships, Norway set up training for independent garages. This allowed EV users to benefit from increased competition but also ensured the safety of mechanics who received the appropriate training.

Case Study 3: Energiesprong (Energy Leap) – Retrofitting the Netherlands housing stock

Residential buildings in the Netherlands used natural gas and electricity, entirely sourced from fossil fuels, for their energy and heating needs. As the price of energy began to rise (+85% between 2000 and 2010), the Dutch government set out to reduce the use of fossil fuels via delivery of more energy and cost-efficient buildings as well as Net Zero Energy (NZE) buildings by 2020 (European Commission, 2018). Energiesprong was launched in 2010, as a government funded programme to develop viable net zero energy retrofit solutions for the mass market.

The aim of this programme was to achieve a target of a minimum 45 per cent energy savings in the built environment. To implement the programme, housing associations, contractors and manufacturers were brought together to avoid a fragmented method. This is an example of an integrated programmatic approach to a problem. Retrofit solutions are designed, manufactured, delivered and installed using a fully integrated industrial supply chain approach. Energiesprong defines the attractiveness of the scheme as an important parameter for success, as typically, homeowners needed to engage multiple contractors, each with their own points of sale. This lack of co-ordination between contractors or suppliers was complex and deterred homeowners from carrying out energy efficiency upgrades. It required a change in how construction companies usually sell retrofit products, to make them desirable and easy to understand.

The first completed retrofits were carried out on terrace houses. Significant energy savings were realised with a 70 per cent reduction in total household energy consumption. However, the cost of this first project was reasonably high, costing €130,000 per unit. Economies of scale, manufacturing developments and continued integration of a supply chain have reduced these costs down to €65,000 per unit. By the end of 2013, Energiesprong reported that it had achieved 45 per cent energy savings in 1,000 new homes and 800 existing houses (European Commission, 2018).

A major achievement for Energiesprong was the 'Stroomversnelling' deal between six housing associations, four construction companies and several other supporting organisations to retrofit 111,000 homes to NZE standards. This deal allowed the construction companies involved to invest in gaining experience in NZE projects**26**. From this, valuable experience was gained, and the skills required to deliver these retrofit projects began to spread throughout the industry via the large projects included in the Stroomversnelling deal.

As more retrofit projects were completed, the construction industry built up the highly skilled labour force that was required. In 2016 the Dutch Government discontinued its funding for the Energiesprong Programme; its sub-programmes, however, are continuing under private sector management. The success of this programme has led it to being exported to international markets, and the UK and France aim to apply this model and retrofit about 100,000 homes each over the coming years.

Some of the valuable lessons learned from the Energiesprong programme came from its implementation stage. The programme had a significant impact on the construction industry, as companies changed the way they delivered their services. As a similar approach is now being adopted in Ireland, the programme manager commented that its success will depend on contractors making significant and time-consuming changes to assimilate different products and upskilling their staff. Ireland is at the start of its retrofitting journey and putting the supports in place to develop the skillsets required and make these projects affordable have been proven to deliver significant results, as the Energiesprong has shown.

26 Veenstra, A. and Kaashoek, P., 2016. Drivers and barriers for large scale retrofitting in the Netherlands.

Case Study 4: Just Energy Transitions Evaluation

The International Institute for Sustainable Development and Global Subsidies Initiatives undertook an evaluation of zero carbon transitions in the energy sector in 2018 and provided valuable insights from case studies of transitioning away from coal in Egypt, Poland, India, Canada, Indonesia and Ukraine. A summary of the key lessons from this comparative study were:

- Early action on a just transition can minimise the negative impacts and maximise positive opportunities.
- Involvement of trade unions in designing and negotiating support measures was an enabling factor.
- A voluntary approach for reducing mine worker jobs is preferable, as is concentrating effort using regional policies.
- Support for localised industries, including decentralised renewables, can counterbalance a loss of jobs and industries in coal regions.
- Reinvestment of savings into programmes with high development benefits.
- Establishing strong communication highlighting the benefits of reform.
- Training government officials in communications.
- Identifying champions and facilitating international and regional exchange and peer learning.

Further detailed information available from https://www.iisd.org/publications/real-people-real-change-strategies-just-energy-transitions

4.2 Developing Zero Carbon Skills in Ireland

The following short synopses provide insight into skills initiatives in Ireland that are relevant to the zero carbon sector.

Initiative 1: Skillnet Ireland Initiatives for companies in the zero carbon sector

Skillnet Ireland is the national agency for workforce learning, with a mandate to advance the competitiveness, productivity and innovation of Ireland's businesses through enterprise led workforce development. Skillnet Ireland is a collection of private sector businesses that collaborate through an array of networks, to address the skills needs either within a sector or a region.

Green Tech Skillnet is a business network for companies of all sizes in the renewable energy and green technology sectors. Membership of the network is open to private enterprises in the renewable energy and green technology sector based in the Republic of Ireland. Current programmes available include "Work in Wind", "Wind Turbine Technician" and "NZEB Building Programme".

Reflecting the diversification of Ireland's energy system and with an overarching responsibility to EU targets and the mitigation of climate change, the Green Tech Network will support the optimisation of renewables on the Irish grid in the short, medium and long term through learning and development initiatives. In this regard, the Network aims to deliver impactful training and networking events to a growing workforce, facilitate thought-leaders within the renewables sector whilst contributing to Ireland's deep decarbonisation and energy transition.

Lean & Green Skillnet is a business network that supports businesses in environmental, water and energy management. It is focused on providing subsidised, innovative training and compliance programmes to embed sustainable and certified staff skills across corporate members, with an objective to support the growth of the Green Economy.

SIMI Skillnet is a business network supporting the motor industry. It currently runs a programme on "Hybrid and electric vehicle systems combined", in response to garage technicians requiring knowledge and skills on the safe repair of these vehicles, given that the operating systems are very different to traditional internal combustion engines.

Climate Ready Academy is an initiative of Skillnet Ireland, and is a collaboration between Chambers Ireland, Wind Energy Ireland and Sustainable Finance Ireland. It equips businesses with the skills they need to respond to climate change and thrive in a low-carbon economy. It aims to support Irish businesses in developing the skills and talent required to mitigate the effects of our changing climate and environment, and current programmes available include "Sustainability Pass", "Energy Leaders Programme" and "Masterclasses".

CITA Skillnet and Construction Professionals Skillnet run a number of training programmes for professional development in skills relating to zero carbon, including project management, people management, managing sustainable construction, BIM and communications.

During 2020, Green Tech Skillnet provided 1,989 person days of training, over a total of 830 participants, while SIMI Skillnet provided 113 person days of training on Diagnostics and Hybrid and Electric Vehicle Systems, the CITA Skillnet provided 1,118 person training days to 25 participants, while the Construction Professionals Skillnet provided 409 person days of training.

Initiative 2: Springboard+

Springboard+ is an upskilling initiative in higher education that offers free and subsidised courses at certificate, degree and masters level leading to qualifications in areas where there are employment opportunities in the economy.

Springboard+ is a key part of the upskilling and reskilling ecosystem in Ireland, and will have an important part to play in developing skills for the zero carbon economy, particularly from the perspective of upskilling and reskilling those in engineering and scientific sectors. The Springboard+ approach, marked by enhanced collaboration between enterprises and higher education, has considerable experience in providing swift responses to changing skills needs.

In recent years Springboard+ has supported level 8 and 9 programmes in areas such as Building Performance (Energy Efficiency in Design), Clean Technology, Climate Entrepreneurship, Climate Resilience for Business, Corporate Environmental Planning, Energy Management (Buildings), Environmental Science, Sustainability and Climate, Near Zero Energy Buildings, Retrofit, Conservation and Sustainability, and Sustainable Building Technology.

Human Capital Initiative (HCI) Pillar 1 is extending the approach currently in place for ICT under Springboard+. It is offering incentivised places for graduates to reskill in areas of skills shortage and emerging technologies e.g. ICT, High End Manufacturing, Data Analytics, Robotics, Artificial Intelligence, via graduate conversion courses.

In the zero carbon economy area, the HCI is supporting programmes in Bio-energy, Building Analysis and Climate Adaptation, Circular Economy and Recycling Technologies, Circular Economy for a Sustainable Built Environment, Environmental Science, Solar Energy, Sustainable Energy Systems, Sustainability in Enterprise and Wind Energy.

Initiative 3: nZEB Centres of Excellence for Green Building skills

After the introduction of Near Zero Energy Building standards in Ireland, an upskilling process within the construction industry was required to ensure enterprises understand what these building standards mean for them and how they can comply.

Training courses were needed to translate new building requirements into industry practice. An nZEB "Centre of Excellence for Green Building Skills" was established through the Waterford and Wexford Education and Training Board, and nZEB training began in 2018. In terms of retrofit training, this is to be provided in five Education and Training Boards, which act as nZEB Centres of Excellence. It is already being offered in Waterford/Wexford and Laois/Offaly; the other ETBs are Limerick Clare, Cork, and the Mayo/Sligo/Leitrim.

€500,000 was allocated under the Government's July 2020 Jobs Stimulus to expand the skills development infrastructure in preparation for the significant increase in reskilling required to deliver the National Retrofitting Programme. The programmes were intended to be ready for rollout and delivery in 2021. Budget 2021 provided for an additional 500 places on 10 week retrofitting courses in addition to the expected increase for existing short courses.

Initiative 4: Ireland's Renovation Upskilling Committee (Reno-NUC)

The work completed by the Irish Green Building Council and Limerick Institute of Technology (LIT) as part of Build Upon and Qualibuild projects showed that a lack of skills at all levels of the supply chain could significantly jeopardise large scale deep energy renovation in Ireland.

Ireland's National Renovation Upskilling Committee (Reno-NUC) was launched in February 2019, to respond to the need to encourage and facilitate upskilling in energy renovation required for construction workers and building professionals.

Reno-NUC was formed as a result of a recommendation of the SEAI funded ECCoPro project. High-level strategic and policy input to support large scale upskilling of building professionals and construction workers in energy renovation in Ireland was initiated. The primary aims were to contribute to the development of a roadmap to launch a user-friendly holistic energy efficiency accreditation system for building professionals and construction workers and to oversee the development of an online self-assessment tool for building professionals and construction workers to help them identify their training needs and pathways to acquire these skills.

The results of this initiative include increased collaboration between IGBC and SEAI; development of the Build Up Skills App that enables building professionals and construction workers to identify energy renovation training courses; the publication of a set of recommendations for a Renovation Register to incentivise upskilling and to ensure property owners' trust in the renovation process (2020); and a review of knowledge and upskilling required for construction professionals when undertaking large scale deep renovation (2017) identifying not only the technical skills, but 'soft skills' (communication, customer care and psychology), and 'multidisciplinary skills' (collaboration skills). In addition, to stimulate demand for energy skills, an nZEB training clause is being developed for inclusion in public procurement tenders and nZEB awareness training for staff in DIY stores is being rolled out (2021).

Initiative 5: Energy Renovation for Traditional Buildings, Continued Professional Development

The SEAI, The Heritage Council, Carrig Conservation International and ICOMOS Ireland National Scientific Committee on Energy, Sustainability and Climate Change published a Deep Energy Renovation of Traditional Buildings report in March 2018, which addressed the knowledge gaps and skills training in Ireland. The report acknowledged a lack of training modules and certification systems as a major barrier to the roll out of large-scale energy renovation programmes for traditional buildings.

A CPD series on the risks challenges and benefits of renovating traditional buildings for improved energy performance was developed by the Heritage Council and Carrig Conservation International, with support from SEAI, Engineers Ireland and the Society of Chartered Surveyors Ireland. Publication by the Department of Housing, Local Government and Heritage of the new guidance document on Energy Efficiency in Traditional Buildings in late 2021 will support a further well informed upgrade of energy efficiency in traditional building and facilitate future training.

The five-day series was delivered in 2019/20, open to qualified building professionals and Continuing Professional Development (CPD) credits were provided by the Royal Institute of the Architects of Ireland (RIAI) and Engineers Ireland (EI). The lecture series was also endorsed by the Society of Chartered Surveyors (SCSI). Of the 120 attendees, 80 attained CPD accreditation and it was intended to continue the series as an online forum in Autumn 2021.

Initiative 6: Just Transition Midlands

The industrial scale extraction of (milled) peat in the Midlands (Laois, Offaly, Longford and Westmeath) was used both to generate electricity and to heat homes. Bord na Móna, a semi-state company, was responsible for harvesting peat. In 2019, 1,743 people were directly employed by Bord na Móna, of whom 1,050 were in the Midlands region. The majority of these workers were aged over 50 years, with relatively low levels of formal educational attainment. However, the decision of An Bord Pleanála to refuse the application of the ESB for continuing production at Shannonbridge, coupled with the ESB's decision not to pursue a planning application for Lanesborough – Lough Ree Power had a significant impact on employment in the energy sector in the Midlands.

A Just Transition Commissioner for the Midlands was appointed by the Government in 2019. Within the European Green Deal, a Just Transition Fund was established along with a dedicated scheme under InvestEU and a public sector loan facility with the European Investment Bank Group to mobilise the additional investment required.

The National Economic and Social Council undertook an analysis of employment vulnerability in the context of Just Transition in 2020, and made 12 recommendations:

Continuous, pre-emptive workforce development

1. Increase Ireland's ambition for workforce development with higher targets for employee training, appropriate resourcing of key bodies, and incentives for employers to help workers attend programmes.
2. Enhance the skills and training advice available by providing it to workers before they may become unemployed, delivering more quality one-to-one coaching, counselling and mentoring, and making potential 'destination' a key consideration in the design of worker training programmes.
3. Improve the information available on skills and training by making greater use of skills audits, better recognition of people's informal skills, and with more information-sharing between the State, firms and workers.
4. Increase the momentum behind efforts to increase participation in lifelong learning, especially by those who are under-represented in this activity.

Building resilient enterprises

5. Extend appropriate enterprise supports to viable but vulnerable firms, convene inter-agency events and scenario planning, and consider supports for early mover firms.
6. Increase support to SMEs to allow them undertake development projects in areas that can build resilience, including support for local enterprise-led networks and a new Transition Voucher.

Delivering high-impact targeted funding to support transition

7. Develop specific means of targeting financial support towards those most affected by the transition, to include social clauses and new firm- and community-based self-identification mechanisms.
8. Improve supports for fund-application and local programme development via seed-funding and more place-based investment funds.
9. Enhance engagement between government departments and agencies, and State and EU finance institutions such as the Strategic Banking Corporation of Ireland (SBCI), Microfinance Ireland (MFI) and the European Investment Bank (EIB) to assist firms.

Initiative 6: Just Transition Midlands

Making it happen

10. Government, through the inter-departmental Future Jobs Ireland process (or similar), should take forward the recommendations of this report to provide more proactive supports for workers, improve enterprise resilience and help target finance to support transition.
11. Enhance communications efforts related to the transitions with a new group with appropriate funding, and roll out a programme to concretise 'the transition' for firms.
12. Establish a social dialogue and deliberative process, called the Just Transition Review Group, to develop a shared vision and associated mission-oriented actions for an Irish just transition.

The Just Transition Fund is available for projects focusing on retraining workers and proposals to generate sustainable employment in green enterprises in the Midlands region.

Provisional offers totalling €1.2 million were made to 16 successful applicants under Strand 1 of the 2020 Fund. Successful projects include a feasibility study to scope out the development of a renewable energy technology, examining the potential of brewing artisan beers in the Midlands region using a Bord na Móna site, extending an existing biodiversity park boardwalk, and renovating a local community hall to facilitate remote working and training.

Initiative 7: Action Plan for Apprenticeship 2021-2025

A five-year action plan for Apprenticeship was published in April 2021.The intention is to fully embed apprenticeship as an option within the national education and training system, transforming apprenticeship from a well-established route to a career in niche areas (the craft professions) to a well-established route to a broad range of careers and which is attractive to employers and learners. By 2025, apprenticeship will sit firmly within the broader education and training landscape as a core offering.

A reformed apprenticeship structure will be rolled out, moving apprenticeships to a single apprenticeship governance system. This follows from the system of 'New Apprenticeships' which was instituted in 2016, which introduced diverse models of training on-and-off the job, as well as different models of delivery. All the new apprenticeships developed from 2016 were industry led.

The Action Plan for Apprenticeship recognises that strategic areas of skills development during 2021-2025 include skills for the zero carbon economy, supporting targets set out within the Climate Action Plan and Project Ireland 2040. The generational challenges such as climate change need powerful responses across education and training in workplaces, and the apprenticeship system needs to be agile to meet the challenges. The Action Plan also identifies the need to upskill craftspeople and to support workers displaced by the rapid pace of change.

Of note is the Wind Turbine Maintenance (Level 6) Apprenticeship, which is currently pending validation.

Initiative 8: Promotion of Training, Apprenticeships and Vocational Educational Training in the Built Environment Sector

Generation Apprenticeship

A national promotional campaign, Generation Apprenticeship, is underway since May 2017, led by the Apprenticeship Council and with co-ordination support from SOLAS. It has been designed to influence parents, teachers and potential apprentices on the career paths and further educational opportunities arising from apprenticeship programmes.

As well as strong branding, there are PR and media campaigns across print, TV, radio and social media by all partners around the country. Along with employer engagement it includes initiatives such as, a Generation Apprenticeship competition which was expanded to second level schools in 2019, employer of year awards and employer ambassadors.

Construction Industry Federation campaign to promote built environment careers in schools

The CIF is running a campaign to promote careers in the built environment throughout secondary schools. The main intention is to increase the number of students selecting Design, Engineering and Construction related subjects in secondary school, as well as at third level, including craft apprenticeships.

A central objective will be to demonstrate to parents, teachers and schoolchildren the scope and scale of routes to careers within the system to enter the construction industry in the widest context. The campaign has three components; School outreach/Curriculum development, a National Competition and a National Awareness Campaign that will roll out over a three-year period.

See: https://cif.ie/cifchallenge/

Vocational Education Training for Low Energy Construction Study (VET4LEC)

This European joint project, undertaken by the European Construction Industry Federation and the European Federation of Building and Woodworkers within the framework of the EU sectoral Social Dialogue for the construction industry, considers how the zero carbon construction and retrofit policies of the EU are coordinated and governed. The need for occupational coordination was identified: energy efficiency works require close coordination between the different occupations on site, placing demands on these occupations going beyond their immediate scope of responsibilities to understand the building fabric as a unified system, and this project focuses on literacy, technical knowledge, lifelong learning and soft skills associated with low energy construction and retrofit.

The final report from February2019, inclusive of input for Ireland is available from: https://www.fiec.eu/application/files/8715/7839/3089/VET4LEC___Report___lowres___EN.pdfA while a separate report, specific for Ireland may be accessed at: https://www.fiec.eu/download_file/force/247/392

Initiative 9: Construction Industry Register Ireland (CIRI)

The Construction Industry Register Ireland is an online register, supported by Government, of competent builders, contractors, specialist sub-contractors and tradespersons who undertake to carry out construction works.

CIRI was established in 2014 to develop and promote best practice. Currently CIRI is voluntary, but legislation is being drafted which will put CIRI on a statutory footing.

The purpose of the General Scheme of the Building Control (Construction Industry Register Ireland) Bill, published in 2017, is to provide for a mandatory statutory register of builders, contractors and specialist sub-contractors, and subject to a limited number of exceptions, a builder will only be permitted to carry out building works in respect of which he or she is registered.

The Construction Industry Register Ireland has been operated by the Construction Industry Federation as a voluntary register since March 2014 and the Government committed to placing the register on a statutory footing in the Action Plan for Jobs and Construction 2020.

The establishment of CIRI as a mandatory statutory register is seen as an essential consumer protection measure which will give consumers who engage a registered builder the assurance that they are dealing with a competent and compliant operator. It will also provide a forum for the investigation of complaints against registered members and the imposition of proportionate sanctions.

5

Preparing for the Future

5 Preparing for the Future

5.1 Introduction to the "PESTLE" Approach

As part of this study, the EGFSN engaged in horizon scanning: the process of identifying early signs of development through the systematic examination of potential threats and opportunities. The PESTLE framework is used to organise and assess external drivers or constraints for change. PESTLE splits the external influences or drivers for change into six factors:

Political: Politics, and the approach to intervention in the economic functioning of society and the influence of policy on skills that are developed and retained in an economy.

- **Economic:** Goods, services, exchange, labour market, and international trade are affected by economic factors. In terms of business planning, the pipeline of projects has a significant impact on the retention of skills.
- **Social:** The underlying structure and networks within society and how this affects outcomes. This can be linked to demographics (age, sex) and social norms or how people interact and approach their work.
- **Technological:** The influence of technology on inputs, processes and outputs. This often concerns digital technology, applications, websites and similar projects, but also more traditional forms of technology linked to manufacturing, distribution or communications and the skillsets to manage changing technological processes.
- **Legal:** How regulations or laws affect business, ideas or concepts. This can sometimes overlap with political factors but can affect skills development in terms of minimum standards and upskilling required to comply with legal requirements.
- **Environment:** Environmental and ecological factors relating to how the physical environment is affected. In this context it is the influence of the natural asset base and geographies on the supply of skills.

While there is overlap between each category in the PESTLE framework, the main drivers and constraints in each category are set out – identifying both global and domestic factors that emerged from the stakeholder engagement – through interviews with Irish enterprises and stakeholders and through group discussion at Workshops.

This section draws heavily from the Key Informant interviews and the interviews of enterprises in the Renewable Energy, Electric Vehicle and Retrofit sectors. 63 interviews were undertaken in total between January and March 2021, and two Workshops were held in February and March 2021 with approximately 30 participants who attended the Renewables/EV Workshop and approximately 45 attendees at the Retrofit Workshop.

5.2 Renewable Energy

Political Factors affecting the Renewable Energy Sector

Global and domestic policy are considered drivers for skills in the renewable energy sector. The political landscape - at EU and national levels – are considered to structurally change the demand for jobs in renewable energy. These changes lead to a decrease in some occupations associated with energy produced from fossil fuels and to an increase in demand for occupations required in the renewable energy sector.

Overall, the focus on skills required for renewable energy results from a series of policy changes in the last three years. Renewable energy targets were set in the Government's first Climate Action Plan to Tackle Climate Breakdown, published in 2019. The Programme for Government 2020 outlines a target of a net zero economy by 2050, with profound implications for the energy sector. This is aligned with the European Green Deal, where there are to be no net emissions of greenhouse gases in 2050.

The Climate Action and Low Carbon Development (Amendment) Bill 2021 sets out a system of carbon budgeting by sector, while the draft amendments to the Petroleum and Other Minerals Development Act signals the end to prospecting and extracting gas. DECC's (2020) National Energy and Climate Plan (NECP) 2021-2030 highlights Ireland's excellent renewable energy resource and the potential for decarbonising the electricity network.

The NECP established the Renewable Electricity Support Scheme (RESS) in Ireland showing the Government's commitment to renewable energy, by instituting a funded scheme that aims to support renewable electricity production in Ireland, including solar photovoltaic and wind. The RESS was designed to improve the county's efforts in reaching the EU renewable energy target and also help Ireland to meet its national energy goal of reaching a share of 70 per cent of renewables in its electricity mix by 2030. A system of RESS auctions was instituted, with the first taking place in 2020 which determined which renewable generators receive contracts. Eligible applicants (renewable energy companies) competed for subsidies on the generation of 2,236 GWh (Deemed Energy Quantity), with successful applicants receiving a premium on top of the energy market price for a duration of 15 years, providing certainty to successful renewable energy companies.

In line with the United Nations Sustainable Development Goals, the UN's International Labour Organization published its "Guidelines for a just transition towards environmental sustainable economies and societies for all",[27] detailing the principles for a just transition. This is of relevance to the transition out of occupations in electricity generation in the Midlands, which was dependent on the burning of peat, and the establishment of a Just Transition Commissioner in 2019 along with a budgetary allocation for a Just Transition Fund. While this initiative is not focused on redeployment of workers within the energy sector itself, it does allow for initiatives that develop skills in renewable energy.

Stakeholder's perspectives on political drivers of change in renewable energy

The interviews with stakeholders highlighted the significance of recent policy change for the renewable sector, with one stakeholder describing the growth in the renewable energy sector as a result of a domestic 'policy revolution', in terms of the Climate Action Plan coupled with the acceleration of European funding due to the European Green Deal. Many stakeholders were optimistic that renewable energy targets will be met and surpassed, with the question facing Ireland being whether it moves to being a net electricity exporter. The sentiment that 'the time is right' was expressed by many stakeholders, and many of the renewable energy companies that were interviewed expressed relief that the sector is scheduled to expand and grow.

27 https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf accessed April 2021

Several stakeholders expressed concern that there could be an element of myopia with a policy focus only on large-scale wind energy. While Ireland's considerable wind resource was recognised, and the potential of the wind in the Atlantic acknowledged, there was concern that other energy generation technologies should be pursued concurrently within policy – solar, biogas and biomass waste, Combined Heat and Power, wave and hydro. One enterprise noted that the targets that are set are about carbon reduction and not energy efficiency, and as such, energy savings brought about through, for example, Combined Heat and Power are not incentivised. Stakeholders stressed that the generation technologies are complementary to each other (particularly wind and solar), and that innovation and skills in emerging technologies, such as wave technology should not be neglected in renewable sector policy.

The development of smart technology, such as transformers, convertors and batteries are also required in the transition to renewables, while a number of firms interviewed stressed the importance of microgeneration, small scale domestic, commercial and agricultural renewable installations. The (anticipated for end 2021) Micro-generation Support Scheme was welcomed by solar installers. A microgeneration scheme is expected to help the residential sector, mid-size installations such as panels on agricultural buildings and larger scale manufacturing sites – such as data centres who increasingly want to guarantee that their electricity comes from renewable sources.

Some stakeholders commented on the government's policy to encourage a community energy sector in Ireland but highlighted that there are a lot of impediments in getting 'fragmented' communities to manage highly commercial, technical processes that even established companies struggle with. The skillsets required to execute renewable energy projects are considerable.

Economic Factors affecting the Renewable Energy Sector

In terms of economic factors affecting the renewable energy sector, the investment climate is considered 'just right'. Advances in solar and wind technology globally over the last two decades have lowered the cost of renewable technology, and renewable technology makes financial sense. Solar costs have come down 90 per cent from ten years ago, making it a viable option. The Government is providing aid for the production of renewable energy, allocated via the Renewable Electricity Support Scheme (RESS) auction. The European Commission agreed to support the production of electricity from renewable resources in Ireland, approving the RESS. The scheme is in line with EU State aid rules and is not considered to unduly distort competition. The RESS will run until 2025, with a budget of between €7.2 – 12.5 billion. The RESS will also provide special auction categories that offer support to projects developed by renewable energy communities and for communities that host projects supported by the RESS. The Government mandated a Public Service Obligation (PSO) levy charged to all electricity customers in Ireland, which is used to support the generation of electricity from sustainable, renewable and indigenous sources. The levy is certified annually by the Commission for Regulation of Utilities.

This combination of affordability and innovation is attracting a wider variety of investment and lending models in the Irish renewable market, and there has been considerable change in the financial markets for renewable energy. The mainstream banks and institutional investors were actively investing in low-risk large (megawatt threshold) wind energy projects in Ireland, whereas there is more activity in the Irish market from foreign and niche funds, bringing experience from investors who may have successfully financed smaller, potentially riskier projects in other jurisdictions.

Stakeholder's perspectives on economic drivers of change in renewable energy

Renewable Electricity Support Scheme (RESS) auctions and grid connection are the biggest determinants/ drivers in terms of delivery of projects. Many renewable energy enterprises commented that the cost of doing business in Ireland is high – especially connection to the grid. There are risks associated with the RESS auctions, as there are considerable 'sunk' costs borne by the renewable energy companies, to bring a project to auction. The frequency of auctions was considered an issue, as it leads to "bunching" of labour demand in concentrated timeframes, with calls to improve the timing to even out the demand for construction of projects.

The supply chain is considered by renewable energy firms as a constraint in delivering renewable energy projects (of scale). This is particularly pronounced for offshore wind, as there is currently a limited supply of wind turbine installation vessels. These ships are strong enough to carry the turbine pieces from port to installation on site through providing a stable platform for turbine erection. There are only 32 of these wind turbine installation vessels in operation globally in 2020, with concern raised that the global fleet (although expanding) will not be able to meet offshore demand beyond 2025.[28] The commitment of the United States to create a New Wind Energy Area offshore will place demand on the supply chain. Delays in project planning and obtaining approval in Ireland can compound the delays experienced by the renewable energy companies for actual construction of offshore facilities and erection of turbines.

Work on the development and future operation of a new consenting regime for offshore renewable energy is underway within the Department of Environment, Climate and Communications (DECC) and other government departments. Development of the Maritime Area Planning Bill (MAP) is being led by the Minister for Housing, Local Government and Heritage under the auspices of the Marine Legislation Steering Group with DECC leading the development of provisions specific to Offshore Renewable Energy. Enacting the MAP Bill will facilitate the marine planning framework for offshore renewable energy development, beyond the limits of the foreshore (12 nautical miles), replacing the existing consent regimes while streamlining arrangements on the basis of a single consent principle.

The MAP Bill will also establish a new professional agency focused solely on regulation in the maritime area, which is to be called the Maritime Area Regulatory Authority (MARA). It will assume the role of assessing and granting maritime area consents for relevant offshore renewable energy projects. An Bord Pleanála and relevant coastal Local Authorities will still serve as the planning authorities for projects requiring planning permission. MARA will therefore have four key roles:

- Granting of all Maritime Area Consents for the maritime area;
- Granting maritime licences for specific scheduled activities, including environmental surveys;
- Ensuring robust compliance; and
- Enforcement measures and managing the existing State Foreshore portfolio of leases and licences.

Although the 'time is right' for renewables in Ireland, the time is also right for the renewable sector globally. It is a very competitive international market for renewable energy jobs with many opportunities for maintenance technicians and engineers in other countries. The issue of affordability and lifestyle for Irish renewable energy workers is considered a threat to the industry, with higher pay and hence potentially better lifestyle choices available to skilled people in the renewable sector elsewhere.

There are many in the renewable energy industry who work outside of Ireland- this was particularly marked in the interviews with solar enterprises, but also for some Irish engineering enterprises. A number of Irish solar companies, in operation for up to fifteen years, had no actual projects in Ireland (many were in planning

28 Rystad Energy (2020) The world may not have enough heavy lift vessels to service the offshore wind industry post 2025

phase) until a 'route to market' emerged with the RESS 1 auction in 2020, but developed solar projects in other jurisdictions. There is a strong skillset in design and project management expertise for solar (highly skilled professions) that is exported, but there is a lack of the specialised unskilled labour for erecting solar panels in Ireland, and these skills had to be imported (particularly from Spain). These imported skills are at a lower cost.

The ability to work in the United Kingdom over the last decade was noted by a selection of Irish firms as driving their growth. Key future growth areas cited in the interviews were renewable energy asset management, battery storage and the likely switch to 'green' hydrogen technology (using renewable energy and electrolysis to split water).

The lack of experience in offshore skills, in comparison to the United Kingdom, was noted by stakeholders. The wider economic and business opportunities associated with the development of Ireland's offshore renewables sector will be explored by a cross-departmental Offshore Renewable Energy Top Team, which is chaired by the Department of the Environment, Climate and Communications. This will include the identification of supporting infrastructure development and supply chain opportunities as Ireland's offshore wind industry is developed. The Offshore Renewable Energy Top Team includes membership from DECC, the Department of Enterprise, Trade and Employment, the Department of Further and Higher Education, Research, Innovation and Science, the Department of Transport, and Enterprise Ireland.

Wage differentials between the offshore oil and gas industry make it difficult for the renewable sector to compete for skills on a wage basis. It was noted that there is movement of skills between the oil and gas sector and the offshore renewable sector, and this may be a viable source of skills for the offshore sector. Recent Irish projects that are progressing have to bring in a lot of UK-based resources for the planning and consenting stages. There is currently a skills shortage in Ireland, which needs to be addressed in preparing for the procurement and construction stage of approved projects.

A number of stakeholders interviewed thought that skills from overseas are very important, particularly knowledge and expertise in areas where the sector in Ireland is still in its nascency. This includes hydrogen, biogas and decarbonising heat. A number of smaller Irish renewable energy companies noted that trying to keep people/skills is tough, particularly with data and mechanical engineers able to get higher wages in other sectors. A comparative deprivation in wages was identified, particularly with the expanding multinational businesses locating in Ireland. There are over 200 overseas companies in the industrial technology sector employing more than 23,000 people (IDA, 2021), many from the engineering sector.

For large scale solar projects, it was noted that there is a skills gap in construction and delivery. Skills have been imported notably from the UK, Spain, France and Germany, and the restriction of this mobile labour source due to COVID presented delays to a number of projects. Certain manufacturers' warranties require installation and maintenance to be undertaken by specialised trained teams, and therefore careful planning and scheduling is required.

In terms of preparing for the future, Corporations (e.g. tech sector) want their own renewable energy on site, for environmental and social accountability. Environmental, Social and Governance (ESG) criteria are a set of standards for a company's operations that socially conscious investors use to screen potential investments, with energy provisioning an important element of the ESG criteria. The proliferation of Data Centres in Ireland is expected to continue to drive growth in the renewable energy sector. Data Centres need onsite generation, as well as heat recovery from factory processes. Industry stakeholders in industrial manufacturing foresee energy systems integration as an emerging skill; integrating water, energy, waste and carbon in a circular economy manner, with a focus on key energy using assets. A number of large medical and software companies have their global energy managers based in Ireland, and although there is a small number of these highly specialised energy managers/engineers there is considerable information sharing and industry collaboration. However, the use of fossil fuels is expected to continue, alongside the integration of renewable energy sources, although Grid access for industrial purposes is considered a constraint.

In terms of market structure for electricity, the Integrated Single Electricity Market is a wholesale electricity market arrangement for Ireland and Northern Ireland. A live market was established in October 2018, which sees electricity providers bid to supply half hour slots. This has triggered the demand for electricity market traders, and market trading as an emerging skill within renewable energy companies. Skills required for this activity include maths-based engineering, coupled with business/stock trading skills to optimise the supply of (renewable) electricity. Renewable energy companies have a trading desk, and some of these desks are outsourced to third parties, aligning with the European market, and structure of electricity trading. These skills are transferable across the EU.

Social Factors affecting the Renewable Energy Sector

Although there is a conscious social change towards renewables in Ireland and Europe, there is still an element of NIMBY'ism ("Not in My Back Yard") towards onshore wind energy. Wind companies are aware that they have to consult with the public and local stakeholders early, and that they must communicate effectively. Renewable energy advocates are required across the renewable energy sector. Many stakeholders stressed that renewable energy enterprises need to be honest with communities about the potential for local jobs, and the level of skills required for those jobs.

Regarding the optimism of harnessing the offshore or marine wind source, there was a poignant observation from one stakeholder that as a country "We've turned our back to the sea for generations", and now we are expecting to redeploy skills to the marine environment. Another observation was that the offshore energy potential in the Atlantic is the "prize", and if/when harnessed, it would surpass the electricity demand on the island of Ireland, and Ireland could become a net exporter of energy. One of the main criteria for offshore wind workers is to have 'sea legs' or an ability to work in inclement maritime conditions. A natural source of skills for the offshore wind industry is in the fishing sector, but it was noted that no transitioning initiative between the fishing and renewable energy sector has occurred to date.

Officials from the Department of Housing, Local Government and Heritage and the Department of the Environment, Climate and Communications are, however, actively examining further opportunities for engagement with the fisheries sector, having identified and recognised a need for effective engagement between the seafood and offshore renewable energy industries. Both Departments are currently evaluating a proposal for the establishment of a seafood industry and offshore renewable energy working group, one of the primary goals of which will be to develop a communications protocol between these two industries. The intention with this is to increase levels of understanding and facilitate constructive engagement between both of these important sectors, in addition to considering relevant issues such as co-existence opportunities, displacement considerations and safety at sea.

A growing consumer demand for microgeneration (particularly solar) is an emerging social trend. This was facilitated at the global level in the decline in costs of solar photo-voltaic technology. However, the market for solar microgeneration in Ireland is underdeveloped or miniscule in comparison to other European countries[29], and as noted above, there is a skills gap in solar installation and maintenance.

29 Stastica https://www.statista.com/statistics/863238/solar-photovoltaic-power-electricity-production-volume-european-union-eu-28/ accessed April 2021.

The gender imbalance in the sector was discussed in a number of stakeholder interviews. In general terms the need to promote STEM subjects for girls in schools and further training was identified, as was the dominance of men working in the renewable wind sector – particularly turbine technicians. The age profile for turbine technicians was also discussed, as technician entrants to the renewable wind sector tend to be in their late 20s, early 30s and have a bit of relevant experience behind them. The job requires them to stay away from home, to be relatively self-sufficient and have skills such as the ability to drive larger vehicles. As per the EGFSN's previous highlighting of gender imbalance in the construction and built environment sectors[30], the same challenges face the renewable energy sector, which draws from a similar pool of skilled labour. While acknowledged by many stakeholders, the gender imbalance was noted as problematic, as girls and women are not equally represented in STEM training and courses.

In terms of promoting the renewable energy sector and attracting new entrants/skilled people to the sector, the need to establish social buy in for new employees was identified by many stakeholders. It was noted that the renewable energy sector needs to posit the industry as a 'problem solving' one for the future- that is, that it is addressing the climate crisis. This issue of communication and clarity about what the sector can achieve and how important it is for addressing and adapting to climate change emerged in numerous interviews. Skills in communications and marketing, combined with technical skills in renewable energy were identified as important for the sector.

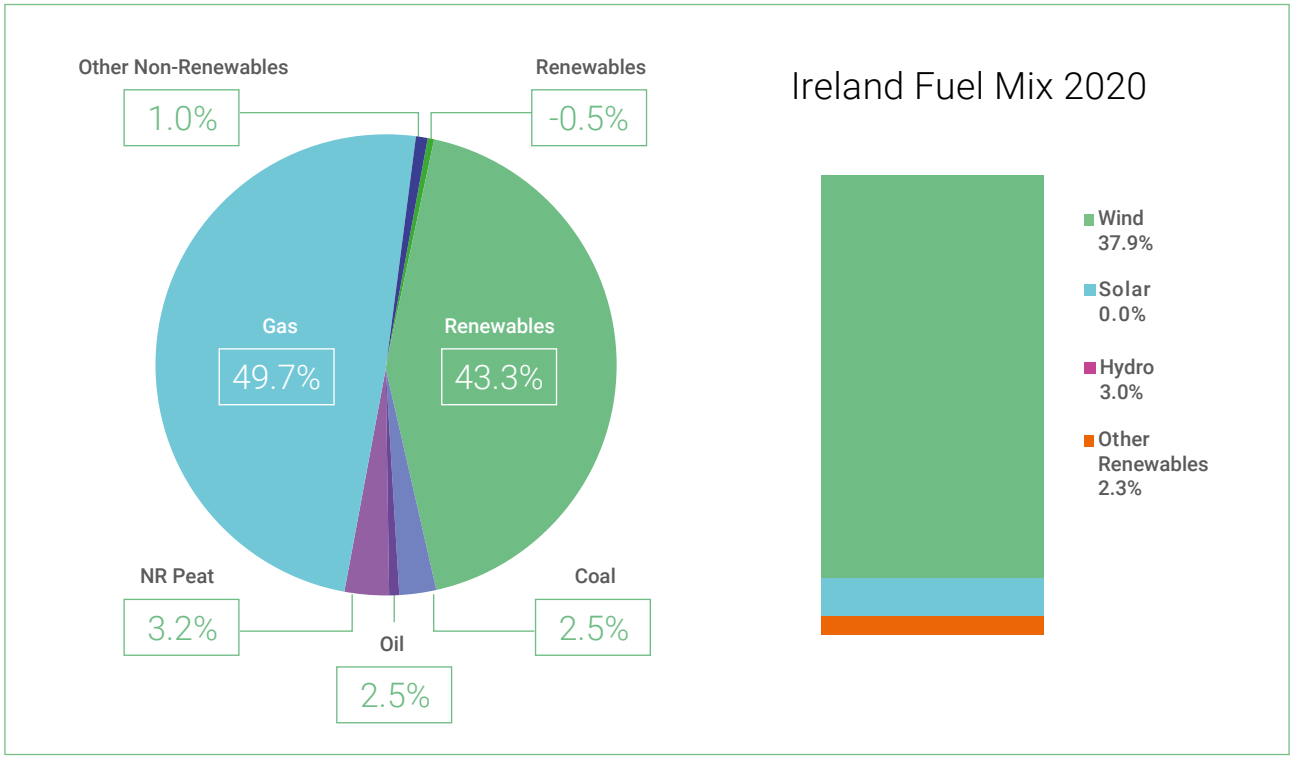
The behavioural capabilities of the existing workforce in the renewables sector were discussed by a number of enterprises as being equally important as technical skills. These skills, such as leadership, strategic orientation for the enterprise, commercial awareness, customer service focus, and performance and innovation, are critical skills that are required in the renewables sector. The focus on these behavioural capabilities signifies a level of organisational maturity in the renewable energy sector, as the existing enterprises enter a rapid growth and competitive phase of industry development. A key behavioural skill that was identified was the adaptability of the renewable energy worker, which is more of a cultural attribute of workforce resilience. The emergence and growth of a new industry requires this adaptability, not least because it takes time to identify and define skills that are required in an emergent sector, but also because the skills used in the renewable sector are sourced from established or traditional disciplines – such as mechanical and electrical engineering, information technology systems and electricians.

Technological Factors affecting the Renewable Energy Sector

In general, the rapid technological change in the transition to renewables is seen to lead to an element of uncertainty about where and how a country should move, and how you prioritise between the different renewable technologies. Ireland is considered 'technology neutral' among available renewables at a policy level. A number of stakeholders interviewed identified the need to upskill at a policy making level, with skilled renewable energy experts within Government and within the planning organisations (Local Authorities, the Office of the Planning Regulator and an Bord Pleanála). Enterprises expressed the opinion that corporates and enterprises are proactive and taking the lead in developing the renewable sector in Ireland, with a sense that policy has been slow and is playing catch up to the industry.

Many stakeholders discussed existing versus emerging renewable technologies. Ireland is seen as a technology taker for solar and wind technologies. Ireland is seen as a leader with a very high share of electricity from onshore wind - countries like Denmark have a higher overall share of electricity from wind, but both onshore and offshore. As stated previously, the use of solar energy is in its nascency in Ireland, which means that there are shortages in solar installation and maintenance.

30 EGFSN (2020) Building Future Skills: The Demand for Skills within Ireland's Built Environment Sector to 2030 http://egfsn.ie/all-publications/2020/building-future-skills-report-with-wit-tud-edits-completed-4.pdf



Source: EirGrid Fuel Mix 2020[31]

The issue of 'Technological Lock-in' was raised, and many stakeholders discussed the coupling of hydrogen with renewable electricity. There was significant optimism that hydrogen can be produced using offshore renewable energy, and although hydrogen is an energy carrier not an energy source, it has the ability to store tremendous amounts of energy and can be used in fuel cells, particularly electric vehicles. This technology is considered to be outside the timeframe of this current study (hydrogen technology may be developed by 2050), but globally there is considerable interest in producing hydrogen. A number of stakeholders expressed caution that we may ignore emerging alternative technology (e.g. wave energy, biogas and geo-thermal). These stakeholders were optimistic about the recent technological advancements in wind and solar, but emphasised the need to invest in blue-sky research in energy alternatives.

Ireland's first offshore wind site at Arklow Bank (operational in 2004) was discussed in terms of its pioneering status as the world's first installation of wind turbines over 3MW. However, the site was never developed fully, beyond the seven turbines, and no further offshore wind farms were built in the intervening 17 years. Turbine technicians who work both onshore and on the Arklow Bank describe the skills required to work offshore as being similar to those for onshore. Additional marine health and safety training is required for 'transfer and transit' from the boat onto the deck/platform, but once attached to the turbine's safety system, a safe working area is established, similar to the process on land.

Difficulties with Grid connection were cited as a technological constraint for many renewable enterprises, prompting a level of frustration expressed by some stakeholders. While it was recognised that EirGrid are future-proofing the network and grid stability was essential, the "dispatch down"[32] loss of renewable electricity is problematic for the industry, as the transmission of the electricity is constraining its generation. Physical access to the Grid was also a constraint to the industry, taking many years for that access.

31 http://www.eirgridgroup.com/site-files/library/EirGrid/Fuel20Mix.jpg updated May 2020. Next update by SEAI in May 2021.

32 Dispatch Down occurs when the transmission system operator instructs a renewable electricity generator to produce less electricity than it can, or even cease producing electricity

In terms of technological revolution, the 'Smart Grid' or 'Internet of Things' is seen as the likely scenario for the future. There are many innovative start-ups working on aspects of this in Ireland. Ireland is considered an ideal location for innovations associated with the Smart Grid, given the long established software engineering and tech capabilities and credentials. Security concerns about Smart metering – "Big Brother" and surveillance of the smart grid were voiced, and there is an element of obtaining public acceptability for a smart grid. Stakeholders identified that big-data analysts will be in demand in the renewable energy sector, as will Power Systems Engineers and highly specialised IT skills.

It was noted that a number of Irish start ups are forming a 'Smart Energy' cluster, investing R&D into the internet of things, battery storage, grid balancing and virtual power stations. This requires a mix of engineers, project managers, data analysts and software developers. These companies are operating internationally

Legal Factors affecting the Renewable Energy Sector

The EU has been at the forefront of regulatory interventions to create a financial system that supports sustainable growth and a more resource-efficient economy. To this end, the European Commission published its Action Plan on Financing Sustainable Growth (the EU Action Plan) in March 2018. Three main regulations originated: Environmental, Social and Governance Disclosure Regulation; Environmental, Social and Governance Taxonomy Regulation; and the Zero carbon Benchmarks Regulation. The Disclosure Regulation (EU 2019/2088) mandates financial market participants and financial advisers to provide transparency regarding environmental, social and governance considerations they incorporate into the services provided to clients. The Taxonomy Regulation (EU 2020/852) provides a framework for a unified classification system for environmentally sustainable economic activities in order to create a common understanding and methodology for investors to make decisions, thereby channelling funding to zero carbon projects and limiting 'greenwashing'.

The intention in finance markets is to initiate systemic change, by mobilising capital from private resources to finance sustainable zero carbon investments, particularly energy efficiency and renewable energy investment. A number of enterprises identified the growth of occupations in carbon accounting, carbon budgeting and new occupations that combine the technical and engineering aspects of energy production with commercial, financial and economic aspects. The skills required for these positions signify a melding of technical and financial skills. While enterprises are aware that they require these skills, it was also noted that these skills are required in the public sector also, to ensure that proposals for renewable energy projects can be assessed and appraised appropriately, particularly with respect to the planning system.

The planning and delay-time (project lead in) was discussed extensively by the renewable energy firms, with adherence to the planning process a problem for renewable wind energy and solar projects. This was cited as an additional cost of doing business in Ireland, and while most companies did not object to the planning process itself, "lots of red tape that holds up development" was a common complaint. A number of enterprises questioned whether there were sufficient resources and skills within the planning authorities to process the applications for renewable energy projects, and they felt that a lack of technical expertise contributed to unnecessary delays.

A number of commercial restrictions on size of systems and inability to send energy between plants was also discussed as limiting legal factors. 'Virtual power plants' (cloud based distributed power plants) are hampered by legal constraints, due to the restriction on sending energy through grid, restrictions over private lines, and restrictions over land to get power across geographies.

Environmental Factors

Ireland's comparative advantage for wind, particularly in the Atlantic Ocean is considered a fortuitous renewable resource. The mismatch between the location of the wind resource of the west coast and population centres on the east coast of the island were noted in the interviews and workshop. Currently there is a concentration of industry planning in the east and south coasts for offshore wind.

While it was recognised that training for renewable energy is available in Kerry, it is also required in other regions/areas (particularly the east coast) where the industry is likely to be concentrated (particularly for offshore wind and solar).

The benefits of co-locating solar and wind energy is considered fortuitous for advancement of the renewable energy sector. Wind tends to blow at night, whereas solar energy is available during the day. This inverse correlation in Ireland is seen positively by stakeholders as, solar PV offers a diversification value of renewable energy.

With the focus on offshore wind energy, there is an increased focus on the marine environment, and skills pertaining to obtaining foreshore licences. This requires the development of marine surveys, insight on the marine environment, expertise in marine geology and archaeology, geophysicists and hydrographers.

5.3 Retrofit

Political Factors

As in the case of the renewable energy sector, the requirement to achieve net zero emissions by 2050 is an overarching policy driver of increased demand for skills in the retrofit sector. Ambitious targets for residential retrofits to be completed by 2030 were set in the Climate Action Plan in 2019. There are targets to retrofit 500,000 homes to a BER level of B2 or cost optimal or carbon equivalent and to install 600,000 heat pumps (400,000 in existing buildings). These targets were later included in the Programme for Government agreed in June 2020. Separately, the Programme for Government also commits to an average 7 per cent per annum reduction in overall greenhouse gas emissions from 2021 to 2030 (a 51% reduction over a decade) and to achieving net zero emissions by 2050. More recently, the Climate Action and Low Carbon Development (Amendment) Act 2021 set out a system of carbon budgeting by sector. It is unclear at this point whether this carbon budgeting process will impact upon residential retrofit targets.

The Department of the Environment, Climate and Communications is currently developing a new national retrofit delivery plan. It will seek to address the key barriers to achieving the retrofit targets which are set out in Ireland's Long-Term Renovation Strategy (LTRS) 2020. The LTRS, which was submitted to the European Commission in 2020 summarises key barriers to achieving the targets and sets out a range of potential approaches to address these across four different pillars which include: customer/homeowner propositions to improve awareness and drive demand; financial/funding models for each consumer segment/cohort; supplier scale-up and contracting and programme governance and roadmap.

The European Green Deal is also an important policy driver for skills in the sector. The Renovation Wave aims to double annual energy renovation rates in the next ten years. As part of the Renovation Wave strategy, a 'Commission Recommendation on Energy Poverty' was also published which highlights that energy renovation is not only essential to reducing greenhouse gas emissions but can also improve the health and wellbeing of vulnerable people while reducing their energy bills. Another important component of the European Green Deal is the Circular Economy Action Plan which notes that the Renovation Wave initiative is intended to be implemented in line with circular economy principles. The European Commission has also introduced the Fit for 55 initiative, which commits to cutting emissions by at least 55% by 2030, in particular through revision of its climate, energy and transport related legislation to align with this 2030 ambition, as well as carbon neutrality by 2050.

The EU's Recovery and Resilience Facility is available to help fund the delivery of Ireland's new retrofit programme. In order to access funding under the Facility, all member states must prepare a 'National Recovery and Resilience Plan' which is subject to assessment by the Commission and approval by the Council of Ministers. These Plans must devote a minimum of 37 per cent of expenditure to climate, with the remaining 63 per cent complying with the 'do no harm' principle'. Renovate (retrofitting/deep renovation) is one of the seven flagship areas identified for reforms and investments which Plans should seek to address. Ireland's Plan, published in June 2021, includes support for a loan guarantee scheme for residential retrofit, as well as funding for SOLAS' Green Skills Programme, which covers training in both nZEB and Retrofit.

The EU Energy Efficiency Directive established a common framework for the promotion of energy efficiency with the Union. Under the Directive, the Energy Efficiency Obligation Scheme, which started in 2014, has set obligations and targets on large energy suppliers, known as obligated parties, to deliver energy savings. These obligated parties offer support to homes to become more energy efficient. This may be in the form of financial support for a deep retrofit project. For every unit of energy saved through the support of a deep retrofit project, an obligated party receives energy credits towards their targets. The first iteration of the scheme ran from 2014-2020, with 2021 a transition year before the new phase for 2022-2030 starts. This scheme also helped to develop the deep retrofit market, as large energy suppliers in Ireland are incentivised to provide support for deep retrofit projects, for them to reach their targets.

The Government provides very substantial support for home energy upgrades and for the improvement of energy efficiency in commercial and public sector buildings through a wide range of schemes operated by the Sustainable Energy Authority of Ireland. Information on the current available range of schemes and supports is available on the SEAI website. The SEAI has been designated as the National Retrofit Delivery Body and is receiving additional resourcing to support them in the role of ensuring delivery of our national retrofit targets. New support schemes are being developed to facilitate and promote retrofit on a significantly larger scale with funding provision to be set in the National Development Plan.

A potential constraint to the required growth of the retrofit sector is competition with the supply of new housing, which in general has stronger visibility and political salience among the public, when compared to the climate crisis and the role of domestic retrofits in contributing to Ireland's targets. The most significant aspect of this is that the demand for labour required for the construction of housing may impact upon the availability of labour for retrofitting projects.

The planned gradual increase in carbon tax over the coming decade is considered to be essential to incentivise retrofitting, alongside the 'carrot' of grant schemes and will also provide an important source of finance for the national retrofitting programme.

Stakeholder's perspectives on political drivers and constraints

In contrast to the optimism which exists regarding renewable energy targets among stakeholders in that sector, there is far less optimism among enterprises in the retrofit sector regarding the feasibility of the 2030 targets.

Although almost all enterprises anticipate significant growth in demand for their services over the coming years, the sector does not have the capacity to deliver the required number of retrofits annually. Stakeholders feel that a lack of long-term certainty and consistency workflow is one of the barriers to building up this capacity and that there is therefore a mismatch between the ambitious targets and the lack of long-term multi-annual funding which ensures a continual work stream.

The current grant system is perceived to be slow and cumbersome, with a significant investment of time required to prepare applications without certainty as to whether they will be successful. There is a strong consensus within the sector that the level of paperwork involved in working on projects availing of retrofit grant schemes is off-putting, with some stakeholders believing that there are too many schemes with different rules at present and that the whole system needs to be simplified.

Numerous interviewees cited the 'stop-start' nature of government funding as a major barrier to expansion. SEAI grants for residential retrofitting have typically been awarded in spring each year and projects must be fully complete with all paperwork signed off by October. This prevents enterprises from retaining crews (as there may be no work for them for four months or more), and some stakeholders also claimed it results in intense pressure to get through the work before a deadline and that this can contribute to quality problems.

While government stakeholders have signalled an intention to move towards more multi-annual funding streams, the industry has not seen concrete evidence of this to date. A number of different interviewees mentioned that funding would need to be ringfenced for at least ten years to support the scale up required, while some mentioned a need for government to 'show industry the long-term plan'.

As mentioned above, there is resource competition between the need to address issues with the supply of housing and to achieve the retrofitting targets. Almost all stakeholders cited the opportunities available in the new build sector as a barrier to attracting people into the retrofit sector. The separate but related problem of a lack of affordable accommodation for workers themselves was also highlighted.

Economic Factors

The most significant driver of increased demand in the retrofit sector at present is assumed to be the 2030 targets and the associated increase in the funding allocated by government to grant schemes. However, the COVID-19 pandemic also presents opportunities with regard to consumer demand. Household savings have hit record levels so many households are now in a better position to fund retrofit works. Increased home working has also increased the importance of having a more comfortable and energy efficient home.

New initiatives are emerging to support homeowners to finance retrofit projects. However, affordability remains an important barrier to uptake. In particular, some stakeholders believe the increased emphasis in terms of grant scheme eligibility criteria on achieving a B2 BER rating lacks sufficient flexibility, as it means that homeowners who cannot afford a full deep retrofit project or a heat pump may be excluded. Staged or stepped home energy improvements on the pathway to a B2 are, and will continue to be, available. The Better Energy Homes scheme continues to facilitate homeowners who seek a step-by-step approach to retrofit, if that is more suitable to their circumstances

Brexit has disrupted supply chains to Ireland and may be driving construction inflation. However, although a small number of people mentioned this issue, or the cost of materials more generally as a barrier they face in their work, the cost and supply of labour appears to be a much more significant barrier to scaling up the industry.

Almost all enterprise interviewees reported that they experience difficulties in recruiting or retaining staff or contractors. Working on new build projects is generally perceived to be much easier as the projects are cleaner, offer more economies of scale, there are no existing residents to work around and work can be done in regular hours. New build projects are also lower risk and much easier to price, while on a retrofit project a contractor does not always know exactly what they will be dealing with. It was suggested that there is a need for government stakeholders involved in designing and evaluating grant schemes to recognise the recent increases in the cost of labour generally which have occurred across the construction industry and also the fact that a pay premium is required for labour time spent on retrofits.

Issues around the barriers to upskilling of individuals already working in the industry were discussed as part of the interviews and workshops. Stakeholders emphasised that the opportunity cost of releasing a worker from a site to attend training was often as or more significant an issue as the monetary cost of a training programme. They highlighted the need for more accessible modular and bite-size programmes and blended learning approaches, although it was also acknowledged that a huge amount of skills acquisition in the industry needs to be done hands on. There was a consensus that there is currently a lack of incentives to upskill in retrofitting as there are no formal requirements to do so and no mechanism to easily demonstrate any upskilling completed. Some stakeholders also felt that some level of compensation for time lost on site may be required to encourage greater participation in upskilling programmes.

In the sectors of the economy which were worst hit by COVID-19, there is a potentially large pool of workers who may be seeking to retrain, and this may present an opportunity for the retrofit sector considering current shortages. A number of interviewees emphasised that it would not be a straightforward task to upskill workers with no prior experience of the construction industry, particularly as their salary expectations may not be aligned with what they could earn in an entry level role. However, it was also mentioned that a significant number of workers who left the construction industry during the last recession were thought to have moved into sectors such as hospitality and there may therefore be some opportunities to attract workers with prior experience of construction back into the industry.

As is the case in the construction industry more broadly, the retrofitting sector has historically been heavily dependent on migrant labour, particularly workers from eastern Europe. The impact of COVID-19 may result in further constraints on labour supply, as some migrant workers have returned home.

Social Factors

There is a strong consensus among stakeholders that one of the contributors to the labour shortages in the sector is that there is a serious lack of apprentices across all construction trades. Some stakeholders believe that there is now a 'cultural obsession' in Ireland with third level education. The opportunities associated with acquiring a trade or working in construction generally are not well promoted to young people and apprenticeships are also not always accessible to school leavers who do not have personal connections. For enterprises, scale and finances are barriers to taking on apprentices. Not all experienced tradespeople are well suited to the role of training an apprentice on-site and the level of supervision required can also be time intensive. The 'Action Plan for Apprenticeship 2021 – 2025', published in April 2021 (subsequent to the completion of the stakeholder engagement phase of this project) may help to address some of these issues, as the Plan contains commitments to increase the number of new apprenticeship registrations annually, improve access for underrepresented groups and provide additional support for employers to take on apprentices.

The scale of the downturn in the construction industry during the last recession contributes to perceptions of insecurity, particularly among parents. Numerous stakeholders highlighted that there is a need to better promote the job security and longevity of careers in the retrofit sector which should be less volatile than the new build sector, since long-term decarbonisation targets are set in law. It is also considered important to promote the retrofit sector to young people as a modern, green sector which is essential to tackling climate change.

Young people today have fewer opportunities to gain practical skills relevant to working on a construction site than previous generations; leisure time is now more occupied by digital devices and due to improved economic circumstances, fewer young people seek part time jobs on sites. It was suggested that more work experience opportunities are needed and that a three week-long placement would be optimal to allow young people to gain real skills and get a feel for what working in the industry is like. It was also suggested that more support for the teaching of construction subjects in schools is required, with enterprises linking in with schools to show examples of the real retrofit projects they are working on.

There is a consensus that the availability of training opportunities will need to be greatly increased to facilitate upskilling of existing workers, reskilling of workers from other industries and opportunities for school leavers. However, it is important that new training initiatives are based on a clear understanding of the specific needs of the market which is considered to be challenging given the current stage of development of the sector; with one enterprise interviewee noting that: "the problem is that at the moment you could meet five different people involved in retrofitting but could get five different answers to the same question". A need to avoid the creation of unrealistic expectations or narratives was also highlighted. For example, it was pointed out that many employers will have more roles available for 'general operatives' than for individuals with a specific qualification and therefore some new entrants could find that completing a Level 5 qualification is not as immediately beneficial to them as they may expect.

Similarly, some frustration was expressed with the way in which a public and political narrative developed in the past around the opportunities for former Bord na Móna workers to reskill in retrofitting as part of the 'Just Transition'. While some former Bord na Móna workers have taken up this particular reskilling option, many others are either not suited to or not interested in roles in the retrofit sector. Public procurement rules also mean that it is not possible to guarantee jobs on large retrofit programmes to any specific cohort of workers.

Training opportunities also need to be carefully designed and regulated. Some stakeholders highlighted that when the BER assessor role was first introduced, many people completed short courses through commercial training providers and were awarded qualifications without sufficient knowledge and experience, which then impacted negatively on more experienced providers of these services. A more comprehensive audit system subsequently had to be brought in to 'clean up' the system.

Other social themes which emerged strongly from the stakeholder engagement related to the importance of building awareness and trust in the benefits of retrofitting in order to drive adoption. It is crucial that individuals within the industry develop good 'soft skills' for engaging with home-owners. Word of mouth and 'influencers' within local communities are considered to be important channels for disseminating awareness of and confidence in the benefits of retrofitting. However, some stakeholders also feel there is a need for a single mass public awareness campaign at national level. Heat pumps in particular are considered to be a tough sell for individual enterprises and there is a concern that many householders will default to simply replacing oil or gas boilers when they stop working in the absence of successful communication of the alternatives.

Technological Factors

The most significant technological themes which emerged in discussions were concerns about the need to ensure that all retrofit works are planned and implemented in a holistic way and concerns about the quality of works implemented.

Some stakeholders feel more emphasis needs to be placed on the importance of 'specifier' roles such as 'retrofit engineers' and architects who would be able to take a more holistic view of all aspects of a building in comparison to a BER assessor. This is considered to be particularly important for traditional buildings, as BER assessors who do not have specialist knowledge of traditional buildings may offer ill-informed advice. The forthcoming Guidance document on Energy Efficiency in Traditional Buildings should help in this regard.

Building Renovation Passports (BRP) were highlighted as a solution which should be considered to avoid lock-ins and encourage ambition, allowing different aspects of a quality retrofit to be delivered in stages. BRPs contain a Roadmap and a Logbook. The Roadmap is a masterplan for the deep energy retrofit of a home which sets out the measures step by step. The Logbook contains information relating to the fabric and performance of the building and includes a record of previous works. By improving the availability of data for valuers and lenders, BRPs can help to de-risk investments and facilitate phased deep retrofit. The Irish Green Building

Council (IGBC), in partnership with Limerick Institute of Technology (LIT) and SEAI, have recently completed a pilot project on the use of BRPs in Ireland and have suggested that there is a strong case to make it mandatory over a period of time and for it to be managed by a public body. To facilitate the transition, it has been suggested it could in the interim be introduced on a voluntary basis and managed by other organisations.

Concerns about the quality of works were expressed by many stakeholders. There is a high risk of reputational damage to the sector as a whole and to public trust in new technologies where works are not well designed or completed to a high standard. Particular concerns were expressed regarding heat pump installations. There was also a perception among some that current inspection regimes focus only on the safety of an installation and do not give sufficient attention to the functionality and design of a system, such as whether a domestic solar panel system has been designed to be fit for purpose.

It was highlighted that some newer technologies require workers that are more multi-skilled than before and this will have to be considered when thinking about training provision. For example, the installation of heat pumps requires both plumbing and electrical skills. There is also a concern that as house holders tend to default to a plumber for advice on their heating system, a failure to upskill existing plumbers could delay the adoption of heat pumps.

A small number of people raised concerns about the technologies which have been incorporated into current targets versus those which have not and suggested that the future skills requirements of more emerging technologies should also be considered. In particular, it was suggested that there are limitations to relying on electrification to decarbonise heating and that Ireland should also consider alternative solutions, such as district heating. It was also suggested that there is a potential role for hydrogen gas in the domestic sector in future.

Legal Factors

Standards and accreditation are considered by many to be key for the success of the retrofit programme. As outlined previously, there is currently a lack of sufficient incentives for workers to upskill in retrofitting. The introduction of a register of building professionals and construction workers who have upskilled in retrofitting would make those who have upskilled more easily identifiable for consumers. It has also been recommended that once such a register is available, public bodies should introduce competency-based tenders and mandate the use of building professionals and construction workers who have upskilled in the area as part of grants or renovation tax incentives. Currently, the Construction Industry Federation maintains a voluntary online register of builders, contractors and tradespersons who carry out construction works known as Construction Industry Register Industry (CIRI). There is an intention to make this register mandatory in the future and the register of construction workers who have upskilled in retrofitting could be combined with CIRI in this case.

Some enterprise stakeholders expressed a desire for stronger building controls or quality controls within the sector more generally. At present, enterprises involved in engaging contractors rely heavily on their own knowledge and previous experiences to differentiate between good competent teams and poor ones. Poor contractors have a negative influence on the entire system as fixes are costly and time-consuming, while poor work also contributes to a lack of trust among consumers. Occasionally, a contractor with a poor reputation will also simply rebrand under a new company name.

Some stakeholders suggested there is a need for additional regulation to encourage retrofit in addition to the ‘carrots’ of grant schemes. As outlined above, the BRP may have a role to play. Other regulatory measures may also be required, such as the introduction of minimum energy efficiency performance standards in the rental sector.

Environmental Factors

Some stakeholders have suggested that in addition to improving the current energy performance of buildings, there is a need to take a more holistic approach to the environmental impact of retrofit projects and consider embodied carbon and resource efficiency. It has been noted that the EU's Circular Economy Action Plan and the Renovation Wave both refer to 'sustainable renovation'. The Renovation Wave commits to developing a 2050 roadmap for reducing whole life-cycle emissions in buildings. This highlights a need to enhance the skills of building professionals in Ireland in carbon accounting and life-cycle environmental assessment. A more holistic approach to resource efficiency and the environmental impact of retrofitting projects may also support the development of new industries around bio-sourced materials, for example, to replace some imported insulation products.

It was suggested that professional bodies in the sector should introduce a requirement for all candidates to undertake sustainability training on a regular basis so that they have a broad understanding of the environmental impact of their work.

5.4 Electric Vehicles

Political Factors

Similar to the renewable and built environment sectors, European and domestic policies are driving the need for skills in the electric vehicle (EV) sector. The European Green Deal has given particular attention to the electrification of road transport. By 2030, the EU Commission wants to achieve an ambitious target of 30 million zero-emission cars on Europe's roads. This will require a Europe-wide effort with binding and verifiable targets. Resulting from this, the Climate Action Plan (CAP) has aligned with it, setting in place legally binding targets for EVs on Irish roads. The Irish government has set a target to have 936,000 EVs on Irish roads by 2030. However, currently the market share of EVs is still low, with EVs accounting for 4.5 per cent of new car sales in 2020. This sits slightly above the EU average of 3.6 per cent. Based on this, the annual market share will have to increase by approximately 75 per cent to the end of the decade for the CAP target to be met. Although an ambitious target, this signals that the rate of change to EVs will happen rapidly and implies that additional policy measures will be put in place to help achieve the target.

The revised 2021 Climate Action and Low Carbon Development Act states that the first two carbon budgets should account for a reduction of 51 per cent in total amount of greenhouse gases (GHG) emissions. Specifically, this sets out emission reduction targets for the transport sector in Ireland. Transport emissions in 2019 represented approximately 20 per cent (12 MtCO2e) of Ireland's total GHG emissions - road emissions accounted for 95 per cent of these. If the transport sector is to meet its target it means it will have to reduce emissions by 50 per cent between now and 2030. Although the contribution of EVs in reducing these emissions is still minimal given the size of the fleet in Ireland, it is projected to contribute substantially towards the latter half of the decade.

In addition to this, the Irish government has committed to increasing the carbon tax on fossil fuels, such as petrol and diesel. Budget 2021 announced an increase of €7.50 a tonne, raising the price from €26 to €33.50 a tonne. This is set to continue to rise towards €100 per tonne by 2030, thus acting as a push factor towards EV uptake. However, as mentioned previously, there are potential political barriers to implementing this change, such as reprioritising political objectives and redeploying resources to address other problems (such as the issues around housing supply) and thus may not have as big an impact on the uptake of EVs as anticipated.

These political factors combined signal the intention of both the EU and Irish government to make a rapid transition to EVs. As a result, the demand for the skills required for EVs is set to grow because of these policy changes, while the demand for the skills required for internal combustion engine (ICE) vehicles will steadily decrease. Although there is still a low market share for EVs and thus currently not a large demand for these skills at present, these strong political drivers signal that these skills will be required.

Stakeholder's perspectives on political drivers and constraints

The stakeholder's perspective represents a disparity between their expectations and the targets set out in the political drivers named above. They felt that the EV target is high, considering the starting point Ireland is at. There is a concern that this will bring a lot of pressure on the industry, and it will be hard to move this along unless the consumers are able to do so. Stakeholders agree that the transition will happen, but it may not be able to move as quickly in line to reach the target. It was noted by one stakeholder that in order to reach this target, EV sales will have to grow exponentially towards the end of the decade to make up for the slow start that the industry is showing. However, stakeholders stated that if ambitious political support was continued and the motor industry displayed an ongoing desire to reach the targets, then it could be possible.

Economic Factors

Although Ireland has set in place multiple supports for EV buyers such as a purchase grant, home charger grant, a reduced vehicle registration tax (VRT) rate, reduced motorway toll rate and a lower rate of motor tax, there has still been a slow acceptance of EVs. Grants for EV purchases range from €2,000 to €5,000, and grants for home charger installers can be up to the value of €600, but the affordability of an EV compared to that of an ICE acts as one of the biggest barriers to progressing the uptake of these vehicles. Previously manufacturers have made an EV offering as a premium option, with more affordable ICE entry level options. Compared against a new ICE vehicle, the price of a new EV can range between 15-50 per cent higher. Despite this, prices of EVs are slowly coming down, as more car manufacturers begin to offer EV models, and more choices of models become available to consumers.

Most of the car sales in Ireland are second-hand, and due to a small market share, there is little offered in choice of EV in this market sector. Recent figures from the CSO show that new car sales fell by 25 per cent during 2020, when compared to the previous year (this reduction is in part explained by the COVID-19 pandemic).

There are significant savings associated with EV cars, as they require less maintenance than ICE vehicles, having fewer moving parts. Additionally, EV users can save on expenses such as energy costs (i.e., diesel and petrol), whilst also availing of a cheaper motor tax rate. Recently, the International Council on Clean Transportation (2018) found that the ownership costs of an EV are lower than those of comparable ICE vehicles, based on the first four years of ownership.

The lack of fast charging infrastructure within Ireland is also a main concern for potential EV buyers. Although ESB maintains 1,100 public charging points across the island of Ireland, the vast majority of these provide a standard charge, with 100 of these being fast chargers. There are other private companies who have installed fast chargers, however the economic incentive to provide this infrastructure is weakened by the high installation cost (i.e., high voltage connection) and the low demand as most car users still drive ICE vehicles.

Stakeholder's perspectives on economic drivers and constraints

One stakeholder expressed concern that as most people cannot afford to buy a new car, this will be putting the motor industry under a lot of pressure in the face of the high EV target. The industry is reliant on the ability and willingness of the consumer to purchase EVs, and as such, progress towards these targets will largely depend upon the pace of demand from consumers. The second-hand market for EVs is also reliant on this, and as such will take time to develop to a point where more second-hand EVs become available.

Regarding the charging infrastructure, stakeholders acknowledged that ESB and local authorities will lead the way in providing nationwide public charging infrastructure, but have also pointed out that private companies have a part to play. For them to do this, there needs to be a better rate of return on investment for providing a fast charger service.

Several of the stakeholders in both the individual interviews and workshops indicated that the car ownership model is changing, with some main dealerships planning to offer a pay-as-you-go service towards the end of the decade. It was pointed out that consumers are beginning to realise the economic advantages of such a service. In 2019, the average annual cost of running a family car for the year was €10,691[33]. Car sharing rather than ownership offers economic incentives as it does not require the large cost of buying, maintaining, insuring and fuelling a privately-owned car. One study carried out by Trinity College Dublin found that the significant financial savings of switching to a pay-as-you-go service is expected to be the most influential factor[34]. Companies who offer this service have already begun to incorporate EV vehicles as an option.

Social Factors

Range anxiety amongst consumers has acted as a constraint on the uptake of EV cars in the Irish market. These concerns are also closely linked to the availability of the charging network. A survey of Irish consumers indicated range anxiety to be the second most common perceived barrier to EV uptake after the financial cost (Behaviour & Attitudes, 2017). However, the SEAI Behavioural Economics Unit highlighted in a recent study that there exist knowledge gaps on the availability of charging infrastructure – with 49 per cent of respondents unable to identify where their nearest public charging point was located. As more models with increased range become available, this has reduced. A standard range for an EV can cover anything from 100km up to 500km. Eighty per cent of car journeys in Ireland cover distances of 20km or under. As this is well within the range of EVs, combined with the knowledge gaps regarding public charge points, this indicates that range anxiety is a perceived social barrier.

Associated to the problem of range anxiety, people are opting to buy hybrid EVs as an alternative to buying a fully electric EV. These types of vehicles are not restricted in range as much as fully electric EVs are. The result is that owners of hybrids can take advantage of improved fuel efficiency for short trips using the battery and having the traditional car range for longer trips. Sales of hybrids in 2020 in Ireland accounted for 15.3 per cent of the market share of new car sales; or 13,378 vehicles sold. As these vehicles still use an ICE, and have grown in popularity, this indicates that the traditional mechanic skills will still be required as people currently favour them over fully electric EVs.

However, the recovery, repair, and maintenance of EVs outside the manufacturers and franchised dealerships is increasing in Ireland. As workers in the motor vehicle repair and maintenance industry become more likely to work on EVs, they need to be aware of the additional hazards they are exposed to when working on such vehicles. EVs by their nature, contain high voltage circuits and some systems may contain harmful chemicals if released.

Stakeholder's perspectives on social drivers and constraints

Many of the stakeholders interviewed agreed that more work needs to be done to raise safety awareness around EV cars for mechanics. Specifically, one stakeholder mentioned that the existing knowledge of motor electronics is poor even on existing 12-volt systems in ICE vehicles. As EVs have high voltage running through them, this was identified as being a considerable concern which will have to be addressed across the industry. During the stakeholder workshop, it was highlighted that currently mechanics with no prior knowledge or qualification in EV training are working on EVs and that this is a safety concern. One of the main themes resulting from this workshop was that proper certification and safety awareness would be a welcome step for the industry.

33 The AA, (2019), Cost of Motoring 2019.

34 Rabbitt, N. and Ghosh, B., 2013. A study of feasibility and potential benefits of organised car sharing in Ireland.

Technological Factors

The technological factors for EVs centre around charging and battery technology. Many EV or potential EV owners may not be able to avail of installing a home charger, as this will only be available to homeowners with a private driveway, and it may be more complicated for people living in apartments or rented properties to install one. Addressing this issue is possible through various planning supports and would help to increase the sales of EVs going forward. The SEAI have put an emphasis on increasing the amount of on-street charge points to allow those who do not have a driveway, through a grant available for Local Authorities. Each grant will offer a total of 75 per cent of the capital costs (to the value of €5,000) per single charge point. An emphasis on providing charging points at the workplace has also helped contribute to overcoming the constraint of not having a home charger available.

Charging technology has progressed significantly since the initial public charging network was installed by the Electricity Supply Board (ESB). As part of the Climate Action Fund, ESB qualified for €10m in funding, which is being used to undertake a comprehensive programme to expand and enhance the public charging network across Ireland. This is expected to help meet the demand brought about from the growth of EVs over the decade, towards 2030. Included in this will be the replacement of 50 standard (AC) chargers with fast (DC) chargers and the replacement of 200 unreliable chargers with more efficient chargers. These new fast chargers can charge an 80 per cent charge in 30 minutes – although this will only apply to newer models of EVs.

The future skills requirements of emerging technologies in the EV sector should also be considered. Connected and Autonomous Vehicles (CAVs) have been identified by stakeholders as the next development in EV technology. Recently a development hub was set up in the West of Ireland by Land Rover Jaguar for the development of CAV technology. The skills needed for this technology will be required as it is developed and brought onto the transport network. Stakeholders acknowledged the importance of considering this and the additional skills required to avoid the risk of technological lock in.

Legal Factors

The Irish government has also indicated in the Climate Action Plan its intention of banning all new sales of ICE vehicles by 2030. However, this proposed ban was not included in the latest Climate Action Act. The ban was not included as under EU law, partial or total bans on the selling of products may fall under the definition of 'technical regulation', which would require EU notification, and this may have delayed the Bill from being released. Despite its omission, the Irish government has made its intentions clear that it will look to ban new sales of ICE vehicles by 2030.

As previously mentioned in Social Factors, currently there is no legal safety certification or standard in place for mechanics working on EVs. Suggestions included putting in place a similar scheme to that of the Registered Electrical Contractor of Ireland (RECI), where registered contractors are issued certificates of competency. Stakeholders identified that this would be a welcome step in providing the skills needed for the existing labour force.

Environmental Factors

As the demand for EVs continues to rise, so does the need to source the raw materials required for batteries, lithium and cobalt. The extraction of these raw materials is both resource and carbon intensive and can have negative impacts on the environment. The extraction process for lithium uses a lot of water- as much as 500,000 gallons per metric ton of lithium. The main concern with cobalt mining is the substantial amount of CO_2 emissions from fossil fuel consumption, as large amounts of energy are required for this process. As both of the markets for these materials have been driven by battery demand, representing 40 per cent and 25 per cent of demand respectively in 2017 (McKinsey, 2018), the negative environmental effects are set to increase and represent a significant concern surrounding the industry.

The whole life costs of EVs will also need to be considered, as the fleet transition progresses. Manufacturing EVs is more carbon intensive compared to ICE vehicles; however, of note for Ireland should be the disposal needed for EVs. The disposal process for EVs is different to that of ICE vehicles, as the large batteries in EVs will have to be disposed of in a safe manner. Authorised Treatment Facilities (ATFs) ensure that vehicles at the end of their use are treated in accordance with the principles of the circular economy, with all hazardous material removed and valuable material reused. In 2018, more than 162,500 vehicles were disposed of in Ireland – an increase of approximately 16 per cent from 2017 (EPA, 2020). The disposal process is different for EVs and currently Ireland does not have the facilities to dispose of EV batteries domestically. Stakeholders identified that all ATFs in Ireland will require training to ensure that EVs at the end of their lifespans are disposed of in not only an environmentally suitable manner, but also in a sustainable and safe manner. It was indicated that extra labour would not necessarily be needed, but that the current labour force would need to receive the appropriate training.

Additionally, the possibility of repurposing EV batteries for energy storage was identified. As smart grid initiatives develop, more energy storage units will be required to allow for the balancing of domestic energy supply. Repurposing these batteries would help Ireland progress towards a circular economy model, reducing the waste produced from EVs. However, other stakeholders identified that the car manufacturers may not be willing to do this, as the batteries were not designed for this purpose.

6

Measuring the Skills Gap

6 Measuring the Skills Gap

Whereas the purpose of Section 3 was to identify the nature of the occupations and skills demanded in the transition to a Zero Carbon Economy, the objective of this section is to quantify this demand, and to analyse the availability of skills in the context of existing labour supply.

A series of labour demand models were developed to forecast the demand for labour based on policy targets set in the Climate Action Plan. Following a similar methodological framework, three separate models were created for renewable energy, electric vehicles and retrofits; which forecast the likely labour demand across different occupations over the 2020-2030 period. Section 6.1 describes the basic methodology and architecture of these models, with additional details and assumptions provided in Appendix VI.

Section 6.2 describes the results of the labour demand modelling. 6.2.1 sets out the scenarios on which the results are based, according to policy targets established in the Climate Action Plan and other policy documents. The results of the demand modelling are then presented in two ways. Section 6.2.2 shows the overall full-time labour demand created by the activities of each of the three main sectors, while Section 6.2.3 presents the labour demand by occupation. The results presented in Section 6.2.3 also take into account the requirements to replace those retiring from the occupation, which is explained in further detail in the section.

Finally, Section 6.2.4 provides an analysis of labour supply through third-level education, apprenticeships, further education and immigration. While differences in how courses and occupations are classified means it is not always possible to provide like-for-like matching between labour demand and supply data, this section provides an indication as to where shortages are likely to occur in light of the available data.

6.1 Methodology

While the labour market analysis is based on separate models for the renewable energy, electric vehicles and retrofit sectors, a similar modelling framework was developed to ensure that the results are consistent and comparable. These basic steps to the modelling process are:

1. **Identify and quantify 2021-2030 targets** – Targets for each of the three sectors were identified and quantified based on the Climate Action Plan, Programme for Government and other relevant policy documents. The purpose of this stage was to express targets in common units or activities against which labour demand could be estimated, such as Megawatts of installed capacity, houses retrofitted etc. While this was relatively straightforward for energy, where clear indicative portfolio targets of installed capacity are signalled[35], it was necessary to break down the high-level EV and retrofit targets into specific tasks. For instance for domestic retrofits, the annual target for houses retrofitted to a B2 standard was used to estimate the number of specific retrofit tasks that would be required (e.g. number of houses requiring external insulation, attic insulation etc.), based on characteristics of the housing stock and data supplied by SEAI. For transport, additional policy documents and data were used to estimate the implications of the high-level vehicle target in terms of the number of new charging points required etc., which formed the basis of the tasks' subsequent steps.
   It should also be noted that the flexibility of the model allows alternative targets and scenarios to be measured, and their impact evaluated.
2. **Identify key occupations** – Once targets and associated tasks were defined, the main occupations typically required to complete these tasks were identified and matched to the Standard Occupational Classification system, as described in Section 3. Occupations involved in the planning, design, construction and operation

35 The CAP is not prescriptive in terms of amount of energy that is from each renewable sector, but that mix is decided by the market: "The exact level of offshore wind, onshore wind, solar and other renewable technology will be determined by a new system of competitive auctions where the lowest cost technology will be determined".

stages were generally included, while manufacturing and transport occupations were excluded. This is important to note when interpreting the results of the labour market analysis, as it does not measure the total 'employment' supported by the sector, but rather, the demand for labour among the key occupations identified.

3. **Identify labour requirements and estimate labour coefficients** – Once a task/target and the typical occupation(s) required to complete the task were identified, the amount of labour required from that occupation was also estimated. Labour requirements are expressed in terms of 'person-days', which refers to the number of days it takes one person to complete a task: for example, if it typically takes 2 plumbers 3 days to install a heat pump, the labour requirements for that task are 6 person-days.
   Labour data was sourced from a literature review and from stakeholder interviews, according to Table 6.1 below. Given the nature of this data, the labour requirements were generally initially based on representative project sizes, such as the labour requirements for a 50MW onshore wind farm. In order to allow for these estimates to be scaled and modelled, these labour requirements were converted into 'labour coefficients' based on the tasks/targets established in Step 1. For example, if the labour requirements for Civil Engineers on a 50MW wind farm are 500 person-days, then the 'labour coefficient' for Civil Engineers would be 10 person-days per MW.
4. **Estimate Full-time Equivalent demand using labour coefficients and demand scenarios** – The establishment of labour coefficients for each occupation and each task allowed these estimates to be scaled based on different demand scenarios. As with Step 1, scenarios were based first and foremost on Climate Action Plan targets with regards to renewable energy, EVs and retrofits, although specific sectoral plans were also used where appropriate.
   For the overall forecast, the labour demand arising from these targets were converted from person-days to 'Full-Time Equivalents' (FTE), which approximates the number of full-time workers that would be required to meet this labour demand. Each FTE was assumed to be equal to 232 person-days[36].

Table 6.1 provides an illustrative example of this basic process for heat pump installation. Although there are additional assumptions and steps involved in each model, this basic process of quantifying targets for each task, identifying occupations, and then estimating and scaling labour coefficients to estimate the FTE labour demand remains constant.

Table 6.1: Illustrative example of the modelling process for heat pump installation

Step	Example
1. Identify and quantify targets	Approximately 43,000 heat pumps installed annually between 2024 and 2030.
2. Identify key occupations	Plumbing and heating and ventilating engineers (5314) to install system Electricians and electrical fitters (5241) generally to connect to electrical system
3. Identify labour requirements and estimate labour coefficients	Average of 8 person-days required of Plumbing and heating and ventilating engineers (5314) Average of 1 person-days required of Electricians and electrical fitters (5241)
4. Estimate Full-Time Equivalent Demand using labour coefficients and demand scenarios	Average of 344,000 person-days for Plumbing and heating and ventilating engineers (5314), or approx.1,480 FTE workers Average of 43,000 person-days for Electricians and Electrical fitters, or approx. 185 FTE workers.

36 One FTE was assumed to be equal to 232 person-days. 232 days is based on the standard number of working days in a year, less the statutory holiday entitlement of 20 days (or 8%).

The most important step of the modelling process was to identify the key occupations involved and to estimate labour coefficients for each occupation and task- that is calculating the person hours for various jobs. This was done over the course of an extensive literature review, as well as interviews with enterprises and contractors involved in the sector. The primary basis of the estimates for each main activity is summarised in Table 6.2 below.

Table 6.2: Basis of occupational coefficients

Sector	Primary Basis of Labour Coefficient Estimates
Energy (Offshore Wind)	International Renewable Energy Agency (IRENA) (2018), supplemented by enterprise interviews with regards to planning and EIA requirements.
Energy (Onshore Wind)	IRENA (2017a), supplemented by enterprise interviews with regards to planning and EIA requirements.
Energy (Solar)	IRENA (2017b), supplemented by enterprise interviews with regards to planning and EIA requirements.
Transport (EV Maintenance)	Based on cost data from UBS (2017) and Harto (2020)
Transport (Charging Infrastructure)	Based on cost data from Holland (2014), EPRI (2013) and Morrow, Karner and Francfort (2008).
Housing Retrofit	Interviews with enterprises working in the sector, supplemented with cost and quantity surveying data

A more detailed explanation of the labour market model and input parameters is contained in Appendix VI.

6.2 Labour Market Analysis

6.2.1 Demand Scenarios

The modelling process was based on 'demand scenarios' for renewable energy, electric vehicles and domestic retrofits, which refer to the level of activity in these sectors over the next decade that will create additional demand for labour. Demand scenarios are based on the targets in the Climate Action Plan (e.g. GW of installed renewable energy capacity), although in some cases, additional steps were required to translate these targets into additional activities (e.g. how the electric vehicles target might affect the demand for additional charging infrastructure).

As outlined in the previous section, the data is presented in terms of Full-time Equivalents (FTE), which means the number of full-time workers that would be required to meet this demand. When using FTE, it is important to acknowledge that the actual number of people required may ultimately be higher, as many people may not work full-time in Zero carbon Economy activities (e.g. if an engineer spends only half of their time working on a Wind Farm, versus work in other sectors). This is likely to become less of an issue as the sector matures and as people and firms become increasingly specialised, but this should be noted when interpreting the modelling results.

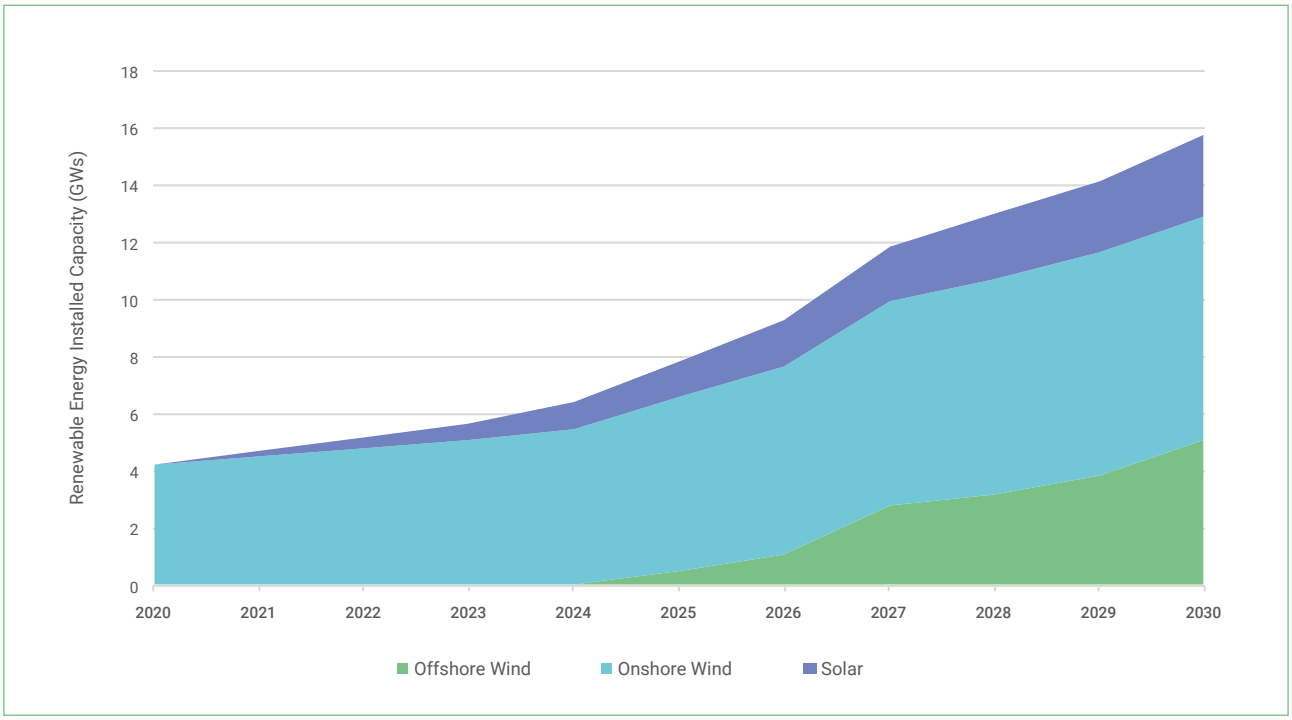
It is also important to emphasise that any estimates provided in this section are predicated on these demand scenarios being met. These scenarios are based on policy targets which, until they are actually achieved, remain just targets. This means that other policy measures to stimulate demand for renewable energy, electric vehicles and domestic retrofit - and to create a pipeline of work for these additional workers – are essential to ensure that no significant mismatches arise between labour demand and supply. A steady pipeline of work also acts as an important signal in itself for workers to upskill and retrain, and the communication of this pipeline also needs to be considered in tandem with measures to increase supply.

The following graphs show the demand scenarios used in the modelling process for the renewable energy, electric vehicles and domestic retrofit sectors.

Renewable Energy

Figure 6.1 shows the modelled cumulative installed capacity of offshore wind, onshore wind and solar energy that formed the basis of the demand scenario for renewable energy. This was informed by the most recent Climate Action Plan and Programme for Government targets, as well as other data from pipeline surveys and RESS auctions. The renewable energy scenario shown below is based on an additional 5GW of new offshore wind, 4GW of new onshore wind, and 2.9GW of new grid-scale solar energy by 2030. It should be noted that increases in small-scale residential solar installations have been captured separately within the Retrofit Model.

Figure 6.1: Modelled Cumulative Capacity (GWs) of Renewable Energy, 2020-2030



Electric vehicles

The Climate Action Plan sets a target of an additional 840,000 passenger EVs on Irish roads by 2030. There are currently over 30,000 electric vehicles in Ireland as of March 2021[37], representing just over 1 per cent of the total passenger car fleet. To reach the CAP target, the total size of the EV fleet needs to grow by approximately 43 per cent each year, until most new passenger cars being sold at the end of the decade are electric or hybrid. Figure 6.2 shows this required growth in electric passenger cars over the decade, which formed the basis of the demand scenario for vehicle maintenance and charging infrastructure installation.

37 Ryan (2021).

Figure 6.2: Modelled ICE and electric passenger cars, 2021-2030

In terms of charging infrastructure, the Climate Action Plan does not set specific targets for new installation, so additional sources were used to develop demand scenarios for charging infrastructure:

- **Home Charging Data** – Data provided by the SEAI suggests that approximately 1 home charger has been installed for every 4 electric vehicles in the fleet, which would amount to approximately 50,000 chargers being installed each year by 2030. It should be noted that this is based on data for home chargers supported by the SEAI, so the true ratio may be higher.
- **Low Emissions Vehicles Taskforce** – The Phase 2 report for the Low Emissions Vehicles Taskforce[38] sets targets of 1,000 new street chargers and 90 new fast chargers over five years, which would represent an annual target of 200 street chargers and 18 fast chargers between 2021 and 2025. These targets were increased by 500 and 40 chargers respectively for the years between 2026 to 2030, to reflect the expected exponential growth in electric vehicles.

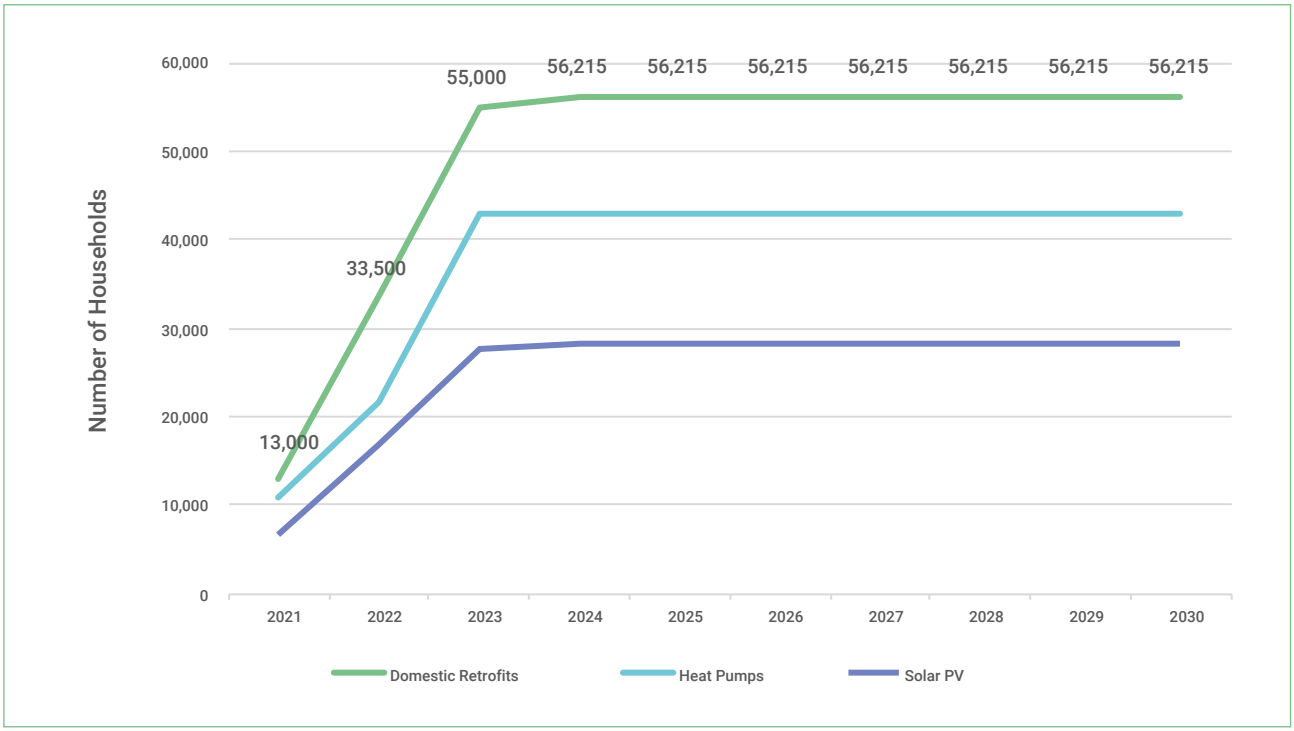
Domestic Retrofits

Scenarios for the domestic residential sector are based on the expected number of retrofits, heat pump installations, and domestic solar PV installations between 2021 and 2030.

These scenarios were developed using the targets contained in 'Ireland's Long-term Renovation Strategy', as well as the 'Medium scenario' analysed as part of the consultation for the proposed Micro-generation Support Scheme. This scenario, illustrated in Figure 6.3, involves a significant ramp-up of activity between 2021 and 2024, before hitting an annual peak of 56,000 retrofits, 43,000 heat pump installations, and 28,000 domestic solar PV installations between 2025 and 2030.

38 Low Emission Vehicles Taskforce, 2019.

Figure 6.3: Modelled annual number of domestic retrofits and installations, 2021-2030



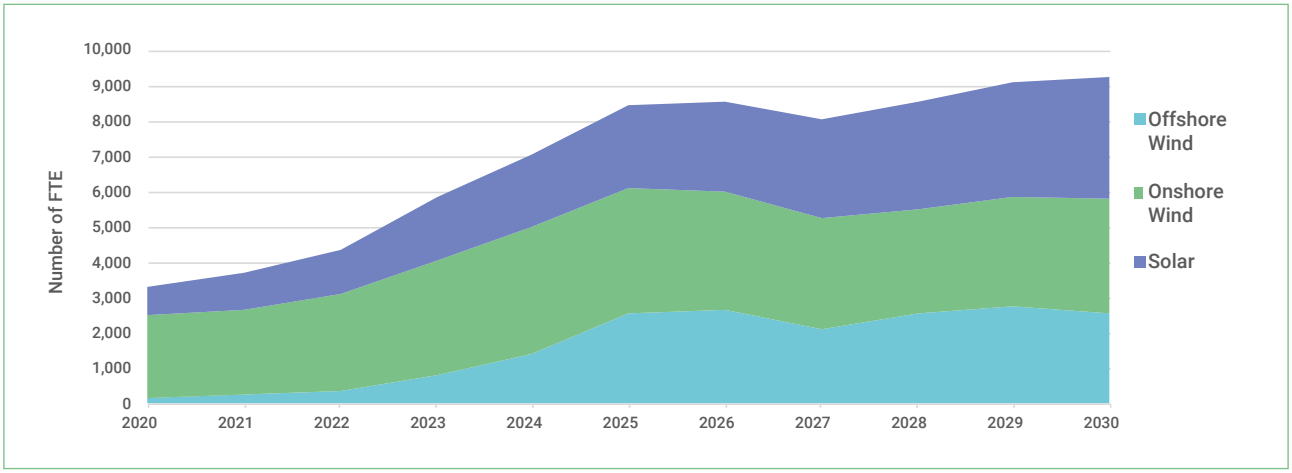
6.2.2 Overall Labour Demand

These demand scenarios and activities were used as inputs into the modelling process undertaken for this study, and formed the basis of identifying key occupations and estimating labour coefficients. This section summarises the overall labour demand modelled as a result of these scenarios.

6.2.2.1 Renewable Energy

Figure 6.4 shows the modelled labour demand expected from offshore wind, onshore wind and grid-scale solar over the 2020-2030 period[39]. Modelled labour demand from offshore wind, onshore wind and grid-scale solar is forecast to triple from approximately 3,500 FTE per year in 2020 to over 9,000 FTE per annum in 2030. As onshore wind is a comparatively mature industry in Ireland, most of this growth in labour demand is expected to come from Offshore Wind and Solar, with growth in onshore wind more moderate.

Figure 6.4: Modelled labour demand from offshore wind, onshore wind and grid-scale solar energy, 2021-2030



39 It should be noted that domestic solar installations are included as part of the Retrofit Model, and the labour demand included as part of these results.

Although grid-scale solar PV has the smallest target of the three energy types, it shows the largest growth in FTE labour demand. This is because solar is the most labour-intensive of the three sectors relative to installed capacity, reflecting the small scale of most solar farms in comparison to wind. The relative labour intensity of each development type, expressed by 'Jobs per MW', is summarised and compared in Table 6.3 below. This confirms solar to be the most labour-intensive, followed by onshore wind and offshore wind respectively.

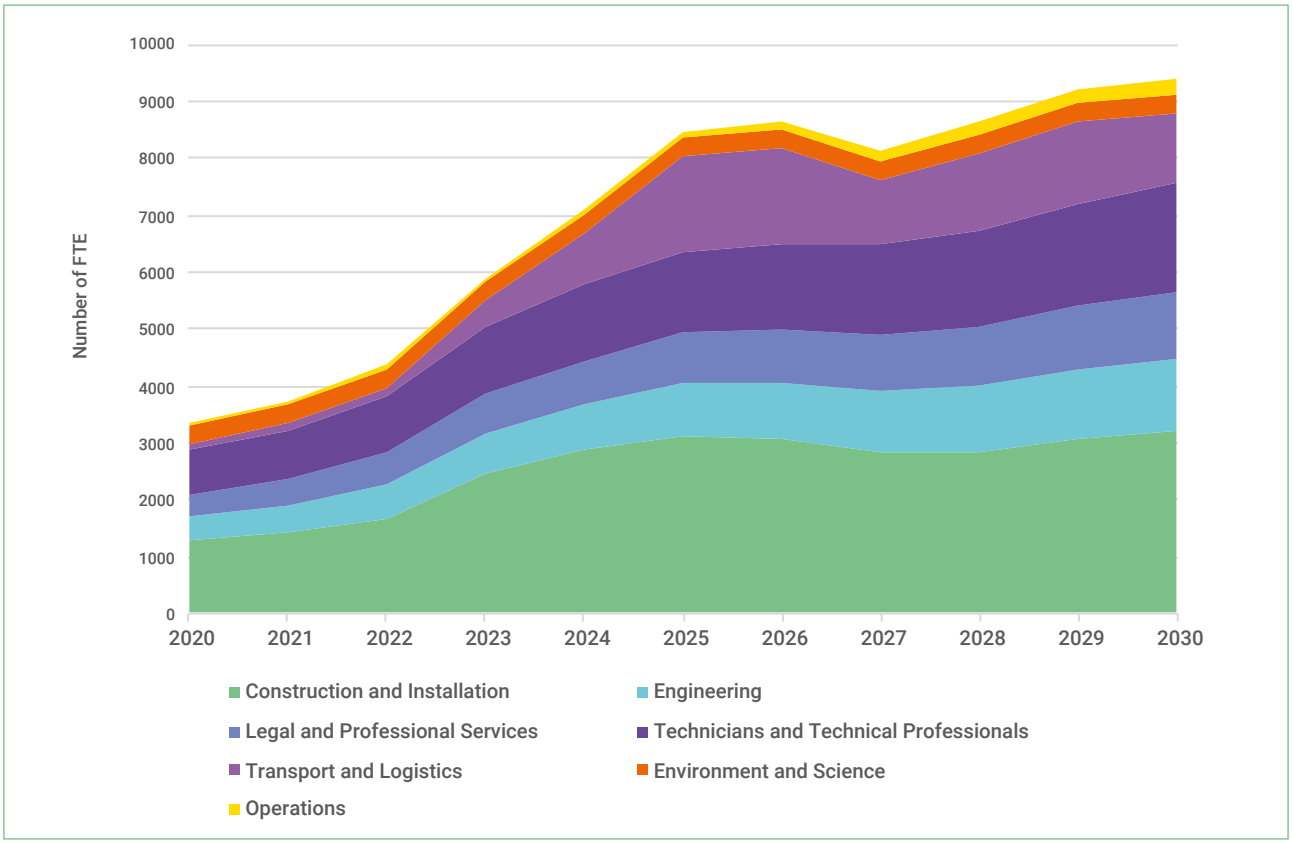
Table 6.3: Full Time Equivalent jobs per MW of installed capacity

	Planning and Installation	O&M (Annual)	Total Job-years per MW*
Offshore Wind	2.3	0.22	7.7
Onshore Wind	3.6	0.23	9.4
Solar	3.7	1.02	29.3

*Based on a 25-year lifespan

Figure 6.5 displays this FTE labour demand in terms of the main occupational groups. By 2030, the main occupational groups are expected to be construction and installation occupations (approx. 3,200 FTE), technicians and technical professionals including maintenance technicians (1,900 FTE), and engineering professionals (1,300 FTE). This is broken down further by individual occupations in subsequent sections.

Figure 6.5: Modelled labour demand from renewable energy by broad occupational group, 2021-2030



6.2.2.2 Electric Vehicles

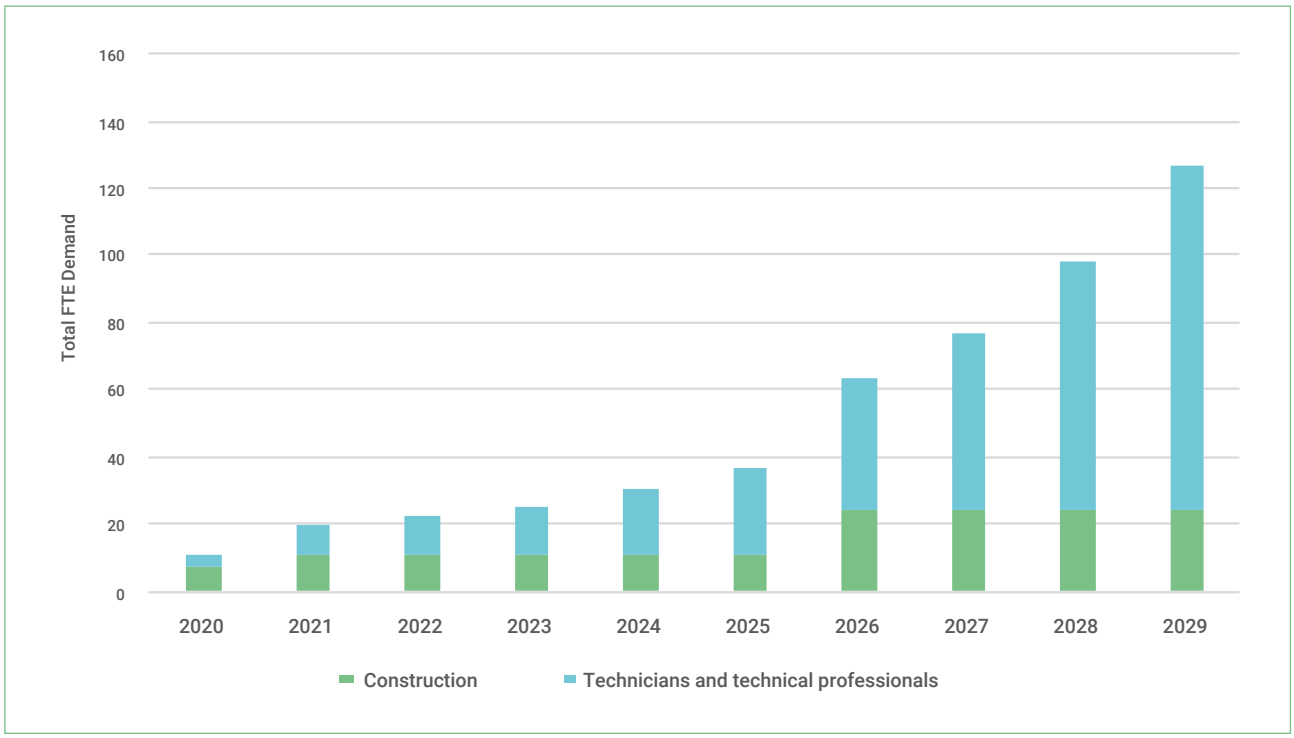
Changes in labour demand as a result of an increase in electric vehicles comes from two primary sources: demand for additional electric charging infrastructure, and changes in demand for vehicle maintenance and repair.

Charging Infrastructure

In terms of charging infrastructure, modelled labour demand shows an exponential increase from around 10 FTE per annum in 2020 to over 160 FTE in 2030, largely reflecting greater demand for home charging points. As such, Technicians and Technical Professionals (mainly electricians) is expected to be the main occupational group required by 2030.

It should be noted however, that the lack of firm targets for on-street and fast charging infrastructure makes it difficult to forecast labour demand for non-domestic charging infrastructure beyond 2025, and the figures presented here are based on the broad assumptions outlined above.

Figure 6.6: Modelled labour demand from EV charging infrastructure installation by broad occupational group, 2021-2030



Vehicle Maintenance

The impact of the growth in EVs on employment and labour demand is still largely hypothetical, given that they currently represent only a small share of the vehicle stock in most countries. Even in Norway (perhaps the most successful country in terms of EV penetration), EVs still only account for 15 per cent of the total private car stock, meaning that it is difficult to identify employment trends from aggregate data.

However, it is well established that the maintenance requirements for EVs are significantly less than ICE vehicles, with several studies estimating the annual maintenance and repair costs to be 40-60 per cent lower for EVs[40], mainly due to fewer moving and mechanical parts. If this reduction in maintenance and repair costs translates into an equivalent reduction in the demand for vehicle mechanics, then there may be negative employment impacts as a result of the transition to EVs.

40 UBS (2017) and Harto (2020)

An analysis of employment and vehicle numbers over the previous two decades suggests that, on average, approximately 1 vehicle mechanic is required in Ireland for every 140 ICE vehicles in the fleet. Assuming that a 50 per cent reduction in maintenance costs translates to a 50 per cent reduction in maintenance costs compared to ICE vehicles, this requirement would reduce to just 1 vehicle mechanic for every 280 EVs. If this scenario happens, Figure 6.3 forecasts how demand for ICE and EV mechanics might change over the decade based on the EV growth scenario outlined in the previous section.

Overall, the demand for vehicle mechanics is expected to remain relatively stable for most of the decade, although a growing shift in demand towards mechanics with EV skills is evident. By 2030, the modelling estimates that approximately 2,900 FTE mechanics with EV skills will be required, representing an average annual re-skilling requirement of just under 300 mechanics per year.

Although an end to the sale of ICE vehicles is expected in the early 2030s, ICE vehicles are still likely to represent a sizeable share of the vehicle fleet until the 2040s at least; albeit with this share declining year-on-year, meaning that ICE skills will still be required for the foreseeable future. Demand for ICE vehicle mechanics is actually expected to increase slightly in the first half of the decade due to natural growth in the size of the national fleet. However, this begins to fall significantly in the latter half of the decade as the share of EVs in the fleet grows. Based on the assumptions regarding maintenance requirements, the overall labour demand for vehicle mechanics is likely to begin to fall from around 2027, with an overall reduction in labour demand of approximately 1,200 FTE by 2030.

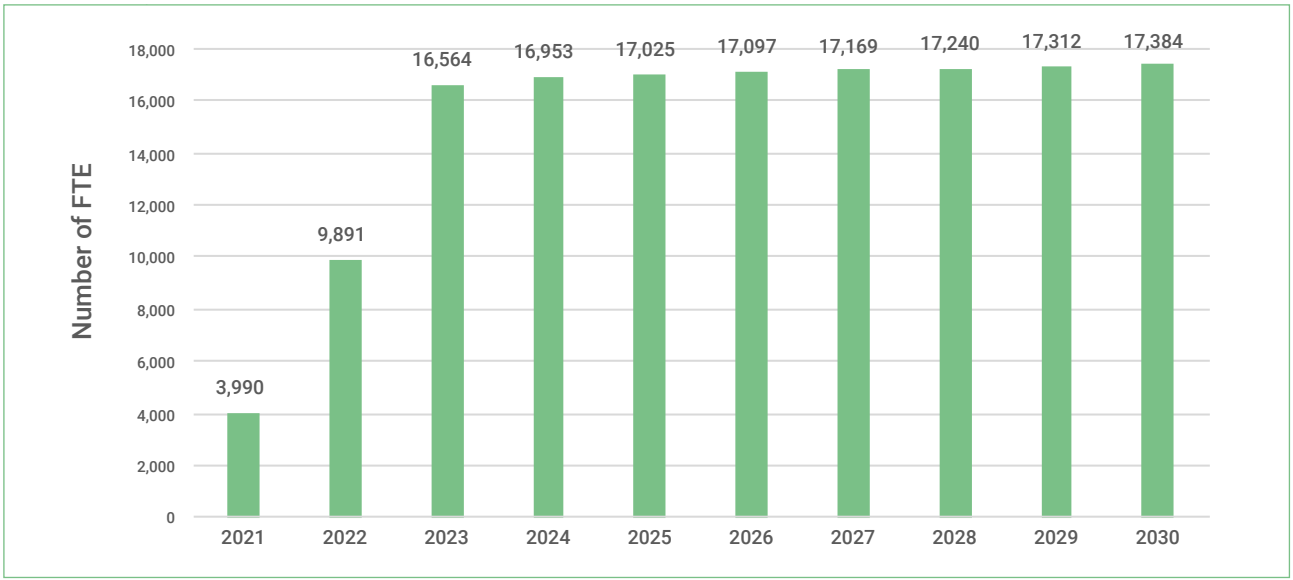
Figure 6.7: Modelled labour demand for vehicle maintenance and repair, 2020-2030

It is important to note that the pace of this change depends entirely on the pace of growth of the EV market. In the short-to-medium term, the focus should be to ensure that existing mechanics are provided with opportunities to upskill and to equip themselves with the necessary skills and qualifications to work on EVs. In the long-term, it may be necessary to explore and develop opportunities for Vehicle Mechanics to retrain into other sectors of the economy, in line with the principles of the Just Transition.

6.2.2.3 Retrofit

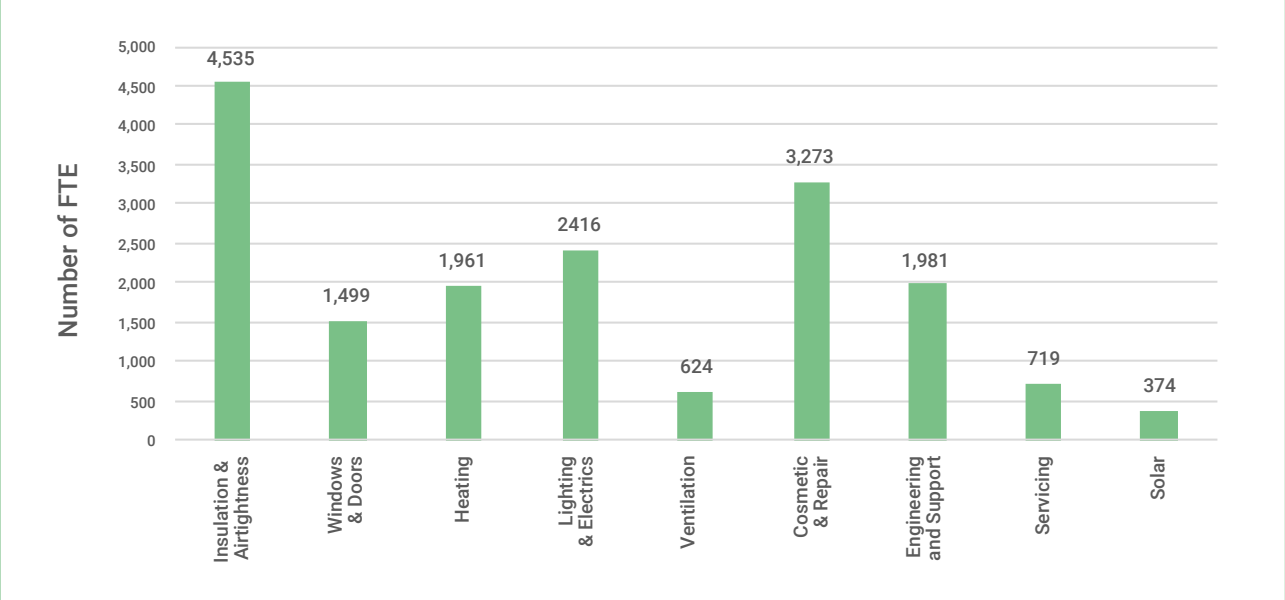
Figure 6.8 displays the total FTE labour demand estimated based on the scenario outlined for domestic retrofits, heat pumps and solar PV installations. Overall, the model suggests that labour demand will increase rapidly as the retrofit and heat pump targets ramp-up, with demand reaching approximately 16,600 FTE by 2024 and 17,400 by 2030.

Figure 6.8: Modelled FTE labour demand for domestic retrofit, heat pumps and solar PV, 2021-2030



Overall, this corresponds to an average labour requirement of approximately 0.3 FTE per retrofit across the jobs measured, although this ranges between 0.2 and 0.6 depending on the house type in question. Figure 6.9 breaks down the 2030 FTE demand by retrofit job type to show the relative labour intensity of different retrofit jobs. Insulation and airtightness works are the largest category, creating demand of approximately 4,500 FTE each year. This is followed by Cosmetic and Repair works, such as plastering, painting, and replacing flooring, with demand of approximately 3,300 FTE. Other significant jobs including lighting and electrics, heating, and engineering and support services.

Figure 6.9: Modelled FTE labour demand by job type, 2030



6.2.3 Occupational Entry Requirements

Building on the labour demand estimates from the previous sections, this section summarises how many additional FTE workers will be required within each occupation. This number – referred to as the 'New Entrant Requirement' – will be compared against education, training and immigration data to identify whether and where potential labour shortages are likely to arise.

While the additional demand created by these activities is obviously an important factor in determining how many additional workers we will need to train or attract into the sector, it is not the only determinant. In any occupation or industry, there also needs to be a steady state of people entering just to replace those who exit for natural reasons, such as retirement, emigration, or transfers to other areas of the economy. This number is referred to as the 'replacement rate' in this analysis, and is considered to be additional to any new demand created from the Zero Carbon Economy.

Ideally, the replacement rate would be estimated using a 'stock-flow model' that is able to track everyone who exits and enters a particular sector or occupation, and the reasons/channels by which they do so. However, data limitations mean that this is not possible, particularly at an occupational level. It is possible however to estimate the number of people likely to retire from different occupations or industries each year. The replacement rate has been estimated for each occupation based on the overall age profile of the workforce[41] and assumptions regarding the retirement age. This replacement rate generally ranges between 1 and 3 percent of the workforce retiring each year, and has been incorporated into the analysis below.

The following tables summarise these results across both the SOC Occupations and Niche/Emerging occupations identified in Section 3. The tables contain several types of output from the labour model, which are defined and described below:

- **Baseline Demand** – This refers to the model's estimate of the baseline FTE labour demand under this occupation as a result of the Zero carbon scenarios inputted into the model. This is based on average demand between 2018 and 2020.
- **Additional Labour Demand** – This refers to the number of additional FTE demanded (compared to a modelled 2019 baseline) under this occupation as a result of the Zero carbon scenarios input into the model. Additional Labour Demand is presented at two points over the 2020-2030 period: 'Mid-decade', referring an average of 2024-2026 labour demand over the baseline; and 'End-decade', referring to an average of 2029/2030 labour demand over the baseline.
- **Total New Entrant Requirements** – This refers to the total number of additional FTE workers required to enter each occupation, based on both the forecasted labour demand above and the required number of replacements. This is again presented at both 'Mid-decade' and 'End-decade' points.
- **Annual New Entrant Requirements** – This is an annualised version of the previous output, and refers to the annual number of people required to enter an occupation to meet the additional labour demand and replacements in each time period. Essentially, this figure provides an order-of-magnitude indication as to how new people need to be trained or attracted into any occupation each year, as is used as the basis for assessing the adequacy of existing supply.

41 Based on data from the Central Statistics Office

The table also indicates whether an occupation has been identified by SOLAS as being difficult to recruit into, based on SOLAS' 'Difficult-to-fill vacancies' survey conducted in October 2020[42]. Table 6.4 shows the combined results for each Core Occupation (as identified in Section 3.2), while Table 6.5 shows the results for some specific Niche and Emerging occupations (as identified in Section 3.3).

Taking wind turbine technicians in Table 6.5 as an example, the first two columns show that an additional 207 FTE are expected to be demanded due to these zero carbon economy activities by 2025, rising to approximately an additional 486 FTE by the end of the decade. Adding the replacement rate to take into account those exiting the sector, the next two columns show that 235 FTE will need to enter this occupation in total by 2025, rising to 552 FTE who will need to enter by 2030. The final two annualise these figures; showing the annual number of new Wind Turbine Technicians that need to enter these sectors in both time periods (based on the growth scenario for wind energy). This can also be interpreted as the annual training requirements in each period. Between 2021-2025, 47 new Wind Turbine technicians will be required each year; rising to 63 each year between 2026 and 2030.

The difference between the final two columns provides an indication as to how frontloaded or backloaded training requirements are likely to be. Ideally, the Annual New Entrant Requirements should be similar between the Mid- and End-decade; which would allow training providers to maintain a steady and consistent level of training over the decade. However, given the nature of the Climate Action Plan targets and timeframes, significant differences between these two columns are common.

For Heat Pump Installers for example, as the retrofit targets are expected to ramp-up fully by 2024, the training requirements also need to be frontloaded towards the first half of the decade. The Annual New Entrant Requirement from 2021 to 2025 is 290, suggesting that training providers need to train almost 300 Heat Pump installers each year. However, assuming this training requirement is met in the 2021-2025 period, this would then fall to 73 after 2026.

For some occupations, the opposite is also true. For EV technicians for example, the Annual New Entrant Requirement rises from 90 in the first half of the decade, to 392 in the second half of the decade. While a significant increase, this type of situation would allow training providers to more gradually ramp up their training provision.

Overall, these differences will pose logistical and resource challenges for education and training providers and need to be considered when offering recommendations. Where targets are frontloaded (i.e. training requirements are much higher in the mid-decade than the end-decade), this suggests that training providers should focus on short training courses, upskilling or retraining. Not only will this allow supply to be ramped up quickly compared to establishing new long-term courses, but it also reduces the risk that a significant expansion in long-term course capacity does not become redundant once demand reaches its peak. Where annual entry requirements are relatively even across the two time periods, or where it is higher in the end-decade period, this suggests than demand is going to ramp up more gradually over time, and that training supply should also do the same. This may make long-term solutions, such as establishing new courses or apprenticeships and increasing capacity, a more sustainable solution in these cases.

42 SOLAS, 2020b.

Table 6.4: Occupational entry requirements for Core Occupations

Occupation (n.e.c = not elsewhere classified)	SOC	Difficult to Recruit** (SOLAS)	Baseline Demand	Additional Labour Demand (by mid-decade)	Additional Labour Demand (by end-decade)	Total New Entrant Requirements (by mid-decade)	Total New Entrant Requirements (by end-decade)	Annual New Entrant Requirements (2021-2025)	Annual New Entrant Requirements (2026-2030)
Civil engineers	2121	-	53	35	23	768	1,540	**154**	**154**
Mechanical engineers	2122		67	79	116	491	968	**98**	**95**
Electrical engineers	2123	-	69	186	297	885	1,742	**177**	**171**
Production and process engineers	2127	-	44	100	207	372	769	**74**	**79**
Engineering professionals n.e.c.*	2129		70	1,690	1,689	2,405	3,088	**481**	**137**
Quality control and planning engineers	2461	-	3	5	4	202	411	**40**	**42**
Telecommunications engineers	5242		128	118	236	491	1,007	**98**	**103**
IT engineers	5245	-	0	0	0	335	692	**67**	**71**
Physical scientists	2113		28	10	7	65	121	**13**	**11**
Social and Humanities Scientists	2114		9	1	-1	52	106	**10**	**11**
Ecologists	2141		107	0	11	46	106	**9**	**12**
Environment professionals	2142		134	38	28	163	287	**33**	**25**
Architects and town planners (incl. Quantity Surveyors)	243	-	18	-3	-3	513	1,065	**103**	**110**
Construction project managers and related professionals*	2436	-	75	6	0	169	338	**34**	**34**
Construction and building trades supervisors	5330	-	34	57	31	397	734	**79**	**67**
Crane drivers	8221		41	193	162	248	275	**50**	**5**
Mobile machine drivers and operatives n.e.c.*	8229	-	49	224	155	740	1,222	**148**	**96**
Elementary construction occupations	9120	-	720	2,782	3,008	3,858	5,115	**772**	**251**
Electrical and electronics technicians*	3112		635	641	885	904	1,428	**181**	**105**
Building and Civil Engineering Technicians	3114	-	13	-3	-3	594	1,232	**119**	**128**
Science, engineering and production technicians n.e.c.	3119		5	5	4	260	533	**52**	**54**
Energy plant operatives	8124		0	108	211	185	370	**37**	**37**
Solicitors	2413		86	120	170	1,065	2,124	**213**	**212**
Chartered Surveyors	2434		28	24	18	402	802	**80**	**80**
Finance and investment analysts and advisers	3534		51	32	29	1,570	3,210	**314**	**328**
Health and safety officers	3567		96	348	566	617	1,122	**123**	**101**
Accountants and tax experts	N/A	-	47	26	34	2,971	6,124	**594**	**631**
Managers and directors in transport and distribution	1161	-	28	33	28	597	1,194	**119**	**120**
Aircraft pilots and flight engineers	3512		1	3	28	120	269	**24**	**30**
Ship and hovercraft officers*	3513		11	460	418	493	487	**99**	**-1**
Large goods vehicle drivers	8211	-	0	2	13	1,582	3,281	**316**	**340**
Marine and waterways transport operatives*	8232		21	854	777	900	873	**180**	**-6**
Electricians and electrical fitters	5241	-	194	2,861	2,956	4,232	5,639	**846**	**281**
Roofers, roof tilers and slaters*	5313		24	289	289	428	560	**86**	**26**
Plumbers and heating and ventilating engineers*	5314		495	1,649	1,972	2,531	3,697	**506**	**233**
Carpenters and joiners	5315	-	36	703	703	2,366	3,958	**473**	**318**
Glaziers, window fabricators and fitters	5316	-	73	1,426	1,426	1,677	1,918	**335**	**48**
Plasterers	5321		85	1,652	1,652	2,129	2,585	**426**	**91**
Painters and decorators	5323		84	1,641	1,641	2,336	3,000	**467**	**133**
Sales related occupations n.e.c.	7129	-	12	230	230	843	1,497	**169**	**131**
Construction Operatives n.e.c.*	8149	-	131	2,547	2,547	3,004	3,441	**601**	**87**

*Denotes that this SOC Occupation category includes figures for a niche or emerging occupation, which is listed separately in the next table below.

**Note Difficulty to recruit IT engineers refers to software engineers only, and only Quantity Surveyors were identified as difficult to recruit within the Architects and town planners category. For the Sales related occupations n.e.c, the Elementary Construction and Construction Operatives Occupations, the difficulty to fill status indicates a labour shortage rather than a skills shortage, given the relatively low level of skill required. Similarly for the Building and Civil Engineering Technicians, the reference in the Difficult-to-fill survey was for ground workers only, again not a skills shortage. SOLAS also note that Accountants are one of the occupations that are expected to be significantly impacted by automation; while demand for accountants across the sector will continue to arise due to replacement demand, the demand is likely to decline due to automation.

Table 6.5: Occupational entry requirements for Niche and Emerging Occupations

	Occupation	Baseline Demand	Additional Labour Demand (by mid-decade)	Additional Labour Demand (by end-decade)	Total New Entrant Requirements (by mid-decade)	Total New Entrant Requirements (by end-decade)	Annual New Entrant Requirements (2021-2025)	Annual New Entrant Requirements (2026-2030)
ENERGY	**Project Manager**	75	6	0	12	13	2	0
	Marine Engineer	1	34	42	34	42	7	2
	Wind Turbine Technicians	378	207	486	235	552	47	63
	Solar Technicians	0	108	211	108	211	22	21
	Marine Equipment and ROV Operators	7	185	153	186	155	37	-6
	Ship Crew and Officers	32	1,314	1,195	1,390	1,372	278	-4
EVs	**EV Technicians**	48	445	2,400	449	2,408	90	392
RETROFIT	**Retrofit Advisor/ Salesperson**	12	230	230	231	233	46	0
	Retrofit Engineer	84	1,576	1,576	1,582	1,591	316	2
	Heat Pump Installer	424	1,416	1,739	1,448	1,813	290	73
	Domestic Solar PV Installer	24	289	289	291	294	58	0
	Insulation Operatives	131	2,547	2,547	2,556	2,570	511	3

6.2.4 Labour Supply

The purpose of this section is to compare the labour demand and entry requirements from the previous section to existing indicators of labour supply. As outlined in Section 3 entry routes can vary significantly between and within occupations, meaning that supply indicators can include:

- Graduates from third-level undergraduate and post-graduate courses in Higher Education Institutions (HEI)
- Completion of Apprenticeships
- Completion of qualifying Further education and training (FET) courses
- Immigration from non-EEA states[43]
- Potential retraining routes from occupations/sectors negatively impacted by the transition to a Zero carbon Economy.

43 As EEA Nationals do not require employment permits, immigration on an occupational basis can only be identified from non-EEA nationals

This section compares the annual entry requirements in key occupations to available indicators of supply. It should be emphasised that these indicators only tell a partial story as to the availability of supply, and are not as relevant for occupations that do not require formal training or qualifications, such as many construction occupations, or occupations that are based on a person's individual expertise, such as legal and environmental occupations. As such, some occupations have been excluded from this section either due to a lack of available supply indicators, a lack of specificity in these occupations relative to the requirements by the Zero Carbon Economy (i.e. if specialist legal experts are required, the overall number of students passing through legal courses is not a reliable indicator of supply for the Zero Carbon Economy). Details on third-level courses, apprenticeships and further education and training were provided by HEIs and other education and training providers, while Employment permit data was provided by the Department of Enterprise, Trade and Employment. Data is based on the most recently-available year. A list of courses and supply indicators is available in Appendix VII.

6.2.4.1 Engineering

The main source of new labour supply for engineering occupations are third-level education and immigration. The data from the previous section suggests that by the end of the decade, an additional 9,500 engineers across all disciplines will need to enter the profession to meet demand and to replace those leaving the sector. This amounts to an average annual entry requirement of just under 1,000 engineers.

Table 6.6 provides a visual overview of supply through engineering courses in HEI by discipline, summarising course data provided in Appendix VII. Individual courses have been grouped into broad engineering disciplines, and while this may not be perfectly reflective of the specific numbers entering each occupation, it provides an indication as to what disciplines may be lacking in Irish HEIs. Table 6.7 also summarises the total number or Employment Permits provided for key engineering occupations.

Table 6.6: Availability of third-level engineering courses by main subject area

Subject Area	Universities							Tech. Universities			Institutes of Technology							Approx. Total*
	DCU	MU	NUIG	TCD	UCC	UCD	UL	MTU	TUD	AIT	DKIT	GMIT	ITC	ITS	LYIT	LIT	WIT	
Civil																		**520**
Mechanical																		**910**
Electrical																		**150**[44]
Electronic / Computer																		**770**
Communication																		**<50**
Energy																		**100**
Environmental																		**130**
Marine																		**<50**
Structural																		**90**
Building Services																		**150**
Production																		**290**
Technology[45]																		**240**

Source: Estimates based on 2019 graduation figures for Level 7-10 courses supplied by HEIs. Figures for multi-disciplinary programmes (e.g. Electronic and Electrical Engineering) have been divided equally across disciplines.

44 Includes the 'Industrial Electrical Engineering' apprenticeship which, with annual supply estimated at approximately 50 based on current enrolment figures.

45 Engineering, building and architectural technology courses

Table 6.7: Employment Permit data for engineering occupations

Occupation	Employment Permits (2019)
Civil engineer	195
Mechanical engineer	140
Electrical engineer (incl. Electronics Engineer)	118
Production and process engineer	135
Engineering professionals n.e.c.	123
Quality control and planning engineer	195

Source: Employment Permit data provided by DETE

Overall, the course data reviewed suggests that over 3,000 engineers graduate each year across Irish HEIs in engineering disciplines relevant to the Zero carbon Economy. The most common course discipline (according to this analysis) is Mechanical Engineering, followed by Electronic/Computer and Civil. While this total figure appears to be sufficient when compared to the labour demand across all engineering disciplines, the data indicates there may be shortfalls in certain disciplines.

Table 6.4 indicates that approximately 170-180 new Electrical Engineers are required each year to meet demand. The estimated figure in Irish HEIs and apprenticeships is around 150, which appears to be less than what is required to meet the increased demand over the next decade, particularly when demand from other sectors and activities is taken into account. While this shortfall is compensated by immigration from non-EEA states (118 Electrical Engineers were given employment permits in 2019), any significant fluctuations in the number of people applying for permits may result in shortfalls in the future. This may also be exacerbated by a lack of obvious entry routes in Ireland to become a 'Telecommunications Engineer', with many initially completing degrees in Electrical Engineering.

The data indicates that there may possibly be difficulty in filling[46] a number of Retrofit Engineer/Designer positions in the future. As outlined previously, while there are multiple routes to becoming a Retrofit Engineer/Designer (including architecture, surveying and engineering), many in Ireland to date have entered the occupation with engineering qualifications in areas like Energy Engineering or Building Services Engineering.

Summing these two disciplines shows approximately 290 graduates with these qualifications which, when compared to the Annual Entry Requirement in the Mid-decade period of approximately 300, would suggest that many of these jobs may become difficult to fill as demand increases. It is very unlikely that all 290 graduates will go into the retrofit sector and the retrofit sector is likely to face competition from other activities, meaning that the demand for Retrofit Engineers/Designers is likely to be greater than the supply into that engineering niche sector. This has been echoed by enterprises working within the Retrofit Sector, with many noting strong competition for suitably-qualified graduates.

While it is unlikely that an entirely new degree programme is necessary, expansion of the availability of and capacity in these engineering courses, as well as post-graduate and CPD training, is likely to increase the pool of engineers who could work in the retrofit sector. Engineers Ireland also provides a range of CPD courses for engineers, including some relating to Retrofit and energy-efficient building design, which are another route by which existing engineers can be trained into the Retrofit sector. In addition, ensuring that viable pathways and training from other areas such as architecture and surveying are available will help to provide a stable supply of Retrofit Engineers/Designers over the coming decade.

46 A difficult-to-fill vacancy can arise for a variety of reasons, including churn, attractiveness of the job (pay, conditions, location etc), even though there may be a sufficient supply of skills onto the labour market.

6.2.4.2 Environmental, Science, Humanities and Professional

While these categories included a range of occupations involved primarily during the planning and construction phases, relevant supply indicators for these professions are relatively limited given the specialised nature of some of the required occupations. Similar to engineering, Table 6.8 displays the provision of selected course disciplines across Irish HEIs.

Table 6.8: HEI course provision for selected Environmental, Planning and Professional occupations

Subject Area	Universities							Tech. Universities			Institutes of Technology							Approx. Total*
	DCU	MU	NUIG	TCD	UCC	UCD	UL	MTU	TUD	AIT	DKIT	GMIT	ITC	ITS	LYIT	LIT	WIT	
Planning																		**90**
Environmental Science / Ecology																		**250**
Surveying																		**370**

Source: Estimates based on 2019 graduation figures for Level 7-10 courses supplied by HEIs.

Overall, the provision of courses through HEIs appears to be sufficient for these Environmental and Planning occupations, relative to the occupational entry requirements outlined earlier. However, enterprises consulted as part of the stakeholder engagement process expressed a demand for professionals with the knowledge of and experience in the sector, meaning that third-level is only one aspect of this, and that people with mid-career skills will be sought after.

In addition to HEIs, short upskilling and training courses are provided for those working in the Renewable Energy sector through Green Tech Skillnet (detailed in Appendix VII). 830 people completed courses through Green Tech Skillnet in 2020, although most of these were in courses aimed at specific engineering or technical professionals, such as Wind Turbine Technicians. In comparison, there were few courses aimed at professionals involved during the planning and environmental impact assessment stages for wind and solar- areas which many in the industry expressed a need for improved knowledge and skills. This suggests there is scope to improve provision in these areas through Green Tech Skillnet or similar existing structures.

6.2.4.3 Construction

While most construction and installation occupations have no formal academic requirements, some sort of upskilling or training is generally an important route into certain jobs, such as crane drivers, mobile machine operators or health and safety officers. Table 6.9 presents available supply indicators for these professions below.

Table 6.9: Supply indicators for construction and installation occupations

Occupation n.e.c = not elsewhere classified	Annual New Entrant Requirements (Mid-decade)	Annual New Entrant Requirements (End Decade)	HEI	Apprentice-ships	FET	Immi-gration	Approx. total
Crane drivers	50	5			<5	<5	**<10**
Mobile machine drivers and operatives n.e.c.	148	96			9		**10**
Health and safety officers	123	101	380		10		**390**
Building and Civil Engineering Technicians	119	128	240		30		**240**
Construction Project Managers and related professionals + Construction and building trades supervisors	113	101	580		97		**600**

Clear potential future shortages are probable, in relation to Crane Drivers and Mobile Machine operatives, with less than 10 observed completing entry-level training courses in the FET sector as well as small levels of non-EEA immigration[47]. While this is likely to be an incomplete overview of supply, it does suggest that shortages are likely to arise in these occupations.

The Labour Market Analysis also indicates that construction and technical occupations will see the largest increase in demand over the next decade. Although the lack of formal qualifications for most occupations in this category makes it difficult to compare this demand with formal supply indicators, feedback from industry and SOLAS' 'Difficult-to-Recruit' vacancies survey makes it clear that there may be a potential future shortage of employees for construction occupations, particularly general construction workers and operatives. This was also analysed as part of the EGFSN's Building Future Skills Report, so most of the main recommendations with regards to Construction and Built Environment Skills will carry through to the Zero carbon Economy.

While the table above shows large numbers taking courses in relation to construction and project management, particular potential future shortages were noted by industry stakeholders in relation to experienced Construction and Building Trades Supervisors and Construction Project Managers. This suggests that HEI data is potentially not reflective of the number of these occupations entering the Zero carbon Economy. In terms of attracting new entrants into jobs in the zero carbon sector, Traineeships offer a pathway for prospective employees.

6.2.4.4 Other Emerging and Niche Renewable Energy Occupations

Table 6.10 presents the available supply data for Emerging and Niche renewable energy occupations.

Table 6.10: Labour supply indicators for emerging and niche renewable energy occupations

	Annual New Entrant Requirements (Mid-decade)	**Annual New Entrant Requirements** (End Decade)	**Third-level**	**Apprentice-ships**	**Further education and training**	**Total education and training**
Wind Turbine Technicians	47	63		18*	10-20	**30-40**
Solar Technicians (grid)	22	21				**-**
Marine Equipment and ROV Operators	37	-6	16			**16**
Ship Crew	180	-6				**-**
Ship Officers	99	-1	40			**40**

*Pending Validation

While the current training provision for Wind Turbine Technicians appears to be low relative to the Annual New Entrant Requirements, this is likely to improve with the launch of a new Wind Turbine Technician apprenticeship at Kerry College (currently pending validation). This apprenticeship is intended to provide a direct entry route for approximately eighteen Wind Turbine technicians each year, in addition to the approximately 10-20 who are trained annually through courses provided by the Green Tech Skillnet network. At the time the first cohort of eight trainees have completed the programme, with two more cohorts of ten trainees undertaking the programme in 2021. Together, these programmes appear to be slightly less than the medium-term demand for Wind Turbine Technicians, which suggests that this supply should be closely monitored over the coming years. As more and more wind farms come onstream, particularly in the latter half of the decade, it is likely that additional training capacity will be required.

47 It should be noted that completion of training courses for experienced operatives in these occupations is not included in this table, although that number of considerably larger than the number of new entrants.

No specific training for grid-scale solar PV installation was included in the data reviewed as part of this report. However, it was noted by stakeholders that installation of solar farms is often carried out by roving crews of technicians, who work on different sites across Europe. This suggests that a lack of domestic training for grid-scale solar technicians is unlikely to pose significant constraints for the development of solar farms in the short-term, although the development of a domestic supply chain will improve the long-term security of labour supply, and is likely to have long-term positive economic and social benefits. Consideration could be given to upskilling existing electrical workers and electricians.

While entry routes to the Marine Equipment and ROV Operators can vary, the most directly-comparable training course available in Ireland is the 'Marine Electrotechnology' BEng degree at the National Maritime College of Ireland (NCMI). This qualifies graduates to work as 'Electo-technology Officers', who are responsible for operating, maintaining and calibrating electrical, electronic and ship equipment on large vessels. Depending on the course content and completion of relevant work experience, this could also act as an entry route into this emerging occupation. Overall, this suggests that the numbers graduating from this course is sufficient in the long-term, although some short-term shortages might arise in the middle of the decade.

The final supply indicators contained in this table relate to Ship Crew and Officers, occupations that are expected to grow significantly over the first half of the decade, primarily due to construction-related activities for offshore wind farm. The only available supply indicator for these occupations also comes from the NMCI, and relates to its 'Nautical Science' programme for ship officers. This shows training capacity of up to 40 people, compared to an Annual Entry Requirement of 99 for the Mid-decade period. While this capacity appears to be sufficient to reach the overall demand for Ship Officers by the end of the decade, the speed at which this demand will increase is likely to result in short-term shortages in the middle of the decade. However, the frequent use of international vessels and crew within the sector will likely alleviate these short-term labour constraints while training capacity increases.

While formal supply indicators are not available for general Ship Crew, this occupation is likely to face a similar issue to Ship Officers. To address this skills gap in the short-term, one potential solution is to provide pathways for those in other sectors of the marine economy with relevant skills to easily transition to the Offshore Wind Sector. As these sectors may be negatively impacted in the future because of the phase-out of out of oil and gas exploration and Brexit (respectively), there may be opportunities to quickly retrain those who already have relevant marine skills to work in the zero carbon sector.

6.2.4.5 Electric Vehicles

Table 6.11 compares labour requirements for EV Technicians to available indicators of supply. These indicators relate to the Motor Vehicle Mechanic Apprenticeship (to become a Vehicle Mechanic), as well as different FET courses to become certified to work with electric vehicles.

Table 6.11: Labour supply indicators for EV occupations

	Annual New Entrant Requirements (Mid-decade)	**Annual New Entrant Requirements** (End Decade)	**Third-level**	**Apprentice-ships**	**Further education and training**	**Total education and training**
EV Technician	90	392		285	100	**385**

The latest data indicates that just under 300 people qualify as vehicle mechanics each year, while a further 100 existing mechanics undertake additional EV training each year in the FET sector and through SIMI Skillnet. This appears to be sufficient to meet increased demand from EVs in the short-to-medium term, although the number of EV mechanics will need to increase significantly in the latter half of the decade. The most obvious way to improve long-term security of supply would be to fully integrate EV content and training requirements into the

existing Vehicle Mechanic apprenticeship. Combined with the existing level of upskilling, this appears to be sufficient to completely meet any additional demand for EV technicians. It would also improve the resilience of the profession in the face of any rapid transition from ICE vehicles to EVs.

In addition to the need to equip existing mechanics with EV skills, as Section 6.2.2.2 indicates, there may be negative impacts on the overall demand for vehicle mechanics as a result of the large-scale take-up of electric vehicles. While the pace and scale of this impact remains to be seen, this may result in a need to introduce retraining schemes for vehicle mechanics in the latter half of the decade. There may be opportunities to put in place retraining pathways into growing occupations that will increase in demand as a result of the Zero carbon Economy. Vehicle mechanics are likely to have transferable skills that would lend well to other technically- or mechanically-oriented occupations, such as Wind Turbine Technicians, once appropriate training pathways are put in place.

6.2.4.6 Retrofit

Retrofit occupations mainly consist of construction or craft occupations with the necessary skills to work in domestic retrofits. This section firstly reviews supply indicators in relation to general craft apprenticeships, as well as retrofit-specific training and upskilling courses for emerging and niche occupations.

When assessing potential shortages in the retrofit sector, it is important to note that the current target – for residential retrofits to increase to 56,000 per annum by the middle decade – implies that most of the training requirements will occur between 2021-2025. There are large differences in most occupations between the Annual Entry Requirements in the mid-decade and end-decade period that complicate the analysis. It may be the case for some occupations that existing training provision is sufficient in the long-term, but not in reaching the annual targets envisaged in these middle years. This will pose dilemmas for policy-makers and training providers as to how to ramp-up training provision in the short- and medium-term, versus the long-term stability of course places and infrastructure.

Craft Apprenticeships

As outlined previously, the apprenticeship system is the primary source of labour for most craft occupations, although additional upskilling is often necessary to allow them to carry out certain retrofit tasks (e.g. plumbers and heat pumps). Table 6.12 provides an overview of labour supply indicators for craft occupations. It should be noted that training people in the craft apprenticeships is time consuming, and has the potential to delay supply into the sector (e.g. duration of craft apprenticeships is set); however, many of the further education and training interventions for some of the craft occupations to re-skill for work in the zero carbon economy will be of a shorter duration, and addressing supply is not as time consuming as it would be, for example to provide the initial training as a plumber or an electrician.

Table 6.12: Labour supply indicators for craft occupations

Occupation	Annual New Entrant Requirements (Mid-decade)	Annual New Entrant Requirements (End Decade)	Third-level	Apprentice-ships	FET	Immi-gration	Total education and training
Plasterers	426	91		7		5	**12**
Glaziers, window fabricators and fitters	335	48			6	<5	**~10**
Plumbers and heating and ventilating engineers	506	233		235	130		**365**
Electricians and electrical fitters	846	281		949	18		**967**
Painters and decorators	467	133		10	23		**33**
Carpenters and joiners	473	318		198	6	102	**306**

The table indicates that there are a number of craft professions where the available jobs are difficult to fill, indicating potential future shortages of these craft occupations to work in the retrofit sector- echoing feedback received from the industry as part of the stakeholder engagement process. The largest shortfalls appear to be in occupations that are not necessarily retrofit-specific, such as plasterers, glaziers and painters and decorators, although it should also be cautioned that these occupations do not necessarily require formal qualifications, meaning that there are likely to be additional sources of supply to these formal channels. However, there also appears to be a shortage in some retrofit occupations in the short-to-medium term, such as plumbers.

Emerging and Niche Retrofit Occupations

Table 6.12 displays available supply indicators for emerging and niche retrofit occupations. This provides an indication as to how many people are undertaking additional training or upskilling necessary to work on domestic retrofits.

Table 6.13: Labour supply indicators for niche/emerging retrofit occupations

	Annual New Entrant Requirements (Mid-decade)	**Annual New Entrant Requirements** (End Decade)	**Third-level**	**Apprentice-ships**	**Further education and training**	**Total education and training**
Heat Pump Installer	290	73	12		28	**40**
Domestic Solar PV Installer	58	0			30	**30**
Insulation Operatives	511	3			126	**126**

Like other retrofit occupations, the table shows considerable shortfalls in labour supply indicators for these niche and emerging occupations relative to the Annual New Entrant Requirements. These shortfalls are particularly acute in the Mid-decade period (2021-2025), where construction is expected to ramp up to its full target of 56,000 houses a year by 2024.

This sudden ramp-up will pose challenges for education and training providers in terms of the resources required to provide additional courses and places, but also presents issues regarding the long-term sustainability of this training provision. This suggests that short-term training courses, upskilling, and re-training of existing workers in the labour force would be appropriate strategies, as it allows a rapid response to increase supply in the short-to-medium term, compared to setting up new long-term course infrastructure. The offering of retrofit training in the new nZEB 'Centres of Excellence' throughout the country is a positive step to rapidly equip people with necessary retrofit skills, although it will be important to ensure that training provision is adequate to meet demand. The table indicates that annual training provision between 2021 and 2026 should be in the order of 500 places per year for insulation operatives, 300 for Heat Pump Installers, and 60 for Solar PV Installers, with current training provision considerably below this level.

Comparing Table 6.13 to Table 6.12, it is also worth noting that there are significant disparities in the numbers who complete an apprenticeship, and those who go on to seek further retrofit-related qualifications and training. For example, the number of plumbers completing heat pump installation training (30) appears to be only a fraction of the overall number completing apprenticeships (235)48. This suggests that a lack of integration of these activities within the apprenticeship system is potentially causing the retrofit sector to miss out on a large pool of potential labour. It was reported by many in the stakeholder engagement process that workers often have little incentive to undertake additional training due to cost and time barriers, as well as the availability of work in other parts of the construction sector.

48 A further 100+ plumbers complete the NZEB training for Plumbers in WWETB

The Apprenticeship Action Plan for 2021 to 2025, which aims to increase the number of apprenticeships to 10,000 per year by 2025, will begin a process of streamlining the delivery of apprenticeships through a new National Apprenticeship Office. While this Apprenticeship Action Plan is ambitious, Tables 6.14 and 6.15 show Consortia led Apprenticeship registrations (since their introduction in 2016) and Craft Apprenticeship Registrations per year since 2009 respectively. The latter shows the effect of the global financial crisis on training in the craft sector, with a considerable pick up in registrations after 2015 to 4,315 apprentices registered in 2019.

Table 6.14: Consortia led Apprenticeship Registrations by year

Classification	Level	2016	2017	2018	2019
Engineering Services Management	7				10
Industrial Electrical Engineer	7	12	19	25	28
Manufacturing Engineering	7		36	20	27
Manufacturing Technology	6		40	34	29
Mechanical Automation and Maintenance Fitting	6				
OEM Engineer	6				11
Principal Engineer	10				

Source: SOLAS dataset

Table 6.15: Craft Apprenticeship Registrations by year

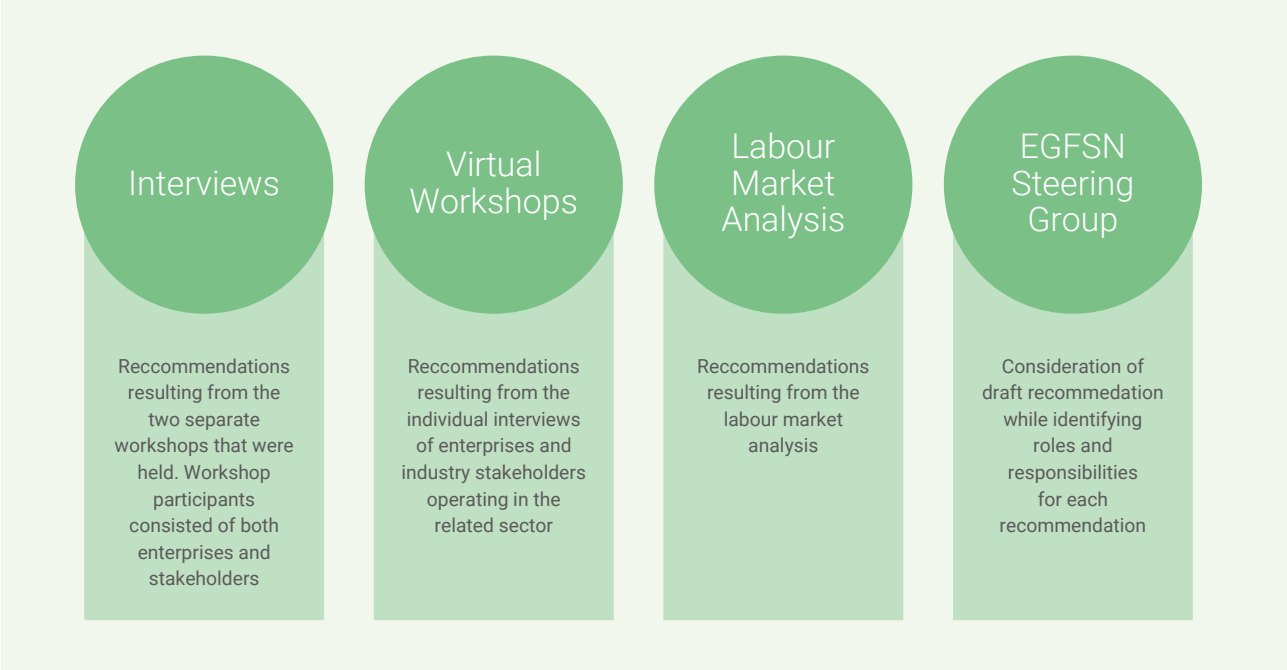
Classification	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bricklayer and Stonelayer	20	10	11	6	3	20	26	52	60	81	80
Carpenter and Joiner	140	96	72	91	99	185	291	399	443	591	597
Construction Plant Fitter	26	30	32	45	54	56	77	59	86	71	73
Electrical Instrumentation							83	106	120	108	125
Electrician	523	373	355	397	522	845	956	1,343	1,705	1,841	1,949
Industrial Insulation							13	10	21	19	20
Instrumentation							8	10	20	17	16
Metal Fabrication							198	186	224	234	266
Motor Mechanics							423	420	353	380	408
Painter and Decorator	19	8	18	11	8	11	19	27	44	30	31
Pipefitting							37	33	25	49	76
Plumber	127	91	146	97	241	318	289	345	532	653	628
Plasterer	14	12	5	4	8	9	7	18	34	29	36
Sheet Metalworking							38	40	53	70	57
Stonecutting and Stonemasonry	-	-	-	-	-	16	13	2	8	7	3
Wood Manufacturer and Finisher	24	13	12	11	21	23	48	71	59	95	102
Vehicle Body Repairs							47	58	46	40	51
Total	**893**	**633**	**651**	**662**	**956**	**1,483**	**2,573**	**3,179**	**3,833**	**4,315**	**4,518**
Source: SOLAS dataset											

7

Recommendations

7 Recommendations

Figure 7.1 Recommendation Categories



This report's recommendations resulted from collecting and collating ideas in the interviews and workshops that were held with industry and stakeholders. Once the labour market analysis was undertaken - which identified the demand for labour over the next decade while also considering the supply pathways for that labour - a long list of recommendations was drawn up. These were presented to the representative Project Steering Group established to guide the progress of the study (see Appendix II), in a draft report. The recommendations were refined, identifying who has responsibility for implementation of each. The 30 recommendations are divided into six categories:

1. Renewable Energy
2. Residential Retrofit
3. Electric Vehicles
4. Promotion of career pathways in zero carbon economy activities
5. Alternative sources of skills supply for zero carbon economy activities
6. Public Sector Programme Management and Carbon Accounting Skills

In the pages that follow these recommendations are set out in greater detail, including their rationale and the stakeholders best placed to carry them forward. The timelines for delivering on these actions should also be guided by the ambitions set out in the Climate Action Plan- as reflected in the rapid increase in retrofit and renewable energy labour demand, this will be frontloaded in the 2021-2025 period, underlining the urgency of the greater part of the recommendations. The exception are those actions relating to electric vehicles, where demand will be concentrated in the 2026-2030 period. For EV technicians, the annual new entrants requirement rises from 90 in the first half of the decade, to 392 later in the decade. While a significant increase, this type of situation would allow training providers to more gradually ramp up training provision.

Renewable Energy	
1	Coordinate planning for training and upskilling within the renewable energy sector, including through establishment of training partnerships or responses for projects between Government, industry and education and training providers.
2	Prioritise training provision for emerging occupations in Onshore and Offshore Energy and Energy Systems.
3	Facilitate the expansion of existing offshore and maritime training to meet the increasing demands of the offshore energy sector.
4	Engage with the fishing and other relevant sectors, such as the oil and gas industries, to source skills for offshore work.
5	Upskill existing engineering, environmental and legal professionals, electrical workers and electricians in zero carbon skills, including through micro credentials and other Continuous Professional Development opportunities.
6	Maximise alignment with industry needs and increase exposure to the Renewable Energy sector at third level for undergraduate engineering, environment and planning students.
7	Increase the availability and capacity of electrical engineering programmes to meet demand from zero carbon activities, in particular Renewable Energy projects.
8	Explore the creation of direct pathways into Emerging and Niche occupations in the Renewable Energy sector, such as specialised engineering professionals, specialised ecology and environmental experts, legal and financial experts, project managers, Solar Technician and Marine equipment and ROV operatives, to stabilise supply. Also promote participation in the forthcoming Wind Turbine apprenticeship programme.
9	Extend the skillsets of the existing zero carbon economy workforce into areas such as commercial skills, electricity trading, adaptability, digital and technology skills, health and safety, problem solving and effective communication.

Residential Retrofit	
10	Support job stability and longevity of careers in the retrofitting sector, by providing clarity on budgetary allocations for retrofit and by developing retrofit grant schemes that facilitate year-round activity.
11	Ensure that the required number of retrofit training places in nZEB Centres of Excellence, as well as other providers of retrofit training, are properly resourced and available to meet the level of retrofit demand in the coming years.
12	Improve the availability and flexibility of retrofit programmes in order to incentivise and facilitate employers in releasing staff for training.
13	Increase training for Retrofit Engineers/Designers, including through an increase in the availability and capacity of Energy Engineering or Building Services Engineering degree programmes, postgraduate programmes and CPD training.
14	Engage with and encourage the urgent upskilling of existing plumbers in the installation and servicing of heat pumps.
15	Explore the full integration of retrofit occupations within relevant apprenticeship programmes.
16	Continue to promote and improve the accessibility of apprenticeships to young people, including their role in addressing climate action.
17	Facilitate adult participation in apprenticeships and traineeships, in particular for general operatives within the Construction sector.
18	Enhance stakeholder engagement skills across the Retrofit sector in order to build awareness and trust in the benefits of retrofitting and to drive homeowner adoption.

19	Assess the benefits of developing a register of workers who have upskilled in retrofitting, in order to underpin consumer confidence and demand for residential retrofit.
20	Explore the utilisation of public procurement processes to incentivise participation in retrofit training.
21	Upskill the existing Built Environment workforce in life cycle environmental assessment and sustainable renovation. Also increase the emphasis on life-cycle environmental assessment/'sustainable renovation' in undergraduate and post-graduate construction professional programmes.

Electric Vehicles	
22	Engage the existing pool of motor mechanics and encourage and support their upskilling to work on Electric Vehicles, in particular through digital skills training, to improve the attractiveness of the sector overall, retain the existing labour force and attract new entrants.
23	Progress the incorporation of Electric Vehicle material into relevant Apprenticeship Syllabuses to secure longer term Electric Vehicle maintenance skills supply.
24	Provide and promote mandatory Electric Vehicle Safety Training to the existing mechanic labour force.
25	Explore the introduction of recognised certifications as a requirement to work on Electric Vehicles and to foster consumer demand.

Promotion of career pathways within Zero carbon Economy Activities	
26	Define and promote career opportunities, and associated education and training pathways, in the zero carbon economy to school leavers, in particular females, career guidance professionals and parents through industry and government outreach and promotional activities.
27	Provide work experience opportunities for students and young people in zero carbon economy activities, including at TY level and through the new Work Placement Experience Programme for the young unemployed.

Alternative Sources of skills supply for Zero carbon Economy Activities	
28	Promote career opportunities and skills mobility for the zero carbon activities from other sectors of the economy through exploring opportunities for career pathways from or within sectors negatively impacted by the transition from fossil fuels or, where feasible, other factors such as the Covid 19 pandemic.
29	Engage in a communications and outreach campaign to attract skills for zero carbon economy activities from the Irish diaspora and the broader pool of international talent.

Public Sector Programme Management and Carbon Accounting skills	
30	Develop programme management and carbon accounting skills within Government to support change and the transition to a zero carbon economy

Given the urgency of meeting Ireland's climate action goals, it is crucial that in the years ahead these recommendations are prioritised within national skills, labour activation and inward migration policy, and are centrally driven by Government- including through the establishment of a high level Implementation Group, working in close collaboration with industry and the education and training system.

Renewable Energy

1	**Coordinate planning for training and upskilling within the renewable energy sector, including through establishment of training partnerships or responses for projects between Government, industry and education and training providers.** **Responsibility:** Department of Environment, Climate and Communications, in collaboration with Industry and Department of Further and Higher Education, Research, Innovation and Science, Further Education and Training and Higher Education Providers, relevant Skillnet Ireland networks

While there is a sense of urgency in the switch to renewable energy, there are many barriers facing the sector in terms of planning, coordination and aligning the supply chain for the construction of renewable energy infrastructure. There is a significant lead in time for projects- at least 6 years, but sometimes up to 10 years, to plan, construct and operationalise. For the renewable energy sector there is also a departure from prevailing skills, if a company is established in energy production, or through the emergence of niche occupations required to develop the renewable energy sector. As with any emerging sector, the skills required are being sourced from other sectors, until the sector reaches a level of maturity and has supporting training and institutions.

As the UK and many other jurisdictions also have ambitious renewable energy targets, it may be difficult to compete for and source labour for the build-up that is required. It is and will become even more of a competitive international market for renewable energy jobs, with many opportunities for maintenance technicians and engineers in other countries. There is also competition with other sectors in Ireland, with renewable energy firms, for example, competing with the industrial technology sector for data and mechanical engineering skills.

With the sector facing skills shortages, and in order to collectively alleviate skills constraints, there is a need for leadership and an immediate response in the form of high-level coordination in response to the renewable sector's broader skills needs, as well as at local or regional level, project specific training partnerships for renewable energy projects, to ensure delays associated with sourcing skilled labour are addressed.

As the policy lead in Government, the Department of Environment, Climate and Communications should work closely through a high-level monitoring group, with industry and the Department of Further and Higher Education, its agencies and the wider education and training system, in helping build the necessary scale and quality in skills supply to deliver on Ireland's renewable energy ambitions. At local or regional level meanwhile, project specific partnerships should be established, leveraging structures such as the Regional Skills Fora, to deliver on the specific needs of individual Renewable energy projects.

A template for such a partnership is the Education Cluster established by Shannon Foynes Port, following the withdrawal of the Shannon Liquefied Natural Gas terminal from the EU Projects of Common interest list, and the Port's examination of the potential for longer term expansion into areas including floating offshore wind. The Port Authority is engaging with industry, manufacturers and developers to determine requirements and has convened a cluster including Limerick Institute of Technology, University of Limerick, Munster Technological University, Griffith College and NUI Galway to help skills planning and delivery.

2	**Prioritise training provision for emerging occupations in Onshore and Offshore Energy and Energy Systems.** **Responsibility:** Department of Further and Higher Education, Research, Innovation and Science, Higher Education Authority, SOLAS

Planning for a significant increase in onshore and offshore energy skills should pay particular attention to a number of specific emerging skills, largely provided through the Higher Education system. These include:

- **Offshore Energy Occupations:** Marine planners (geophysicists, hydrographers, marine ecologists); Offshore wind technicians; Hydrogen experts (chemical engineers).
- **Onshore Energy Occupations:** Photovoltaic installers; Asset Management (ageing turbines, renewal and/or decommissioning and recycling of existing turbines).
- **Energy Systems Occupations:** Smart Grid planners; Energy analysts and Carbon Accountants; Electricity traders; Renewable systems engineers; Software designers and data analysts; Socially focused engineers; Hybrid technicians; Energy storage experts/technicians.

Those skills associated with onshore and offshore energy will require a significant ramp up in numbers; those associated with energy systems are more niche, and it is anticipated that they do not necessarily require large numbers, or that there will be a significant number of jobs created overall in the economy. Nevertheless, provisioning for these skills is a priority to ensure the development of the renewable energy sector and to ensure that the risk of skills shortages within the sector is mitigated.

Enterprises consulted for this study highlighted that the niche skills are currently sourced from other sectors, and that an element of holistic planning is required to ensure sufficient supply for all sectors. This is particularly the case for energy systems occupations dependent on programming and IT skills, for which competition across all sectors is strong. For skills associated with data analytics, while the supply of Third Level graduates is deemed to be sufficient, working in the renewable energy sector will require some training in electricity systems.

3	**Facilitate the expansion of existing offshore and maritime training to meet the increasing demands of the offshore energy sector.** **Responsibility:** Department of Further and Higher Education, Research, Innovation and Science; Higher Education Authority, National Maritime College of Ireland, Bord Iascaigh Mhara

For the offshore energy sector, and in addition to the energy specific mechanical and electrical skills associated with floating wind technology, there are a number of merchant navy occupations that are required for the development of offshore energy. These include boat crews for supporting surveying work in the planning phase, maintaining and servicing marine vessels that transport technicians to the marine wind farms, and depending on the distance of the offshore turbine sites, servicing 'Flotels' or marine structures akin to living accommodation for offshore oil workers. Ireland currently relies on international crews and vessels.

The National Maritime College of Ireland (NMCI) is currently the main institution in Ireland providing training and promoting and preparing people for careers at sea. As well as its degree level programmes, NMCI currently offers courses from the Global Wind Organisation, a non-profit body founded by wind turbine manufacturers and owners; this aims to achieve an injury-free work environment in the wind turbine industry through the deployment of common international standards for safety training and emergency procedures. The College also offers training approved by the Offshore Petroleum Industry Training Organisation (OPITO), which provides the global industry standard in oil and gas safety, skills and competence.

In order to build domestic skills supply for offshore work, the existing training infrastructure needs to be strengthened, through committed funding allocations to service the training needs of the offshore renewable energy sector. Building up the sector will take time, however, and there is an urgency due to the demand for offshore skills spiking in 2025. Marine training institutions consulted for this study were surprised at the scale of the forecast demand for maritime skills, which would require a significant increase in their capacity; this would pose a challenge in terms of capital outlay and trainer availability.

These capacity challenges will be further tested by the long history of institutions such as NMCI in training international students; with the expected surge in demand for offshore wind energy production globally, this will increase demand from this cohort. Any worker who is going offshore also requires by international law to have at least four or five training courses for safety.

The availability of other maritime training institutions to facilitate training e.g. Bord Iascaigh Mhara training facilities in Donegal and the Marine Institute in Galway, has the potential to ease some of these capacity challenges, and inter-institutional collaboration should be considered. The urgency in coordinating a response to the offshore renewable industry's training needs is recognised by training providers. Bord Iascaigh Mhara in particular have expressed interest in the upskilling and retraining opportunities in offshore work for fishing communities.

4	**Engage with the fishing and other relevant sectors, such as the oil and gas industries, to source skills for offshore work.** **Responsibility:** Industry, in collaboration with Department of Housing, Local Government and Heritage, Department of the Environment, Climate and Communications, Department of Agriculture, Food and the Marine

Stakeholders from the limited number of enterprises currently operating offshore expressed the view that one of the main attributes of offshore renewable energy workers is their 'sea-legs', or ability to work within the marine environment. Pathways for careers at sea, it was emphasised, should include the renewable energy sector. Sourcing of skills from the fishing, as well as oil and gas industries, were considered a priority for the offshore renewable sector. Fishing was cited as a significant source of transferable skills, with stakeholders noting that it may be desirable for fisheries workers to work part of the year in the offshore wind sector. There are also highly transferable mechanical and practical skills that oil and gas workers have with the renewable sector- there has been an ebb and flow of workers between oil and gas into wind over the last 10 to 15 years. The issue of maritime pay and levels of remuneration between the oil and gas sector and the renewable wind sector was considered a constraint for the offshore wind companies however, particularly if workers are living offshore.

The Department of Housing, Local Government and Heritage, the Department of the Environment, Climate and Communications and the Department of Agriculture, Food and the Marine are actively examining further opportunities with the fisheries sector, having identified and recognised a need for effective engagement between the seafood and offshore renewable energy industries; this collaboration could be leveraged to transition workers to offshore renewable activities. The three Departments are currently evaluating a proposal for the establishment of a seafood industry and offshore renewable energy working group, one of the primary goals of which will be to develop a communications protocol between the two industries. The intention is to increase levels of understanding and facilitate constructive engagement between both sectors, in addition to considering relevant issues such as co-existence opportunities, displacement considerations and safety at sea. There is also scope to redeploy workers from Ireland's more limited oil and gas sectors, which includes a cohort of international workers.

This recommendation is consistent with the National Marine Planning Policy Framework, which supports the sourcing of skills from coastal communities through its Employment Policy 1. This aims to improve access to employment in rural coastal and island communities, placing emphasis on ensuring that local communities can meet the employment requirements of current and future marine activities through appropriate use and development of skills. This policy has the scope for improving access to direct employment, through new or existing activities (including offshore wind energy and fisheries) and indirect employment through supporting industries, such as manufacturing and services.

5	**Upskill existing engineering, environmental and legal professionals, electrical workers and electricians in zero carbon skills, including through micro credentials and other Continuous Professional Development opportunities.** **Responsibility:** Department of Further and Higher Education, Research, Innovation and Science, Industry representative organisations and professional bodies, Further Education and Training and Higher Education Providers, relevant Skillnet Ireland networks

A number of specific areas should be targeted for upskilling and CPD within the existing workforce. A lack of engineering, environmental, legal and financial professionals with knowledge and experience of the zero carbon economy sector was identified as an issue during the research. The key role of engineering professionals aside, Environmental professionals are often involved during the planning and design phases of wind and solar developments. Legal and financial occupations meanwhile provide specialist advice and services to developers of large-scale renewable energy infrastructure; they are heavily involved in the early stages of projects, providing advice in relation to financial feasibility, contracts, land and regulation.

Training providers and industry bodies should put in place short courses to allow existing professionals to upskill in topics related to renewable energy, such as planning, environmental impact assessment and specific renewable energy technologies. On the publicly funded side, interventions such as Springboard+ and Skillnet Ireland can be leveraged. Professional bodies in the sector should introduce a requirement for all candidates to undertake sustainability training on a regular basis so that they have a broad understanding of the environmental impact of their work.

Within FET, the upskilling of existing electrical workers and electricians for photovoltaic installation, to ensure a domestic supply of this skillset, is already taking place- for example in the likes of Laois Offaly ETB- and this activity should be maintained and increased to address the level of demand forecast in this report. Along with interventions such as SOLAS's Skills to Advance for existing employees, this provision will be further strengthened through SOLAS' Green Skills Programme, which is being funded through Ireland's National Resilience and Recovery Plan.

The emerging area of micro-credentials has the potential to help address this upskilling requirement. Under Pillar 3 of the Human Capital Initiative, which concerns Innovation and Agility, a number of funded initiatives are developing micro credential frameworks as part of their projects to facilitate the development of modular courses in the coming years. A number of the projects include collaborating with enterprise to support lifelong learning opportunities in areas including climate change. The Irish Universities Association, together with Dublin City University, is being funded for the 'Towards a Multi-Campus Micro-Credentials (MC2) system', which is aiming at the establishment of a micro credential framework system across the University network; it is anticipated that this could be expanded to involve all higher education and accredited course providers. QQI have also developed an approach to micro-credentials which can substantially support more flexible and modular awards, particularly within Further Education and Training.

6	**Maximise alignment with industry needs and increase exposure to the Renewable Energy sector at third level for undergraduate engineering, environment and planning students.** **Responsibility:** Industry in association with Higher Education Institutions

Following on from the knowledge and experience deficit of the Renewable Energy sector within the existing workforce, a shortage of graduates with relevant knowledge and experience of the sector was also identified in feedback from industry- although the Labour Market analysis did not necessarily show a shortage, compared with longer-term demand, in terms of the numbers of people graduating from relevant courses, such as those in engineering and environmental studies. A review of existing and emerging course provision at Higher Education level (see Appendix VII) shows that across the Higher Education sector there are a range of new or forthcoming

programmes specifically targeted at the climate action agenda- often in a multi-disciplinary manner. Guided by the evidence set out in this report, as well as close engagement with the Renewable Energy sector, Higher Education Institutions and course providers should continue to review course content in these areas to ensure that students are exposed to these topics, particularly in the areas of planning, environmental impact assessment and specific renewable energy technologies.

7	**Increase the availability and capacity of electrical engineering programmes to meet demand from zero carbon activities, in particular Renewable Energy projects.** **Responsibility:** Department of Further and Higher Education, Research, Innovation and Science, Higher Education Authority, Higher Education Institutions

For the most part, across engineering disciplines there does not appear to be a significant gap in FTE labour demand relative to overall HEI supply- other than a shortage of engineers with the necessary skills and experience to work in the sector. This should be addressed through the upskilling/CPD and HEI interventions described above. By the end of the decade, an additional 9,500 engineers across all disciplines will need to enter the profession to meet demand and replace those leaving the sector. This amounts to an average annual entry requirement of just under 1,000 engineers, compared with annual HEI supply of just over 3,000.

The data, however, indicates that there may be a shortfall in Electrical Engineers, an occupation important to the Renewable Energy sector. Approximately 170-180 new Electrical Engineers will be required each year to meet demand, with existing HEI and apprenticeship supply standing at around 150. While this shortfall may be compensated by inward migration (118 Electrical Engineers were granted employment permits in 2019), account also needs to be taken of future demand and competition from other sectors and activities across the Irish economy. This may also be exacerbated by a lack of obvious entry routes in Ireland to become a 'Telecommunications Engineer', with many initially completing degrees in Electrical Engineering.

To address future demand and security of supply, the availability and capacity of electrical engineering programmes, at undergraduate, postgraduate and apprenticeship level, should be expanded. Awareness of employment opportunities within the Renewable Energy sector should also be enhanced, as part of the career promotion activities under recommendation 26.

8	**Explore the creation of direct pathways into Emerging and Niche occupations in the Renewable Energy sector, such as Specialised engineering professionals, specialised ecology and environmental experts, legal and financial experts, project managers, Solar Technician and Marine equipment and ROV operatives, to stabilise supply. Also promote participation in the forthcoming Wind Turbine apprenticeship programme.** **Responsibility:** Industry, in collaboration with Further Education and Training and Higher Education providers

To offset the competition for skills from other sectors, and to enhance Renewable energy's status as a distinct and viable employment option, consideration should also be given to the creation of direct pathways into a number of Emerging and Niche occupations in the Renewable Energy sector. These occupations include:

- **Specialist and experienced professionals:** As mentioned above, particular shortages of experienced professionals, including engineers, environmental/planning experts, solicitors, accountants and project managers with the necessary experience and knowledge to allow them to work on large energy developments were identified during the research. Although the initial entry route to most of these occupations is through the third-level sector, the specialist nature of these roles in renewable energy developments often means that additional postgraduate qualifications and/or professional experience is a necessary prerequisite.

- **Marine operatives:** This includes ship crew, officers and operators of marine equipment and remote-operated vehicles. It is reasonable to expect that marine careers will be a significant growth area with the expansion of offshore wind, and new roles will be required in operating the vessels and equipment required during the planning and construction phases.
- **Renewable Energy Technicians:** This primarily includes Wind Turbine and Solar Technicians, who are primarily involved in servicing and repairing renewable energy developments. Solar Technicians also play a significant role in the installation of solar farms. Entry routes to date for these occupations have been relatively informal and ad-hoc, and are typically comprised of a mixture of technical qualifications and on-the-job training.

As an example, a formal direct pathway for Wind Turbine Technicians is emerging through the apprenticeship system by way of the forthcoming programme (currently pending validation) in Kerry ETB, reflecting the maturity of the sector and the increased attractiveness of Renewable Energy as a career option. This apprenticeship is intended to provide a direct entry route for approximately eighteen Wind Turbine Technicians each year, in addition to the approximately 10-20 who are trained annually through courses provided through Green Tech Skillnet.

While together these programmes appear to be slightly less than the medium-term demand for Wind Turbine Technicians, which suggests that this supply should be closely monitored over the coming years. The onshore and offshore Wind Energy sector should engage closely and promote participation in the new apprenticeship programme on its expected introduction, and underpin any expansion in its capacity in the coming years.

9	**Extend the skillsets of the existing zero carbon economy workforce into areas including commercial skills, electricity trading, adaptability, digital and technology skills, health and safety, problem solving and effective communication.** **Responsibility:** Industry representative organisations and professional bodies, Further Education and Training and Higher Education Providers, relevant Skillnet Ireland networks

There also needs to be an extension of skillsets within the zero carbon economy workforce, in particular those engaged in renewable energy, in the face of a radically changing electricity generating industry and the new demands and tasks that are required. These centre around the melding of 'softer' and transversal skills with technical skills already required in occupational training. Aside from their reflection or broader incorporation into initial FET and undergraduate and postgraduate programmes, these should be provided for the existing workforce through industry representative or sector specific Skillnet training. These include:

- **Adaptability:** This relates to the ability to respond on an individual and organisational level to changing roles and opportunities. The emergence and growth of a new industry requires this adaptability, not least because it takes time to identify and define skills that are required in an emergent sector, but also because the skills used in the renewable sector are sourced from established or traditional disciplines- such as mechanical and electrical engineering, information technology systems and electricians. This is a cultural attribute, and the willingness and ability to upskill and retrain is a form of workplace resilience, particularly in the renewable energy sector. The skills used in the renewable sector are sourced from established or traditional disciplines- such as mechanical and electrical engineering, information technology systems and electricians. Multidisciplinary skills are considered ideal, which implies new entrants into the sector having a number of years' experience, with an ability to work in multidisciplinary teams.
- **Behavioural capabilities**: These skills- such as leadership, strategic orientation for the enterprise, commercial awareness, customer service focus, performance and innovation- were discussed as being equally important as technical skills and as critical skills sought by firms in the sector. Technical skills in

areas such as renewable energy generation are necessary, but not the only skill, as firms are operating in highly competitive markets, where participation in RESS auctions require meeting technology, financial and community eligibility.

- **Commercial skills:** These skills are increasingly sought by renewable energy and retrofit firms, as many projects are joint venture partnerships and/or involve sourcing funding for the projects- in particular the ability to negotiate contracts, position the business and put forward proposals. Given that all renewable projects are joint ventures, collaboration is required. There are commercial, contractual structuring and procurement skills required for large programmes.
- **Digital/technology skills:** With the advent of a "Smart Technology" revolution, centred around renewable energy, there will be increased emphasis on power systems engineering, software development and data analysis of complex systems. Turbine technicians increasingly control the renewable energy systems remotely, and techniques and processes such as drone use are becoming part of a technician's job. Mechanics are also increasingly required to undertake diagnostics and require digital literacy.
- **Effective communication:** There will be an increased need to engage and communicate at many levels. Communities need to be brought along the journey of developing the renewable energy sector; communities need to see a return also. A significant barrier that the industry faces is stakeholder management and managing society's expectations- the benefits of renewable energy should be communicated in a transparent and informative way.
- **Electricity trading:** The introduction of a live electricity market in October 2018, with bidding in half hour slots requires a combination of technical engineering skills coupled with the business acumen of market traders. This requires mathematics and price modelling skills- akin to a traditional stock trading room, with the energy companies having trading desks.
- **Health and safety:** These skills are especially important for people with technical skills but working in new environments e.g. offshore wind. There are also safety risks working with electric vehicles, as there are additional hazards that people working in motor vehicle repair are exposed to, due to the high voltage components and cables capable of delivering a fatal electric shock.
- **Problem solving skills:** This relates to the ability to have a broad spectrum of knowledge and experience in the renewable energy sector.

Residential Retrofit

10	**Support job stability and longevity of careers in the retrofitting sector, by providing clarity on budgetary allocations for retrofit and by developing retrofit grant schemes that facilitate year-round activity.** **Responsibility:** Department of Environment, Climate and Communications and Sustainable Energy Authority of Ireland

While not directly skills related, a lack of long-term certainty and the 'stop start' nature of government funding for retrofitting was repeatedly raised by enterprises as a barrier to recruitment, retention and investing in skills development. This echoes findings in the EGFSN's 2020 report Building Future Skills, which found that the perceived insecurity of careers in the construction industry is a barrier to young people entering the industry and that these negative perceptions are particularly prevalent among parents who have a significant influence on the choices made by school leavers.

There is an opportunity, in the context of the forthcoming Retrofit strategy, to promote the retrofit sector as a high-quality, stable, secure sector within the overall construction industry, as long-term decarbonisation targets are set in law. This will be particularly important in light of the Housing for All plan. A labour demand forecast undertaken for that plan for the Expert Group on Future Skills Needs estimates that, in order to meet the ambitious new build targets set for the next decade, the new housing workforce will have to double from a 2020 baseline of 40,000 to 80,000 by the later part of this decade.

Although almost all retrofit enterprises consulted during this study anticipate significant growth in demand for their services over the coming years, the sector does not have the capacity to deliver the required number of retrofits annually. Almost all enterprise interviewees reported that they experience difficulties in recruiting or retaining staff or contractors. Working on new build projects is generally perceived to be much easier as the projects are cleaner, offer more economies of scale, there are no existing residents to work around and work can be done in regular hours. New build projects are also lower risk and much easier to price, while on a retrofit project a contractor does not always know exactly what they will be dealing with.

In particular, a lack of work during the winter months due to the current structure of grant schemes and the fact that funding is only awarded on an annual basis prevents some enterprises from retaining experienced crews. Enterprises who have been negatively impacted by the abrupt ending of or cuts to grant schemes in the past also continue to lack the confidence to expand rapidly to the level required to meet current demand. Enterprise stakeholders are keen to see the 'long-term plan' with some believing that funding needs to be ringfenced for ten years to support the required expansion in capacity. This should be addressed in the national retrofit plan which is currently being developed by Government, and which should be leveraged as part of a broader careers promotional campaign around zero carbon careers described in recommendation 26.

11	**Ensure that the required number of retrofit training places in nZEB Centres of Excellence, as well as other providers of retrofit training, are properly resourced and available to meet the level of retrofit demand in the coming years.** **Responsibility:** Department of Further and Higher Education, Research, Innovation and Science, SOLAS and Education and Training Boards/Education and Training Boards Ireland (ETBI), Industry

The offer of retrofit training through the new nZEB 'Centres of Excellence' provides opportunities to rapidly scale up the training provision in line with the figures outlined in this report's Labour Market Analysis. When assessing potential shortages in the retrofit sector, it is important to note that the current target – for residential retrofits to increase to 56,000 per annum by the middle of this decade – implies that most of the training requirements will occur between 2021-2025. Particular focus should be given to courses for Insulation operatives, Heat Pump installers (also see recommendation below), and Solar Photovoltaic installers. The Labour Market analysis indicates that annual training provision between 2021 and 2026 should be in the order of 500 places per year for insulation operatives, 300 for Heat Pump Installers, and 60 for Solar PV Installers, with current training provision considerably below this level.

There is also a need to ensure a good regional distribution of training opportunities. The offer of retrofit training is being developed in five centres of excellence and this is expected to be operational in 2021. These are in the Education and Training Board (ETB) areas of: Waterford and Wexford; Laois and Offaly; Cork; Limerick and Clare; and Mayo, Sligo and Leitrim. There may be a need to increase the number of locations to ensure accessibility to retrofit training for people in all parts of Ireland. In particular, the planned five locations do not include a centre in Dublin or close to Meath or border counties (Cavan, Monaghan, Louth).

12	**Improve the availability and flexibility of retrofit programmes in order to incentivise and facilitate employers in releasing staff for training.** **Responsibility:** Department of Further and Higher Education, Research, Innovation and Science, SOLAS and Education and Training Boards/Education and Training Boards Ireland (ETBI)

Issues around the barriers to upskilling of individuals already working in the retrofit and broader construction industry were discussed as part of the interviews and workshops. Stakeholders emphasised that the opportunity cost of releasing a worker from a site to attend training was often as or more significant an issue as the monetary cost of a training programme, indicating that not all employers see the long term benefits of upskilling their staff in retrofit. Stakeholders also highlighted the need for more accessible modular and bite-size programmes and blended learning approaches, although it was also acknowledged that a huge amount of skills acquisition in the industry needs to be done hands on.

While it needs to be acknowledged that a large proportion of retrofit training is likely to require a practical 'hands on' element, opportunities for blended/online delivery of the theoretical components of courses should be provided where possible to reduce the amount of time a participant needs to spend travelling and integrate better with their work. The Waterford and Wexford Education and Training Board (WWETB) are already working on introducing an online delivery option for the classroom-based component of their Near Zero Energy Building (NZEB) programmes, which will help to facilitate the national rollout of these programmes. In the area of heat pump training, training centres such as METAC in Mountrath also run courses split across weeks and weekends to facilitate participants.

13	**Increase training for Retrofit Engineers/Designers, including through an increase in the availability and capacity of Energy Engineering or Building Services Engineering degree programmes, postgraduate programmes and CPD training.** **Responsibility:** Higher Education Institutions, Industry representative organisations/professional organisations

Along with electrical engineers, the labour market analysis suggests that Retrofit Engineers or designers- one of the main emerging or niche retrofit occupations- will also pose a recruitment challenge in the coming years. There are multiple routes to becoming a Retrofit Engineer/Designer- including architecture, surveying and engineering. To date, many in Ireland have entered the occupation with qualifications in areas like Energy Engineering and Building Services Engineering. Summing these two disciplines shows approximately 290 graduates with these qualifications which, when compared with the annual entry requirement mid-decade of approximately 300, suggests that many of these jobs may become difficult to fill as demand increases. Furthermore, with competition from other activities it is unlikely that all 290 graduates will go into retrofit. This has been echoed by enterprises working within the Retrofit Sector, with many noting strong competition for suitably qualified graduates.

While it is unlikely that an entirely new degree programme is necessary, expansion of the availability of and capacity in these engineering courses, as well as post-graduate and CPD training, is likely to increase the pool of engineers who could work in the retrofit sector. Engineers Ireland also provides a range of CPD courses for engineers, including some relating to Retrofit and energy-efficient building design, which are another route by which existing engineers can be trained into the Retrofit sector. In addition, ensuring that viable pathways and training from other areas such as architecture and surveying are available will help to provide a stable supply of Retrofit Engineers/ Designers over the coming decade.

14	**Engage with and encourage the urgent upskilling of existing plumbers in the installation and servicing of heat pumps.** **Responsibility:** SOLAS and Education and Training Boards, relevant Higher Education Institutions, in collaboration with Sustainable Energy Authority of Ireland, Unions and Trade Organisations,

As well as channelling new entrants into the area, there is a need to engage with the existing body of plumbers and urgently facilitate their rapid upskilling in the installation and servicing of heat pumps. At present, there are currently insufficient numbers of qualified individuals available to scale up the sector to the level required. For Heat Pump Installers, as the retrofit targets are expected to ramp-up fully by 2024, the training requirements also need to be frontloaded towards the first half of the decade. The Annual New Entrant Requirement from 2021 to 2025 is 290, suggesting that training providers need to train almost 300 Heat Pump installers each year.

Households who purchase a new oil or gas boiler in the coming years will be 'locked-in' to a fossil fuel heating system for a period of time, probably the lifespan of the new boiler- due to the level of investment involved. It is therefore important that householders who turn to a plumber for advice should be made aware of the benefits of heat pumps. There is a risk that plumbers who have not upskilled in this area will continue to recommend the installation of a new boiler simply because it is 'what they know', regardless of whether it is the best option for the particular household. This should be a collaborative approach between Government, industry and plumbing trade unions, in order to maximise the take up of the available upskilling opportunities.

15	**Explore the full integration of retrofit occupations within relevant apprenticeship programmes.** **Responsibility:** National Apprenticeship Office, National Apprenticeship Alliance

While there is currently content on renewable energies in the construction and electrical apprenticeships, it is worth noting that there are significant differences in the numbers who complete an apprenticeship, and those who go on to seek further retrofit-related qualifications and training. For example, the number of plumbers completing heat pump installation training (30) appears to be only a fraction of the overall number completing apprenticeships (235)[49].

This is largely accounted for by the fact the Plumbing apprenticeship contains content that enables apprentices to be employed in both the domestic housing sector and large-scale construction sites. The majority of employers who employ apprentice plumbers predominantly work on large scale industrial projects- where the installation or maintenance of domestic heat pumps would not in most cases be required- reflecting recent activity in the sector.

As house building and retrofitting projects scale up, more domestic plumbing companies will seek to employ apprentices with training in heat pump installation. A lack of integration of these activities within the apprenticeship system, however, suggests that there may be issues around stability of supply going forward, especially as demand ramps up significantly. It was reported by many in the stakeholder engagement process that workers often have little incentive to undertake additional training due to cost and time barriers, as well as the availability of work in other parts of the construction sector.

The trend towards enrolling in additional training courses was highlighted as a barrier for the Zero carbon sector. If true, this suggests that training providers should review the content of existing programmes to ensure that apprentices are given opportunities to receive the necessary industry certifications as part of their apprenticeship, in order to reduce any barriers to entry. Consideration could be given, for example, to making it mandatory that plumbing apprentices complete heat pump installation training.

This would require the identification of training specifications, as part of a gap analysis on the current content in apprenticeships. Alternative approaches to additional post-apprenticeship training by craft-persons to a standard

49 A further 100+ plumbers complete the NZEB training for Plumbers in WWETB

set by industry would require careful consideration with regards to governance and quality assurance. In light of this, it should be noted that Plumbing is one of five apprenticeship programmes that are currently under full programmatic review. These reviews are being undertaken by programme boards, which include industry experts, in light of industry requirements.

It is important to note, however, that any such review- which may not necessarily advise on the inclusion of heat pump installation as part of the next iteration of the programme- as well as any subsequent roll out, will take time. In terms of addressing immediate short-term industry needs, emphasis should therefore be placed on the additional, non-apprenticeship provision, as well as its availability and flexibility, in order to keep pace with installation targets.

16	**Continue to promote and improve the accessibility of apprenticeships to young people, including their role in addressing climate action.** **Responsibility:** National Apprenticeship Office and National Apprenticeship Alliance of employers, employee representatives, learners and further and higher education providers, Institute of Guidance Counsellors

A need to improve the promotion of apprenticeships to young people was raised by numerous stakeholders during the workshops and also in enterprise interviews. Some participants felt that there is a focus on academic third level education in Ireland and that practical and vocational third level education, such as apprenticeships, are not equally valued for school leavers. It was also highlighted that it can sometimes be difficult for prospective apprentices without relevant connections to access an apprenticeship place.

There is an opportunity to promote the role apprenticeship programmes across construction will play in addressing the climate challenge, in particular through the Generation Apprenticeship promotional campaign; this will be relevant not just to retrofitting activity, but also the sector's role in delivering on the renewable energy agenda and energy efficient new builds.

Under the new Action Plan for Apprenticeship, 2021-2025, there are a range of commitments to enhance the promotion of apprenticeship programmes, in support of its ambition to reach 10,000 annual apprenticeship registrations by 2025. Apart from enhanced employer supports for apprentice recruitment, these include:

The publication of information on access to apprenticeship and pre-apprenticeship courses, as well as the advertising of all apprenticeship opportunities and clear guidance on apprenticeship.ie

The positioning of apprenticeship within career guidance websites and support structures, as a clear route to qualifications and a career in areas of proven skills need.

Promotion of the availability of apprenticeship opportunities alongside other FET and HE offerings through e.g. reciprocal links to FETchcourses.ie and assessing the ability to indicate expressions of interest through the CAO

Delivery of an information pack detailing developments in apprenticeship to all guidance counsellors, and an assessment of the potential for short programmes for guidance counsellors providing on-location/in company experiential learning opportunities.

Involvement of under-represented groups and a wider variety of stakeholders in designing promotion campaigns, to reflect the participation and positive experience of people from all backgrounds and the availability of assistive supports.

Extension of the existing female bursary for craft apprenticeships to all apprenticeship programmes with greater than 80% representation of a single gender

17	**Facilitate adult participation in apprenticeships and traineeships, in particular for general operatives within the Construction sector.** **Responsibility:** National Apprenticeship Office and National Apprenticeship Alliance of employers, employee representatives, learners and further and higher education providers (for apprenticeships), SOLAS (for traineeships)

A further source of retrofit skills supply is the general operative cohort within the construction sector. While there will be demand for general operatives as part of retrofit activity, apprenticeships and traineeships offer progression pathways for such workers who already have significant experience of working in the sector. This has the potential to contribute towards addressing retrofit skills demand more effectively than reskilling workers from other sectors- challenges are posed by workers with no prior experience of the construction industry.

Under the Action Plan for Apprenticeship, for example, there is a commitment towards an inclusive apprenticeship access and delivery structure. At present, all national apprenticeships are structured on a full-time basis, and many are designed to be delivered within a set period of time. As part of the review of programmes, the Plan commits to ensuring that apprentices with existing workplace commitments can be facilitated through, for example, modular learning or recognition of prior learning, or potentially by increasing the flexibility of learning provision, allowing for part-time delivery. Such flexibility is already embedded in the shorter-term traineeship model.

Industry should work closely with education and training providers to leverage this greater flexibility in apprenticeship and traineeship provision and support the development of a broader skills base within the existing construction workforce.

18	**Enhance stakeholder engagement skills across the Retrofit sector in order to build awareness and trust in the benefits of retrofitting and to drive homeowner adoption.** **Responsibility:** Sustainable Energy Authority of Ireland, Industry Representative organisations

A social theme which emerged strongly during the research related to the importance of building awareness and trust in the benefits of retrofitting in order to drive adoption. The scale of the change envisaged in the Climate Action Plan not only requires buy-in from industry and policymakers, but also from households and communities. While the science of climate change and the risk associated with changing global temperatures is uncontested, the ability to navigate through complex scientific concepts and communicate solutions to customers in terms that they understand and value is a skill deficit that many enterprises are facing.

Many of the firms interviewed for this study noted that it is important for workers in the zero carbon economy sector, particularly those with front facing roles, to be able to seamlessly communicate and sell the benefits of the zero carbon transition to potential customers and community members. It is crucial that individuals within the retrofit industry develop good 'soft skills' for engaging with home-owners. Heat pumps in particular are considered to be a tough sell for individual enterprises and there is a concern that many householders will default to simply replacing oil or gas boilers when they stop working in the absence of successful communication of the alternatives.

Development of such training could be informed by the Sustainable Energy Authority of Ireland, in collaboration with the retrofit sector and Heat Pump representative associations and rolled out through these associations to their memberships to maximise their reach.

19	**Assess the benefits of developing a register of workers who have upskilled in retrofitting, in order to underpin consumer confidence and demand for residential retrofit.** **Responsibility:** Sustainable Energy Authority of Ireland, Department of Environment, Climate and Communications, Department of Housing, Local Government and Heritage, Irish Green Building Council/Limerick Institute of Technology

There was a consensus that there is currently a lack of incentives to upskill in retrofitting as there are no formal requirements to do so and no mechanism to easily demonstrate any upskilling completed. To help address the current lack of incentives to upskill in retrofitting, the potential and practicalities of a register of building professionals and construction workers who have upskilled in retrofitting should be explored; this would make those who have upskilled more easily identifiable for consumers, including public authorities, and further underpin consumer confidence and consequently retrofit demand.

Research into the development of such a 'Renovation Register' has already been undertaken by the Irish Green Building Council and Limerick Institute of Technology, with support from the Sustainable Energy Authority of Ireland (Developing a Register of Building Professionals and Construction Workers who have Upskilled in Energy Renovation (2020)). The introduction of such a register would need to be examined, however, in the context of and complement the operation of the Construction Industry Register Ireland (CIRI), a hitherto voluntary online register of builders, contractors and tradespersons who carry out construction works.

The Department of Housing, Local Government and Heritage is currently working towards making the CIRI register mandatory; its provisions are being phased in over a number of years, and once fully established, it will represent a robust, mandatory, statutory register of providers of building services, giving those who engage a registered builder the assurance that they are dealing with a competent and compliant operator. Its criteria will be relevant experience, relevant qualifications or a combination of both.

20	**Explore the utilisation of public procurement processes to incentivise participation in retrofit training.** **Responsibility:** All relevant public contracting authorities, Irish Green Building Council

The introduction of such a register could be complemented by the introduction of provisions in "green public procurement" to further incentivise engagement in retrofit training. This would be around competency-based tenders and the use of building professionals and construction workers who have upskilled in retrofitting- which such a register would certify- within tendering processes for public projects, as well as within the criteria for grant schemes or renovation tax incentives. An example of how public procurement has influenced upskilling in Ireland in the past was the introduction of requirements for professionals working on historic buildings to have conservation expertise, which led to an increase in upskilling in the area.

The requirement for conservation expertise on historic buildings involved a voluntary registration scheme, which required specific specialised skills. The specific skills necessary for retrofitting projects would in turn need to be clearly identified in any procurement process; this would be the responsibility of individual contracting authorities, who have operational responsibility for Works procurement. Again, the inclusion of a training clause in public procurement to support energy efficiency upskilling is an area that is currently being examined, albeit in the context of nZEB, by the Irish Green Building Council and Limerick Institute of Technology, as part of the Horizon 2020 BusLeague project; this is aiming to stimulate demand for sustainable energy skills within the construction sector.

21	**Upskill the existing Built Environment workforce in life cycle environmental assessment and sustainable renovation. Also increase the emphasis on life-cycle environmental assessment/'sustainable renovation' in undergraduate and post-graduate construction professional programmes.** **Responsibility:** Industry representative organisations, in particular Irish Green Building Council, in collaboration with Higher Education Providers, Skillnet Ireland

Finally, there is an increasing need to consider embodied carbon and resource efficiency as part of a holistic approach to the environmental impact of retrofit projects. The EU's 'Renovation Wave' commits to developing a 2050 roadmap for reducing whole life-cycle emissions in buildings. As well as the broader skillset of carbon accounting, the skills of building professionals in Ireland should be enhanced to include environmental life-cycle assessment. In particular, there is a need to ensure that sufficient formal education on these topics is integrated into undergraduate and postgraduate construction professional programmes, as well as for the existing construction workforce, through upskilling interventions such as Springboard+, the Construction Professionals Skillnet or the Green Tech Skillnet.

Electric Vehicles

22	**Engage the existing pool of motor mechanics and encourage and support their upskilling to work on Electric Vehicles, in particular through digital skills training, to improve the attractiveness of the sector overall, retain the existing labour force and attract new entrants.** **Responsibility:** Sustainable Energy Authority of Ireland, in collaboration with industry/SIMI, SOLAS, SIMI Skillnet

As identified in the research, the increase in demand for skills relating to electric vehicles will be gradual, with growth concentrated in the middle to later part of the coming decade. This demand will be concentrated on the maintenance side; due to their small numbers, no supply issues have been identified for the engineering/technician skills required for charger installation and hence no associated intervention is recommended.

This is in the context of projected demand for Internal Combustion Engine mechanics remaining high towards the end of the 2020s. The latest data indicates that just under 300 people qualify as vehicle mechanics each year, while a further 100 existing mechanics undertake additional EV training each year in the FET sector and through SIMI Skillnet. This appears to be sufficient to meet increased demand from EVs in the short-to-medium term.

Notwithstanding this, the motor mechanic industry has a problem holding onto skilled workers. This has been attributed to the fact that as a mechanic becomes more experienced, there is no difference in the wage structure. This has acted as a disincentive for mechanics to upskill and remain in the industry. No career progression is seen and most leave the industry for factory work. This disincentive to upskill directly effects the problem of not having a skilled labour force to work on Electric Vehicles in the coming years. Creating an incentive to upskill to work on Electric Vehicles, via the development of ICT skills, which is not currently covered in the apprenticeship syllabus, was suggested as a possible approach.

Outside of the car dealerships, programmes such as SOLAS' Skills to Advance, which imparts digital, transversal and sector specific skills (there is currently an EV programme under 'Skills to Compete'), as well as the hybrid and electric vehicle systems programme delivered by SIMI Skillnet offer solutions. Due to the more gradual increase in EV skills demand, Government should monitor the transition to EVs, and through engagement with industry and education and training providers on such digital skills programmes, help ensure a 'Just Transition' for the existing pool of ICE motor mechanics.

It is also important that mechanics, as well as electricians, are educated on the charge points and electrical infrastructure required to supply power to a vehicle. This should be addressed through upskilling, as well as apprenticeship content for new entrants.

A further consideration, which may facilitate alternative employment for mechanics, is how the training to handle EV batteries and repair or replace battery and power electronic components could be broadened to support the growing market for static energy storage in the home, as well as for larger grid applications, which offer a commercial avenue. Power electronics such as inverters are very similar for Electric Vehicles and Photovoltaic systems, so the skills should be transferable.

23	**Progress the incorporation of Electric Vehicle material into relevant Apprenticeship Syllabuses to secure longer term Electric Vehicle maintenance skills supply.** **Responsibility:** National Apprenticeship Alliance, in collaboration with industry

The most obvious way to improve long-term security of Electric Vehicle skills supply is to fully integrate EV content and training requirements into the existing Vehicle Mechanic apprenticeship. This will improve the resilience of the profession in the face of any rapid transition from Internal Combustion Engine vehicles to Electric Vehicles. The motor mechanic apprenticeship does not cover Electric Vehicle material in its current format, although a review of the curriculum has started, with it intended that Electric Vehicles be key to its future focus. The programme is being developed with relevant industry and education and training stakeholders, and will be submitted to QQI for validation.

During the research, the deficit in Electric Vehicle content was identified as a significant concern if the skills to service the future EV market are to be met. This will especially benefit the independent garages, who are not associated with main (i.e. car brand) dealerships- where this training is already provided for- and which are most at risk of not being able to adapt to the skills required for a zero carbon economy. Other recommendations regarding the updating of the syllabus relate to the inclusion of more maths, science, and ICT based topics, as this will benefit the industry as the technology becomes more advanced and digital.

24	**Provide and promote mandatory Electric Vehicle Safety Training to the existing mechanic labour force.** **Responsibility:** Industry/SIMI, Sustainable Energy Authority of Ireland, SOLAS, SIMI Skillnet

There is a recognition that EVs contain high voltage systems, and these represent a danger to the current labour force if they are not familiar with them. During the project workshops, this was identified as an immediate issue that would have to be addressed through the training of mechanics. Mechanics who have no prior training in EVs are currently carrying out works on EVs, and this needs to change. Although there is no legislation in place for who can work on EVs and ICE vehicles, EVs poses a higher danger and require skilled labour, Personal Protective Equipment, and specialist tools to be able to work on them safely. Currently there are courses available to address this, but there is not a huge demand for this currently as there are few EVs on Irish roads.

However, the recovery, repair, and maintenance of EVs outside the manufacturers and franchised dealerships is increasing in Ireland. As workers in the motor vehicle repair and maintenance industry become more likely to work on EVs, they need to be aware of the additional hazards they are exposed to when working on such vehicles. EVs by their nature, contain high voltage circuits and some systems may contain harmful chemicals if released. The introduction of such training could be informed by bodies such as the Health and Safety Authority and Road Safety Authority, which oversees the National Car Test (NCT) system.

25	**Explore the introduction of recognised certifications as a requirement to work on Electric Vehicles and to foster consumer demand.** **Responsibility:** Industry/SIMI in collaboration with SOLAS/ETBI, Sustainable Energy Authority of Ireland,

Connected with the provision of mandatory safety training, a recommendation that emerged from both the workshop and enterprise interviews was the establishment of a standard legal safety certification for mechanics working on electric vehicles. The example used was the Registered Electrical Contractor Ireland (RECI) certification introduced for electricians, which should be emulated for EV mechanics. Introducing such a certification would recognise the skills for EV mechanics and provide an industry standard. This recommendation will ensure that only trained mechanics are able to work on EVs and remove any safety concerns for both the mechanics and users of EVs. During the EV workshop it was noted that ETBs should be involved in the rendering of these certifications. This would also allow independent garages to be able to offer EV services, with recognised certifications. In its role supporting electric vehicle adoption, SEAI should promote awareness of this certification and encourage the public to check for it if and when they take their vehicle to an independent mechanic.

Promotion of career opportunities within Zero carbon Economy Activities

26	**Define and promote career opportunities, and associated education and training pathways, in the zero carbon economy to school students, in particular female students, career guidance professionals and parents through industry and government outreach and promotional activities.** **Responsibility:** Industry and Professional Representative organisations, in collaboration with Sustainable Energy Authority of Ireland, SFI Smart Futures, Institute of Guidance Counsellors, Further Education and Training and Higher Education Providers

To secure a flow of new entrants into zero carbon economy activities in the longer term, there is a need to promote and embed awareness of environmental and sustainability issues, as well the associated career opportunities, across the second and third level student cohort. As the renewable energy and retrofitting sectors are subsets of the broader built environment sector (comprising construction, engineering, architecture, waste, water and power), many of the challenges attracting new entrants to these sectors are similar to those identified in the EGFSN's previous Building Future Skills report. These were reiterated by stakeholders and interviewees during the engagement undertaken for this study.

The current cohort of school aged children and teenagers have an environmental awareness and are the generation that will have to adapt to the effects of climate disruption. Most young people are acutely aware of the challenges their generation faces and should be exposed to the career opportunities where they can contribute to the changes required across the climate action agenda. Climate change is a cross cutting theme that is explored in many different subjects (Geography; Science; Civic, Social and Political Education; Business Studies; Economics) as part of the curriculum in Ireland, along with programmes such as Green-Schools, and developed through projects such as those prepared for the annual Young Scientist and Technology Exhibition.

Advancement of the zero carbon economy's career opportunities should build upon this- firstly, by the wider industry properly defining and clarifying these opportunities and their associated education and training pathways, and then by promoting these pathways into renewable energy and retrofitting activities, promoting the sectors as modern, problem solving sectors offering solutions to reduce greenhouse gas emissions.

This should involve, in particular, linkages with the Institute of Guidance Counsellors and Careers Portal, and increased engagement of girls in Science, Technology, Engineering and Mathematics (STEM) education- the latter is a key objective of the existing STEM Education Policy Statement, 2017-2026. In common with the Built Environment sector, the gender imbalance in zero carbon roles, as reflected for example in the dominance of men working in the renewable wind sector, will impact on future skills supply.

The climate action agenda should be emphasised in promotional initiatives targeting school age students, such as Science Foundation Ireland's Smart Futures, Discover Science Week, the I-Wish initiative to promote STEM amongst girls, Engineers Ireland's STEPS engineering experience programme for TY students, the activities of the Techno Teachers Association of Ireland, as well as the annual Ireland Skills Live event. The 'This is FET' promotional campaign could also highlight the Further Education and Training sector's role in addressing the climate action challenge through its provision.

The role of parents as key formative influences on the career choices of school leavers is also important- as was identified in the Review of Guidance commissioned by the Department of Education and Skills and published in 2019. Parents should be targeted in an effort to promote careers in zero carbon sectors. This requires an ongoing communication and engagement campaign, showcasing the range of skills the sectors require and viable pathways into those careers/occupations.

27	**Provide work experience opportunities for students and young people in zero carbon economy activities, including at TY level and through the new Work Placement Experience Programme for the young unemployed.** **Responsibility:** Industry in collaboration with Transition Year Coordinators, Institute of Guidance Counsellors, Further Education and Training and Higher Education Providers, Department of Social Protection

Promotion of career opportunities should also include school outreach by industry and improved work experience opportunities across zero carbon economy activities, for example during TY, which in turn can help influence FET, apprenticeship or Higher Education course choices, by providing students with the opportunity to gain real skills and a feel for potential careers. Such placements could be provided for a continuous, substantial period of time (e.g. three weeks) rather than on a 'one day per week' basis to facilitate skills development. The commitment in the Action Plan for Apprenticeship 2021-2025 to explore the development of apprenticeship taster courses as part of TY and Senior Cycle is an important development in this respect.

Placement opportunities could also extend, where possible, to FET and Higher Education programmes, to enhance awareness of and the attraction of zero carbon economy careers- helping to mark them out as viable career options. Under the 2020-2024 Further Education and Training Strategy, Future FET: Transforming Learning, for example, employers are to be offered the opportunity to engage in a range of FET support activities, including work placement, to ensure alignment between provision and employer needs.

Zero carbon economy activities should also be a key focus of the new Work Placement Experience Programme, which is being rolled out as part of the 2021-2025 Pathways to Work strategy and funded under Ireland's National Recovery and Resilience Plan. This programme will deliver 10,000 six-month work placements for jobseekers unemployed for more than six months- including periods in receipt of the pandemic unemployment payment- to the end of 2022. Importantly, at least 3,000 of these places are being reserved for young unemployed jobseekers, with the scheme subsuming the Youth Unemployment Support Scheme.

Under this scheme all participants will be paid at €306 per week, and significant training and development opportunities will also be available to participants on the programme. This is in the context of a broader emphasis on addressing youth unemployment in the new Pathways to Work. The strategy will also see the relaunch and promote of the Employer Youth Employment Charter, and a tailoring of bespoke job promotion and local recruitment events for young jobseekers, where reskilling and upskilling options will be outlined, and referrals made to the Education and Training Boards.

Alternative sources of Skills Supply for Zero carbon Economy Activities

28	**Promote career opportunities and skills mobility for zero carbon activities from other sectors of the economy through exploring opportunities for career pathways from or within sectors negatively impacted by the transition from fossil fuels or, where feasible, other factors such as the Covid 19 pandemic.** **Responsibility:** Industry, in collaboration with Department of Social Protection, Further Education and Training and Higher Education providers, Skillnet Ireland

In the coming years there is also the potential to service the growing skills needs of zero carbon economy activities through the transitioning of workers from roles or sectors impacted by digitalisation or decarbonisation, or by the Covid 19 pandemic. This should include promotion of its employment opportunities to career changers and facilitating, through reskilling or upskilling, both the transitioning of workers between sectors, as well as within transitioning sectors. At regional level, this should involve close industry and education and training provider engagement to support in-firm or in-sector redeployment, or in the case of redundancy, a coordinated approach between the Department of Social Protection, education and training providers and zero carbon enterprises to facilitate workforce reintegration.

In implementing the new Pathways to Work 2021-2025 strategy, the Department of Social Protection and national Intreo network should emphasise the labour activation potential of zero carbon economy activities and engage with firms across the retrofit and renewable sector accordingly. The strategy aims at strengthening employer outreach, as well as the hosting of job promotion events, employer roadshows and Work and Skills weeks, to facilitate linkages between jobseekers and employers. Zero carbon economy firms should also engage with the 'Returner' programmes the strategy commits to developing, to encourage and support people who have left the workforce to take up employment.

In relation to redeployment within sectors, the skills associated with an energy plant operation may be directly transferable into the renewable energy sector or other sectors within the zero carbon economy and this is a process that is occurring within industry itself. The ESB have had a policy of "RRR"- "Retraining, Reskilling and Redeployment" for many years. It was stressed that while certain activities i.e. those associated with carbon-intensive electricity, will decline, overall roles within the organisation will not and displaced workers will be supported to find a role in the zero carbon energy sector.

Efforts are also already underway to provide ex-Bord na Móna employees with opportunities in the retrofit or wind sectors. For Bord na Mona employees, Skills to Advance training is being offered through Laois Offaly ETB, providing an opportunity to gain a level 5 certificate in Thermal Insulation Installation, with the intention being to expand to include Ventilation and Air Tightness. It was emphasised, however, that not all Bord na Móna workers are necessarily well suited to or interested in roles in the retrofit sector.

Further potential pathways include:

- **Opportunities for those in the fishing sector** – which has been negatively impacted by Brexit – as well as the Oil and Gas sectors to use their skills to fill vacancies in the Offshore Wind Sector.
- **Potential training routes** for vehicle mechanics into other technical or mechanical roles in the Zero carbon Economy in the long-term, such as Wind and Solar Technicians.
- **Plumbers with Gas Boiler qualifications** can secure heat pump qualifications to reduce the impact of a long-term reduction in the number of gas boilers.

Jobs and occupations permanently displaced due to the Covid-19 pandemic e.g. permanent business closures in retail or hospitality, could also provide avenues for redeployment into the renewable energy or building retrofitting sectors. There are, however, significant challenges in getting some people - for example, a person who is made redundant in retail - up to the skill levels required in the zero carbon economy, particularly if they have no prior experience of renewable energy or of the construction industry. With regard to the retrofitting sector in particular, it was suggested that the wages available for entry level roles may not be aligned with expectations for workers who already have significant experience of another industry. However, it is also believed that a significant number of workers who left the construction industry during the last recession subsequently moved into sectors such as hospitality and there may therefore be some opportunities to attract workers with prior experience of construction back into the industry.

Training providers and industry bodies should continue to provide and increase direct training pathways into the Zero carbon Economy from roles or sectors that are likely to be negatively impacted by the Zero carbon transition or other economic developments. This transitioning activity should leverage the investment by the Department of Further and Higher Education, Research, Innovation and Science in 50,000 additional places in further and higher education, including SOLAS' Skills to Compete programme, which covers digital skills, transversal skills and sector specific skills provision, Skillnet Ireland, Springboard+ and the Human Capital Initiative. Skillnet Ireland's Skills Connect programme, for example, is facilitating the rapid reskilling of workers impacted by Covid-19 in areas of identified skills needs.

This includes a number of courses in the zero carbon economy space, run through the Midland Border East Skillnet- in Domestic Heat Pump Systems, Micro Generator Electrical Installations and Micro Solar Photovoltaic Systems. Under Ireland's National Resilience and Recovery Plan, funding is also being provided for SOLAS' Recovery Skills Response programme, which will see a range of additional educational and training programmes rolled out as part of Skills to Compete and the establishment of the SOLAS Green Skills Action programme, which will be focussed on providing training to address climate and zero carbon economy issues. There will be a particular focus on provision in Near Zero Energy Building and Retrofitting, as well as the development of new modules in green skills.

29	**Engage in a communications and outreach campaign to attract skills for zero carbon economy activities from the Irish diaspora and the broader pool of international talent** **Responsibility:** Industry, in collaboration with Department of Public Expenditure and Reform, Department of Enterprise, Trade and Employment, Department of Foreign Affairs and Embassy Network, EURES Ireland

With regard to both the renewable energy and retrofitting sectors/construction industry, and in spite of the competitive international market for zero carbon economy skills, efforts should nevertheless be made to attract international talent to help deliver on Ireland's Climate Action commitments. This is particularly the case given the scale of the skills demand forecast for the coming years, the rapid ramping up of retrofit and renewable energy activities, and the time needed for domestic supply to fully respond to education and training initiatives.

There may be opportunities to attract back skilled workers from the Irish diaspora, particularly workers who emigrated during the last recession and who would by now be highly experienced. Most of the renewable energy companies interviewed also had plans to expand their workforce, with many currently actively recruiting. A number of these companies commented that the response to their recruitment campaigns came from non-Irish applicants, and that the renewable energy sector is truly a global workforce. A further perspective was that many eastern Europeans are returning to their home countries, which is contributing to skills shortages.

It should be noted that significant efforts have been exerted to attract diaspora workers back to Ireland in recent years, but success appears to have been limited. It was noted that employers in the renewable energy sector in particular will have to offer good salaries to attract back workers, and depending on the skillset, there may be competition from higher income earning sectors within the Irish economy. Much like the confidence required to promote career prospects across built environment roles, another comment was that returnees need to be confident of a steady and sustained pipeline of work, which could be conveyed through government commitment to a clear programme of action and projects.

Through the investment set out in the Economic Recovery Plan, the revised National Development Plan, as well as the recommitment to Ireland's climate goals in the Climate Action Plan, policy commitments will underpin confidence in a steady and sustained pipeline of work in the coming years. This in turn should be promoted to the international talent pool for zero carbon activities, through a communications and outreach campaign involving both industry and government. This campaign should include a number of strands:

Promotion of Ireland's employment opportunities in zero carbon economy activities through the global communications strategy operated under the aegis of Global Ireland- Ireland's Global Footprint to 2025. This promotes Ireland as a place in which to live, do business and invest, through a coordinated, cross departmental, multi-agency approach to communicating Ireland's message internationally. It includes operation of the Ireland.ie digital hub for information relating to the Government's international engagement and a social media programme and media communications programme, with targeted media partnerships in overseas markets. It should be noted that efforts are already being made to attract overseas capacity within the construction sector through the promotion of Ireland's infrastructure project pipeline at the World Expo and as part of Ireland's annual trade delegations for St Patrick's Day.

Engagement with the Department of Foreign Affairs as it implements Global Ireland- Ireland's Diaspora Strategy 2020-2025 in the coming years. The strategy highlights the benefits returning emigrants bring in terms of skills and knowledge gained abroad, which can help develop both the national and local economies. To this end, it commits to improving the provision of information on returning to Ireland as well as the dissemination of information on skills needs.

Enhanced industry engagement with the employment permit system, which since 2019 has covered a number of occupations key to zero carbon activities across both the critical skills list and those occupations eligible for general employment permits. The Department of Enterprise, Trade and Employment should continue to ensure that the eligibility lists for employment permits remain responsive to identified and evidence-based skills shortages within the Irish economy.

Industry should also engage more proactively with the services offered by the Department of Social Protection through EURES Ireland (the European Employment Service), established by the European Commission to facilitate the free movement of workers between EU/EEA countries. As a cooperation network formed by public employment services in all EU/EEA countries, it is a resource with the potential for targeting roles other than professional or managerial occupations. It allows for the advertisement of vacancies on the EURES job mobility portal, facilitates specially tailored recruitment projects and jobs fairs for individual employers, as well as industry or sector specific onsite or online jobs fairs and recruitment events.

The industry representative organisations should also tap into their respective networks to promote employment opportunities associated with the zero carbon economy in Ireland. An existing example is how Engineers Ireland engages with Irish engineers working abroad, through its 'Global Engineers' events aimed at helping corporate partners connect with talented international engineers seeking to establish themselves in Ireland. Engineers Ireland has also established and promotes international agreements with overseas professional engineering institutions, which guarantee mutual recognition of engineering qualifications and facilitate the professional mobility of engineers.

Public Sector Programme Management and Carbon Accounting Skills

30	**Develop programme management and carbon accounting skills within Government to support change and the transition to a zero carbon economy** **Responsibility:** Department of Public Expenditure and Reform, Public Appointments Service **Other key stakeholders:** Department of Environment, Climate and Communications

As the research has indicated, attaining the Climate Action Plan targets will require a transformation of society and transition to a new normal. In particular, it will require the establishment of new industries and the implementation of changes involving technology, people and processes. As this will inevitably meet resistance to change- be it through embedded traditional practices, traditional skills and cultural norms- it will require a whole Programme Management skillset within Government and Planning agencies associated with the management of change, not just for the management of major capital programmes, such as construction or building programmes.

During the stakeholder interviews and workshops discussions centred as much on the barriers and challenges faced by industry and Government that need to be addressed, before people are deployed into zero carbon activities. There can be active resistance to change, particularly depending upon the age of people and stage that they are at in their lives. A number of stakeholders interviewed identified the need to upskill at a policy making level, with skilled climate policy and zero carbon activity experts within Government and within the planning organisations (Local Authorities, the Office of the Planning Regulator and an Bord Pleanála)- particularly in understanding the technical and commercial constraints faced by the zero carbon economy sector in their project delivery.

The development of skillsets in carbon accounting will also be important. The Climate Action and Low Carbon Development (Amendment) Act includes the introduction of sectoral carbon budgets, five-year budgeting cycles and transparent reporting and carbon accounting requirements. While enterprises are aware that they require these skills, it was also noted that these skills are required in the public sector, to ensure that proposals for climate related policies, programmes and projects can be assessed and appraised appropriately, particularly with respect to the planning system.

The recruitment and professional development resources of the Civil and Public Services are and can be responsive to these changing business needs within Government. Working with relevant Departments, offices or agencies, the Public Appointments Service can recruit specialist skills, while OneLearning, the Civil Service's Learning and Development Centre works with relevant Civil Service subject matter experts to incorporate relevant business priorities and contexts. The Senior Public Service Team within the Department of Public Expenditure and Reform also engages with OneLearning and other internal and external stakeholders to provide tailored Learning and Development supports, including networking events, masterclasses and formal training courses for civil servants at Management Board level.

The Department of Public Expenditure and Reform's Public Service Reform Unit is also responsible for implementing the reform agenda for the Public Service and the implementation of the Public Service Innovation Strategy. Under the Our Public Service framework, there is an ambition to provide for continuous and responsive professional development across the Public Service, and as part of this ambition the unit is examining the feasibility of introducing a suite of core learning and development programmes for the wider public service. As part of this exercise, consideration is to be given to meeting evolving business priorities and specific topics in a national context which may include climate-related and programme and project management learning interventions.

On carbon accounting, it is also important to note that on Government accounting, the Department of Public Expenditure and Reform is currently reviewing the existing accounting framework for Government Departments. The intention is to move towards an international standards-based framework (the International Public Sector Accounting Standards). These standards are subject to an ongoing process of review and development, to take account of new requirements in financial reporting, including wider issues of sustainability. Any changes will assist Ireland's awareness of international trends towards better financial reporting of wider sustainability issues and to help incorporate these changes across Government.

Appendix I Terms of Reference of Study

The Department of Enterprise, Trade and Employment (DETE) has commissioned research to determine the demand for, and nature of, the skills required to deliver on key elements of Ireland's Climate Action Plan to Tackle Climate Breakdown over the years to 2030. The Expert Group on Future Skills Needs (EGFSN), which advises the Irish Government on current and future skills needs of the Irish economy, and on other labour market issues that impact on Ireland's enterprise and employment growth, will be the main client. Research and secretariat support is provided to the Group by DETE.

Rationale for current study

The Government's Climate Action Plan to Tackle Climate Breakdown, published in 2019, sets out the measures through which the magnitude of long-term climate change is to be mitigated through actions to reduce greenhouse gas emissions and decarbonise all sectors of the economy. Some of these measures are further elaborated on in the National Energy & Climate Plan (NECP) and the Long Term Renovation Strategy. By 2030 the Climate Action Plan (CAP) aims to reduce emissions levels by 30% relative to 2005 levels, including through a commitment that 70% of electricity needs will come from renewable sources. In 2018, 33.2% of electricity in Ireland was produced from renewable sources.

The ultimate objective is to achieve a transition to a competitive, low carbon, climate resilient and environmentally sustainable society and economy by 2050. In order to achieve this objective, Ireland will require a change in its overall emissions trajectory of the order of a 2% decline each year from 2021-2030, and a much steeper decline of 7% per annum between 2030 and 2050; this is to be achieved on the basis of a minimum 80% emissions reduction by 2050, relative to 1990.

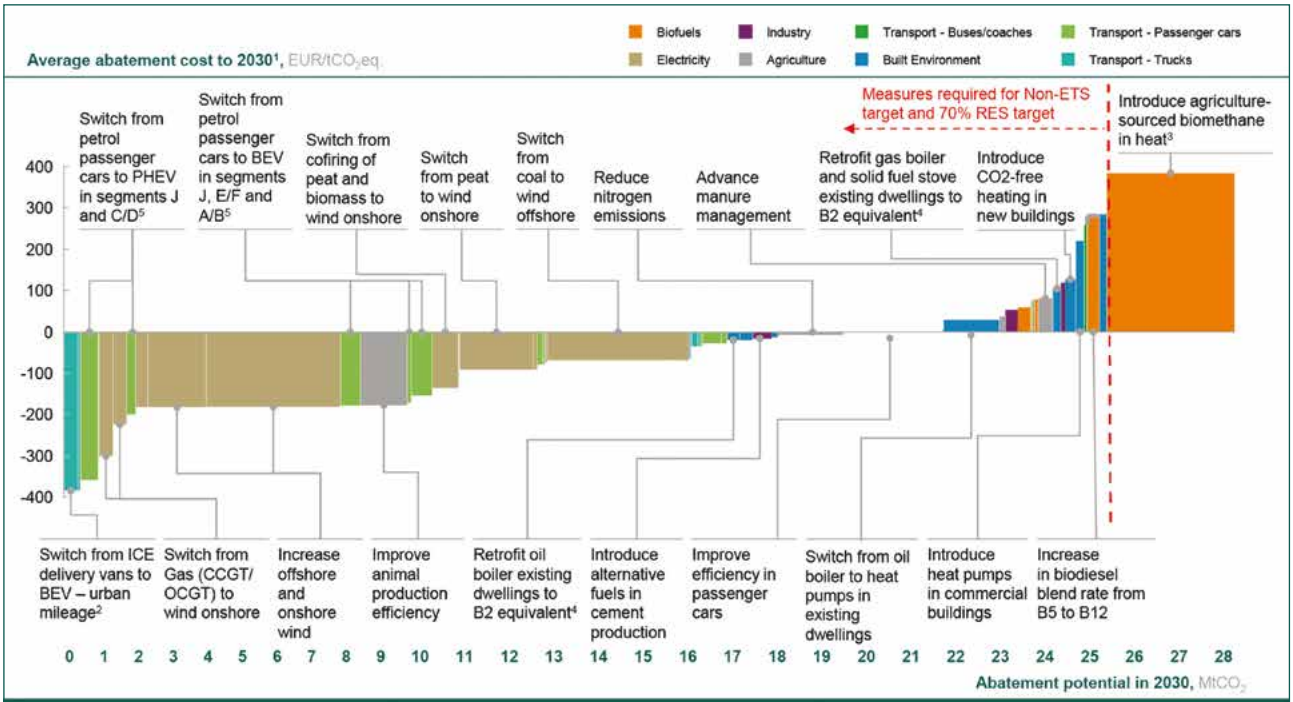
The transition to a low carbon economy will require the transformation of economies, homes, workplaces, enterprises and labour markets, encompassing a focus on sustainability, energy efficiency and renewable energy combined with a major reduction in reliance on fossil-based resources. The Climate Action Plan therefore sets out a number of key measures, which have been recommitted to in the 2020 Programme for Government, which will be integral to emissions reduction and this low carbon transition. These include:

1. **Energy efficient retrofit of buildings and installation of Heat Pumps and other renewable heating options**
   Under the Climate Action Plan and 2020 Programme for Government there is a target to increase the cumulative number of buildings retrofitted to B2 equivalent Building Energy Rating (BER) to c.500,000 by 2030, and through the promotion of widespread adoption of heart pump or other renewable heating options, the installation of c.600,000 renewable energy heating sources in residential buildings, and c.25,000 in commercial premises.[50]
2. **Development of onshore and offshore Wind and Solar power energy generation**
   There are also significant ambitions around the deployment of onshore and offshore wind energy generation, through a switch from gas, peat, biomass and coal-based energy sources. The Plan's target of at least 3.5GW of offshore renewable energy of mainly offshore wind- has subsequently been increased to 5GW in the Programme for Government,51 while an increase of onshore wind capacity of up to 8.2GW is also being targeted. There are also ambitions around solar energy generation, with an ambition to generate up to 1.5GW of grid scale solar energy.

50 There is a need for training of new installers and upskilling of plumbers- in particular to promote the installation of this form of home heating technology over fossil fuel-based boilers, especially outside of grant supported schemes. Liaison with plumber stakeholder bodies will be important to determine how best to engage plumbers on upskilling pathways.

51 For more background on the potential of offshore wind, see the Irish Wind Energy Association's Harnessing our Potential.

3. **Rollout of comprehensive Electric Vehicle fleet and charging infrastructure**
   To support the ambition to increase the number of passenger Electric Vehicles on the road to 840,000 by 2030, as well as 95,000 electric vans and trucks, there is also a need to build a pool of mechanic skills52 and an Electric Vehicle charging network53 to support the growth of EVs at the rate required and develop a fast charging infrastructure that stays ahead of demand and ensures the charging network underpins public confidence. This will be across key locations on the national road network, new and existing non-residential buildings and garage forecourts.



Note: The horizontal axis shows the abatement potential of the technology switches. The vertical axis displays the average abatement cost as EUR/tC02 for each switch. The C02 price of the EU ETS is included in the cost of measures for industry and power and heat

According to a Marginal Abatement Cost Curve (see above)- developed for the Climate Action Plan in order to provide a solid analytical foundation on the most cost-effective pathway to reduce emissions in line with Ireland's decarbonisation targets- these measures represent key non-agricultural elements in any effort to achieve Ireland's 2030 non-Emissions Trading System target and the ambition to meet 70% of electricity needs from renewable sources.

In order to facilitate the reorientation of Ireland's built environment energy efficiency, renewable energy generation capacity and electrification of road transport in the manner required, there will be a need for clear planning by public and private sector stakeholders in order to deliver the nature and scale of skills and expertise across the enterprise base necessary to enable these transitions.[54]

Many of the already identifiable skills associated with these transitions, in areas such as construction, building renovation, environmental services and the renewables sectors, are, however, currently in short supply. The use of clean technology will also require inter-disciplinary skills in engineering, science and business.

52 For EV battery and electrical system repairs and diagnostics.

53 This would include electrician training for EV charger installation and safe integration with other energy systems into the Home, On-Street, Commercial Premises and fast charger type locations.

54 To note- in the Programme for Government there is a commitment to develop a comprehensive Green Further Education and Skills Development Plan, ensuring that learners are equipped with the environmental awareness and green skills that can drive future change.

Study objectives and Methodology

This study aims to be a key input into this planning, by identifying the nature, scale and evolution of the skills required by enterprises to facilitate Ireland's transition to a low carbon economy in the years to 2030. This will permit the undertaking of evidence-based planning by both Government and the broader low carbon economy stakeholder community around the nature and scale of required education and training responses, as well as around other sources of skills supply.

In order to properly support the delivery of these built environment energy efficiency, renewable energy generation and road transport electrification objectives over the coming decade, this study will seek to:

- Identify the nature and quantify the scale of the skills needs of enterprises supporting the transition to a low carbon economy in the coming years. This will include activities related to:
  - Energy efficient retrofit both in Dwellings and Commercial buildings
  - Installation and subsequent servicing of Heat Pumps and other renewable heating systems/options
  - Development and subsequent maintenance of onshore and offshore Wind energy capacity
  - Development and subsequent maintenance of Solar energy capacity
  - Rollout of comprehensive Electric Vehicle fleet and charging network infrastructure
- This will include the development of skills demand forecasts based on a number of assumptions, including the targets set out in Irish Government and EU strategies; and
- Develop a suite of recommendations that can be drawn upon to ensure that the future skills needs of activities supporting the transition to a low carbon economy are fully addressed by stakeholders through the education and training system and any other relevant sources of skills supply.

The methodology of this study will comprise several integrated qualitative and quantitative elements.

A. **Concise Literature Review**
   The focus of this review will be on available international or domestic information and research on the evolving skills needs of the activities supporting the transition to a low carbon economy over the coming decade.

B. **Research exercise conducted through structured interviews and workshops with companies, organisations and stakeholders**[55]
   The aim of this phase of the research, to be undertaken by the successful contractor, will be to:
   - Identify the main trends and drivers that will impact on the nature and demand for skills to support the transition to a low carbon economy over the coming decade, on the numbers employed and their skillsets, competences and qualification requirements;
   - Identify the main trends and drivers that will impact on the supply of these skills over the coming decade, including the nature of employment on offer and the availability of career pathways;
   - Identify any current/anticipated skills and competency gaps that will arise;
   - Consider how enterprises plan to address any such skills gaps, including through further and higher education, upskilling/reskilling, continuing professional development or inward migration;
   - Identify any regulatory changes or alternative mechanisms required to ensure the markets have access to and use labour resources with the skillset required within an acceptable timeframe;[56] and
   - Elicit proposals in relation to the building up of an adequate talent pool of skills in Ireland to support the transition to a low carbon economy

55 Note- aside from key stakeholders, including representative organisations covering the key areas of focus for this study, consumers should also be consulted in order to understand the full spectrum of skills required, in particular those relating to consumer engagement e.g. communication skills.

56 For example, through a review of the regulatory requirements on competency, certification and CPD for certain professions or trades, to identify any gaps and actions required.

This mainly qualitative research element will comprise of:

i. Structured interview surveys with at least 40 enterprises involved in activities that support the transition to a low carbon economy.

ii. Structured interview survey with at least 20 key informants, including sectoral representative organisations.

iii. Discussions with a wider group of enterprises, organisations and key informants at 2 workshops.

C. **Skills demand scenarios for Low Carbon Economy skills related occupations to 2030**
This element will present three possible demand scenario forecasts to 2030- the difference between them illustrating the level of any uncertainty in relation to the realisation of their underlying assumptions, drivers and supporting conditions- for the occupations relevant to enabling the transition to a Low Carbon Economy.
Each scenario will depict credible forecasts based on key drivers and trends, in particular the targets set out in the Climate Action Plan and 2020 Programme for Government, relating to the demand for skills necessary to enable the low carbon economy. There will be one central scenario that is anticipated as most likely to occur.
The 2016 Census employment figures (SOC 2010 occupational codes) for the occupations identified by the successful tenderer as relevant to the analysis will represent the baseline data for each scenario, with input from other data sources relating to 2016-2020 trends (including Labour Force Survey data on occupations from Q3 2017 on).

D. **International Review of Actions by selected countries to develop and attract a supply of talent for activities supporting the transition to a low carbon economy**
This element is to include an assessment of a selected number of countries, which have been identified as good examples or "early adopters" in transitioning to a low carbon economy, and the education and training initiatives that have supported this transition.

E. An assessment of the current supply of skills for the low carbon economy at NFQ levels
This element will be an assessment of the current supply of skills at NFQ levels categorised by those participating on public and private:

   A. Higher Education programmes

   B. Further Education and Training programmes

   C. Continuing professional development programmes

Outputs Expected

A report (80-90 pages- excluding appendices), with an Executive Summary, which will include the following:

- The mapping of identified skills needs against existing/planned programme provision for skills required to deliver on key elements of the Climate Action Plan and relevant targets in the Programme for Government;
- Identification of any current/anticipated gaps in skills provision for delivering key elements of the Climate Action Plan, and the scale and nature of the developmental response(s) required to address any such gap;
- Three demand scenarios outlining how the demand for the identified skills will develop in the years to 2030; and
- Recommendations on any tailored measures to build up the domestic supply of skills required to enable the low carbon economy, including through (a) the third level education and further education systems; (b) upskilling/reskilling, (c) continuing professional development, (d) inward migration, and (e) any other supply. Recommendations made will advise on optimising the use of existing resources- both Government and private sector.

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Appendix IV Glossary of Terms

AIT	Athlone IT (formerly)
ABP	An Bord Pleanála
CAP	Climate Action Plan 2019
CPD	Continuous Professional Development
CSO	Central Statistics Office
BER	Building Energy Rating
DCU	Dublin City University
DECC	Department of Environment, Climate and Communications
DETE	Department of Enterprise, Trade and Employment
DKIT	Dundalk IT
DoT	Department of Transport
EGFSN	Expert Group on Future Skills Needs
EPA	Environmental Protection Agency
ESCO	European Skills/Competences, qualifications and Occupations
ESD	(EU) Effort Sharing Decision
ESR	(EU) Effort Sharing Regulation
ESRI	Economic and Social Research Institute
ETB	Education and Training Board
FET	Further Education and Training
FTE	Full-time Equivalent
GMIT	Galway-Mayo IT
GW	Gigawatt
HEI	Higher Education Institution (universities and institutes of technology)
IGBC	Irish Green Building Council
ILTRS	Ireland's Long-Term Renovation Strategy (2020)
IRENA	International Renewable Energy Agency
ICE	Internal Combustion Engine
IT	Institute of Technology
ITC	IT Carlow
ITS	IT Sligo
LIT	Limerick IT
LYIT	Letterkenny IT
MTU	Munster Technological University
MU	Maynooth University
MW	Megawatt
NDP	National Development Plan
NCMI	National Maritime College of Ireland
NUIG	National University of Ireland Galway
PfG	Programme for Government (2020)
SEAI	Sustainable Energy Authority of Ireland
SOC	Standard Occupational Classification
TCD	Trinity College Dublin
TU Dublin	Technological University of Dublin
UCC	University College Cork
UCD	University College Dublin
UL	University of Limerick
WEI	Wind Energy Ireland
WIT	Waterford Institute of Technology
WWETB	Waterford Wexford Education and Training Board

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Appendix VI Labour Market Analysis Model- Detailed Methodology

This section explains the Labour Market Analysis Model that was developed for this study, and used to forecast labour demand in the energy, transport and retrofit sectors up to 2030. As outlined in Section 6 of the main report, three models were developed for renewable energy, electric vehicles and retrofits based on a common modelling methodology. This four-step process is summarised again below:

1. **Identify and quantify 2021-2030 targets** – Targets for each of the three sectors were identified and quantified based on the Climate Action Plan, Programme for Government and other relevant policy documents. The purpose of this stage was to express targets in common units or activities against which labour demand could be estimated, such as Megawatts of installed capacity, houses retrofitted etc. While this was relatively straightforward for energy, where clear targets of installed capacity have been set in policy, it was necessary to break down the high-level EV and retrofit targets into specific tasks. For instance for domestic retrofits, the annual target for houses retrofitted to a B2 standard was used to estimate the number of specific retrofit tasks that would be required (e.g. number of houses requiring external insulation, attic insulation etc.), based on characteristics of the housing stock and data supplied by the SEAI. For transport, additional policy documents and data were used to estimate the implications of the high-level vehicle target in terms of the number of new charging points required etc., which formed the basis of the tasks subsequent steps.
2. **Identify key occupations** – Once targets and associated tasks were defined, the main occupations typically required to complete these tasks were identified and matched to the Standard Occupational Classification system, as described in Section 3. Occupations involved in the planning, design, construction and operation stages were generally included, while manufacturing and transport occupations were excluded. This is important to note when interpreting the results of the labour market analysis, as it does not measure the total 'employment' supported by the sector, but rather, the demand for labour among the key occupations identified.
3. **Identify labour requirements and estimate labour coefficients** – Once a task/target and the typical occupation(s) required to complete the task were identified, the amount of labour required from that occupation was also estimated. Labour requirements are expressed in terms of 'person-days', which refers to the number of days it takes one person to complete a task: for example, if it typically takes 2 plumbers 3 days to install a heat pump, the labour requirements for that task are 6 person-days.
   Labour data was sourced from a literature review and from stakeholder interviews, according to Table 6.1 below. Given the nature of this data, the labour requirements were generally initially based on representative project sizes, such as the labour requirements for a 50MW onshore wind farm. In order to allow for these estimates to be scaled and modelled, these labour requirements were converted into 'labour coefficients' based on the tasks/targets established in Step 1. For example, if the labour requirements for Civil Engineers on a 50MW wind farm are 500 person-days, then the 'labour coefficient' for Civil Engineers would be 10 person-days per MW.
4. **Estimate Full-time Equivalent demand using labour coefficients and demand scenarios** – The establishment of labour coefficients for each occupation and each task allowed these estimates to be scaled based on different demand scenarios. As with Step 1, scenarios were based first and foremost on Climate Action Plan targets with regards to renewable energy, EVs and retrofits, although specific sectoral

plans were also used where appropriate.

For the overall forecast, the labour demand arising from these targets were converted from person-days to 'Full-Time Equivalents' (FTE), which approximates the number of full-time workers that would be required to meet this labour demand. Each FTE was assumed to be equal to 232 person-days, which (232 days) is based on the standard number of working days in a year, less the statutory holiday entitlement of 20 days (or 8%).

Although each of the three models followed this basic structure, each relies on slightly different assumptions and parameters at different stages. This section describes additional assumptions and processes employed in the Energy and Retrofit Models not detailed in the main report.

A.1 Energy

The energy model focused on labour demand from three key activities: the development and operation of offshore wind, onshore wind and grid-scale solar PV**57**. Demand for each development type is based on a simplified project lifecycle comprised of 5 project phases:

- Planning and Environmental Impact Assessment
- Post-planning project development
- Installation
- Operations (for a 25-year period)
- Decommissioning
- Manufacturing and transport activities were not included within the model.

The model is based around annual delivery targets for offshore wind, onshore wind and grid-scale solar (i.e. the new installed capacity in each year). Once this delivery target has been input, the model forward- and back-casts activities for the different development phases based on assumptions regarding their length and timing, as shown in the table below. For example, if 100 MW of new solar energy is expected to be delivered in 2030, the model would assume construction activities to take place in 2029, project development activities to take place between 2026 and 2028, and planning activities to take place in 2025. This 100 MW of solar would then operate until 2055 before being decommissioned.

Table 7.1: Assumptions regarding typical length of project phases

Project Phase	Offshore	Onshore	Solar
Planning and Environmental Impact Assessment	3-4	3	1
Post-planning project development	2	2	3
Installation	3	2	1
Operation	25	25	25
Decommissioning	1	1	1

While this lifecycle approach provides great flexibility in developing and testing multiple scenarios, it is not without its weaknesses. This typical lifecycle is derived from assumptions outlined in WEI's Building Onshore Wind and Building Offshore Wind reports[58], which itself makes several assumptions regarding certain policy instruments being in place at certain points (e.g. the Marine Planning and Development Management Bill).

57 Domestic solar installation was included in the Retrofit Model rather than the Energy Model

58 WEI (2020a and 2020b)

As these measures have not yet been fully implemented, some of the early offshore wind projects (i.e. those delivered in the 2025-2030 period) tend to have had more protracted planning and project development phases than the model might suggest. As the model concentrates labour demand for these phases over a 3-4 year period, the effect of this is that the labour requirements for certain planning-related occupations (such as ecologists and planners) have been forecasted for earlier than might be the case (i.e. around 2018-2020, rather than 2020-2022). These figures have been provided for this earlier period in the occupational requirements table to provide additional context where this might be the case.

Assumptions regarding the success rates of different projects were also incorporated, as this will affect the required labour in earlier project phases. If for example, it was assumed that only 75 per cent of solar developments are successful in the planning process, in order to actually deliver 100 MW of new solar energy, approximately 133 MW would actually initially need to go through the planning system. This means the workload required in these earlier stages is likely to be greater than the initial target would suggest. Success rates for wind energy are also based on assumptions outlined in WEI's Building Onshore Wind and Building Offshore Wind reports, while solar assumptions are based on figures provided by enterprises and stakeholders involved in the sector.

A.2 Retrofit

When carrying out interviews with enterprises as part the stakeholder engagement, one of the most common refrains with regards to domestic retrofits was that 'no one retrofit is the same', with the tasks carried out varying based on house characteristics and homeowner preferences. When carrying out a retrofit, the contractor will design a programme of works to suit both the house and householders, meaning that the specific tasks carried out are likely to vary significantly from house-to-house. As well as this, the characteristics of each house, such as its age or size, can affect the length of time it takes to complete certain jobs, as well as the labour required.

Despite this diversity, any economic model requires some degree of simplification to allow for estimates to be developed. A methodology was therefore designed to take into account both the diversity of the housing stock, as well as the differences in retrofit jobs carried out.

Housing Typologies

As a result, the high-level retrofit target was broken down into targets based on nine typical housing typologies; chosen to capture the main housing types that are likely to undergo a retrofit. House types were largely based on those identified in the Irish TABULA Project[59], with the SEAI BER Database used to identify those that represent a significant share of the Retrofit Stock[60], as well as defining characteristics. The main characteristics that typically distinguished these house types (and which would influence the types of works required to bring each up to a B2 standard) were:

- Construction period
- Location (i.e. urban/suburban vs. rural)
- Storeys
- Main Heating Fuel
- Wall construction type

59 Badurek et. al. (2014)

60 The 'Retrofit Stock' refers to the subset of the housing stock that currently has an Energy Rating of B3 or worse.

Once these broad housing types were identified, assumptions were made for more detailed characteristics based on the BER Database, as well as other sources such as the Irish National Survey of Housing Quality[61]. These assumptions (referred to as 'Parameters' in the model) mainly relate to physical characteristics like average floor area, wall area, number of rooms, number of windows etc.- factors which can have an impact on length of time and labour required to complete certain retrofit jobs.

Table 7.2 provides details of the nine housing types and their associated parameters.

Table 7.2: Retrofit housing types and assumptions

Characteristics	House Type								
	1	2	3	4	5	6	7	8	9
Location	Rural	Rural	Rural	Rural	Urban	Urban	Urban	Urban	Urban
Type	Detached	Detached	Detached	Detached	Semi-detached[62]	Semi-detached	Semi-detached	Terrace	Terrace
Storeys	2	1	2	2	2	2	2	2	2
Construction period	Pre-1950s	1950-1999	1978-1999	2000-2009	1700-1977	1978-1999	2000-2009	Pre-1950s	1950-1999
Heating	Oil / Solid Fuel	Oil / Solid Fuel	Oil / Solid Fuel	Oil / Solid Fuel	Gas	Gas	Gas	Gas	Gas
Wall type	Solid	Cavity	Cavity	Cavity	Solid	Cavity	Cavity	Solid	Cavity
BER	G	E1	D2	C3	D2	D1	C2	G	D1
Weighted share of retrofit stock	3.7%	13.5%	8.9%	9.1%	15.4%	15.9%	17.6%	5.1%	10.8%
Floor Area (m2)	147	118	175	187	105	100	105	84	84
External Wall Area (m2)	157	100	152	162	95	89	95	59	51
Roof Area (m2)	96	117	122	122	60	54	55	49	49
Habitable Rooms	7	7	7	8	6	6	6	5	5
Windows	11	12	16	16	10	9	8	6	7

61 ESRI (2001/2002)

62 Types 5-7 also include end-of-terrace houses with similar characteristics.

Retrofit Requirements and Plans

For each house type, a typical Retrofit Plan was also used to specify the works that would be carried out. Works were divided into three types of works: 'core retrofit works', 'householder preference works', and 'cosmetic and repair'.

Core retrofit works refer to the mandatory works required to achieve a B2 standard, including:

- Wall Insulation (Cavity, External, Internal)
- Attic Insulation
- Floor Insulation
- Airtightness works
- Windows and doors
- Heat Pumps
- Ventilation
- Energy-efficient lighting

The requirements of each house type for each job type were estimated generally using proxies contained in the SEAI BER Database, such as U Value data and other housing parameters. These upgrade thresholds were also based on the 'Advanced Level' upgrade standards contained in the Irish TABULA Project.

Table 7.3 shows the basic decision tree that was used to identify the proportion of each house type requiring certain retrofit works, including the 'Housing Requirement', which was used to identify the proportion of each house type requiring each job; and the 'Housing Parameters' that were used to adjust labour estimates between different house types. For example, the proportion of each house type requiring Attic Insulation was estimated based on the proportion whose Roof U Value is below threshold, while the person-days estimates for doing this job was varied according to the Roof size in each house.

Table 7.3: Decision tree for retrofit plans

Job	Housing Requirement	Housing Parameter
Attic Insulation	Roof U Value below threshold	Roof Area (m2)
Underfloor Insulation	Suspended Wood Floors (Unsealed)	Ground Floor Area (m2)
Wall Insulation	Wall U Value below threshold	Wall Area (m2)
Cavity Insulation	Unfilled Cavity Walls	
External Insulation	Solid Wall or filled Cavity Walls, Semi-detached or detached	
Internal Insulation	Solid Wall or filled Cavity Walls, Terraced pre-1950s house	
Windows and Doors	Window U Value below threshold	No. of windows
Heat Pump	80% of all houses (target)	Floor Area (m2)
Ventilation	Houses getting insulation upgrades	No. of Habitable Rooms
Energy-efficient lighting / Rewiring	Houses with <50% energy-efficient lighting	Floor Area (m2)

Householder preference works are a subset of core retrofit works, and refer to more intensive energy efficiency improvements that, while not necessarily required to achieve a B2 rating or to avail of SEAI supports, are often chosen by homeowners to improve the performance, comfort or efficiency of their new systems. This includes the installation of underfloor heating, Mechanical Heat Recovery Ventilation systems, and Solar PV systems. The rates for these works were estimated based on uptake rates derived from SEAI grant data.

Finally, Cosmetic and repair works refer to the jobs necessary to return the house to a habitable condition following a Deep Retrofit, such as painting, plastering, and the replacement of floors and skirting boards. While acknowledging that these works are not considered to be part of a 'Deep Retrofit' for policy and grant purposes, they are often still necessary from the perspective of the homeowner, and should be considered as part of the labour requirements of a retrofit.

To attempt to draw a line under cosmetic and repair works that are considered to be 'necessary' as part of a Retrofit, these were generally linked to the uptake of Core Retrofit Works. Certain works were considered to represent 'trigger points' for necessary cosmetic works (e.g. if a house gets internal insulation, this will introduce a requirement to plaster and paint afterwards), which were used to estimate the rates of Cosmetic and Repair works in each house. While the purpose of this was to avoid overestimating the 'necessary' cosmetic and repair works, there is also a potential that this underestimates the true labour demand from these works; as householders undertake additional works due to their own preferences.

Labour Requirements

For each job type, the types and quantity of occupations required was estimated based on several sources:

Interviews with enterprises involved in the sector were the primary source of data for labour requirements. In each interview, enterprises were asked about the labour requirements (in person-days) for different jobs they carry out, as well as details regarding the occupations and types of houses they are carried out on. This was the primary source of data with regards to Insulation, Heat Pumps, Ventilation and Solar PV.

Quantity surveying data from the 'RSMeans Cost Data'[63] manual was the primary basis of estimates for most cosmetic and repair works, such as plastering, painting, and skirting.

These estimates were supplemented and sense-checked against other publicly-available sources, such as product manuals, company websites and video demonstrations, and cost-comparison websites.

Where estimates were based on a certain house type, this was noted. Labour Requirements were generally adjusted across the different house types based on the Housing Parameters, such as footprint, wall area, number of rooms etc.

It should be noted that retrofit requirements are based on estimates of the number of person-days required to complete specific modelled tasks, and generally do not include other supporting roles, such as administration or marketing. There may also be inefficiencies or underutilisation that are not taken into account, such as labour lost due to travel to sites, although some of the person-day estimates provided by enterprises do factor this in. However, it is also likely that as retrofit activity scales up in the coming years, a more equal geographic distribution of retrofit enterprises and economies of scale by combining multiple retrofit jobs may reduce some of these potential inefficiencies.

63 RSMeans (2012).

Appendix VII Labour Supply Data

A.3 Higher Education Institutions (HEI)

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Athlone Institute of Technology	Construction Management		7	
	Construction Management	1	8	PT
	Civil Engineering	1	6	FT
	Civil Engineering	2	6	FT
	Civil Engineering	3 years	7	FT
	Civil Engineering	Add-on Yr 1	8	FT
	Civil Engineering	Add-on Yr 2	8	FT
	Energy and Business Management	1	8	FT
	Master of Science in Environmental, Health and Safety Management	2 (P/T)	9	Part time (2 evenings per week with some Saturdays); completely online
	BSc in Environmental Health and Safety Management	2 (P/T)	7 (AIT hope to offer level 8 soon)	Part time (2 evenings per week with some Saturdays); predominantly face to face- small number of modules delivered online
	HDip in BIM for Civil Engineering and Construction	1	8	PT
	Manufacturing Technology		8	
	Mechanical Engineering Higher Certificate	2 years	6	FT
	Bachelor of Engineering (Honours) in Mechanical and Polymer Engineering	4 years	8	FT
	Mechanical Engineering BEng	3 years	7	FT
	Mechanical Engineering BEng (Hons) (one year add on L8 programme)	1 year	8	FT
	Mechanical Engineering and Renewable Energy	3 years	7	FT
	Quantity Surveying	1	8	FT
	SPA Construction Management	1	8	PT
Dublin Business School	Advanced Diploma in Project Management	14 weeks / (42 contact hours)	N/A	PT, onsite
	Diploma in Project Management	14 weeks + 1 Saturday (49 contact hours)	N/A	PT, onsite
	Higher Diploma in Business in Project Management	2 semesters of 12 weeks each	8	FT/PT Multimodal blended delivery of synchronous and asynchronous modes
	Online Diploma in Project Management	12 weeks (24 contact hours)	N/A	PT, online

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Dublin Business School	BA (Hons) in Business with elective pathway in Project Management	3yrs FT: 6 semesters of 12 weeks each 4years PT: 8 semesters of 12 weeks each	8	FT/PT, onsite* This programme was validated in 2019 for onsite delivery. However, DBS is working towards a blended learning environment and is actively incorporating a blend of learning modes which incorporate asynchronous, synchronous online and onsite teaching, learning delivery modes.
	MBA with elective pathway in Project Management	1yr FT: 3semesters of 12 weeks each 2years PT: 5 semesters of 12 weeks each	9	FT/PT, onsite* This programme was validated in 2019 for onsite delivery. However, DBS is working towards a blended learning environment and is actively incorporating a blend of learning modes which incorporate asynchronous, synchronous online and onsite teaching, learning delivery modes.
Dublin City University	BSc in Global Challenges	4 years	8	FT (blended delivery- with minimum 15% online delivery)
	Electronic and Computer Engineering		8	FT
	Electronic and Computer Engineering (Graduate Certificate)		9	
	Engineering Analysis and Technologies (Higher Diploma)		8	FT
	Environmental Science and Technology	4 years (incl work placement)	8	FT
	Mechanical and Manufacturing Engineering		8	FT
	Mechatronic Engineering		8	FT
	MEng in Electronic and Computer Engineering		9	FT/PT
	MEng in Mechanical and Manufacturing Engineering		9	FT/PT
	MSc in Climate Change: Policy, Media and Society	1 year FT or 2 years PT	9	FT/PT
	MSc in Electronic and Computer Technology		9	FT/PT
	Sustainable Systems and Energy		8	FT
	Sustainable Energy Systems (Graduate Diploma)		9	FT
Dundalk Institute of Technology	Applied Electrical Engineering (Certificate)		6	PT
	Architectural Technology		7	FT
	Architectural Technology		8	FT
	Bio-energy (Certificate)		9	PT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Dundalk Institute of Technology	Bio-energy (Diploma)		9	
	Building Energy Management (Certificate)		6	PT
	Building Information Modelling (using Autodesk Revit)			PT
	Building Surveying		7	FT
	Building Surveying		8	FT
	Building Surveying		9	FT/PT
	Building Surveying (Diploma)		9	
	Civil Engineering		7	FT
	Civil Engineering		8	FT
	Civil Engineering Add On		8	FT/PT
	Construction Management		7	FT
	Construction Management		8	FT
	Construction Project Management		8	PT
	Digital Design and Fabrication (Certificate)		6	PT
	Engineering Entrepreneurship		8	FT
	Electrical and Electronic Engineering		8	FT
	Electrical and Electronic Systems		7	FT
	Certificate in Health and Safety (Manufacturing Industry) Springboard funded 2020-21, application for funding 2021-22	One academic year	6	PT-Blended – This is a predominately on-line programme with classes delivered on 2 evenings per week, in addition, students are required to attend for face to face classes (in either the DkIT campus or in an outreach centre) 09.00hrs to 16.00hrs 2 days per semester.
	Heat Pump Installer		6	PT
	Mechanical Engineering		7	FT
	Mechanical Engineering		8	FT
	Ocean Energy (Certificate)		9	PT
	Renewable Energy (Certificate)		6	PT
	Renewable Energy Systems		9	
	Solar Energy (Certificate)		9	PT
	Solar Energy (Diploma)		9	FT
	Welding for Beginners			PT
	Wind Energy (Certificate)		9	PT
	Wind Energy (Diploma)		9	FT
Galway Mayo Institute of Technology	Architectural Technology	3 years	7	FT
	Architectural Technology	4 years	8	FT
	Building Information Modelling (Higher Diploma)	1/ 2 years	8	PT
	Civil Engineering	3 years	7	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Galway Mayo Institute of Technology	Civil Engineering	4 years	8	FT
	Climate Resilience for Business	1 year (Jan to Dec)	8 (35 ECTS)	PT online/blended certificate (fully online since March 2020)
	Construction Management	3 years	7	FT
	Construction Management	4 years	8	FT
	Energy Engineering	3 years	7	FT
	Energy Engineering	4 years	8	FT
	Industrial Automation	1 year	7	PT
	Industrial Engineering	1 year add on	8	PT
	Manufacturing Engineering	1 year	7	PT
	Manufacturing Engineering Design	4 years	8	FT
	Mechanical Engineering	3 years	7	FT
	Mechanical Engineering	4 years	8	FT
	Quantity Surveying and Construction Economics	3 years	7	FT
	Quantity Surveying and Construction Economics	4 years	8	FT
	Software and Electronic Engineering	4 years	8	FT
	Sustainable Building Technology (Certificate)	1 year	8	PT
Griffith College Dublin	BIM (using Revit) Introduction			PT
	Building Information Modelling and Graphic Illustration (Certificate)	1 semester	8	PT
	Industrial Engineering (Online)	1 year	7	PT
	Manufacturing Engineering (Higher National Certificate)	1 Year	6	PT
	Manufacturing Engineering (Higher National Diploma)			PT
	Prince2- Foundation			PT
	Prince2- Practitioner			PT
	Project Management- Diploma			PT
	Retrofit, Conservation and Sustainability (Special Purpose Diploma)	2 semesters	8	PT
Institute of Technology Carlow	Architectural Technology		7	F/T
	Architectural Technology		8	F/T
	BIM Management (Certificate)	1 semester	9	PT
	BIM and Construction Project Management (Certificate)	1 semester	9	PT
	Building Control Management (Certificate)		7	
	Civil Engineering		7	F/T
	Civil Engineering		8	F/T
	Construction (common entry)		8	F/T
	Construction Administration (Certificate)		6	
	Construction- Facilities and Building Services Management		8	F/T
	Construction Management with Building Services		7	F/T

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Institute of Technology Carlow	Electrical Principles (Certificate)		6	PT
	Electronic Engineering		7	
	Electronic Engineering		8	
	Energy Management (Buildings)		7	PT
	Energy Sustainability		7	PT
	Health, Safety and Environmental Management		7	PT
	Health and Safety at Work (Diploma)		7	PT
	Health, Safety and Environmental Management MSc (forthcoming) Also application made for Springboard funding		9	PT
	Introduction to BIM for Construction		6	
	Management in the Built Environment		9	FT
	Mechanical Engineering		7	PT
	Mechanical Engineering	3 years	7	FT
	Mechanical Engineering		8	PT
	Mechanical Engineering	4 years	8	FT
	Project Management and Communications (Certificate)			PT
	Quantity Surveying		8	F/T
Institute of Technology Sligo	Advanced Wood and Sustainable Building Technology		7	Fulltime
	Applied Construction Technology (Higher Certificate)		6	Fulltime
	Architecture		8	Fulltime
	Automation and Instrumentation (Certificate) (Online)		6	PT
	Automotive Artificial Intelligence (Certificate)		9	PT
	BIM and Lean Construction Management- Certificate (Online)		9	Part-time
	Certificate, PG Diploma and MSc in Sustainable Enterprise	1 year	9	PT (online) with UCC and NUI Maynooth, funded by HCI Pillar 3
	Certificate, PG Diploma and MSc in Water Service Management	1-3 years	9	PT (online) most students funded by Irish Water and Local Authorities
	Certificate in Waste Management	1 semester	6	PT (online) funded by LA WERLA
	Civil Engineering		8	Fulltime
	Civil Engineering (Higher Certificate)		6	Fulltime
	Connected and Autonomous Vehicles (Diploma)		9	FT/PT
	Construction Economics- Higher Certificate (offline)		6	Fulltime
	Construction Economics- Higher Certificate (online)		6	Part-time
	Construction Law Procurement and Finance- Certificate (Online)		9	Part-time
	Construction Management- Online (with CIF)		7	Part-time

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Institute of Technology Sligo	Construction Project Management		8	Part-time
	MSc in Project Management		9	Part-time
	Construction Project Management and Applied Technology		8	Fulltime
	Construction Site Management (Certificate in Science)		7	PT
	Digital Construction Technology (Certificate in Science)		7	PT
	Electronics and Automation (Certificate) (Online)		6	PT
	Electronic and Computer Engineering (Campus/ Online)		7	FT
	Electronic and Computer Engineering		8	FT
	Electronics and Self Driving Technologies		8	FT
	Engineering- Civil Engineering		7	Fulltime
	Engineering (Higher Certificate)		6	FT
	Engineering		7	FT
	Environmental Health and Safety Management (Online)	2 years	9	PT (online)
	Environmental Management (Online)	2 years	8	PT (online)
	Environmental Protection (Online) (Diploma)	2 years	9	PT (online)
	Environmental Protection	3 years	7	FT
	MSc in Environmental Protection (Add on) (Online)	3 years	9	PT (online)
	Environmental Science	4 years	8	FT
	Environmental Science with Ecology	2 years	6	FT
	Environmental Science with Ecology	3 years	7	FT
	Environmental Science with Ecology	4 years	8	FT
	Geotechnical/Structural Engineering Joint Programme		9	PT
	Geotechnical Engineering with Structural Engineering		9	FT
	Geotechnical and Structural Engineering (Certificate)		9	PT
	Mechanical and Electrical Quantity Surveying (Certificate)		9	Part-time
	Mechanical Analysis and Automation (Certificate) (Online)		6	PT
	Mechanical Engineering		7	FT
	Mechanical Engineering		8	FT
	Mechatronics (Online)		7	PT
	Mechatronics (Online)		8	PT
	Mechatronics		8	FT
	Mechatronic Systems		7	FT
	Occupational Safety and Health (Higher Certificate)	2 years	6	PT (online)
	Occupational Safety and Health (Certificate)	1 semester	6	PT (online)

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Institute of Technology Sligo	Occupational Safety and Health Management	2 years	7	PT (online)
	Occupational Safety and Health Management	2 years	8	PT (online)
	Occupational Safety and Health	3 years	7	FT
	Occupational Safety and Health	4 years	8	FT
	Precision Engineering and Design (Campus/Online)		7	PT
	Project Management (Diploma) (Online)		9	PT
	Quantity Surveying		7	Fulltime
	Quantity Surveying (Online)		7	Part-time
	Quantity Surveying (Offline/Online)		8	Fulltime
	Quantity Surveying (Offline/Online)		8	Part-time
	Road Maintenance Engineering and Network Management- Postgraduate Certificate (Online)		9	Part-time
	Engineering in Road and Transport Engineering (Postgraduate Diploma)		9	Part-time
	Master of Eng in Road and Transport Engineering		9	Part-time
	Sensors for Autonomous Vehicles (Certificate) (Online)		9	PT
	Strategic Construction Management- Certificate (offline/online)		9	Part-time
	Structural Engineering with Geotechnical Engineering		9	FT
	Water and Wastewater Operations (Certificate in Science) (Online)		6	PT
	Waste Water Treatment Operations (Certificate)		6	PT
Letterkenny Institute of Technology	Applied Fire Safety Management		7	Blended -postponed due to Covid 19
	BSc Architectural Technology		7	Full Time/Part Time
	BSc (Hons) Architectural Technology		8	Full Time
	BIM 4D- Navisworks (Certificate)		7	Part Time
	BIM- Revit (Certificate)		6	Part Time
	Certificate in Revit and 4D BIM The two part-time courses above have been combined into a new course for Springboard+		7	Part Time
	Building Services and Renewable Energy		7	Full Time/Part Time
	Civil Engineering HCI funding applied for 2020		7	Full Time/Part Time
	Construction Contracts Management		8	Full Time/Part Time
	Electronic Engineering BEng	3 years	7	FT
	Electronics BEng (Hons)	4 years	8	FT
	Embedded Systems BEng (Hons)	1 year add on	8	FT
	Introductory Construction Economics and Land Surveying		6	Part Time
	BSc (Hons) Construction Management		8	Full Time/Part Time

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Letterkenny Institute of Technology	BEng (Hons) Fire Safety Engineering		8	Full Time/Part Time
	BSc (Hons) Fire Safety Engineering		8	Full Time/Part Time
	Mechanical Engineering BEng	3 years	7	FT
	Mechanical Engineering BEng (Hons)	4 years	8	FT
	Mechanical Engineering BEng (Hons)	1 year add on	8	FT
	Quantity Surveying		7	Full Time/Part Time
	Quantity Surveying		8	Full Time/Part Time
	Renewable Energy and Physics Fundamentals		6	Part Time
Limerick Institute of Technology	Architectural Technology	4 years	8	Full Time
	Automobile Technology- Higher Certificate	2 years	6	FT
	Automotive Engineering and Transport Management BEng	4	8	FT
	Building Information Modelling- BIM with REVIT MEP- Classroom/Online	15 weeks 10 ECTS	6	Part Time
	Built Environment- Common Entry FT programmes	1 year	8	Full Time
	Civil Engineering	2/3 years	6 and 7	Full Time
	Civil Engineering Management	4 years	8	Full Time
	Construction Health and Safety	One year add on	7	Part Time
	Construction Management	4 years	8	FT
	Construction Project Management (Online)	15 week 10 ECTS	6	PT
	Electrical Engineering BEng	3 years	7	FT
	Electrical Engineering BEng	4 years	8	FT
	Electrical Systems for Mechanical Personnel	15 weeks	N/A	PT
	Electronic Engineering BEng	3 years	7	FT
	Electronic Engineering	4 years	8	FT
	Environmental Science		7	FT
	Environmental Science and Climate		8	FT
	Industrial Automation and Robotic Systems BEng	3 years	7	FT
	Industrial Automation and Robotic Systems	4 years	8	FT
	Mechanical Engineering BEng	3 years	6 and 7	FT
	Mechanical Engineering BEng	4 years	8	FT
	Mechanical Engineering (Facilities)			
	Near Zero Energy Buildings (Certificate) (Online)	10 ECTS	6	PT
	Occupational Health and Safety (Certificate) (Online)	15 weeks	N/A	PT
	Precision Engineering BEng	2/3 years	6 and 7	FT
	Precision Engineering BEng	4 years	8	FT
	Process and Engineering Management	1 year	8	FT
	Process and Engineering Management (Online)	2 years	9	PT
	Property Valuation and Management	4 years	6 and 8	FT
	Quality Management (Certificate) (Online)	30 weeks	9	Online

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Limerick Institute of Technology	Quantity Surveying	4 years	8	FT
	Quantity Surveying MSc	1 year	9	FT
	Renewable and Electrical Energy Engineering BEng	4 years	7 and 8	FT
	Road Transport Technology and Management BEng (Automobile Technology and Automotive taken in Year 2) (Engineering and Technology Management taken in Year 3)	4 years	6, 7 and 8	FT
Munster Technological University	Advanced Manufacturing Technology (BEng Hons)	+1 yr following Cognate L7	8	FT and PT over 2 years
	Applied Building Information Modelling and Digital AEC (Postgrad Diploma)	1 year	9	PT (Online)
	Applied Building Information Modelling and Management (Certificate)	8 months	8	PT (Online)
	Architectural Technology		7	Full Time
	Architectural Technology		8	Full Time
	Architecture		8	Full Time
	Architecture (MArch)		9	Full Time
	Automation and Control Systems	1 year	7	PT
	Automotive Business Management and Technology	4 years	8	FT
	Automotive Manufacturing Engineering	2 years part time	8	PT
	Automotive Technology and Management	3 years	7	FT
	Bioeconomy with Business (Graduate Diploma)	1 year part time	9	PT
	Building Information Modelling and Digital AEC (MSc)	1 year	9	PT (Online)
	Building Information Modelling and Management (BSc)	2 years	8	Part Time
	Building Information Modelling- BIM with Revit		6	Online part time Springboard
	Building Information Modelling Technologies (Certificate)	4 months	7	Part Time (Online)
	Building Regulatory Engineering (Short course)		8	Part Time
	Certified Manufacturing Engineer	1 year	6	PT
	Certificate in Intelligent Manufacturing Systems	1 year	9	PT
	Civil Engineering		7	Full Time
	Civil Engineering		8	Full time CAO
	Civil Engineering (Environment and Energy) (MEng) (Full and Part Time)		9	Part Time
	Civil and Environmental Engineering		7	Full time CAO
	Construction (Higher Certificate)		6	Included under next row
	Construction (Common Entry)		7	Full Time
	Construction Management		7	Full time CAO
	Construction Management		8	Full time CAO

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Munster Technological University	Construction Project Management MSc		9	N/A
	Digital Land Surveying and GPS (short course)		7	Part Time
	Electrical Engineering	3 years	7	FT
	Electrical Engineering	4 years	8	FT
	Electronic Engineering BEng	3 years	7	FT
	Electronic Engineering BEng (Hons)	4 years	8	FT
	Engineering (Common Entry)		8	Full Time
	Engineering Services Management (post-2016 apprenticeship in association with CIF led consortium)		7	Part Time
	Environmental Engineering		7	Full Time
	Environmental Science and Sustainable Technology	4 years	8	FT
	Engineering- Sustainable Energy Engineering		8	Full Time
	Fire Safety Certification (short course)		8	N/A
	Fire Safety Engineering (short course)		8	Part Time
	Industrial Instrumentation and Automation (Certificate)	1 year part time	6	PT
	Industrial Physics	4 years	8	FT
	Interior Architecture		7	Full Time
	Interior Architecture		8	Full Time
	Mechanical and Automation Engineering		7	FT
	Mechanical and Electrical Quantity Surveying	Cert	8	Part Time
	Mechanical, Electrical and Plumbing- BIM applications		7	Part Time
	Mechanical Engineering	3 yrs	7	FT – 3 years PT – 3rd year of programme on a 2 yr cycle
	Mechanical Engineering	4 yrs	8	FT
	Mechanical Engineering Integrated Masters	+2 yrs	9	FT
	Mechanical Engineering Science (Bridging programme minor award 20 credits to prepare mature learners to enter mechanical L7 3rd year on a PT basis indicated above. 50% of the credits are maths based)	1 yr	6	PT
	Mechatronics	1 year	7	PT
	Practical Land Surveying (short course)		7	Part Time
	Process Plant Technology BEng Hons	+1 yr following cognate L7	8	PT over 2 years FT 1 year
	Project Management (Diploma) Special Purpose Award	5 months	8	PT
	Quantity Surveying		7	Full Time
	Quantity Surveying		8	Full Time

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Munster Technological University	Scada and Automation Systems Certificate	1 semester	7	PT
	Strategic Building Information Modelling Management (Certificate)	4 months	8	PT (Online)
	Structural Engineering (Full and Part Time)		8	Full Time
	Structural Engineering (MEng) (Full and Part Time)		9	Full and Part Time
	Technical Architecture (Taught Masters and Masters by Research)		9	N/A
National Maritime College of Ireland	Bachelor of Science in Nautical Science	3.5 years	7	Fulltime
	Bachelor of Science in Nautical Science (Hons) (1 year programme for Chief Mates and Masters)	1 year	8	Fulltime
	Bachelor of Engineering in Marine Engineering	4	7	Fulltime
	Bachelor of Engineering in Marine Electrotechnology	3	7	Fulltime
	BBus Global Supply Chain New 1 year CPD programme for existing supply chain professionals who wish to upskill. NMCI working to incorporate renewables elements into programme from Autumn 2021	1 year	8	Part time. Blended
	BBus Supply Chain Management 1 year CPD programme for existing supply chain professionals who wish to upskill- NMCI working to incorporate offshore renewables elements into programme from Autumn 2021 STCWII/1 Officer in Charge of Navigational Watch STCWII/2 Master and Chief Mate STCWIII/1 Officer in charge of Engineering Watch STCWIII/2 Chief Engineer and Second Engineer STCWIII/6 Electro Technical Officers	1 year	7	Part time. Blended
NUI Galway	Biodiversity and Land Use Planning MSc	2 years	9	PT Blended (Online/in person)
	Civil Engineering		8	Full Time
	Civil Engineering (ME)		9	Full Time
	Corporate Environmental Planning (Specialist Diploma)	1 year	8	PT (usually blended, online due to Covid)
	Corporate Environmental Planning (elective stream of BSc Science and Technology)	1 year	8	PT (usually blended, online due to Covid)
	Earth and Ocean Sciences Focussed on producing geoscience graduates who can work in challenging and changing environments. Recent graduates working in wind energy, groundwater management, resource exploration, carbon sequestration, geothermal energy and science communication.	4 years	8	FT Online/blended since March 2020 Graduates suited to meeting needs in relation to energy (site suitability work, geothermal modelling and planning), critical elements (batteries needed to power electric fleet), water resources (surface water, groundwater, coastal and estuarine water) and mitigation of climatic impacts).

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
NUI Galway	Electrical and Electronic Engineering (BEng, MEng)		8/9	FT
	Electrical and Electronic Engineering ME		9	FT
	Electronic and Computer Engineering (BEng and MEng)		8/9	FT
	Electronic and Computer Engineering ME		9	FT
	Energy Management CPD	1 semester (4 months)	8	CPD (usually blended, online due to Covid)
	Energy Systems (BEng and MEng)	4 years	8	FT, on campus and 8 month paid work placement
	Energy Systems Engineering ME	1 year	9	FT, on campus
	Environmental Awareness and Corporate Social Responsibility	2 semesters (4 months)	8	CPD (usually blended, online due to Covid)
	Environmental Health and Safety	4 years	8	Full time
	Environmental Leadership MSc	1 year	9	FT
	Environmental Legislation and Compliance	1 semester (4 months)	8	CPD (usually blended, online due to Covid)
	Environmental Management for Organisations	1 semester (4 months)	8	CPD (usually blended, online due to Covid)
	Environmental Science CPD	2 semesters (4 months)	8	CPD (usually blended, online due to Covid)
	Environmental Science (BSc)	4 years	8	FT
	Global Environmental Economics MSc	1 year FT 2 years PT	9	FT/PT
	Introduction to Environmental Science	2 semesters (4 months)	7	CPD (usually blended, online due to Covid)
	The Lean Organisation and Technology CPD	1 semester (4 months)	8	CPD (usually bended, online due to Covid)
	Lifecycle Assessment and Design for Environment	2 semesters (4 months)	8	CPD (usually blended, online due to Covid)
	Marine Science	4 years	8	FT
	Mechanical Engineering (BEng and MEng)	4/5 years	8/9	FT
	Mechanical Engineering ME	1 year	9	FT
	Mechanical Engineering MSc	1 year	9	FT
	Occupational and Environmental Health and Safety- MSc and HDip	1 year FT 2 years PT	9	FT/PT- On campus delivery (delivered primarily online as emergency measure in 2020/21, due to Covid-19)
	BSc Physics (with options in Applied, Climate*, Biomedical, Theoretical & Astrophysics)	4 years	8	Full time *Applied Climate Module introduced September 2021
	Project and Construction Management		8	Full Time
	Sustainable Environments MSc	1 year	9	FT
	Sustainable Resource Management: Policy and Practice- Inter-Institutional Programme (MSc)	1 year	9	FT
	Waste Management and Compliance	2 semesters (4 months)	8	CPD (usually blended, online due to Covid)
	Water Management and Conservation	2 semesters (4 months)	8	CPD (usually blended, online due to Covid)

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
NUI Maynooth	Biological and Geographical Sciences	4 years	8	FT
	Climate Change MSc	1 year	9	FT- though flexible delivery, most students working. Traditionally offline but will likely persist with good bits from teaching online this past year.
	Electronic Engineering BE (students specialise in Electronic Engineering with Computers, Electronic Engineering (EEG) or Electronic Engineering with Communications (COM) in Year 4)	4 years	8	FT
	Electronic Engineering ME	1 year	9	FT
	Electronic Engineering (Embedded and Wireless Systems) MEng	1 year	9	FT
	BSc Robotics and Intelligent Devices	4 years	8	FT
TU Dublin	Applied Building Information Modelling and Management	3 years	9	PT
	Applied Computing for Technologists MSc	1 year	9	FT
	Architectural Practice Diploma (SPA)	1 year	9	PT
	Architectural Technology	4 years	8	FT
	Architecture (Bachelor)	5 years	8	FT
	Architecture MArch	1 year	9	FT
	Architecture MArch	2 years	9	PT
	Architecture CPD PG Certs	1 year	9	PT
	Automation Engineering (Bachelor Engineering Tec (Ord)	3 years	7	FT
	Automation Engineering (Bachelor Engineering Tec (Ord)	3 years	7	FT
	Automation Engineering (Bachelor Engineering Tec (Ord)	3 years	7	Distance Education
	Automotive Management and Technology (Bachelor Engineering Tec (Ord)	3 years	7	FT
	Bachelor of Engineering Technology (Ord)	2 years	7	PT
	Bachelor of Engineering Tec (Ord) Engineering (General Entry)	1 year	7	FT
	Bachelor of Engineering (Common Entry)	1 year	7	FT
	Bachelor of Engineering (Hons) (Common First Year)	1 year	8	FT
	Bachelor of Engineering (Hons) (Common Entry)	1 year	8	FT
	BIM (Digital Construction) BSc (Hons)	1 year	8	PT
	BIM Technologies Postgraduate Certificate	1 year	9	PT
	Building Engineering (Higher Certificate)	3 years	6	PT
	Building Engineering (Higher Certificate)	3 years	6	FT
	Building Engineering		7	FT/PT
	Building Engineering		8	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
TU Dublin	Building Performance (Energy Efficiency in Design)- Postgraduate Certificate	1 year	9	PT
	Building Performance (Energy Efficiency in Design)- PG Diploma	2 years	9	PT
	Building Services Engineering Higher Certificate	3 years	6	PT
	Building Services Engineering Bachelor Engineering Tec (Ord)	3 years	7	FT
	Building Services Engineering BEng (Hons)	4 years	8	FT
	Building Management (Maintenance and Conservation) Higher Certificate	2 years	6	PT
	Civil Engineering BEng Tec (Ord)	3 years	7	FT
	Civil Engineering BEng Tec (Ord)	5 years	7	PT
	Civil Engineering BEng (Hons)	2 years	8	FT
	Computer Engineering in Mobile Systems BEng (Hons)	4 years	8	FT
	Computer Engineering in Mobile Systems BEng (Hons)	1 year	8	FT
	Construction informatics (IT) MSc	3 years	9	PT
	Construction (Management) BSc (Hons)	4 years	8	FT
	Construction Site Management Bachelor of Technology (Ord)	3 years	7	PT
	Construction Technology Bachelor of Technology (Ord)	1	7	PT
	Control and Automation Systems BEng Tec (Ord)	3 years	7	FT
	Data Centre Operations Certificate (SPA)	1 year	6	eLearning
	Data Centre Operations and Management	2 years	7	eLearning
	Design, Technology and Innovation BSc	3 years	7	FT
	Electrical/Electronic Engineering Bachelor of Engineering (Hons)	4	8	FT
	Electrical/Control/Communications/Computer Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Electrical and Control Engineering		7	FT
	Electrical and Electronic/Computer and Communications Engineering		8	FT
	Electrical Energy Systems MEng	1 year	9	FT
	Electrical Energy Systems MEng	3 years	9	PT
	Electrical Services and Energy Management Bachelor of Science (Hons)	4 years	8	FT
	Electrical Services and Energy Management Bachelor of Science (Hons)	1 year	8	FT
	Electrical Services and Energy Management Bachelor of Science (Hons)	2 years	8	PT
	Electrical Services Engineering Higher Certificate	3 years	6	PT
	Electrical Services Engineering Bachelor Engineering Tec (Ord)	3 years	7	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
TU Dublin	Electrical Services Engineering Bachelor Engineering Tec (Ord)	2 years	7	PT
	Electronics and Communications Engineering		7	FT
	Electronics and Communications Engineering		9	FT
	Electronic Design Engineering		7	PT
	Electronic Engineering Higher Certificate in Engineering	2 years	6	FT
	Electronic Engineering Higher Certificate in Engineering	2 years	6	PT
	Electronic Engineering Bachelor of Engineering	1 year	7	FT
	Electronic Engineering Bachelor of Engineering	3 years	7	FT
	Electronic Engineering Bachelor of Engineering	1 year	7	PT
	Electronic Engineering Bachelor of Engineering (Hons)	1 year	8	FT
	Electronic Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Electronic Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Electronic Engineering Bachelor of Engineering (Hons)	1 year	8	PT
	Electronic Engineering Bachelor of Engineering (Hons)	4 years	8	PT
	Electronic Engineering Master of Engineering	2 years	9	FT
	Electronic Engineering (Doctoral Degree)	4 years	10	PT
	Electronics and Information Engineering Bachelor Engineering Tec (Ord)	3 years	7	FT
	Electronics and Information Engineering Master of Science	1 year	9	FT
	Electronic and Software Engineering (General Entry)		7	FT
	Electronic System Design ME		9	PT
	Energy Management MSc	3 years	9	PT
	Energy Management MSc	1 year	9	FT
	Engineering Analytics/Digital Construction Analytics		9	FT
	Engineering Reliability Management BEng Tec (Ord)	3 years	7	FT
	Engineering Reliability Management BEng Tec (Ord)	4 years	7	PT
	Engineering Software BEng	3 years	7	FT
	Engineering Software BEng (Hons)	4 years	8	FT
	Engineering Systems Maintenance BEng Tec (Ord)	3 years	7	FT
	Environmental Health		8	FT
	Environmental Planning and Management BSc (Hons)	4 years	8	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
TU Dublin	Geographical Information Systems (MIN) CPD	1 year	9	PT
	Geographic Science BSc (Hons)	4 years	8	FT
	Geomatics (Surveying and Mapping) BSc (Hons)	4 years	8	FT
	Higher Certificate in Electronic Engineering (FLASHE)		6	PT
	Industrial Automation Certificate	2 years	7	PT
	Industrial and Environmental Physics		7	FT
	Internet of Things Technologies MEng	2 years	9	PT
	Internet of Things Technologies MEng	2 years	9	FT
	Internet of Things Technologies MEng	2 years	9	eLearning
	Internet of Things Technologies Postgraduate Diploma in Engineering	1 year	9	FT
	Internet of Things Technologies- Certificate (Minor Award) in Engineering	1 year	9	eLearning
	Manufacturing Engineering BEng (Hons)	4 years	8	FT
	Masters of Science in Environmental Health and Safety Streams: Masters of Science in Environmental Health and Safety/Masters of Science in Health, Safety and Human Factors		9	FT/PT
	Mechanical Engineering Higher Certificate in Engineering	2 years	6	FT
	Mechanical Engineering Bachelor of Engineering	3 years	7	PT
	Mechanical Engineering Bachelor of Engineering	3 years	7	FT
	Mechanical Engineering Bachelor Engineering Tec (Ord)	3 years	7	FT
	Mechanical Engineering Bachelor of Engineering (Hons)	1 year	8	FT
	Mechanical Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Mechanical Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Mechanical of Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Mechanical Engineering Bachelor of Engineering (Hons)	1 year	8	PT
	Mechanical Engineering Bachelor of Engineering (Hons)	4 years	8	PT
	Mechanical Engineering MEng	2 years	9	FT
	Mechanical Engineering MEng	1 year	9	FT
	Mechanical Engineering MEng	2 years	9	PT
	Mechanical Engineering PhD in Engineering	4 years	10	FT
	Mechanical Engineering (Automation) Bachelor of Engineering (Hons)	4 years	8	FT
	Mechatronic Engineering Higher Certificate	3 years	6	PT
	Mechatronic Engineering Bachelor of Engineering	3 years	7	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
TU Dublin	Mechatronic Engineering Bachelor of Engineering	3 years	7	FT
	Mechatronic Engineering Bachelor of Engineering	2 years	7	eLearning
	Mechatronic Engineering Bachelor of Engineering	2 years	7	eLearning
	Mechatronic Engineering Bachelor of Engineering (Hons)	1 year	8	FT
	Mechatronic Engineering Bachelor of Engineering (Hons)	4 years	8	FT
	Mechatronic Engineering Bachelor of Engineering (Hons)	1 year	8	eLearning
	Networking Applications and Services BSc (Hons)	1 year	8	FT
	Networking Technologies Bachelor of Technology (Ord)	3 years	7	FT
	nZEB Policy and Technology CPD Certificate		9	PT
	Physics with Energy and Environment		8	FT
	Power Plant Technology (Plant Operations) Higher Certificate	2 years	6	PT
	Project Management		9	PT
	Process Instrumentation and Automation BSc	3 years	7	FT
	Process Instrumentation and Automation BSc	2 years	7	PT
	Professional Engineering CPD Certificate (SUPP)	1 year	9	PT
	Quantity Surveying MSc	3 years	9	PT
	Quantity Surveying and Construction Economics BSc (Hons)	4 years	8	FT
	Quantity Surveying and Construction Economics BSc (Hons)	6 years	8	PT
	School of Mechanical and Transport Engineering CPD Certificates (MIN)	1 year	7	PT
	School of Multi Disciplinary Technologies UG CPD Certificates (MIN)	1 year	7	PT
	School of Surveying & Construction Management CPD PG Certificate	1 year	9	PT
	School of Surveying & Construction Management CPD Certs	1 year	8	PT
	Spatial Planning MSc	3 years	9	PT
	Spatial Planning and Transport Certificates			
	Structural Engineering BEng (Hons)	4 years	8	FT
	Surveying (Property Economics) BSc (Hons)	4 years	8	FT
	Sustainable Development MSc	1 year	9	FT
	Sustainable Electrical Energy Systems		9	FT/PT
	Sustainable Energy Engineering (add on) in Energy Systems Engineering BEng (Hons)	1 year	8	FT
	Sustainable Energy Engineering (add on) in Energy Systems Engineering BEng (Hons)	1 year	8	PT
	Sustainable Energy and Environmental Engineering in Energy Systems BEng	3 years	7	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
TU Dublin	Sustainable Energy and Environmental Engineering in Energy Systems BEng	3 years	7	PT
	Sustainable Energy and Environmental Engineering in Energy Systems BEng (Hons)	4 years	8	FT
	Sustainable Energy Systems		8	FT
	Sustainable Infrastructure MEng	1 year	9	FT
	Sustainable Infrastructure MEng	1 year	9	FT
	Sustainable Infrastructure MEng	3 years	9	PT
	Sustainable Infrastructure MEng	3 years	9	PT
	Thermal Bridge Assessment Certificate (SPA) CPD	1 year	8	PT
	Timber Product Technology Bachelor of Technology (Ord) (Now Sustainable Timber Technology NFQ L8)	3 years	7	FT
	Transport and Mobility MSc	2 years	9	PT
	Urban Regeneration and Development MSc	2 years	9	PT
Trinity College Dublin	Applied Building Repair and Conservation		9	Part Time
	Civil, Structural and Environmental Engineering	Specialism from Year 3 of 4 year degree	8	FT
	Climate Action for Engineering (PG Diploma)	1 year	9	FT (evening and weekend delivery)
	Construction Law and Contract Administration		9	Part Time
	Electronic Engineering		8	FT
	Electronic and Computer Engineering		8	FT
	Electronic Information Engineering MSc/PG Diploma		9	FT
	Engineering BAI		8	Full Time
	Engineering MAI		9	Full Time
	Engineering with Management BAI		8	Full Time
	Engineering with Management MAI		9	Full Time
	Engineering (Environmental/Structural and Geotechnical/Transport/Sustainable Energy) MSc/ PG Diploma	1 year	9	FT/PT
	Environmental Monitoring, Assessment and Engineering PG Diploma	1 year	9	PT
	Environmental Science and Engineering	5 years, 4 year degree with integrated masters	8, 9	FT
	Environmental Sciences MSc/PG Diploma	1 year	9	FT- face to face, but blended during Covid-19
	Fire Safety Practice (Buildings and other Structures)		9	Part Time
	Global Challenges for Sustainability (Charm EU) MSc	18 months	9	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Trinity College Dublin	Health and Safety in Construction		9	Part Time
	Mechanical Engineering MSc/PG Diploma	1 year	9	PT
	Mechanical and Manufacturing Engineering BAI	4 years	8	FT
	Mechanical and Manufacturing Engineering MAI	5 years	9	FT
	Project Management PG Diploma	1 year	9	PT (3 hours on Friday evenings and Saturday mornings)
	Smart and Sustainable Cities MSc/PG Diploma	1 year	9	FT
	Structural and Geotechnical Engineering (MSc)		9	Full Time Part Time
	Sustainable Energy (MSc)		9	Full Time Part Time
University College Cork	Architecture (run with CIT)		8	Full Time
	M Arch (run with CIT)		9	Full Time
	Civil, Structural and Environmental Engineering BE	4 years	8	FT
	Civil, Structural and Environmental Engineering ME	5 years	9	FT
	Electrical and Electronic Engineering BE	4 years	8	FT
	Electrical and Electronic Engineering ME	5 years	9	FT
	Energy Engineering BE	4 years	8	FT
	Energy Engineering ME	5 years	9	FT
	Environmental Science		8	FT
	Environment, Sustainability and Climate- Diploma	2 years	7	PT
	Industrial Physics	4 years (split 50-50 between UCC and MTU)	8	FT
	MEngSc Engineering- Electrical and Electronic Engineering	1 year	9	FT
	MEngSc Engineering- Mechanical Engineering (Manufacturing Process and Automation Systems)	1 year	9	FT
	Engineering- Sustainable Energy (MEngSc) (1 year)	1 year	9	FT
	MPlan in Planning and Sustainable Development	2 years	9	FT
	MSc Geology- Applied Environmental Geoscience	12 months FT 24 months PT	9	FT/PT, blended
	MSc/Certificate in Project Management	2 years (1 year for Certificate)	9	PT (Blended)
	Process and Chemical Engineering- Certificate/ Diploma	1 year Certificate 2 years Diploma	7	PT Evening
	Process and Chemical Engineering BE/ME	4/5 years	8/9	FT
	Safety, Health and Welfare at Work- Certificate	1 year	7	PT
	Safety, Health and Welfare at Work- Higher Diploma	2 years	8	PT
	Sustainability in Enterprise- Meeting the Challenges of the Future (Higher Diploma)	1 year	8	FT
	Sustainability in Enterprise – PG Certificate/PG Diploma, Masters (forthcoming)		9	

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
University College Dublin	BSc Architectural Science	Stages 1-3	8	FT
	Bachelor of Architectural Science	4	8	FT
	BSc Landscape Architecture	Stages 1-4	8	FT
	BSc in City Planning and Environmental Policy	Stages 1-2	8	FT
	BA in Planning Geography and Environmental Policy	Stages 2-3	8	FT
	BA in Planning Geography and Environmental Policy International	Stage 3	8	
	Certificate in Safety and Health at Work	1 year	7	PT- Blended online (online with 4 attendance/workshop/tutorial days in UCD during the year)
	Chemical and Bioprocess Engineering BE	3 years	8	FT
	Chemical Engineering with Biochemical Minor (Stage 3 and 4 for BE Pathway)	2 years	8	FT
	Chemical Engineering Biochemical Engineering Minor (from 18/19) (Stage 4 for ME Pathway)	1 year	8	FT
	Chemical and Bioprocessing Engineering (Stage 4 1st year of ME)	1 year	8	FT
	Chemical and Bioprocess Engineering ME	1 year	9	FT
	MEngSc Chemical Engineering	1 year	9	FT
	Civil Engineering	Stages 2-4	8	FT
	Civil Structural and Environmental Engineering	Stage 4	8	FT
	Civil Structural and Environmental Engineering		9	FT
	Electrical/Electronic Engineering	4 years	8/9	FT- normally on campus
	Stage Four Electrical Power Engineering (First Stage of ME)	1 year	8	FT
	ME Electrical Power Engineering	2 years	9	FT
	Electrical Power System Analysis Professional Diploma	1 year	9	PT
	Electronic Design Professional Diploma	1 year	9	PT
	Engineering with Business Stream Stage 4 (Civil)	Stage 4	8	FT
	Higher Diploma in Safety, Health and Wellbeing at Work	2 years	8	PT- in person attendance in UCD
	Mechanical Engineering	4 years	8	FT (Blended- Covid 20-21- Normally FT on campus)
	ME Management	2 years	9	PT
	Stage Four Energy Systems Engineering (First Stage of ME)	1 year	8	FT
	ME Energy Systems	1 full academic year or 2 years	9	FT (Blended- Covid 20-21- Normally FT on campus)
	ME (Engineering with Business) (Civil)	Stages 1-2	9	FT
	Stage Four Materials Science and Engineering (First Stage of ME)	1 year	8	FT
	ME Materials Science and Engineering	2 years	9	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
University College Dublin	ME Mechanical Engineering	3+2 years (ME=2 YEARS)	9	FT/ (Blended- Covid 20/21- Normally FT on campus)
	MEngSc Engineering Management	1 year	9	FT
	MEngSc in Materials Science and Engineering	1 year	9	FT
	MEngSc (Structural Engineering)	Stage 1	9	FT
	MEngSc (Structural Engineering)	Stage 1	9	PT
	MEngSc (Water, Waste and Environmental Engineering)	Stage 1	9	FT
	MEngSc (Water, Waste and Environmental Engineering)	Stage 1	9	PT
	Master of Architecture	Stages 1-2	9	FT
	MArchSc in Landscape Studies (Inactive 19/20)	Stage 1	9	FT
	MArchSc in Landscape Studies	Stage 1	9	FT
	Master of Landscape Architecture	Stage 1	9	FT
	Master of Regional and Urban Planning (A/P)	Stage 1	9	FT
	Master of Regional and Urban Planning	Stages 1-2	9	FT
	MSc in Urban Design and Planning	Stage 1	9	FT
	MSc in Environmental Policy	Stage 1	9	FT
	MSc Environmental Technology	1 year	9	FT
	MSc in Occupational Safety and Health	2 years/1 year	9	PT/FT- in person attendance in UCD
	MSc in Planning, Development and Urban Design	Stage 1	9	FT
	MSc in Planning, Development and Urban Design	Stage 1	9	PT
	MSc in Architecture, Urbanism and Climate Action	Stage 1	9	FT
	MSc in Renewable Energy and Environmental Finance	12 months	9	FT/PT*pre-Covid: on campus *covid: blended approach; synchronous and asynchronous
	MSc in Sustainable Energy and Green Technologies	1 year	9	FT- designed as a face to face programme, but operated as fully online programme due to Covid 19- planned return to face to face in September 2021.
	MSc in Project Management	1 year FT 2 years PT	9	FT/PT Online and class based
	Procurement and Contracts (CPD)			
	Professional Diploma (Architecture)	Stages 1-2	9	PT
	Professional Diploma (Architecture) (Online)	Stages 1-2	9	PT
	Structural Engineering with Architecture	Stages 2-3	8	FT
	Structural Engineering with Architecture	Stage 3	8	FT
	Structural Engineering with Architecture	Stage 4	8	FT
	Structural Engineering with Architecture		9	FT

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
University of Limerick	Architecture		8	
	Architecture MArch		9	
	Civil Engineering BE	Years 2-4 of engineering degree	8	FT
	Civil Engineering MSc	1 year	9	FT
	Construction Management and Engineering	4 years	8	FT
	Design and Manufacture BE	Years 2-4 of engineering degree	8	FT
	Embedded Systems Engineering- Professional Diploma		9	PT
	Engineering Practice MSc	1 year	9	PT
	Environmental Science- Higher Diploma	1	8	FT- online for 2020/21 (due to Covid- hopefully face to face in 2021/22)
	Environmental Science	4	8	FT- always face to face except for 2020/1 (online due to Covid)
	Mechanical Engineering BE	Years 2-4 of Engineering degree	8	FT
	Mechanical Engineering MEng	1 year	9	FT
	Mechanical Engineering MSc	1 year	9	FT
	Mechatronics MEng	1 year	9	FT
	Professional Skills for Engineers- Module		9	PT
	Project Management MSc	1 year	9	FT
	Project and Programme Management MSc (Online)	2 years	9	PT (delivered 100% online)
	Project Management- Professional Diploma (Online)	1 year	9	PT (delivered 100% online)
	Sustainable Resource Management: Policy and Practice MSc *		9	FT * Run in conjunction with NUI Galway (see NUIG entry)
	Technology Management	4 years	8	FT
Waterford Institute of Technology	BSc in Applied Computing (Automotive and Automation Systems)	4 years	8	FT
	BSc in Applied Computing (Internet of Things)	4 years	8	FT
	BSc Architectural Technology		7	FT
	BArch Architecture		8	FT
	BSc Architectural and Building Information Modelling Technology		8	FT
	BEng Automation Engineering	4 years	8	FT, offline (partial online due to Covid 19)

Institution	Course Title	Length of course	NFQ Level	Mode (part time/full time)
Waterford Institute of Technology	Certificate Automation Engineering Springboard programme set up to cater for employees in region, to skill up in the field of automation engineering.	2 Semesters	7	PT, offline (partial online delivery due to Covid 19)
	BEng Building Services Engineering		7	FT and PT
	Certificate in nZEB design		9	PT
	BEng Civil Engineering		7	FT
	MSc Construction Project Management		9	FT and PT
	BSc Construction Management and Engineering (Hons)		8	FT
	Construction Site Management BSc		7	PT
	Construction Site Management BSc (Hons)		8	PT
	BEng in Electrical Engineering		7	
	BEng Electrical Engineering (Hons)		8	
	BEng in Electronic Engineering		8	
	MEng Electronic Engineering	12 months FT/ 24 months PT	9	FT- offline, lectures typically held 2 days per week PT- offline, attendance on 1 day per week
	BEng Fire Engineering		7	PT
	BEng Mechanical Engineering	3 years	7	FT- traditional mode of delivery, with approximately 50% theory and 50% practical classes
	Certificate in Project Management		8	
	BSc Quantity Surveying (Hons)		8	FT
	BEng Sustainable Civil Engineering		8	FT
	BEng Sustainable Energy Engineering		8	FT
	MSc Sustainable Energy Engineering		9	FT and PT

A.4 Apprenticeships

The following two tables show data for completions and registrations in the Apprenticeship system, including completion numbers for traditional craft apprenticeships and registration numbers of post-2016 apprenticeships

QQI Awards for Craft Apprenticeships (Level 6)	2016	2017	2018	2019	2020
Craft - Agricultural Mechanics	3	21	20	47	26
Craft - Aircraft Mechanics	4	8	6	14	5
Craft - Brick and Stonelaying	1	6	6	13	8
Craft - Cabinet Making	3	4	3		
Craft - Carpentry and Joinery	6	59	57	148	198
Craft - Construction Plant Fitting	3	22	29	56	42
Craft - Electrical	6	113	118	415	949
Craft – Electrical				84	
Craft - Electrical Instrumentation	3	18	20	34	44
Craft - Electronic Security Systems	4	5	6	39	25
Craft - Farriery	2	1	1	6	
Craft - Floor and Wall Tiling	2		1		
Craft - Heavy Vehicle Mechanics	3	37	44	72	129
Craft - Industrial Insulation		4	1	9	5
Craft - Instrumentation	3	7	3	7	7
Craft - Mechanical Automation and Maintenance Fitting	6	49	50	103	119
Craft - Metal Fabrication	3	45	43	68	134
Craft - Motor Mechanics	9	77	64	285	227
Craft - Painting and Decorating	2	3	3	9	10
Craft - Pipefitting				18	23
Craft - Plastering	3	10	5	8	7
Craft - Plumbing	7	69	71	204	235
Craft - Print Media	3	2	6	2	4
Craft - Refrigeration and Air Conditioning	3	28	24	55	63
Craft - Sheet Metal Working	4	8	10	16	11
Craft - Stonecutting			1		
Craft – Stonecutting and Stonemasonry			9	7	5
Craft - Toolmaking	4	24	25	55	48
Craft - Vehicle Body Repairs	4	11	21	24	30
Craft - Wood Manufacturing and Finishing	4	10	8	23	34

Name of Apprenticeship:	Commencement Year	Duration	Year of completion	Registrations 2016	Population 2016	Registrations 2017	Population 2017
Engineering Services Management	Aug-19	2 years	Aug-21	-	-	-	-
Industrial Electrical Engineer	2016	2 years	2018	12		19	31
Manufacturing Engineering	2017	3 years	2020	-	-	36	39
Manufacturing Technology	2017	2 years	2019	-	-	40	36
Mechanical Automation and Maintenance Fitting	Craft	-	Craft to confirm	163	575	183	612
OEM Engineer	Oct-19	3 years	Oct-22	-	-	-	-
Principal Engineer	2020	4 years	2024	-	-	-	-

Name of Apprenticeship:	Commence-ment Year	Duration	Registrations 2018	Population 2018	Registrations 2019	Population 2019	Registrations 2020	Population 2020
Engineering Services Management	Aug-19	2 years	-	-	10	9	17	23
Industrial Electrical Engineer	2016	2 years	25	54	28	77	30	104
Manufacturing Engineering	2017	3 years	20	55	27	78	20	94
Manufacturing Technology	2017	2 years	34	73	29	95	30	118
Mechanical Automation and Maintenance Fitting	Craft	-	180	616	199	652	142	637
OEM Engineer	Oct-19	3 years		-	11	11	16	25
Principal Engineer	2020	4 years		-	-	-	5	5

A.5 Irish Green Building Council Training course completions

	CURRENT TRAINING	2019	2020	2021
Home Performance Index Assessor Training	The IGBC is building a pool of skilled Home Performance Index Assessors by delivering the HPI Assessor training. HPI is Ireland's first national quality and sustainability assessment system for new housing. HPI is based on five verifiable categories: Environment, Economic, Health and Wellbeing, Quality Assurance and Sustainable Location.	15	38	8 in Q1
Whole Life Carbon Training	Addressing the environmental impact of buildings across their whole life cycle is imperative to reducing carbon in the construction sector. This training teaches designers how to quantify the carbon emissions associated with their building designs by using life cycle assessment tools. This low cost training will be run twice a month throughout 2021 to train as many architects as possible in whole life carbon.			59 in Q1
nZEB Training	Understanding the key changes to Parts L&F of Building regs, how to achieve airtightness and the need for team work to produce a low energy buildings		26	
LEED GA Training	LEED (Leadership in Energy and Environmental Design) is an internationally recognised green building certification system. The LEED GA (Green Associate) training programme helps professionals get started on the path to LEED accreditation.	60	57	6 in Q1
LEED for Contractors	This workshop helps site contractors to meet their LEED credits by providing a walk-through of the primary credits for which the contractor has responsibility, including tools and strategies for achieving LEED points			
Webinar Series	IGBC keeps construction professionals up to date with regular CPD webinar series (Wednesday's lunchtime, 1 hour) topics covered include:			
	nZEB for Residential: Key updates on what nZEB means for the sector (4 episodes)	227		
	nZEB for Commercial: Key updates what nZEB means for the sector (4 episodes)	345		
	Better Homes: Considering the Environmental, Health and Wellbeing, and Economic impacts of new housing (8 episodes)		483	
	Green Homes Solutions: Showcasing a range of services, technologies and materials that can assist in creating high quality, energy efficient, green homes (6 episodes)		608	
	Renovation Solutions: How to achieve high quality renovation that guarantees performance and safeguards the health of the occupants (6 episodes)		559	
	Green performance Solutions: Saving energy in existing commercial buildings (7 episodes)		289	
	Whole Life Carbon & Circularity in Construction: Exploring solutions available for reducing the carbon emissions associated with the construction of buildings (4 episodes)		195	
	Building Circularity: Exploring the latest tools and initiatives available for achieving resource efficiency, circularity and zero waste (6 episodes)			568

A.6 Further Education & Training (FET) course completions

This table shows the number of completers for relevant FET courses, grouped by corresponding SOC Occupation. An asterisk (*) indicates that the course has less than 5 completions.

Course Title	SOC Occupation	2019	2020
IMI International Level 2 Electric/Hybrid Vehicles Routine Maintenance Activities	Vehicle technicians, mechanics and electricians (5231)	45	16
Skills to Compete - IMI International L2 Electric/ Hybrid Vehicles Routine Maintenance Activities	Vehicle technicians, mechanics and electricians (5231)	0	6
Wind Turbine Maintenance Traineeship	Electrical and electronics technicians (3112)	8	0
Domestic Heat Pump Installation/ Solar Hot Water Systems Installation	Plumbers and heating and ventilating engineers (5314)	28	16
Nearly Zero Energy Building (NZEB) for Plumbers	Plumbers and heating and ventilating engineers (5314)	6	111
Nearly Zero Energy Building (NZEB)- Ventilation	Plumbers and heating and ventilating engineers (5314)	16	0
Dry Lining/Dry Lining Traineeship/Skills To Compete - Dry Lining	Construction Operatives n.e.c. (8149)	32	28
CSCS - Tower Crane Operations for New Entrants	Crane drivers (8221)	*	*
CSCS - Telescopic Handler Operations for New Entrants	Marine and waterways transport operatives (8232)	13	7
CSCS - 180º or 360° Excavator Operations for New Entrants	Mobile machine drivers and operatives n.e.c. (8229)	6	0
CSCS - 360Â° Excavator Operations for New Entrants	Mobile machine drivers and operatives n.e.c. (8229)	0	10
CSCS - Articulated Dump Truck Operations for New Entrants	Mobile machine drivers and operatives n.e.c. (8229)	*	*
Plant Machinery Operator Tickets (New Entrants)	Energy plant operatives (8124)	7	0
CSCS - 360° or 180 Excavator Operations for Experienced Workers	Mobile machine drivers and operatives n.e.c. (8229)	31	40
CSCS - Site & Articulated Dumper Operations For Experienced Workers	Mobile machine drivers and operatives n.e.c. (8229)	14	11
CSCS - Telescopic Handler for Experienced Worker	Marine and waterways transport operatives (8232)	17	20
Basic Introduction to Window and Door Glazing	Glaziers, window fabricators and fitters (5316)	6	0
Certificate in Mechanical Engineering	Mechanical engineers (2122)	*	9
Carpentry Techniques	Carpenters and joiners (5315)	0	*
Nearly Zero Energy Building (NZEB) for Carpenters	Carpenters and joiners (5315)	0	*
Decorative Painting Skills: Marbling and Woodgraining	Painters and decorators (5323)	6	8
Decorative Painting Skills: Painted Furniture	Painters and decorators (5323)	9	0
Decorative Painting Skills: Trompe L'Oeil, Distressing and Gilding	Painters and decorators (5323)	8	10
CPC - Control of Vehicle & Eco-Driving Techniques	Large goods vehicle drivers (8211)	8	19
CPC - Health and Safety for the Professional Driver	Large goods vehicle drivers (8211)	14	0
CPC - Minimising Risks & Managing Emergencies	Large goods vehicle drivers (8211)	8	0
CPC - Professional Truck Driver	Large goods vehicle drivers (8211)	7	0
CPC - Role of the Professional Driver	Large goods vehicle drivers (8211)	16	0

A.7 Green Tech Skillnet

The following tables show existing and planned courses delivered by Green Tech Skillnet in 2020 and 2021.

Programmes Delivered in 2020 - Specified by EGFSN	Duration of programme	Mode of delivery	2020 Participants	2021 Participants
Application of Irish Legislation and Standards in the Procurement and Takeover of High voltage Installations	1	Instructor Led	15	8
Dispatch Down and Energy Storage	1	Instructor Led	10	
District Heating: Energy Efficiency for Urban Areas	4		0	11
ECP-2 Connection Process in Ireland	2	Instructor Led	9	
Electrical Installation and Commissioning of Micro Generators	2	Mixed Learning Event	18	10
Generator Grid Connections Process in Ireland	1	Instructor Led	26	
GWO Working at Height	2	Instructor Led	8	
High Voltage Switching and Operations	5	Instructor Led	5	
Introduction to High Voltage (HV) electrical installation	1	Instructor Led	23	8
Introduction to Hydrogen	1	Instructor Led	8	
IOSH Managing Safely for Wind Power	4	Mixed Learning Event	7	11
LV Isolation/LOTO	1		0	5
Management & Control of Electrical Installations and Application of IS EN 50110 1&2	1	Instructor Led	14	
Offshore Consenting and Development	2	Instructor Led	24	
Project Finance with RESS	2	Instructor Led	8	
QQI Domestic BER Course	6	Instructor Led	17	
QQI Level 6 Micro Solar Photovoltaic Systems Implementation (6N0306)	4	Mixed Learning Event	22	
Safety of Grid Scale Battery Energy Storage Systems	1	Instructor Led	28	
Wind Turbine Safety Rules	1	Instructor Led	36	3
Other Relevant Programmes Delivered in 2020 - Not Specified by EGFSN	Duration of programme	Mode of delivery	2020 Participants	2021 Participants (Estimate)
Advanced Composite Wind Turbine Blade Repair	5	Instructor Led	2	
Clean Energy Package Review and Risk Assessment (code: GTS20-08)	4	Instructor Led	16	
Delivering 3.5 GW of offshore wind - 70x30 Implementation Plan - Module 4	1	Other	26	
Delivering 8.2 GW of onshore wind 70x30 Implementation Plan - Module 3	1	Other	40	
Feasibility Study for Offshore Wind Enterprise Zone in Ireland (code: FSP20-01)	2.5	Mixed Learning Event	14	
Financial Modelling Services (code: GTS20-162)	2	Online Course	5	
Grid Review for Wind Farms (code: GTS20-163)	2	Online Course	4	

Programmes Delivered in 2020 - Specified by EGFSN	Duration of programme	Mode of delivery	2020 Participants	2021 Participants
GWO Advanced Rescue - Hub, Spinner and Inside Blade Rescue	1	Mixed Learning Event	19	
GWO BST	5	Mixed Learning Event	6	2
GWO BTT (Basic Technical Training)	5	Mixed Learning Event	6	
GWO Fire Awareness	1	Instructor Led	9	
GWO Manual Handling	1	Mixed Learning Event	9	
GWO Working at Heights – Refresher - 1 day	1	Mixed Learning Event	15	
IAA Drone Training	3	Instructor Led	2	
Introduction to Wind	10.5	Instructor Led	26	7
IOSH Managing Safely for Wind Power For HV Operators	7	Mixed Learning Event	6	
MS Project Intermediate	1	Instructor Led	9	
Near Zero Energy Buildings	11	Online Course	24	
Negative Pricing Analysis Course for RESS	1	Instructor Led	48	
Negotiation and Conflict Management	1	Mixed Learning Event	44	
Review of Rating Systems (code: GTS20/152)	3	Online Course	10	
Saving Money - 70 by 30 Implementation Plan - Module 1	1	Other	98	
Saving Power 70x30 Implementation Plan - Module 2	1	Other	74	
Technical Report Writing Course	1	Instructor Led	5	
Thermal Imaging Training (code: GTS20/146)	1	Instructor Led	2	
Wind Turbine Technician - GWO Suite	21.5	Instructor Led	10	
Workshop on Potential CoP with HAS	1	Instructor Led	9	
Zero Carbon Energy System to 2050	2	Mixed Learning Event	14	

Other Programmes Planned for 2021 Include;	Year of Introduction	Duration of programme	Mode of delivery	2020 Participants	2021 Participants (Delivered by or Planned by May 2021)
4x4 Off-Road Training	2021	1	Instructor Led	0	3
Asset Management in the Wind Sector - A foundation course	2021	2	Online Training	0	12
Avanti Lift Training	2021	4	Online Training	0	5
Biodiversity Officer Training	2021	1	Online Training	0	8
Clean Energy Package - Review and Risk Assessment	2021	1	Instructor Led	0	27
Data Centres and Ireland's power system- an industry perspective		1	Instructor Led	0	11
Dispatch Down		1	Online Training	0	10
Domestic BER Course		10	Online Training	0	15
Environmental Impact Assessment Training	2021	1	Online Training	0	8
Finance for Non-Financial Managers	2021	1	Online Training	0	15
GWO Advanced Rescue Training- Hub		1	Instructor Led	0	4
GWO Advanced Rescue Training- Hub Refresher		2	Instructor Led	0	3
GWO Work at Height & Hub Rescue & Confined space		3	Instructor Led	0	3
Halio Lift Training	2021	4	Online Training	0	5
IOSH Managing Safely for Wind Power - Refresher		5	Online Training	0	2
LUGS		2	Online Training	0	5
Management & Control of Electrical Installations and Application of IS EN 50110 1&2		1	Online Training	0	8
Managing Health and Safety in Construction PSCS	2021	3	Online Training	0	5
Mental Health Training	2021	1	Online Training	0	5
Middle Management Training	2021	2	Online Training	0	6
Operating Zarges Service Lift TBS 6000-5	2021	4	Online Training	0	5
Overview of Wind (Intro to Wind)	2021	5	Online Training	0	10
Permit to Work Training		1	Instructor Led	0	8
Power Climb Lift Training	2021	4	Online Training	0	5
QQI Level 6 Micro Solar Photovoltaic Systems Implementation		4	Online Training	0	10
Recording and Slides from Negative Pricing and Energy Balancing for RESS Workshop		1	Online Training	0	10
Review of International Grid Connection approaches and best practices for Ireland		1	Online Training	0	12
Social Media Training	2021	2	Instructor Led	0	7
Time Management Training		1	Instructor Led	0	8
Webinar on Access to Information on the Environment (AIE) Requests		1	Instructor Led	0	10

A.8 Other Relevant Skillnets

The following tables display training and upskilling courses from other relevant Skillnets, including the Construction Professionals Skillnet, CITA Skillnet, SIMI Skillnet, and Midland Border East (MBE) Skillnet.

Skillnet Network	Programme	Year of introduction	Duration of programme	Mode of delivery	2020 participants	2021 participants*
Construction Professionals Skillnet	BIM ISO 19650 Essentials (also Condensed and Delivering Information Management)	2021	2 x 6 hrs; 1 x 12 hrs.	Virtual classroom		30
Construction Professionals Skillnet	Communication Skills I for Safety Officers	2020	Half day	Virtual classroom	13	5
Construction Professionals Skillnet	Communication Skills II for Safety Officers	2020	Half day	Virtual classroom		5
Construction Professionals Skillnet	Communication Skills I for Site Supervisors	2020	Half day	Virtual classroom	4	14
Construction Professionals Skillnet	Communication Skills II for Site Supervisors	2020	Half day	Virtual classroom		10
Construction Professionals Skillnet	Construction Project Resources and Cost Management (CIOB)	2021	100 hours	Virtual classroom		11
Construction Professionals Skillnet	Contractual and Legal Responsibilities (CIOB)	2020	100 hours	Virtual classroom	8	7
Construction Professionals Skillnet	Developing Your Construction Company- for SME Owner Managers	2020	3 half days plus 3 one to one sessions	Virtual classroom	0	6
Construction Professionals Skillnet	Digital Delivery for Site Workers (TU Dublin Level 6 CPD Certificate)	2021	100 hours	Virtual classroom		15
Construction Professionals Skillnet	Managing People in a Professional Construction Context (CIOB)	2021	100 hours	Virtual classroom		11
Construction Professionals Skillnet	Managing Sustainable Construction (CIOB)	2020	100 hours	Virtual classroom	7	4
Construction Professionals Skillnet	Managing the Quality of Construction Works (CIOB)	2020	100 hours	Virtual classroom	9	14
Construction Professionals Skillnet	Managing the Technology of Modern and Traditional Construction Works (CIOB)	2020	100 hours	Virtual classroom	6	11
Construction Professionals Skillnet	Organisation of the Construction Site (CIOB)	2021	100 hours	Virtual classroom		11
Construction Professionals Skillnet	Project Planning, Control, Monitoring and Risk for Construction (CIOB)	2021	100 hours	Virtual classroom		11
Midland Border East (MBE) Skillnet	Orbital Welding		4 days	Blended	12	
SIMI Skillnet	Electrical Systems Fault Diagnosis (VSE 1)	2013	2 days	Classroom and garage workshop	10	24
SIMI Skillnet	Hybrid and Electric Vehicle Systems Combined Level 2 and 3	2016	3 days	Classroom and garage workshop	31	100
CITA Skillnet	Higher Diploma in BIM		102 days	Blended; Modular	9	

Skillnet Network	Programme	Year of introduction	Duration of programme	Mode of delivery	2020 participants	2021 participants*
CITA Skillnet	Online BIM ISO 19650 Bundle: BIM essentials & information management		7 day	Blended	8	
CITA Skillnet	Certificate in BIM		18 days	Blended	8	
CITA Skillnet	MSc. in Applied Building Information Modelling Management (aBIMM)		18 days per module	Blended; Modular		9
Note: 2021 participant figures include places for upcoming programmes scheduled to year end, which will be delivered subject to demand.				Total	125	331

Skills Connect	Programme	Year of introduction	Duration of programme	Mode of delivery	2020 participants	2021 participants*
Midland Border East (MBE) Skillnet	Domestic Heat Pump Systems- QQI Level 6	2021	14 days	Face-to-Face	0	12
Midland Border East (MBE) Skillnet	Micro Generator Electrical Installations- QQI Level 6	2021	18 days	Face-to-Face	0	12
Midland Border East (MBE) Skillnet	Micro Solar Photovoltaic Systems- QQI Level 6	2021	15 days	Face-to-Face	0	18
Midland Border East (MBE) Skillnet	Orbital Engineering Technology	2021	12 days	Face-to-Face	12	24
Note: 2021 participant figures include places for upcoming programmes scheduled to year end, which will be delivered subject to demand.					12	66

A.9 Engineers Ireland CPD Courses

The table below displays a list of Engineers Ireland Continuous Professional Development (CPD) training courses on energy/climate action. The short courses in the table are currently being delivered by Engineers Ireland.

Course Title
Achieving Zero carbon Development through the Planning Process
Air Tightness and Vapour Control in Modern Homes
Air to Water Heat Pumps- An Introduction
An introduction to Condensing Oil Boilers, Wood pellet boilers and Air to Water Heat pump
Building Defects Analysis
Building Capacity: Local Authority Climate Action Training Programme
Building Regulations Explained
Calculation Competency: Conventions and Standards for Thermal Bridging Calculations and Compliance
Certificate in Construction Dispute Mediation
Certified Energy Manager
Championing Leadership: Local Authority Climate Action Training Programme
Climate Action Raising Awareness Training for Local Authorities
Comfort in the Indoor Environment
Condensing Oil, Wood pellet and Heat pump Product Training
Construction Product Regulations for Structured Cabling
Contract Supervision for Staff in Water Services Projects
Creating Effective Drainage and Insulation on Flat Roofs
Design and Control for Natural Ventilation
Development of Guidance and Training on the Implementation of Solid Fuel Regulations
Development of Guidance and Training on the Management and Operation of Waste Water Overflows
Development of Guidance and Training on Water Supply Hygiene
Diploma in Construction Law
ECOdesign Directive 2009/125
Electric Vehicle Charging- Infrastructure, Market and Connectivity
Electrical Components
Energy Management Systems according to ISO50001
Energy Mapping for Spatial Energy Demand Analysis
Energy Monitoring Systems
Energy Performance of Buildings Directive EN 15193
Environmental Considerations for Renewable Energy Strategies
Fundamentals of Heat Pump Design (Geothermal, Air/Water and Exhaust Air)
Galvanizing and Sustainable Construction
Guidance and Training on the Inspection of Domestic Waste Water Treatment and Disposal Systems
Guidance, Procedures and Training on Enforcement of the Waste Management Packaging Regs 2007
Height Safety Systems
IIoT- Low Voltage Connectivity, Communications and Energy Efficiency
Introduction to Specification and Design of NZEB Buildings (Short course- 1 day, runs 3-4 times per annum, capacity of 16)
Introduction of Uninterruptible Power Supply (UPS) Systems and Batteries
Introduction to Windfarm High Voltage Electrical Installations (Short course- 1 day, runs once per annum, capacity of 16)
Irish Wind Power- Our Competitive Advantage

Leading the rEVolution- An Introduction to Commercial Electric Car Charging and Payment Processing
Master of Science in Management in the Built Environment
Medium Voltage Switchgear
Part L 2011, Fabric Performance and towards Nearly Zero Energy Buildings (NZEB) and Zero Carbon House Standards
Passive House Design
Planning and Implementing Community Engagement for Local Authority Renewable Energy Strategies (LARES)
Polyethlyene (PE) Electrofusion and Butt Fusion Welding (Gas)
Polyethlyene (PE) Electrofusion and Butt Fusion Welding (Water)
Project Management Modular Course (Short course- 4 days, runs 4-5 times per annum, capacity of 16)
Renewable Energy in the Urban Environment
Renewable Energy Policy, Resources and Conversion Technologies
Renewable Energy Technology and Control Systems
Renewable Technologies (Wind and Solar PV)
Retrofitting of underfloor heating without raising floor heights
Smart LV Panels
Solar PV- overview and system design
Specification and Design of Heating Systems with Heat Pumps (Short course- 1 day, runs 2-3 times per annum, capacity of 16)
Specification of Fixed Gas Detection
Sustainable Building Choices
Thermal Energy Storage Solutions Using Phase Change Materials
U-Value calculations as per standard EN 6946 and in accordance with BR 443 conventions
Ventilating a Home- Choosing the Correct Ventilation System
VRV Heat Recovery
Water and Heat Metering- How to Comply with Current Regulations
Wireless Temperature Sensing Systems

A.10 Construction Industry Federation

Construction Industry Federation Training
Course Title
BCAR- Building Control (Amendment) Regulations
BIM Starter Pack for Contractors
City and Guilds Assured Appointed Person (Lifting Operations)
City and Guilds Assured Building Regulations
City and Guilds Assured Construction Safety Representative
City and Guilds Assured Site Managers- A Practical Approach to Building Regulations
City and Guilds Assured Site Supervisor Safety Programme
City and Guilds Assured Project Supervisor Construction Stage

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