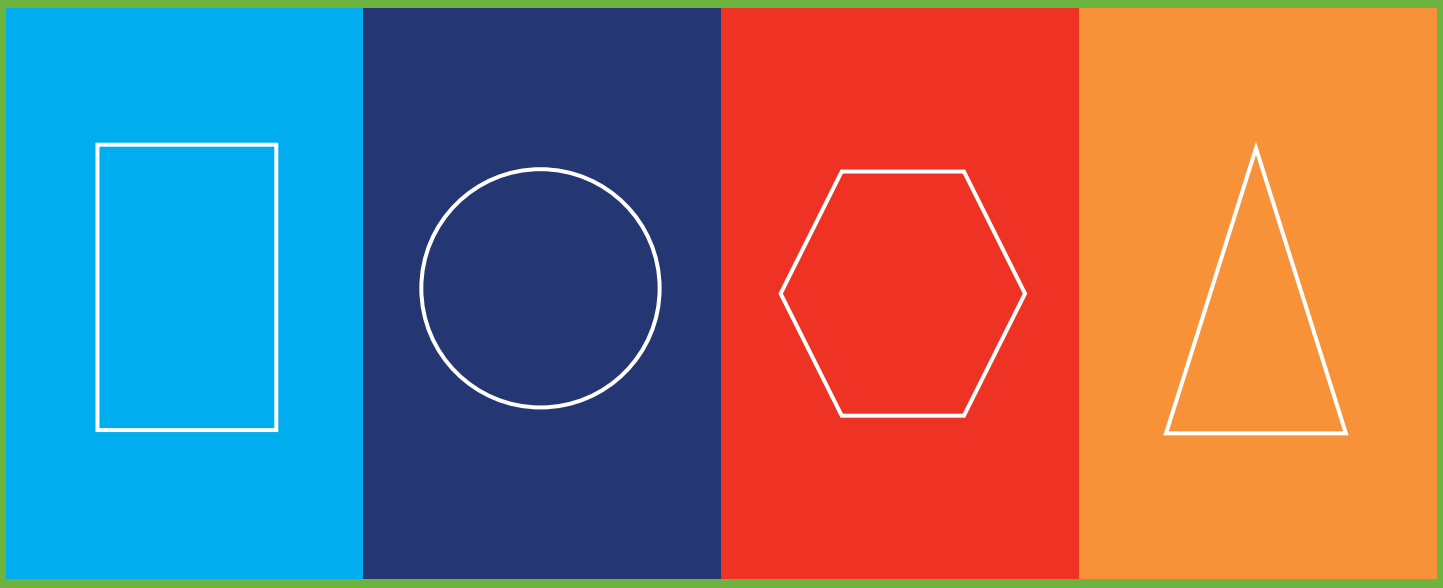

Future Skills Needs of Enterprise within the Green Economy in Ireland

November 2010

Expert Group on
Future Skills Needs

Future Skills Needs of Enterprise within the Green Economy in Ireland

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Acknowledgements

Forfás would like to acknowledge the valuable input of the many senior executives of companies who participated in the research work for this Study. Also to those expert staff from professional and trade organisations who provided valuable insights at workshops and meetings. Thanks are due to the Skills and Labour Market Unit at FÁS which provided data and analysis on the supply of education and training provision relevant to the sector. Forfás would like to acknowledge the quality of work of CollierBroderick Management Consultants who undertook the fieldwork and analysis of the research work with companies.

Foreword

This Study identifies the future skills needs of enterprises engaged within the 'green economy' in Ireland and proposes a range of measures to ensure that their future skills base will drive business and employment growth. This will help companies take advantage of export growth opportunities in eco-construction, energy efficiency, renewable energies, water, waste, 'Green' ICT and consultancy as well as significant business opportunities arising on the domestic market within renewable energies, energy efficiency, water and waste. The Study informs education and training providers on the required alignment of their programmes to meet enterprise needs and will help individuals make an informed decision around potential employment opportunities and their career choice.

The sector employs 18,750 people and its market size is estimated at €3.05 billion. The six sub-sectors considered are renewable energies; efficient energy use; water and waste water treatment; waste management, recovery and recycling; environmental consultancy; and 'Green' ICT. The sector as such is not well defined within existing classification systems. In this regard, extensive research work was undertaken with senior executives from companies across sub-sectors and professional and trade organisations. The study also draws upon current EU and international research and practice.

There are strong global and domestic drivers of growth positively impacting on the sector. At the same time, there are identified challenges to be addressed for growth potential to be realised. If substantive progress were made, it is anticipated that employment in the sector could rise to 29,000 by 2015. Taking into account 'expansion' and 'replacement' demand, around 14,500 employment opportunities would arise over the next five years. Much of this demand would be for higher-skilled staff. Key skill requirements are for the development of core business, engineering and ICT skills capability. Generic skills including entrepreneurship, maths proficiency, commercial awareness, foreign languages, finance, marketing, problem solving and communication skills are also important. Ireland's strong supply of business, science and technology graduates is a competitive strength, compared for example to other EU countries where the numbers of such graduates are in decline.

I would like to thank all those who contributed to the report. I wish to express my thanks to George Bennett, IDA Ireland, who chaired the Steering Group that oversaw the completion of the report and to each member of the Steering group for their full commitment and support. Finally, I would like to thank the team at Forfás for leading this project to a successful conclusion.

Una Halligan
Chairperson, Expert Group on Future Skills Needs

Executive Summary

Aim of Study

The aim of the Study is to identify the future skill requirements of enterprises engaged with the 'green economy' in Ireland and to propose a range of measures to ensure that their skills base will drive employment and business growth and sustain competitiveness. The Study aims to inform education and training providers on the required alignment of programmes to meet enterprise skills needs and to help individuals make an informed decision around employment opportunities and their career choice. The overarching vision set by the Steering Group for the Sector is:

'For Ireland to be the benchmark 'smart green' economy for population centres under 20 million by 2015 - and to have the skills base and talent to drive innovative and high value products and services and maximise future business and employment growth potential'.

Future skills demand is considered over a 3-5 year time period in terms of:

- Providing the quality of skills required to drive business growth in the sector;
- Providing the diversity of skills to reflect the complexity of business; and
- Providing a sufficient quantity of skills to fill employment opportunities arising in the sector.

Scope of Study

The 'green economy' has been identified as an area of potential business and employment growth across many countries – including Ireland. However, it is recognised that there is no exact boundary around the sector and that it is not well defined within existing classification systems. The six sub-sectors considered within the scope of this Study were identified as having significant business and employment growth potential[1]. The sub-sectors included are:

- Renewable Energies
- Efficient Energy Use and Management
- Water and Waste Water Treatment
- Waste Management, Recovery and Recycling
- Environmental Consultancy Services
- 'Green' ICT Applications/Software

These sub-sectors are overlapping and interactive with enterprises engaged within and across sub-sectors. The *Report of the High-Level Group on Green Enterprise* highlighted the potential for the 'green economy' to make a significant contribution to Ireland's employment and exports[2]. It also

[1] The Report of the High-Level Group on Green Enterprise- *Developing the Green Economy in Ireland*, Forfás Nov 2009)
[2] The potential for a Green International Financial Services Centre was also highlighted in the report and the IFSC Banking and Treasury Group under the Department of the Taoiseach is currently developing plans to establish such a centre. It can also be noted that 'green tourism' can also be considered an area of business potential through Ireland marketing itself as a ' green low – carbon' destination, though this specific business area is not part of this report.

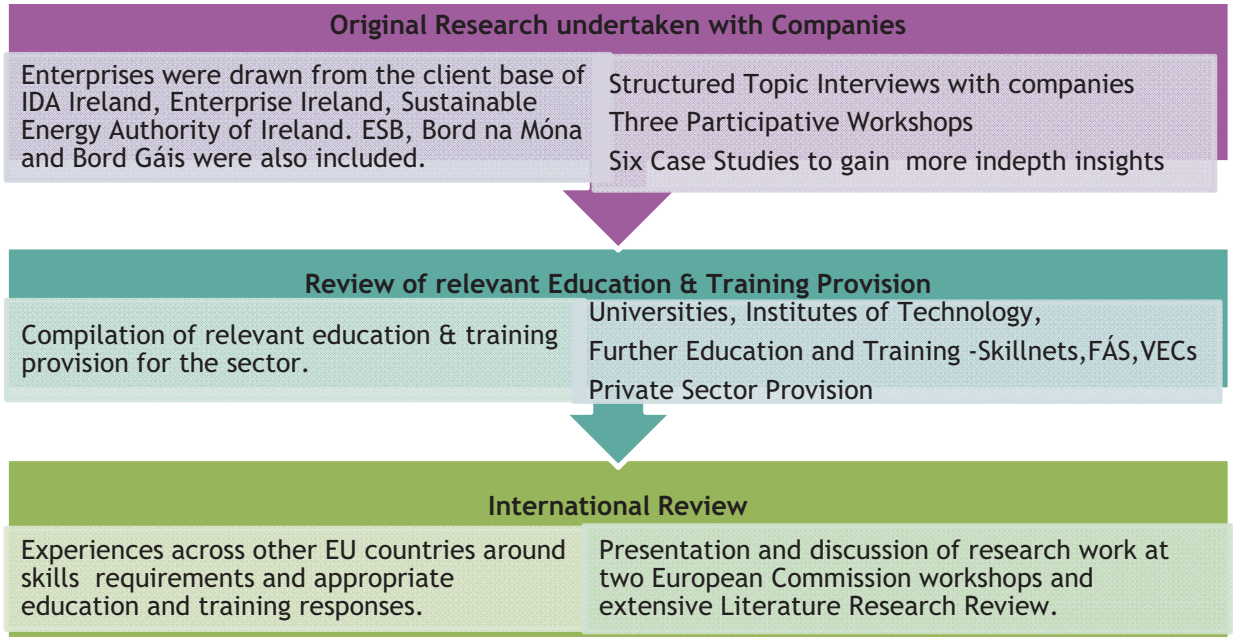
highlighted several basic technical, regulatory and planning barriers hindering investment and job creation in the green economy which needed to be addressed.

Methodology

The methodological approach comprised extensive research work undertaken with a cohort of 40 companies drawn from sub-sectors around their current and anticipated skills demand; any current skills gaps or shortages – and how these could be addressed. Secondly, information was compiled on current education and training provision in Ireland relevant to the supply of skills to the sector. Finally, the approach included an in-depth review of domestic and international research literature and current labour market responses across countries[3].

For each sub-sector there is an assessment of the current and future skill requirements within each stage of the business process in terms of changing occupational profiles, skill sets and competencies. These business stages are - (a) Research and Development (b) Pilot/Test and Design (c) Marketing and Sales (d) Manufacturing/Generation (e) Delivery and Installation (f) Operation and Maintenance and (g) Repair and Customer Support.

Figure E1: Research Approach



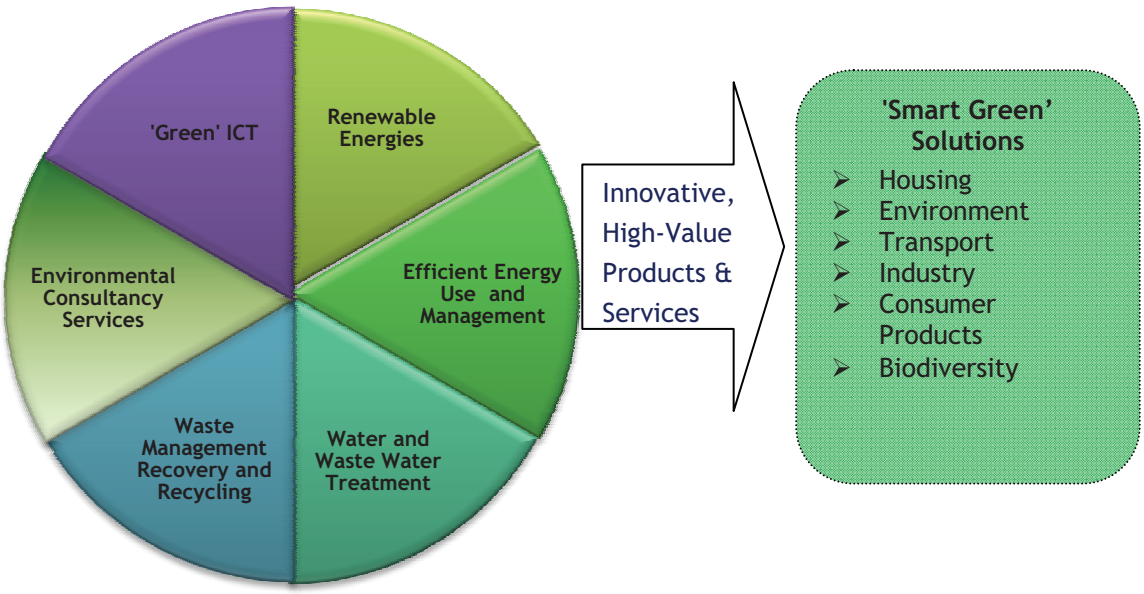
Findings drawn from the overall research work identify future skill set requirements to drive enterprise business and employment growth (job maintenance as well as job creation). A range of proactive measures are proposed to help ensure that initial education and training and continuing professional development provision are optimally aligned to addressing upskilling needs in terms of the quality, diversity and quantity of skills required.

[3] Study research findings discussed at Meeting of the Directors General for Vocational Education and Training, Genval , Belgium , Sept 2010 and Belgium Ministerial Conference, *Promoting Green Economy : a successful transition towards a competitive Low Carbon and Green Economy*, La Hulpe, Belgium, Sept 2010.

Profile of Sector

The market size of the Environmental Goods and Services sector in Ireland is estimated at approx €3.04 billion. An estimated 18,750 people are employed within the six sub-sectors included in the scope of this Study. Of these, some 5,000 are employed in the business areas of retrofitting and energy efficient improvements of housing. Enterprises deliver innovative products and services solutions across the areas of housing, environment, transport, industry, agriculture and consumer products. These solutions deliver significant economic, social, and environmental benefits and returns to enterprises, consumers and society.

Figure E 2: Employment and Business Growth Potential



Drivers of Change

Several environmental, economic and technological drivers of change are impacting on the productivity and growth within the sector. These external and internal drivers include:

- Climate change and rising energy cost pressures are resulting in changes in behaviour by consumers, enterprise and Government. EU and Domestic Environmental Directives and Regulations have been introduced which need to be complied with.
- Export opportunities arising from green economic recovery initiatives across economies. Global supply chains are responding to changing regulatory and purchasing demands – with moves by several major international companies to 'green' their supply chain.
- Technological convergence is leading to new 'green' convergent business products and services.
- Targets have been set for 16% of all domestic energy consumption to come from renewable resources by 2020, including 40% for electricity, 12% for heat consumption and 10% for transport.
- Domestic Public and Private Investment Programmes provide business growth opportunities.
- Introduction of green public goods and services procurement criteria will boost business growth.

Convergent Technologies provide a unique 'new space' for job creation in Ireland. Previously distinct and separate technologies such as ICT, biotechnology, nanotechnology and cognitive sciences are coming together. Potential 'green' business convergence opportunities for Ireland include improving energy efficiency, reducing cooling requirements of ICT equipment, decreasing Co_2 emissions from buildings, wind and wave energy technologies, the development of 'smart' grid technologies, solar energy conversion, water management and water and air filtration.

Export Opportunities

Export markets with high growth potential for Irish companies are eco-construction products and services; energy efficiency, renewable energies, water and waste; 'green' ICT and environmental consultancy services. A key challenge will be to increase the value of exports by indigenous clean tech companies, estimated at €370m in 2009 - representing an average (across sub-sectors) of 20% of their total sales.

Key issues for companies are access to business market intelligence, awareness of cultural differences; ability to form strong business and client relationships, Intellectual Property Protection and the need for due diligence and contractual information. For sustainable building, knowledge of international energy assessment systems is essential - the main ones being the UK Method of Building Energy Assessment (BREEAM) and the USA Method of Building Assessment (LEED). For companies seeking global supply chain business opportunities, the adoption of the international ISO 14001 environmental management system standard would be valuable[4].

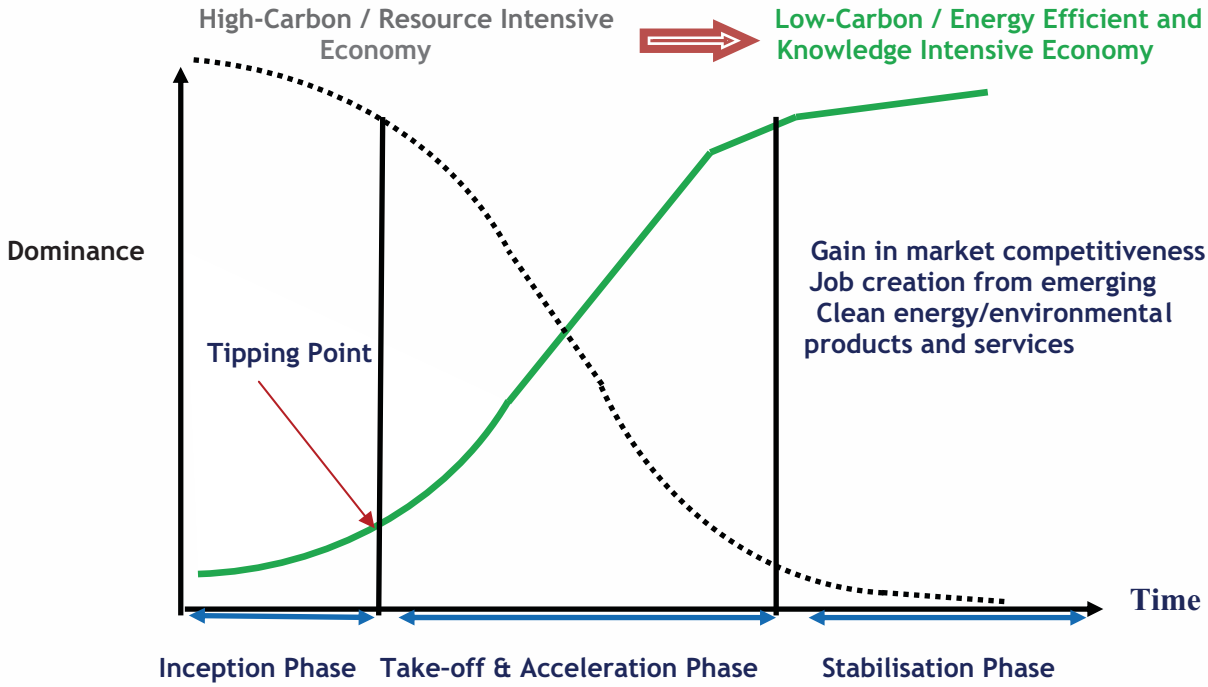
The global market for environmental goods and services (EGS) is estimated at approx €1,100 billion. A recent study commissioned by the German Environment Ministry anticipates that global EGS spending could reach €1,900 billion by 2020 (of which 33% of expenditures would be in Europe, 34% in North America, 27% in Asia and 6% the rest of the world). The sector is also attracting considerable investment and is now the third largest sector for venture capital, after ICT and Life Sciences. Export market opportunities exist particularly to the UK as a large adjacent market and into the wider EU, Middle-East, USA and China markets. The green stimulus package in China was the largest of any country, (accounting for 40% of a USD $586 billion package). The American Recovery and Investment Act 2009, included $60 billion in clean energy investments aimed at supporting the economy and creating clean energy jobs. The stimulus package in France comprised €26 billion of which 20% was designated for 'green' measures – including investment in energy efficient buildings, low carbon vehicles, high speed rail, renewable energies and grid infrastructure. Germany has dedicated €5.7 billion to 'green' technologies, Australia Aus $5.7 billion, and Canada CAD $2.8 billion. South Korea has focused its significant stimulus package on the development and use of 'green' technologies. In the Middle-East there are substantial export opportunities for water, waste water and environmental consultancy services and supply of equipment.

[4] For example, IBM has issued a new supply chain management system requirement to its 28,000 'first -tier' suppliers to establish an environmental management system and that this requirement be communicated to all 'second –tier' suppliers that are material to IBM's products- April 2010.

Transition towards a 'Smart Green Economy'

The Government's Infrastructure Investment Priorities 2010-2016[5], contains a set of priorities to assist the transition towards a 'smart green', low-carbon economy. The figure below illustrates the potential business and employment opportunities that arise as economies move towards a low-carbon/energy efficient economy – while at the same time there are also job losses in the high-carbon /resource intensive. There are 'first mover' competitive advantages for companies and countries providing new clean technology /environmental goods and services.

Figure E 3: Transition towards a 'Smart Green Economy'



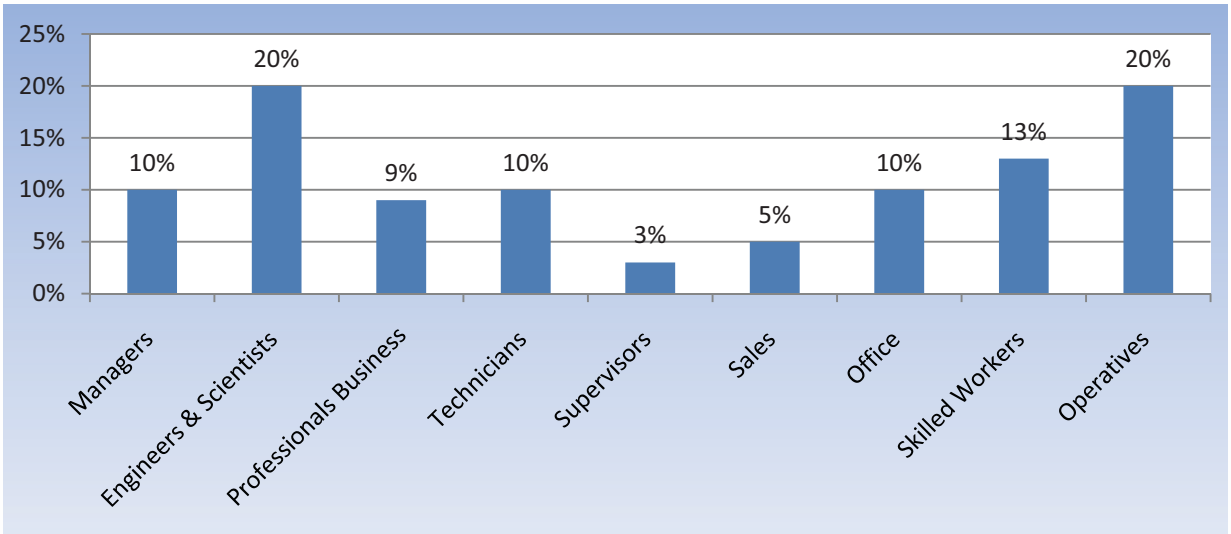
It is anticipated that the green growth transition will be an important driver of structural labour market changes with a potentially large impact on job-skill requirements[6]. Countries are supporting this transition through skills development strategies which meet upskilling needs within the workplace. A strong supply of high-skilled business, science and technology graduates is required to support this transition. In this regard Ireland has a comparative strength given its strong supply of such graduates compared to other EU countries such as Germany where the numbers of these graduates are in decline – or as is the case in the USA where there is a concern that workforce supply bottlenecks will slow the transition to a low-carbon economy regardless of the commercial readiness of the underlying technologies[7].

[5] Ireland – the Smart Economy – Investing for Growth and Jobs – Infrastructural Investment Priorities 2010-2016.
[6] John P. Martin, Director for Employment, Labour and Social Affairs, OECD, - presentation at Belgium Ministerial Conference on *Transition Towards a Competitive Low-Carbon and Green Economy*, Brussels, 2010.
[7] Due to an ageing workforce, new workers will need to fill as many as one third of USA 400,000 current electric power jobs over a five year period - a problem that will be exacerbated by the fact that US students are not graduating at the same rates in the relevant fields as in the past- Source: *Report of Taskforce on America's Future Energy Jobs, (2010)*.

Occupational Profile of Sector

Table E1 below provides a breakdown of the estimated occupational workforce profile of the sector. There are differences at sub-sector level – with a relatively higher proportion of engineers, scientists and professionals employed within the renewable energies, environmental consultancy, and 'Green' ICT sub-sectors. On the other hand, there are a relatively high proportion of skilled workers and operatives employed in the efficient energy use, and waste management and recovery sub-sectors.

Table E1: Estimated Occupational Profile of Total Sector Workforce (all Sub-Sectors) – 2010



Supply of Appropriate Skills and Talent

Companies view the supply of appropriate skills and talent as crucial for their long term productivity and competiveness. Future skills supply must be right in terms of the quality, diversity and quantity of skills required. There are core business, engineering and ICT skill requirements within companies across sub-sectors. Additional expertise is also required in emerging areas such as wind, solar, geothermal, biomass, tidal and wave energy. There are also a range of generic competences important across occupations. These include entrepreneurship, commercial awareness, maths proficiency, foreign language fluency, critical thinking, problem-solving, ICT, creativity, finance, ability to work independently, communications and influencing and teamwork.

The need for improved mathematical proficiency at all skills levels is a key requirement. The view of companies is that while the mathematical proficiency requirement of the workplace has gone up, the proficiency levels of recruits has not improved in line with this. Staff must be more proficient in applying their mathematical knowledge in 'real-life' business situations – such as engineers calculating the commercial returns of a project, technicians and electricians analysing data from energy instrumentation and controlling devices or skilled workers providing advice to householders on economic returns arising from various energy efficient heating and lighting appliances.

Sixty percent of the companies surveyed stated that they had current skill gaps and 40% had experienced a difficulty in filling some positions. Around one third of companies had recruited abroad, mainly for smaller numbers of experienced and specialist professional staff, particularly within the Renewable Energies and 'Green' ICT sub-sectors. Skill gaps identified within sub-sectors related to business, engineering and ICT skills as well as non-technical skills. These skill gaps arise from the drive by companies to generate export and domestic business growth, utilise new and emerging technologies in their processes and products, achieve productivity improvements through changes in work organisation and meeting customer demand for more efficient and innovative product and service solutions.

From the research work with companies, Irish graduates are generally well regarded for their technical skills and competences – but specific weaknesses cited relate to their maths proficiency, business acumen, communication skills and problem-solving capability. It was considered that education and training provision should have a stronger practical dimension with greater opportunities for collaborative interdisciplinary 'real life' business project work as part of course work. Companies consider that well structured internship programmes with identified learning goals and outcomes would enhance graduate employability.

Figure E 4: Key Skill Sets and Competency Requirements across Occupations

Core Professional Skills	Technical Skills
Business Skills: Export Marketing and Sales and Finance/Business Development **Core Engineering & ICT Skills** with 'add-on' specialism knowledge: wind, solar, wave, tidal **Sustainable Building:** Use of sustainable materials and renewable energy systems	▪ Commercial Awareness ▪ Mathematical Proficiency ▪ Foreign Language fluency ▪ Sustainability Awareness ▪ ICT Proficiency ▪ Finance – economic payback ▪ Health and Safety
Organisational Skills	**Personal Skills**
▪ Project Management ▪ Planning and Co-ordination ▪ Decision Making and Analytical Skills ▪ Ability to apply theory to practice ▪ Team working	▪ Entrepreneurship ▪ Leadership ▪ Critical Thinking ▪ Integrity-to act ethically ▪ Communication and Influencing ▪ Initiative and Adaptability ▪ Creativity and Innovation

In relation to companies surveyed, staff training mainly focussed on the development of professional and technical staff. Training for skilled workers and operatives mostly related to meeting regulatory and health & safety requirements and acquiring knowledge of the operation of specific pieces of equipment/processes. In the companies surveyed, around 20% of the workforce was female. This low ratio is not just an issue in Ireland, as women are underrepresented in the engineering profession across most countries. Around 14% of engineers in Ireland are female compared to 16% in Germany, and 26% in Sweden.

Anticipated Level of Skill Demand

It is anticipated that job opportunities will arise within domestic and export markets including:

a) New jobs opportunities arising in the 'Clean Tech' space from company start-ups;

b) Employment creation within existing firms – through increasing the proportion of their existing environmentally related business and/or new business within domestic and export markets;

c) Additional jobs arising from companies outside the sector at present 'going green' as a result of changing processes and products in response to market demand;

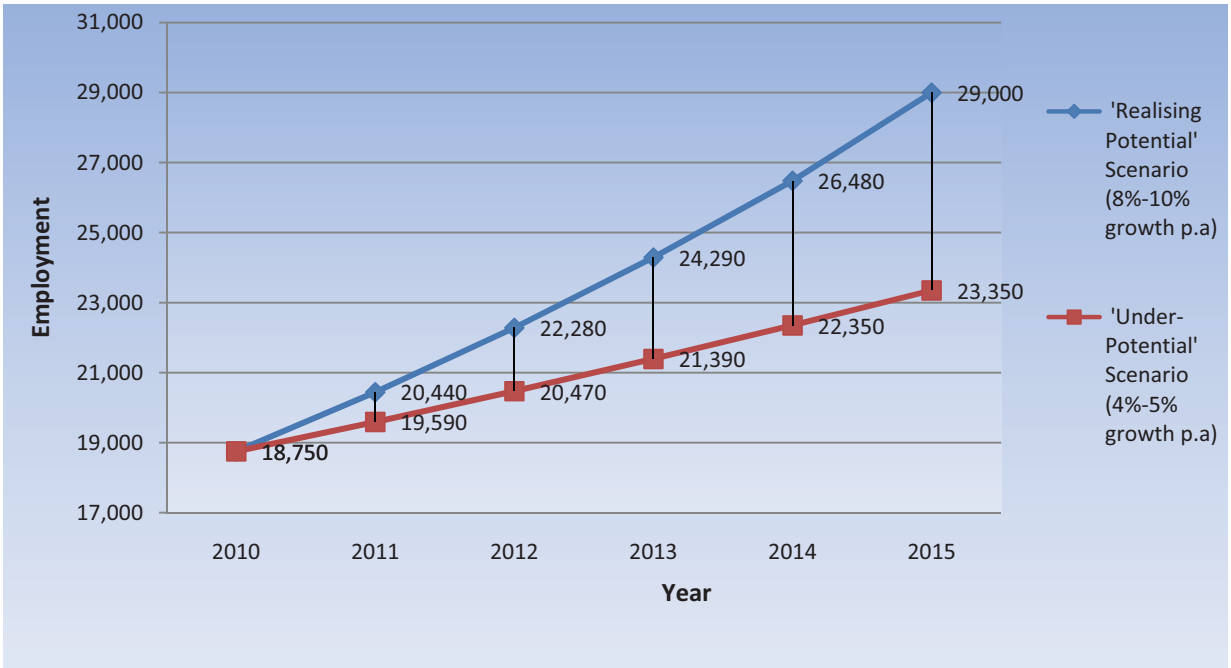
d) Where substitution of employment may take place.

It is also important, when assessing future skills demand, to consider the level of 'replacement' demand (resulting from retirements, people leaving the workforce for various reasons etc) as well as 'expansion' demand. Utilising comparable replacement data information an estimate of 3.5 % per annum is used to calculate replacement demand[8].

Scenarios of Anticipated Level of Skills Demand

The Study outlines two Scenarios of the level of future skills demand. Both Scenarios anticipate levels of employment growth – on the basis of strong international and domestic drivers of growth, feedback from companies and the opinion of key informants. There are some uncertainties however around the actual level of this growth. The two Scenarios are therefore based upon different assumptions made around external and internal drivers of business and employment growth.

Figure E 5: Anticipated Total Sector Employment under the two Scenarios

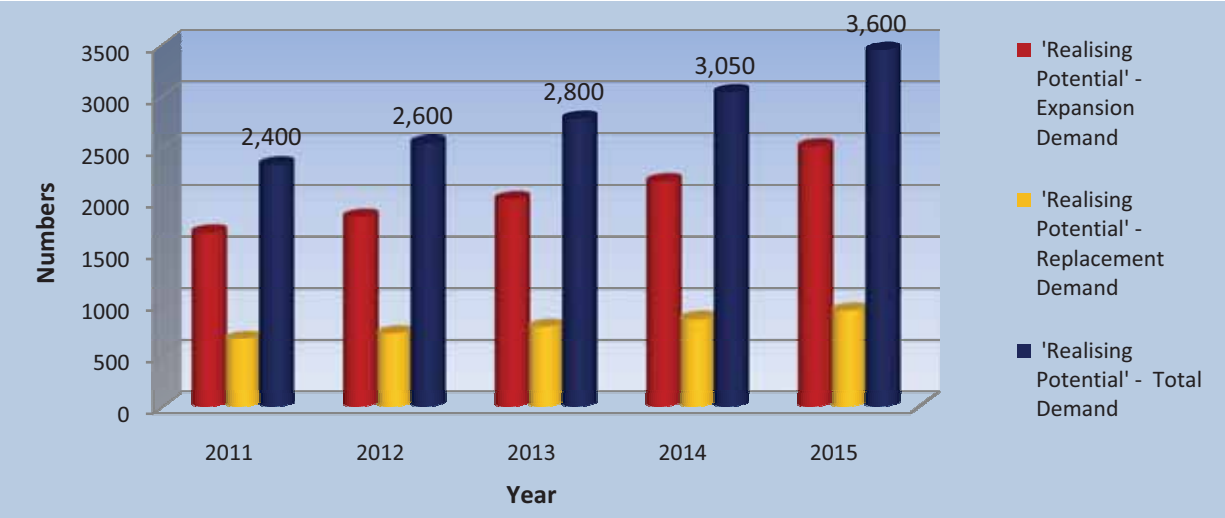


[8] The replacement rate would be higher for more mature utility companies like the ESB.

The first Scenario is termed the 'Realising Potential' Scenario – on the basis that it would be possible to meet these stretch targets if identified barriers to the development of the sector are addressed. In this regard, the Scenario is considered challenging but realisable.

This Scenario is based on an anticipated increase in employment of between 8%-10% per annum over the period 2010-2015. Under this scenario employment rises to around 29,000 by end of 2015. Total skills demand (expansion demand plus replacement demand) over the period averages 2,900 per annum (2,400 in 2011 rising to 3,600 in 2015).

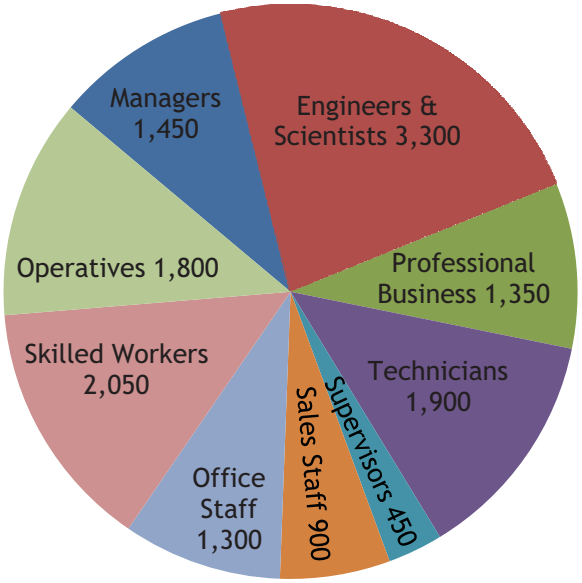
Figure E 6: 'Realising Potential' Scenario-Anticipated Total Skills Demand



The following figure provides a breakdown of the estimated total skills demand by main occupational group for the period up 2010-2015 under the 'Realising Potential' Scenario. Taking into account both 'expansion' and 'replacement' demand, it is anticipated that around 14,500 employment opportunities would arise over the next five years.

In terms of the workforce profile, it is anticipated that the proportion of engineers and scientists and technicians and skilled workers share in total employment will increase. The proportion of managers and business professionals is likely to remain the same. It is anticipated that while the proportion of operatives will decrease, employment opportunities will continue to arise resulting from job expansion and replacement demand.

Figure E 7: 'Realising Potential' Scenario-Anticipated Total Skills Demand broken down by Occupational Groups over period 2010-2015



The second Scenario termed the 'Under Potential' Scenario, also anticipates an increase in the employment level – but at half that of the 'Realising Potential' Scenario. Assumptions under this Scenario include that there is slower progress towards the removal of identified barriers to the development of the sector. The outturn of this Scenario would mean that the sector has under-performed in terms of its future potential. Under this Scenario, employment rises to 23,350 by the end of 2015. Anticipated total skills demand (expansion demand plus replacement demand) over the period averages 1,600 per annum (1,500 in 2011 rising to 1,800 in 2015).

Skills Demand - Quality and Diversity of Skills

In terms of the quality and diversity of skills, the Study identifies several skills gaps across the sector both for business, engineering and ICT skills as well as non-technical skills. A summary outline of the skills requirements by sub-sector is as follows.

Renewable Energies

Ireland has set an individual target of 16% energy consumption from renewable resources by 2020. The target is to be met by renewable energy providing 40% of energy consumption in the electricity sector, 10% of energy consumption in the transport sector and 12% of energy consumption in the heating sector by 2020. Key drivers of demand for skills in the renewable energy sub-sector are:

- Skills capability requirements to develop export market opportunities overseas;
- Installation, servicing and maintenance of renewable energy installations;
- The development of a distributed grid connection system incorporating small-scale and community-owned renewable power supplies;
- Development of smart network technologies including smart metering, ICT and electric cars.

Managers, professional engineers & scientists and technicians comprise the main occupational groups within the sub-sector. Core skills requirements across occupations are for high-level technical skills combined with commercial awareness, marketing, finance, communications, and project management skills. There are ongoing requirements for power engineers for the development of the electricity grid into a 'smart distribution network' – requiring core engineering skills with a bias towards electrical engineering – combined with business and ICT systems skills. As increasing numbers of wind turbines, solar energy, marine, and other renewable technologies get up and running here and abroad, there will be an increasing demand for engineering and technician skills (combination of electrical, mechanical and electronic skill sets) to support their operation and maintenance. The growth in electric vehicle charging points will give rise to demand for technician and skilled workers with a combination of electrical/electronic and mechanical skills. Potential risks militating against the demand for skills include the need to improve time periods for granting permissions in relation to the building of on and offshore wind farms and the need to upgrade and improve access to the grid.

Energy Efficiency Use and Management

Buildings are estimated to use over 40% of Europe's energy and to create 40% of its carbon dioxide emissions. The Government has committed to achieving, by 2020, a 20% reduction in energy demand across the economy through energy efficiency measures. The funding for SEAI's sustainable energy schemes along with funding the low-income housing retrofit programme is planned within a multi-annual National Retrofit Programme to be introduced in 2011. An investment of €880m in energy efficient upgrades to residential, public and commercial buildings is planned between 2010 and 2016. Key drivers of demand for skills in the sub-sector are:

- Developing the skills capability base to take advantage of export market opportunities;
- Government commitment to achieving, by 2020, a 20% reduction in energy demand across the economy through energy efficiency measures - including a 33% reduction in public service use.
- Leveraging and expanding existing skills in energy management gained through the early adoption of the Irish Energy Management Standard (IS393), and for export services, the implementation of the recently adopted European Energy Management Standard EN16001.

Identified skills gaps in the sub-sector are for energy engineers and sales staff with the technical ability to sell overseas. Architects and professionals also require enhanced skills in the eco-design of sustainable building and use of renewable energy efficient products. New skill demands are for energy auditors to assess the scope for energy savings and efficiency initiatives and for home energy consultants to assess energy efficiency in dwellings. There is a requirement for the upgrading of workers for the external and internal insulation of existing buildings and new build construction. Skilled workers require systems knowledge of energy efficient heating and lighting appliances to ensure their optimal usage by householders. In relation to the training of persons to carry out Building Energy Rating assessments, the numbers now trained and certified are sufficient to meet the level of current demand in the immediate future.

Water and Waste Water Treatment

In recent years, there has been a significant investment in waste water treatment infrastructure, both for new plants and the upgrading of existing plants to meet the requirements of the *EU Urban Wastewater Treatment Directive*. The Governments *Infrastructure Investment Priorities 2010 – 2016 Framework* envisages that €3.4 billion will be invested in upgrading and expanding the national water services infrastructure over the next five years. Key priorities will be on sustainable development and complying with EU and national environmental requirements for wastewater treatment and drinking water. Investment will include addressing existing infrastructural deficits, particularly in urban centres with a focus on minimising the amount of treated drinking water lost through leakages in the distribution network. Key drivers of demand for skills in the sub-sector are:

- Skills capabilities required to win export market opportunities arising overseas;
- Proposals for water metering when implemented will require new skill sets;
- Sludge management is an increasingly important area requiring attention;
- Major issues of groundwater protection, Geographic Information Systems (GIS) network management, specialist leak detection and repair;
- Extensive use of private sector Design-Build-Operate and long term operate and maintain contracts for wastewater.

Skilled workers and operatives account for a relatively large proportion of the workforce. Demand for skills relates to the design, planning installation and use of modern technology in the operation and maintenance of water and waste water treatment facilities. Demand for skills is also dependent on domestic water metering going ahead. When it does, the main volume of skills required will be for skilled workers for welding using polyethylene materials and installing water meters (there are current business opportunities in the UK, where between 30% and 40% of domestic properties are metered and this level is expected to increase to 80% by 2020). There will also be a requirement for a small number of professional experts to plan and manage water metering development. New and emerging skills are for plumbers specialising in rainwater harvesting – diverting rainwater off-roof to be used for toilet flushing, gardening and cleaning.

Waste Management, Recovery & Recycling

In Ireland, the use of landfill waste is decreasing while the use of waste recovery is increasing. Three waste incinerators have been licensed by the Environmental Protection Agency – but have yet to commence operations. The Governments' *Infrastructure Investment Priorities 2010 – 2016 Framework* indicates that over €100m is to be invested in important waste infrastructure over the next five years. The private sector is also planning significant investment in emerging technologies and new business systems. Key drivers of demand for skills in the sub-sector are:

- Export business and services opportunities arising overseas;
- New skills required in recycling and reuse technologies;
- Highly competitive nature of the waste collection sector; and
- Changing dynamics of the market due to the introduction of new technology e.g. incineration.

There were no current major skills gaps identified for the sector- apart from odour control as a niche area. Most of the future skill requirements are related to the scaling up the delivery of services and the operation and maintenance of existing and new technologies – particularly for additional skilled staff. Anaerobic digestion is one such new technology where new skills will have to be learnt and developed over time. There is little experience in Ireland of the incineration or managing of hazardous waste. The training and development of skills for the operation and maintenance of incinerator(s) is likely to be provided by the contractor engaged to design, plan and build same.

Environmental Consultancy

While the focus of environmental consultancy in recent years has been on domestic opportunities, the sector is now more likely to focus on export growth while maintaining domestic capacity within housing, commercial property and publically funded infrastructure. New areas of business opportunity in renewable energies, energy efficiency and water & waste management are likely to increase in the coming years. Key drivers of demand for skills in the sector include:

- Different skill sets are required for international consultancy than for domestic consulting;
- New Business opportunities arising in growth energy areas such as renewable energies, water conservation, energy efficiency, waste recycling/recovery - at home and abroad.
- Smooth Implementation of the *Water Services Investment Programme*.

Communications, commercial awareness and mathematical proficiency are core requirements. Adaptability and flexibility in the undertaking of various assignments is the main attribute required for those working in environmental consultancy. Companies are making greater use of redeployment of staff to ensure the most efficient use of existing skills and human resources. Anticipated skills requirements are for energy engineers with knowledge of both UK and USA methods of building energy assessment; environmental engineers for the prevention, control and remediation of environmental health hazards; and electrical engineers for consultancy in renewable energies.

'Green' ICT

'Green' ICT includes energy efficiency improvements within the ICT sector and for software solutions across other industries, such as for wind power management, smart buildings, efficient management of water supplies and water loss reduction, waste management and transportation. Key drivers of demand for skills in the 'Green' ICT sub-sector are:

- Export business and services opportunities arising from growth in 'Green' ICT knowledge management opportunities world-wide;
- Providing the cross disciplinary understanding and skill sets to identify and realise opportunities for ICT applications to facilitate carbon management, smart electricity networks, automated energy monitoring and energy and environmental management software applications; and
- Taking into account the increasing need for an 'intelligent' pan-utility approach towards the provision of water, waste water, electricity and solid waste services.

There are strong business growth prospects for the sub-sector in terms of ICT infrastructure management to reduce energy consumption in buildings and industry and enhanced energy efficient approach for the provision of water, energy, waste, transport services. The 'green agenda' is a significant part of companies' future sales proposition. For example, IBM recently introduced a new supply chain management initiative that encourages suppliers to align their own environmental management systems with the international green operating standard, ISO 14001.

Professional engineers and scientists account for a high proportion of the workforce. Core skills for companies include software engineers and subject experts educated to Masters and PhD level. The requirement will be for high-skilled professional engineering and science staff with the commercial awareness required to drive the development of existing and new products.

An outline of key skill sets requirements for occupations by each sub-sector over the next 3 to 5 years is outlined in the following table.

Table E 2: Key Skill Sets Requirements for Occupational Groups by Sub-Sector in the next 3 to 5 Years

	Renewable Energy	*Energy Efficiency*	*Water & Waste Water*	*Waste Management,*	*Consultancy Services*	*Niche "Green" ICT*
Managers	• Export Marketing • Leadership • Governance • Finance /Contracts • Project Management	• Export Marketing • Leadership • Governance • Finance /Contracts • Project Management	• Export Marketing • Leadership • Governance • Finance • Project Management	• Commercial Acumen • Leadership • Governance • Finance/contracts	• Project Management • Leadership • Governance • Finance / Business	• Pan-utility approach re provision of water, waste, electricity services • Business Planning
Professional Engineers & Scientists	• Smart Technology • Integrating Systems • Electrical Engineering • Marine & Tidal • Foreign Languages • 'Green Chemists'	• R & D • Power Generation • Product Knowledge • Home Energy • Foreign Languages • Energy Saving	• Project Management • Design & Installation of Infrastructure • Asset Managers– Water Meters • Foreign Languages	• New Technology • Anaerobic Digestion • Hazardous Waste • Incineration Tech • Mechanical/Biological Treatment	• Masters qualifications – business & technical • Grid planning • Tendering • Traffic Planning • Maths & Finance	• High end IT disciplines • Software applications • Cross – disciplinary skills- IT/Business • Researchers with commercial orientation
Professional Business	• Regulations & Standards • Contracts & tendering	• Sustainable buildings • Regulations & Standards • Contracts & Tendering	• Managing Water Assets • Regulations and Standards	• Transport logistics • Regulations & Standards	• BREEAM Assessment • LEED Assessment • Health & Safety	• Business Analysis • Mathematical & Statistical Skills
Technicians	• High Voltage Electrical • IT- Smart Grids • Wind Turbines • Marine/Tidal	• Installing and Servicing small scale renewable technologies • Retrofitting	• Increased multi-skilling	• Anaerobic Digestion • Thermal Treatment of Municipal Waste	Not applicable	Not applicable
Supervisors	• Managing Dispersed Teams • IT skills new software	• Managing Dispersed Teams • IT skills new software	• Increased multi-skilling	• Managing dispersed teams	Not applicable	Not applicable
Sales & Marketing	• Technical Sales • Foreign Languages • 'Green' public procurement	• Technical Sales • Foreign Languages • Green public procurement • Building Regulations	• 'Green' public procurement • Foreign languages	• Green public procurement • Foreign Languages	• Foreign Languages • 'Green' public procurement	• 'Green' public procurement • Foreign Languages
Office Admin	• ICT Skills	• ICT Skills	• ICT Skills	• ICT Skills	• ICT Skills	• ICT skills
Skilled Workers	• Operation & Maintenance • Customer Service	• Systems knowledge • Retrofitting/ Insulation • Customer pay-back advice	• Installation of meters • Operation & Maintenance	• New Technology • Thermal treatment of municipal waste	Not applicable	Not applicable
Operatives	• Health & Safety • Customer Service	• Retrofitting • Health & Safety • Customer Service	• O&M • Health & Safety • Meter installation	• Health & Safety • Customer Service	Not applicable	Not applicable

Conclusions and Recommendations

This Study identifies the future skills needs of enterprises engaged within the 'green economy' in Ireland and proposes a range of measures to ensure that their skills base will drive business and employment growth. There are strong global and domestic drivers of change positively impacting on the growth of the sector. At the same time, there are identified challenges which need be addressed for growth potential to be realised. If substantive progress were made, it is anticipated that employment in the sector would rise from 18,750 in 2010 to 29,000 by 2015. Taking into account 'expansion' and 'replacement' demand, around 14,500 employment opportunities would arise over the next five years - with much of the demand for higher-skilled staff.

A substantive number of programmes are underway/or planned around 'green skills' education and training provision (approx €25m – €30m per annum). In total some ninety-one Higher Education courses were identified. The supply of high-level skills from business, computing and engineering disciplines are also essential for the sector as they are for the wider economy. There is scope for improving the alignment of current provision towards meeting the skills needs of enterprise while optimising the use of existing funding and expertise. There should be closer collaboration between industry and education/training and between institutions themselves for the design, development and delivery of education and training provision[9]. It is more feasible to have one centre build up expertise within an emerging specialism area, and then share the module(s) across the system. This should be done on an all-island basis to make optimum use of available expertise and resources.

A key requirement for future skills supply is that the focus should be on the development of core Business/Engineering/ICT skills. New areas of expertise could best be acquired through the integrated provision of 'add-on' specialism modules that build upon core skills within the third and fourth year of undergraduate programmes and through Masters Degrees/Postgraduate Diploma provision (important for continuing professional development). Further education and training programmes including those for unemployed should take account of the relevant competences individuals may already possess and provide upskilling in the additional specialism area(s) required to avail of employment opportunities.

It is worth noting that several of the recommendations made are also similar to those made in previous skills reports particularly the need to improve the alignment of education and training provision to meet the skills needs of enterprise, enhance management development, improve the levels of mathematical proficiency and the need to increase structured graduate placement and internship opportunities.

In the following recommendations reference is made to National Qualification Framework (NFQ) levels. An outline of the NFQ is given in Appendix 9.

[9] For example Veolia Water (Ireland) have indicated that there are model courses for water and waste water operations , provided for at Veolia Water's 12 training campuses around the world , which third-level education could draw upon for the benefit of the overall sub-sector (see case study : Veolia Water Ireland).

Recommendations

The following recommendations are made in terms of ensuring that enterprise skills capability needs are met over a 3-5 year time period in terms of providing:

- the quality of skills required to drive business growth in the sector;
- the diversity of skills to reflect the complexity of business; and
- a sufficient quantity of skills to fill employment opportunities arising in the sector.

(1) Align Education and Training Provision to Enterprise Needs

A substantive number of programmes are underway/or planned around 'green' education and training provision (approx €25m – €30m per annum). The supply of high-level skills from business, computing and engineering disciplines are also essential for the development of the sector as they are for the wider economy. There is significant scope for improving the alignment and coherence of this provision towards meeting the skills needs of enterprise while optimising the use of existing funding. The following recommendations are made in this regard.

- Focus higher level education and training provision for the sector on the development of core business, engineering and ICT skills with knowledge of emerging areas being acquired by way of 'add-on' specialism modules in the third and fourth year of undergraduate programmes and through Master Degrees and Postgraduate Diplomas. Programme delivery should be flexible, modular, accredited and made available via blended learning techniques and distance learning.
- Strengthen collaboration between Universities and IOT's with business around the development, design and delivery of specialism modules on emerging skills topics. Expertise should be built up within specific Universities/Colleges for the design and development of new modules and qualifications, drawing upon curricula already developed by other European and USA institutions. These modules should then be shared within the system. The criteria for identifying a centre of expertise should include the quality of its research and teaching capabilities. A similar approach should apply to further education and training provision which are of shorter duration.
- Further education and training programmes including those for unemployed should take into account the relevant competences individuals may already possess and provide upskilling in the additional specialism area(s) required to help them avail of employment opportunities in the sector.
- Integrate the development of generic competencies into curricula at all levels – including entrepreneurship, commercial awareness, sustainability, critical thinking, problem-solving, maths, finance, foreign languages ICT, creativity, communications and teamwork. Opportunities should be made available within the learning process for collaborative project work.
- Ensure the continuing professional development of staff in third level and further education and training in new emerging skills topics and flexible teaching and delivery methods.

Responsibility: HEA, Universities, Institutes of Technology, FÁS, Skillnets, VECs, Enterprise.

(2) Enhance Management Development (NFQ Levels 7-9)

There are significant potential business opportunities for the export of environmental goods and services. At present, an average 80% of the sales of indigenous companies in the sector are generated in the domestic market compared to 20% from exports. For business to grow, Irish companies in the sector need to be more successful in internationalising their business. Key considerations for companies are access to business market intelligence, awareness of cultural differences and forming strong strategic business and client relationships. The level of human resource planning within smaller sized enterprises needs to improve to ensure that their skills base will drive business growth.

- Build on existing support within Enterprise Irelands *Leadership 4 Growth* and *International Selling and Transform* programmes for indigenous companies to internationalise their business. Key skill requirements are for export marketing and sales, market specific knowledge, finance, managing partnerships, foreign language fluency, project development, environmental standards and regulations (BREEAM and LEED for building energy assessment, EN16001/ ISO4000 for global supply chain opportunities), legal /contracts, Intellectual Property and understanding of cultural differences. Provision should be benchmarked against best practice in competitor countries.

  Responsibility: Enterprise Ireland

- Incorporate key competences into management development programmes for all companies including export marketing and sales, business development, leadership, eco-design of products and processes, Lean Six Sigma, finance and human resource planning (within smaller sized companies). Provision should be flexible, modular, accredited and accessible via distance learning.

  Responsibility: Enterprise Ireland, IBEC, ISME, SFA, Engineers Ireland, Skillnets.

(3) Build Engineering and Business Skills Capability (NFQ Level 8 & 9 &10)

Key skill requirements for Engineers and Scientists across sub-sectors are for core business, engineering and ICT skills capability with commercial awareness and product knowledge. Additional knowledge of new emerging areas could be build upon core skills in an integrated way. There is also a demand for related ICT skills and telecommunications skills - relating to the upgrading of the grid and connection of renewable energy sources.

- Focus professional engineering programmes on the development of core engineering skills, which offer 'add-on' specialism modules - wind, wave, solar, geothermal, biomass energy etc.
- Meet demand for power engineers – requiring core engineering skills with a bias towards electrical engineering – combined with ICT and business skills.
- Meet demand for business analysts experienced in renewable energies to work with software engineers on solutions for environmental problems. Also for principal researchers who can help translate research ideas into a commercial business proposal.
- Meet demand for professionals requiring knowledge of sustainable building design and energy efficiency standards, including carbon management and accounting and knowledge of overseas construction techniques and regulations - UK Method of Building Energy Assessment (LEED) and USA Method of Building Assessment (BREEAM) – and for an integrated approach towards the design and provision of related transport, water and waste services.

Responsibility: HEA, Universities, Institutes of Technology, Enterprise.

(4) Develop Technicians' Skills Capability (NFQ Level 7)

Technicians are a key occupational group across sub-sectors - particularly within the renewable energies and energy efficiency sub-sectors. There is a high demand for technicians with skills and experience in renewable energies for the installation, servicing and maintenance of on-shore wind turbines and other renewable energy power sources.

- Meet strong demand for technician's skills within education and training provision. A main emerging skill will be for wind turbine service technicians with electro-mechanical skills; for technicians with high-voltage ICT skills (electrical technicians with enhanced ICT Skills); for skills re the installation and servicing of small scale renewable technologies; installation of electric car charging points; and the operation and maintenance of biomass installations. Telemetry skills are required around the remote control of water/waste water plants.
  Responsibility: Institutes of Technology, Skillnets, Enterprise.

(5) Develop Sales & Marketing Skills Capability (NFQ Level 5-6)

Sales and marketing skills are essential for helping companies generate export and business growth. Around 5% of staff within companies are engaged in sales and marketing.

- Provide for the upskilling requirements of marketing and sales staff around opportunities that will arise through the introduction of green public procurement especially on the concept of life -cycle costing – the requirement will be for short updating programmes.
- Meet demand for technical staff to sell internationally. Technical knowledge, foreign language skills, legal awareness regarding tender/contracts and ICT skills are important requirements.

  Responsibility: Enterprise, Institutes of Technology, Skillnets.

(6) Develop Skilled Workers' Capability (NFQ Levels 5-6)

For skilled workers there is a move towards multi-skilling in areas of installation, operation and maintenance work. There is also a requirement for the upskilling in the energy upgrading and retrofitting of buildings. Requirements while high in numbers are for short training periods. In relation to the training of persons to carry out Building Energy Rating Assessments, the numbers now trained and certified are sufficient to meet demand in the immediate 2-3 year period.

- Ensure skilled workers gain system integration knowledge around optimum energy efficiency lighting and heating systems installations for housing and buildings and advising consumers on their economic paybacks- large numbers are involved but the upskilling period is short.
- Anticipate training demand that will arise from the planned installation of domestic and commercial water meters. There would be 400 additional jobs engaged in such work.
- Anticipate demand for skills required for the maintenance of electric vehicles.
  Responsibility: Institutes of Technology, FÁS, Skillnets, VECs
- Monitor and communicate the oversupply compared to demand in relation to the numbers now trained and certified to carry out Building Energy Rating Assessments.

  Responsibility: Sustainable Energy Authority of Ireland.

(7) Develop Operatives Skills Capability (NFQ Levels 3-4)

There is a relatively high proportion of skilled workers and operatives within the energy efficiency & management; and waste management and recovery sub-sectors (the highest proportion of operatives is found within the waste management and recovery sub-sector). Demand for operative skills will be linked to the scaling up of the manufacturing, operation and maintenance business stages of renewable energies and with the level of continuing investment in the retrofitting of housing and buildings. Another area of demand will be within the water and waste water sub-sector and in the thermal treatment of municipal waste. Given the work environment there is a need for health and safety training.

- Meet demand for workers to perform a range of activities in upgrading internal and external insulation in existing and new buildings. Customer service skills and health and safety are important.
- Anticipate demand requirements for between 100-150 skilled operators in anaerobic digestion.

Responsibility: FÁS, VECs.

(8) Increase Structured Graduate Placement and Internship Opportunities

Companies consider that well structured internship programmes would enhance graduate employability and benefit both the student and the employer. Internships should have identified learning goals and outcomes with credits awarded towards the achievement of a qualification award. Graduates benefit from the practical skills experience acquired through structured placement with companies.

- As part of the process of enhancing innovation in domestic SMEs, focussed support for graduate placement should be examined by Enterprise Ireland, including the development of a funding mechanism which would be flexible and responsive to the companies needs. A funding support of 50% of salary for the first year could be considered.
  Responsibility: Enterprise Ireland.
- Increase availability of structured internship opportunities for students within companies at home and abroad (including through Enterprise Ireland's recently introduced *Graduates for International Growth* programme). Learning should be linked to the awarding of qualifications.
  Responsibility: HEA, Universities, Institutes of Technology, Business, Engineers Ireland, ICT Ireland.
- Support the development of networks of smaller companies who could provide an internship opportunity between them - to overcome the difficulty of smaller companies lacking the capacity to provide internship opportunities.
  Responsibility: Enterprise, IBEC, SFA, ISME, Engineers Ireland.

(9) Communicate Career Opportunities on offer within the Sector

Companies anticipate that they will increase their employment level over the next five years – particularly for higher skilled staff – in line with the changing skills profile of their workforce. It is important that the sector will be able to draw upon a quality supply of science, engineering and technology (STEM) skills – at all levels to meet anticipated 'expansion' as well as 'replacement' demand requirements. A relatively low proportion of the workforce in the sector are female (20% in the companied surveyed).

- Communicate the attractive professional career opportunities on offer within this growing sector. Support the uptake of STEM subjects particularly for more women into engineering disciplines.
  Responsibility: Enterprise, Engineers Ireland, ICT Ireland, Software Ireland.

(10) Enhance the Mathematical Skills of the Workforce

Mathematics and science skills are key competency requirements across all occupations in the sector. The view of companies is that while the mathematical proficiency requirements of the workplace have gone up, the mathematical standards of those leaving the educational system have remained the same.

- Incorporate 'real life' mathematical examples from business into curricula. Increase the numbers of students taking Higher Level Leaving Cert Maths.
- Develop mathematical knowledge skills modules at different NFQ levels to meet the upskilling needs of workers across occupations.

  Responsibility: NCCA, FETEC, NALA, VECs.

(11) Develop Skills within Enterprise across the Economy

Environmental concern impact on enterprises and organisations across the economy, around how they can improve resource usage and energy efficiency in buildings and manufacturing processes, reduce waste through use of new materials and production processes, and how they can gain market share through responding to consumer demands for more environmentally friendly products and services. There were a number of skills requirements arising for enterprises both private and public across the economy that have been identified through the work of this Study. These are:

- Communicate energy and resource efficiency savings awareness within companies and homes.

  Responsibility: Sustainable Energy Authority of Ireland.
- Promote an eco-design approach within business aimed at reducing the environmental impact of products throughout their life cycle.

  Responsibility: Enterprise.
- Upskill procurement staff within the public service implementing green public procurement procedures – particularly on the concept of life-cycle costing.

  Responsibility: Sustainable Development Unit, Department of the Environment, Heritage and Local Government.

Chapter 1: Introduction

1.1 Aim of Study

This Study, *Future Skills Needs of Enterprises within the Green Economy in Ireland,* was undertaken by Forfás on behalf of the Expert Group on Future Skills Needs (EGFSN). The EGFSN has the task of advising Government on future skills requirements and associated labour market issues that impact on national potential for enterprise and employment growth. It has a central role in ensuring that the labour market needs for skilled workers are anticipated and provided for.

The 'green economy' has been identified an area of potential business and employment growth (job creation as well as job maintenance) across many countries. There are growing business opportunities in domestic and export markets for innovative products and services which deliver economic, social and environmental benefits for enterprises, consumers and society.

The aim of the Study is to ensure that the future skills base of enterprises engaged within the 'green economy' in Ireland will enhance employment and business growth potential and sustain competitiveness. The Study identifies the future skills requirements of enterprises and proposes a range of proactive measures to ensure these needs are met. The Study will inform education and training providers on the required alignment of their programmes to meet enterprise needs – and help individuals to make an informed decision around their career choice.

The overarching vision set by the Steering Group for the Sector is:

'For Ireland to be the benchmark 'smart green' economy for population centres under 20 million by 2015 - and to have the skills base and talent to drive innovative and high value products and services and maximise future business and employment growth potential'.

The Terms of Reference for the Study and membership of the Steering Group are provided in Appendix 1 and 2.

1.2 Background

Building Ireland's Smart Economy - A Framework for Sustainable Economic Renewal[10], sets out a framework to address the current economic challenge and enable Ireland to return to sustainable growth. It recognises the business opportunities that exist for investment and jobs in the clean energy / 'green' enterprise sector – and the need to provide for the skills to realise this. Government strategy includes a movement away from fossil fuel-based energy production through investment in renewable energy and the promotion of the 'green' enterprise sector.

The 'green economy' has been identified as an area of potential business and employment growth across many countries – including Ireland. However, it is recognised that there is no exact boundary

[10] Building Ireland's Smart Economy: A Framework for Sustainable Economic Renewal (2008).

around the sector and that it is not well defined within existing classification systems. It includes companies created specifically to service the environmental goods and services market as well as those within more traditionally defined sectors (such as engineering) that are diversifying in response to growing market opportunities.

Companies and regions that become leaders in 'green' innovation, design and technology development are seen as more likely to retain and create new 'green' jobs. These new job opportunities may be viewed in a relative and highly dynamic context[11].

The skills and competencies required by enterprises within the 'green economy' can be either new or modified skill sets – or an amalgam of existing skills. Business projects often require professional and skilled workers from different disciplines working together in multi-disciplinary teams. As well as technical and professional skills there are requirements for personal competences such as leadership, creativity, innovation, team working, and communication skills.

1.3 Objectives of the Study

The focus of this Study is on sub-sectors of the 'green economy' identified as having substantial export growth and employment potential (jobs maintenance as well as jobs creation). These include sub-sectors identified within the *Report of the High Level Group on Green Enterprise – Developing the Green Economy in Ireland*[12]. An additional sub-sector-'Green ICT' has also been added, as it has been identified by the OECD as an area of increasing business potential[13]. Within each sub-sector there is a focus on the current and future skills requirements of occupational groups in terms of their changing job profiles, skill sets and competencies.

The sub-sectors included within the scope of the project are:

- Renewable Energies
- Efficient Energy Use and Management
- Water and Waste Water Treatment
- Waste Management, Recovery and Recycling
- Environmental Consultancy Services
- 'Green' ICT Applications/Software

These sub-sectors are overlapping and interactive with enterprises engaged both within and across sub-sectors. A high degree of technological convergence is occurring – especially in key nexus points like energy and ICT.

[11] United Nations Environment Programme, (2008), Green Jobs Initiative.
[12] The potential for a Green International Financial Services Centre was also highlighted in the report and the IFSC Banking and Treasury Group under the Department of the Taoiseach is currently developing plans to establish such a centre.
[13] OECD (2009),*The impact of the crisis on ICT and ICT related employment.*

The specific objectives of the Study are to:

1 Determine the current size and skills profile of enterprises engaged within the green economy (as defined).

2 Identify the main economic, social and environmental drivers of change impacting on the productivity and growth of enterprises within the 'green economy' and assess their likely influence on future business growth and employment trends.

3 Estimate future skills demand for occupational groups - management, professional, technical, sales and marketing, skilled trades and operative. This includes both changing skills demand arising from skills profiles in existing jobs being modified (job maintenance) as well as new skills requirements arising from additional jobs being created.

4 Assess the adequacy of (a) the current and planned supply of relevant skills from the education and training system, (b) the pool of skills within the existing workforce and (c) potential recruitment - which together are required to meet anticipated skills demand.

5 Identify any anticipated enterprise skills capability gaps/shortages likely to arise (including from technological convergence).

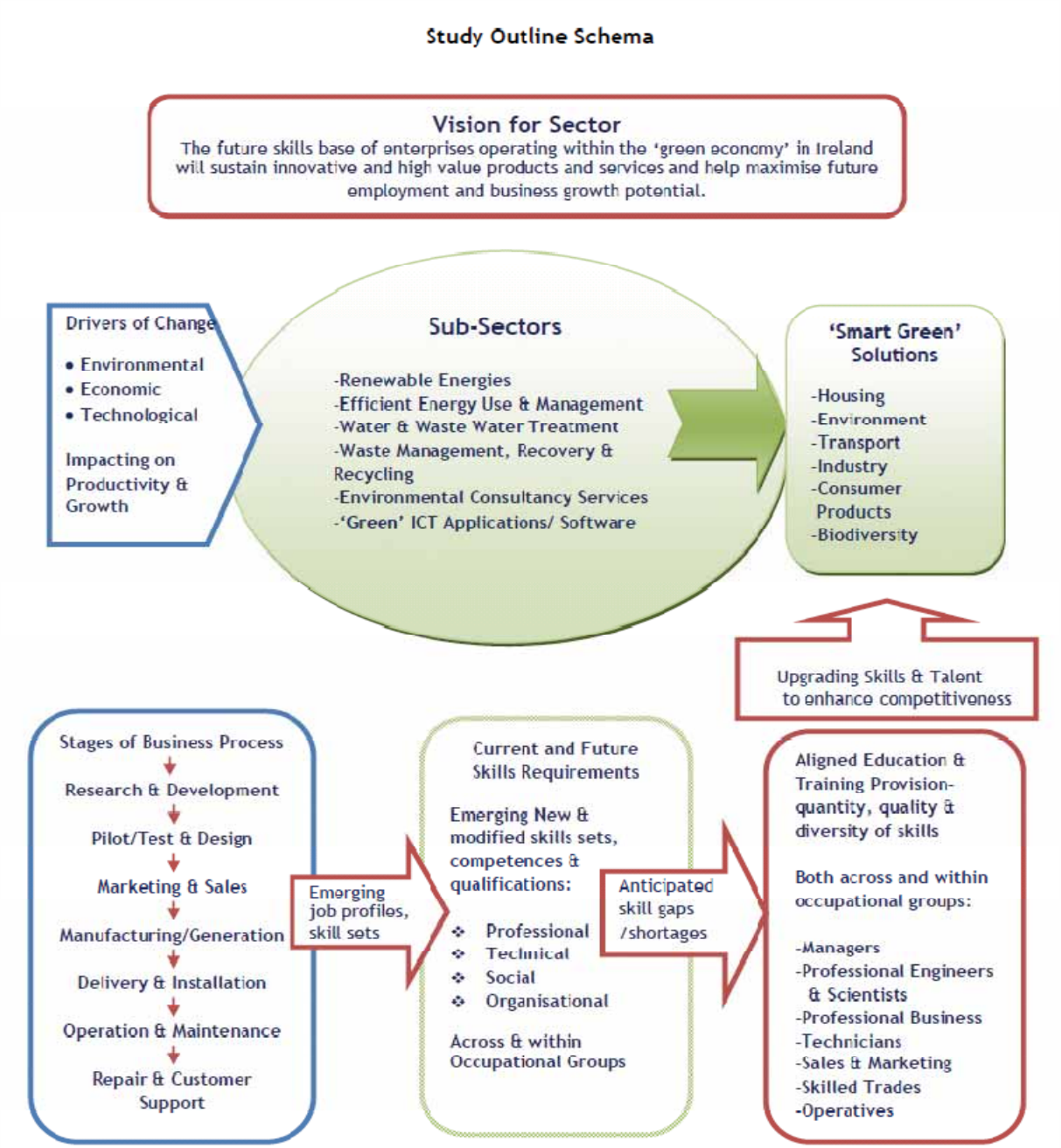
6 Put forward recommendations on proactive action(s) required to ensure that the supply of skills will be sufficient to meet the future skills base needs of enterprise.

Recommendations made focus on the use and redirection of funding aimed at upskilling the workforce and include third level education, continuing professional development and training programmes for the unemployed. The time period for consideration of the implementation and impact of recommendations is up to 2015.

1.4 Methodology

The focus of the Study is on those enterprises engaged in sub-sectors of the 'green economy' identified as having substantial export growth and employment potential. Within each sub-sector there is an examination of the current and future skills requirements of occupational groups within each stage of the business process in terms of their changing job profiles, skill sets and competencies. These stages are - (a) Research and Development (b) Pilot/Test and Design (c) Marketing and Sales (d) Manufacturing/Generation (e) Delivery and Installation (f) Operation and Maintenance (g) Repair and Customer Support. The Study makes recommendations around current and future education and training provision aimed at upgrading the skills base and talent available to boost business potential and competitiveness. Figure 1.1 below outlines the methodological approach taken to meet the objectives of the Study.

Figure 1.1: Methodological Approach



The methodology included an original piece of research undertaken with a cohort of 40 companies within sub-sectors around their current and future skills requirements; any current/or anticipated skills gaps or shortages – and their proposals to ensure that future skills needs are met. Companies were drawn from IDA Ireland and Enterprise Ireland supported companies as well as several

companies certified and monitored by Sustainable Energy Authority of Ireland regarding the green homes scheme – retrofitting-eco construction. State owned enterprises which included ESB, Bord Gáis and Bord na Mona are also included. The research comprised three main elements:

- Structured Telephone Interview Survey – at senior company representative level based upon a structured topic questionnaire format - developed by EGFSN Secretariat and Steering Group;
- Three workshops were held– two in Dublin and one in Cork. These were also based upon a structured topic format. This included a presentation and discussion of preliminary research findings from the interview survey stage to companies and a wider group of stakeholders;
- Six case studies were undertaken with selected companies for more in-depth case study work – designed to explore skills gaps and future skills needs in greater detail. These were undertaken through company visits to carry out structured face-to-face interviews.

For the first time, information on current education and training provision in Ireland relevant to the supply of skills to the green economy has been complied[14]. While the primary focus is on the courses specifically related to green technologies and environmental studies, the compilation also provides an overview of the supply of computing, engineering and business skills provision relevant to the performance of enterprises within the green economy.

The approach included a review of domestic and international research and literature and best practice examples in several comparator countries.

1.5 Report Outline

The outline of the report is as follows:

Chapter 1 – Introduction

Chapter 2 – Profile of the Sector

Chapter 3 - Key Drivers of Change

Chapter 4 - International Trends – Employment and Skills Change

Chapter 5 – Country Profiles – Developments within the Green Economy

Chapter 6 - Research into Enterprises Skills Requirements

Chapter 7 - Assessment of Future Demand for Skills

Chapter 8 – Assessment of Supply of Relevant Skills

Chapter 9 – Conclusions and Recommendations

[14] The compilation of information on current ' green skills ' related education and training provision in Ireland was undertaken by the FÁS SLMRU Unit.

Chapter 2: Profile of the Sector

2.1 Introduction

There are an estimated 18,750 people employed by enterprises operating within the six sub-sectors included in this Study. This includes approx 5,000 persons employed within the energy efficiency sub-sector on the insulation and retrofitting of homes and buildings and the installation of energy efficient products and services. The market size of the Environmental Goods and Services sector in Ireland is estimated at €3.05 billion. Opportunities exist for companies to export – particularly to the UK as an adjacent, large market and into the wider EU market, Middle-East, USA and China- given the size of their green energy stimulus packages and a move towards achieving a low-carbon economy. There is also potential to attract environmental goods and services related foreign direct investment seeking to service the UK and European markets in particular.

There are a number of major enterprises engaged within in the EGS market – both private and commercial semi-state companies which account for a high percentage of the business market. Examples are Glen Dimplex, Kingspan, Airtricity, Greenstar, Dalkia Ltd, ESB, Bord Gáis and Bord na Móna. The majority of firms are small and medium sized enterprises which have been established over the last decade. There are also several subsidiaries of UK and EU parent companies, such as RPS Consulting, providing environmental consultancy services across several sub-sectors.

Several companies have been successful in developing business models to commercialise R&D intensive environmental goods and services related technologies. An example of growing R&D investment activity is the announcement by the United Technologies Group to establish a €15m investment hub for European collaborative research in renewable energies, energy efficiency and integrated building systems based initially at the Tyndall National Institute, University College Cork.

The *Report of the High-Level Group on Green Enterprise* highlighted the potential for the green economy to make a significant contribution to Ireland's employment and exports in several areas. The report estimated the global market for environmental goods and services at approx €1,100 billion in 2007 with an expectation that it would grow by 35% by 2015 [15]. It also highlighted several technical, regulatory and planning barriers hindering investment and job creation in the 'green economy' in Ireland which need to be addressed. The report identified key strengths Ireland has in terms of capturing enterprise opportunities in several niche areas. These are:

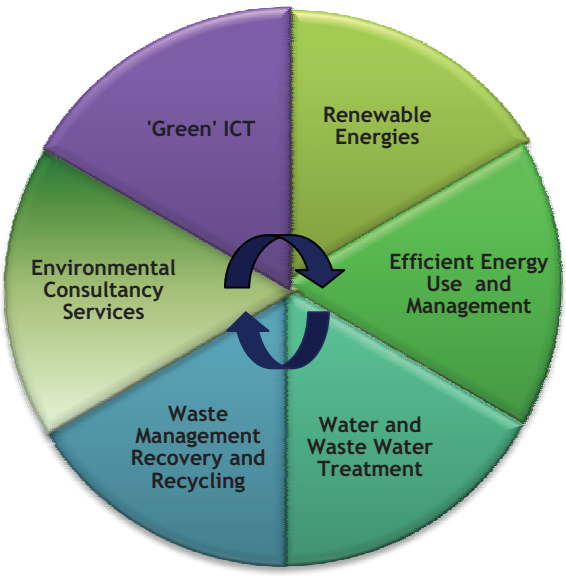
- Ireland's location is one of the most favourable for wind and ocean energy in the world;
- Ireland has strong science & technology, finance, and food sectors which can attract foreign owned companies into its 'green economy';
- Ireland's indigenous R & D base is strong and capable of competing at an international level;
- Ireland's significant investments in improving environmental performance and creating the infrastructure and capabilities can be leveraged to support green enterprises; and
- Ireland's strong reputation as a 'Green Island' could be built upon.

[15] With a further projected value of €2,200 billion by 2020 (according to German –based Roland Berger Strategy consultants – as referenced in UN Green Jobs Report (2008).

2.2 Scope of the Study

The following sub-sectors are included within the scope of this project. They have been identified in various reports as having high employment and export growth potential for Ireland.

Figure 2.1: Green Economy Sub-Sectors



The estimated annual domestic market values of these sub-sectors are as follows:[16]

- Renewable Energies – €700 million
- Water and Waste Water Treatment – €1,000 million
- Waste Management Recovery and Recycling– €550 million
- Environmental Consultancy Services – €560 million
- Efficient Energy Use & Management- of which public expenditure on the energy efficiency retro-fitting of homes is €130 million (with an additional €110m leveraged from the private sector).
- 'Green' ICT applications and services (market value not estimated).

2.3 Profile of Sub-Sectors

A profile of each of the sub-sectors included in the Study is as follows:

- **Renewable Energies**: from sources such as wind, solar, hydro, tidal, geothermal and biomass. It is estimated that worldwide investment in sustainable energy reached €140 billion in 2007[17]. Patents in renewable energies are the most dynamic group of environmental technologies[18]. Ireland has some of the best wind and wave resources in the world and is an ideal location for

[16] The Report of the High-Level Group on Green Enterprise Opportunities, provided estimates on the first four sub-sectors. SEAI is source for estimated value of the Efficient Energy Use and Management sub-sector.
[17] Source: Building Irelands Smart Economy.
[18] OECD (2010), *Science,Technology and Industry Scoreboard 2009*, OECD.

the research and development of systems that can allow high levels of intermittent energy sources on a conventional grid system or as part of a smart grid [19].

- **Efficient Energy Use and Management**: Homes account for a quarter of the energy used in Ireland. As part of the *EU Directive on the Energy Performance of Buildings*, a Building Energy Rating (BER) Certificate requirement was introduced for all new domestic dwellings from Jan 2007 and extended to all existing buildings offered for sale, rent or lease from Jan 2009. Eco-construction techniques and technologies are increasingly required to comply with building regulations, both here and abroad. Business opportunities are for the development of energy efficient products and materials; assessment of buildings' energy efficiency; design and construction of energy efficient buildings, and energy efficiency retrofitting of existing housing.

- **Water and Wastewater Treatment:** This market is being driven by a high level of public investment in infrastructure and opportunities globally in leak control, monitoring and supply networks and water analysis. Substantial investments have been made in drinking water and waste water treatment infrastructure since 2000. The compliance rate with the *EU Urban Waste Water Directive* has risen from 25% to 92%. While progress has been made towards meeting EU Water Framework Directives goals by 2015, some problems persist with bacterial contamination in smaller group water schemes and a high leakage rate from urban supply systems[20].

- **Waste Management, Recovery and Recycling**: includes the collection, transport, processing, recycling of disposable waste material both to reduce their effect on human health and environment, and/or to recover resources from them. The *National Waste Prevention Programme 2009-13*, included a suite of projects to overcome the barriers to waste prevention by increasing awareness of the environmental impact of excess consumption and waste; the diversion of biodegradable municipal waste from landfill; and improve the co-ordination of regional waste management plans, in particular those for biodegradable and hazardous waste.

- **Environmental Consultancy Services:** consisting of new business opportunities driven by increasing levels of compliance with EU and national legislation as well as specialised services provided to companies. Consulting opportunities are arising in areas such as carbon offsetting, energy audits, environmental impact assessments, integrated pollution prevention and control, licensing, waste permits, water evaluation chemical analysis, and energy retrofitting.

- **'Green' ICT:** Applications and Software includes energy efficient microprocessors; efficient batteries; controllers and sensors for 'smart' products; energy efficient servers and PC's; smart grids and solar cells. A recent OECD report noted that, notwithstanding the current economic crisis, activities such as 'Green' ICT applications and software are increasing employment as firms invest in this technology to remain competitive[21].

[19] IDA Clean Tech commentary,
[20] OECD (2010), *OECD Environmental Performance Review, Ireland.*
[21] OECD (2009), *The Impact of the Crisis on ICT and ICT Related Employment.*

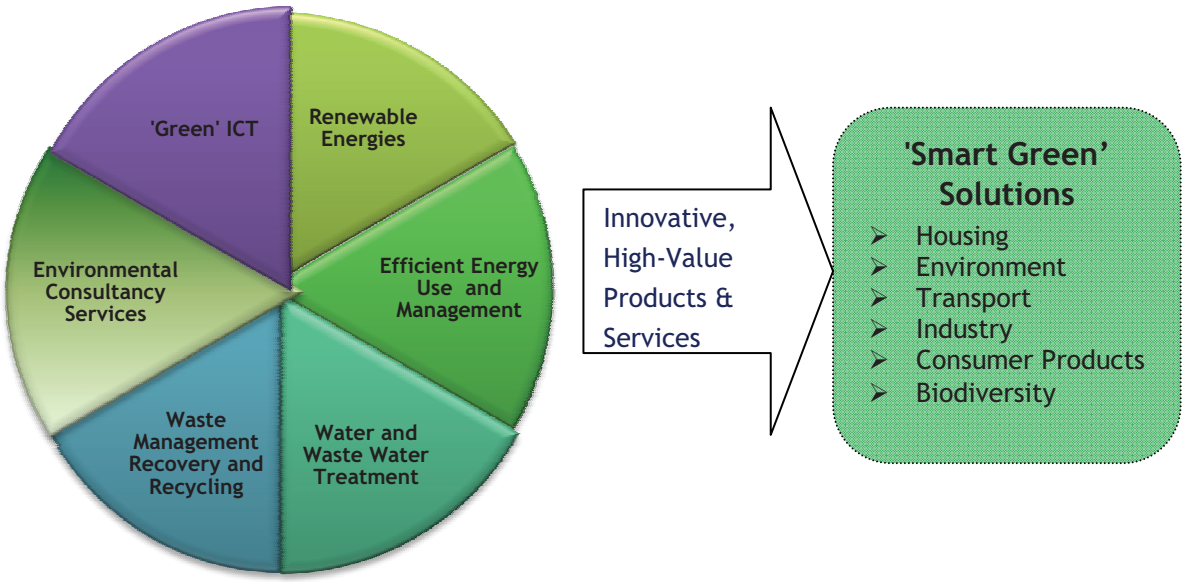
2.4 Nature of Enterprises

The sub-sectors included are overlapping and interactive, with many larger enterprises operating across a number of sub-sectors. The majority of SME's operate mainly within one sub-sector – particularly those involved in retrofitting – and in some cases two. While the main proportion of companies' business is in environmental goods and services, this varies – as firms may also engage in business activities in related sectors – for example engineering products and services. In larger ICT companies and commercial semi-state companies, 'green' related business activities are often undertaken within a newly set up division.

2.5 'Smart Green' Solutions

Enterprises within the six sub-sectors deliver innovative products and services solutions across the areas of housing, environment, transport, industry and consumer products. These solutions deliver economic, social, and environmental returns to enterprises, consumers and society. Convergent Technologies provides a unique 'new space' for job creation in Ireland. This convergence is driving a revolution in how people live and work. A practical example of this interconnectivity is IBM's first Smarter Cities Technology Centre located in Dublin where IBM is building-up a highly skilled and cross-disciplinary team to help cities around the world better understand, interconnect and manage their core operational systems - transport, communication, water and energy. The team will work with city authorities, universities, businesses and experts from the IBM Research and Software Development Lab in Ireland to research, develop and commercialise new ways of making city systems more connected, sustainable and intelligent.

Figure 2.2: 'Smart Green' Solutions



Chapter 3: Key Drivers of Change

Several global and domestic economic, environmental and technological drivers of change are influencing the growth of the 'green economy' in Ireland. These are:

3.1 Global Drivers

1. Climate Change pressures are driving a process of change by government, consumers and enterprise – resulting in a realignment towards a cleaner, low-carbon economy[22]. Volatile energy costs and concerns about supply certainty are encouraging enterprises and consumers to consider action on energy efficiency.

2. In 2007, the EU endorsed an integrated approach to climate and energy policy. A series of targets were set to be met by 2020 (collectively known as the 20/20/20 targets). These are:
   - A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels;
   - 20% of EU energy consumption to come from renewable resources- double the 2006 level;
   - 20% reduction in EU primary energy use compared with projected levels.

3. Need to comply with EU and domestic Environmental Directives and Regulations (such as the Integrated Pollution Prevention Control, Waste Electrical and Electronic Equipment, restriction of Hazardous Substances, and Water Framework Directives).

4. Investments in 'green' recovery initiatives form a significant part of economic stimulus packages. EU investment in green initiatives comprised €18 billion of a €30 billion stimulus budget[23]. R&D investment is central to the uptake of new and improved technologies.

5. Global supply chains are responding to changing regulatory and purchasing demands. There are 'first mover' competitive advantages for companies in developing new clean energy/ environmental goods and services.

6. Technological change - previously separate technologies such as ICT, biotechnology, nanotechnology and cognitive sciences are coming together. These areas of overlap are generating new convergence business opportunities[24]. There have been advances in low- carbon sustainable building materials and products and energy systems etc.

[22] SEAI (2009), Motherway B, Walker Neil, Ireland's Low-Carbon Opportunity - An Analysis of the Costs and Benefits of Reducing Greenhouse Gas Emissions.
[23] The Commissions European Economic Recovery Plan (2008), recommends investment in green measures including alternative and sustainable energy sources, increased energy efficiency, low CO_2 emission cars and public transport networks.
[24] Forfás Annual Report 2007.

7. In 2008 the EU proposed a target of 50% of all EU's public procurement tendering procedures to be 'green' by 2010 (expressed in both number and value of contracts concluded in the sectors for which common core green public procurement criteria have been identified.

3.2 Domestic Drivers

1. **Building Ireland's Smart Economy: A Framework for Sustainable Economic Renewable** – sets out a range of actions to reorganise the economy over the next five years including Government intention to harness the State's industrial, educational and enterprise resources for the development of the green technology sector.

2. **Ireland's Energy Research Strategy**: The remit of Science Foundation Ireland has been extended to include sustainable energy and energy efficient technologies. This research is building up a capacity of highly skilled researchers in sustainable energy and environmental related technologies and is being deployed through projects within Centres for Science, Engineering and Technology around adaptive sensor networks; and through Strategic Research Clusters, including ICT for sustainable and optimised building operation; advanced for solar energy conversion; advanced geotechnologies; and material science. The Charles Parsons Energy Research Awards cover ocean energy, biofuels, and power grids.

3. **Ireland's National Climate Change Strategy, 2007-2012,** outlines measures aimed at limiting our greenhouse gas emissions by 2012 to 13% above the 1990 level.

4. **Ireland National Renewable Resource Targets for 2020** are for 16% of all energy consumption to come from renewable energy sources by 2020[25]. The National Renewable Energy Action Plan (2010) sets out in detail how national targets are to be met including:
   - 40 % of consumption in the electricity sector to come from renewable sources by 2020 - with an interim target of 15% by 2012. This target is being assisted by 'feed-in-tariff' prices for onshore and offshore wind, ocean energy and biomass CHP. Wind accounted for 10% of all electricity generation in 2009 - with an installed wind capacity of 1,264 MW. For ocean energy there is a target of generating 500MW of power by 2020. Over the next two years, €400 million will be spent by the private sector building an additional 400 MW of wind power.
   - 12% of consumption in the heating sector to come from renewable sources by 2020-with an interim target of 5% by 2010 (compared to 3.6% in 2008, with industrial biomass energy use then accounting for 70% of all thermal renewable energy). Geothermal energy will contribute towards meeting this target[26].
   - 10% of energy consumption in road and rail transport to come from renewable energy sources by 2020. This can be compared to 1.5 % in 2009, the majority of which was biofuel.

[25] In 2007, fossil fuels accounted for 96% of all energy use in Ireland. Approximately €6 billion was spent on imported energy.
[26] A Geothermal Energy Development Bill is currently being drafted to allow for the licensing of companies to explore for and develop geothermal energy sources (Sept 2010)

Indigenous production accounted for 43% of biofuels used or stockpiled in 2008[27]. There is a target that 10% of all vehicles will be electrically powered by 2020.

5. The **Ocean Energy Development Programme, 2008-2012** is fast-tracking the development and commercialisation of ocean energy technologies. The consent process for energy developments on the foreshore is to be modernised.

6. **Eirgrid will invest €4 billion up to 2025** building a new electricity transmission system to connect into renewable energy resources, under the Grid 25 Strategy. The East-West interconnector between Ireland and Wales is to be completed in 2012. The 500 MW of interconnection between Ireland and Wales when added to existing 400MW interconnection with N.Ireland will represent around 14% of total generation capacity when complete. **The ESB zero emissions plan** for 2030 is backed up with a €22 billion investment programme to 2020. Half of this investment will be devoted to (a) direct investments in renewable energy projects and (b) initiatives supporting sustainability such as smart meters and smart networks (there are plans to place 21,000 **'smart' meters** in Irish homes as a test project prior to the planned roll out of the new smart grid countrywide). **Bord Gáis has a €5 billion investment strategy to develop the gas network and clean energy technologies.**

7. The ***National Energy Efficiency Action Plan*, (2009-2020),** has a target of achieving 20% energy efficiency savings in 2020 as compared to the average use over the period 2001-2005. This includes a 33% targeted improvement in energy efficiency for the public sector. A new **National Retrofit Programme** will be introduced in 2011 building upon investment of €130m in 2010 which aims to reduce energy costs and carbon emissions in homes and business. The new programme will bring together the Home Energy Saving Scheme[28] administered by the SEAI and the Warmer Homes Scheme (which provides insulation and energy efficient improvements support for low income housing) along with supports for business and the public sector.

8. The Governments *Infrastructure Investment Priorities 2010 – 2016 Framework*, indicates that €3.4 billion will be invested aimed at upgrading and expanding the national water services infrastructure over the next five years. The National Waste Prevention Programme 2009-13, aims to overcome the barriers to waste prevention and improve the co-ordination of regional waste management plans to achieve national waste targets particular for biodegradable and hazardous waste.

9. Ireland's **National Biodiversity Plan 2002**, sets out a range of actions aimed at securing the conservation and sustainable use of biodiversity and its enhancement.

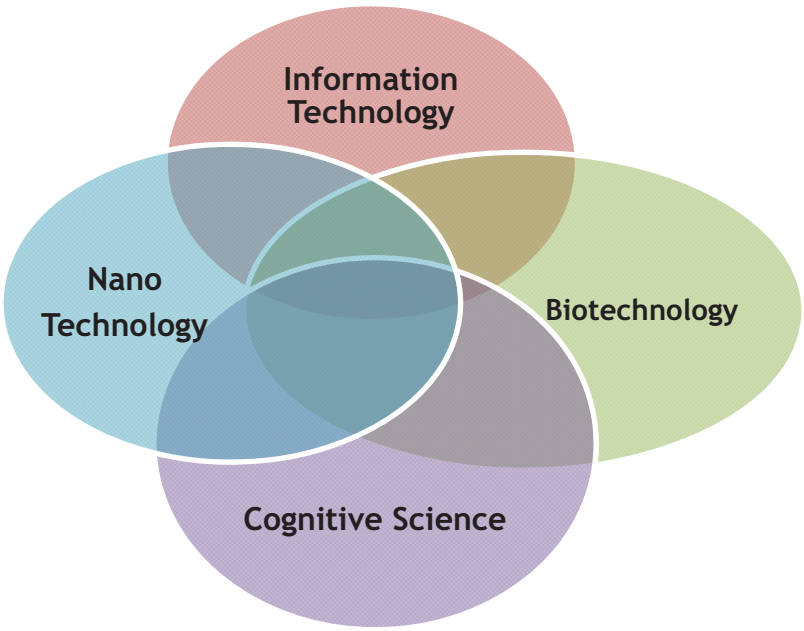
[27] Renewable Energy in Ireland, 2010 Update, Sustainable Energy Authority of Ireland, May 2010.
[28] The Home Energy Saving Scheme provides grant assistance to homeowners for energy efficiency retro-fitting measures including attic and wall insulation, high-efficiency boilers, hearting controls and Building Energy Rating (BER) assessments.

10. **Green Public Procurement Opportunities** - The annual procurement budget of the Irish public sector is in the order of €16 billion. The introduction of an EU target of 50% of all public procurement tendering procedures to be 'green' will 'move the market' towards providing environmental goods and services. The *Renewed Programme for Government* (2009), plans new public procurement procedures and guidelines to ensure that green criteria are at the centre of all state procurement, including public-private partnerships.

3.3 Technological Convergence

The rapid pace of advances in science and technology is giving rise to synergies in key sectors such as ICT, biotechnology, nanotechnology and cognitive sciences. Overlaps between these previously distinct and separate technologies are leading to new products and services business opportunities. A high degree of technological convergence is occurring in nexus points like energy and ICT. Given its strength in the ICT and Biotechnology sectors, Ireland is well placed to capture future enterprise opportunities, particularly in domains in which a strong ICT capability is a prerequisite. There is an opportunity for Ireland to brand itself as an ideal location for new convergent technology business products and services by enhancing its 'value proposition' for such operations - including inward investment, joint venture operations, and domestic industry growth. These include wind and wave energy technologies allied to the development of 'smart' grid technologies, solar energy conversion, improving energy efficiency in manufacturing, reducing cooling requirements of ICT equipment, decreasing CO_2 emissions from buildings, bio fuels and bio waste transportation, fuel usage, water management, water and air filtration and the management and recovery of waste.

Figure 3.1: Synergy of Convergent Technologies



As technological convergence increases it will impact on skills requirements in several ways. Technologies will emerge which need to be understood by professionals across a range of

disciplines. Deep knowledge and experience in disciplines like biology, chemistry, computer science, engineering and cognitive science will be essential. This requires a sufficient output and quality of science, engineering and technology graduates and a high level of national mathematical achievement. Interdisciplinary collaboration is required between marketing, design and technical professionals for the development of commercial applications. The essential competencies required for successful collaboration are creativity, innovation, communication and team-working skills. These skills can be developed through project based group work at all levels of education and within business itself.

3.4 Export Market Opportunities

Significant business opportunities arise from the export of environmental goods and services. Key considerations for companies are access to business market intelligence, awareness of cultural differences; forming strong strategic business and client relationships, establishing a local presence, Intellectual Property protection, and the need for due diligence and contractual information. For sustainable building opportunities, knowledge of international energy assessment systems is essential–the main ones being the UK Method of Building Energy Assessment (BREEAM) and the USA Method of Building Assessment (LEED). For companies seeking international supply chain business opportunities adoption of the international green operating standard, ISO 14000 environmental management system standard/EU Eco-Management and Audit Scheme[29] are valuable.

Green stimulus and investment packages in the USA, China, Middle-East and other major countries offer export market opportunities[30]. These are outlined as follows.

USA

The American Recovery and Investment Act 2009, included $60 billion in clean energy investments. This will see a doubling of the production of alternative energy over the next three years. The funding includes provision for:

- $11 billion for a smarter grid to move renewable energy from rural places where it is produced to the cities where it is used, as well as for 40 million smart meters to be installed in homes.
- $5 billion for low-income home weatherisation projects.
- $4.5 billion to 'green' federal buildings and so cut their energy bills.
- $6.3 billion for State and local renewable energy and energy efficiency projects.
- $600 million in 'green' job training programs, comprising $100 million to expand line worker training programs and $500 million for green workforce training.
- $2 billion in competitive grants to develop the next generation of batteries to store energy (Advanced Battery Grants Programme) and $400 million for electric vehicle projects.
- $2.5 billion in research grants awarded on a competitive basis.

[29] The Irish National Accreditation Board (INAB) is the competent body handling registrations in Ireland for the EU Eco-Management and Audit Scheme (EMAS). The scheme is a voluntary environmental management system (EMS), under which companies and other public organisations evaluate, manage and continuously improve their environmental performance. The latest revision (EMAS III) came into effect on January 2010 and was strengthened by the integration of ISO 40001. Currently, across the EU , 4,400 organisations are EMAS-registered.

[30] Source: Enterprise Ireland Green Stimulus Event, April 2010.

China

The 'green' stimulus package in China was the largest of any country (accounting for 40% of a USD $586 billion package). Coal comprises 70% of energy consumption and one third of all industrial waste. Ninety percent of domestic waste is released into rivers without treatment. Identified environmentally related export market opportunities are for:

- Wind energy resources – has the greatest export market potential.
- Solar Energy resources – but has not developed as fast as expected due to cost.
- Biomass Energy resources – from agricultural, domestic and municipal waste.
- Ocean Energy Resources – a small number of pilot projects are underway around the coastline – some regions are looking for investors.
- Water and Waste Water Treatment – currently 20% of cities and 70% of towns have no waste water treatment plants.

China's stimulus policies comprise direct fiscal subsidies (i.e. small scale wind farms), tax incentive measures (corporation tax and VAT), subsidised loans on commercially borrowed loan interest, price compensation through use of feed-in tariffs for electricity generated through renewable energy, import tax incentives and subsidised loans for a list of technologies and products that can be imported. The latter (import tax incentives and subsidised loans for a list of technologies and products that can be imported) could be particularly attractive for Irish firms[31].

Middle-East

In Saudi Arabia there are opportunities for water, waste water and environmental consultancy services and supply of equipment[32]. Plans for the privatisation of all water supply systems began last year with the awarding of two $60 m contracts to the French companies Veolia and GDF to operate water networks in Riyadh and Jeddah respectively. Ten similar private – public partnership contracts are due to be awarded, covering all the water and waste water systems for Saudi Arabia's larger cities. A future need is for *Asset Information and Management Systems* for maintenance purposes – particularly to define quality control procedures. In Jeddah, for example, there is a significant problem with leaking water tanks at homes. In terms of overseas supplier companies the main countries are Germany and Spain for solar power and Germany, Denmark and Spain for wind power. South Korea is notable as a smaller but growing supplier of renewable goods and services.

In Oman there is now a focus on renewable energy potential and a diversification away from hydro carbons as these supplies are running out. Much of the demand for electricity occurs in the summer and is related to air conditioning. Oman does not have feed-in tariffs. Their approach is to have a competitive tendering process and a contract of obligations with the successful bidder which specifies an agreed tariff for the length of the contract. The challenges for the utilisation of solar and wind renewable will be their connection to the grid. It was concluded that the potential for biogas, geothermal and wave is limited at present.

[31] China Speaker, Shelly Xiong, HaoLiWen Partners, EI Accessing Green Stimulus Funding Seminar, April 2010.
[32] Jens Meir-Klodt, Deputy DG, National Water Company, Saudi Arabia, EI Gulf CleanTech Seminar, June 2010.

In Qatar a *National Vision Strategy 2010*, highlighted the challenge of sustaining economic growth, social development and environmental management. In terms of new building projects clients must now take a holistic view and consider the life-cycle cost of the project. Consultants are chosen on the basis that they have a demonstrated concern for sustainability and can help educate clients and promote innovative design. Contractors must use materials which have less impact on the environment and minimise construction waste. The message is that sustainability is here to stay and is the responsibility of everyone[33].

3.5 'Green' Sector Growth and Investment Trends

The global EGS market is projected to grow significantly over the period up to 2020. Several countries have adopted economic stimulus packages containing a major 'green' investment component. They include investments for the promotion of energy efficient buildings, public transport as well as diversifying the supply of clean and renewable energy. The transition to a low-carbon economy will not only benefit jobs in 'green sectors' but also – in the same way as ICT – have a pervasive effect across many sectors.

The *EU Renewable Energy Road Map* anticipates that EU electricity production from renewable energies could increase to around 34% of overall electricity consumption by 2020. Of this, wind could contribute 12% of EU electricity by 2020 – one third of which could come from offshore installations. Renewable technologies such as photovoltaic, solar thermal power, wave and tidal power are expected to grow more rapidly as their costs reduce. It is expected that the biomass sector can grow significantly using wood, energy crops and bio-waste in power stations.

A recent report published by the *EU Joint Research Centre's Institute for Technology*, indicated that renewable energy sources accounted for 62% of new electricity generation capacity installed in the EU 27 in 2009 (the share of renewable energy sources in 2008 was 57%)[34]. Wind energy accounted for the largest share of the new capacity–38% of the total. In absolute terms, renewable energy sources accounted for 20% of Europe's electricity consumption in 2009. If current growth rates are maintained up to 2020, the report concludes that renewable energy sources would account for approx 35%-40 % of overall electricity consumption in the EU.

[33] Quote from Ahmad Jassim Al Jolo, Chairman of the Qatar Society of Engineers, EI Gulf CleanTech Seminar, June 2010.

[34] Renewable Energy Snapshots Report (2010), EU Joint Research Centre's Institute for Energy.

Chapter 4: International Trends - Employment and Skills Change

4.1 Definitions of 'Green' Jobs and 'Green' Skills

There are several definitions, of what can be described as the 'green economy', suggested by different organisations internationally. These are useful to consider as a guideline.

EU

A recent EU Study highlights the strong links between the economy and the environment that go beyond the narrow definition of eco-industries as they are traditionally measured[35]. Different definitions of the eco-industries were outlined as follows:

1. Narrow definition of the eco-industries – largely pollution prevention treatment (air, water, waste, energy) – directly employing 2.3 million people and €270 billion annual turnover in EU.

2. Wider definition – as well as pollution prevention treatment - includes activities closely dependent on a good quality environment (such as environment related tourism), sustainable forestry, organic agriculture, renewable energy etc) – directly employing 4.4 million people and €405 billion annual turnover in the EU.

3. Moving to the widest definition – as well as (1) and (2) above this includes all activities dependent on the environment (including agriculture) – employing 21 million people and €3 trillion annual turnover in the EU. This accounts for 10% of jobs in the EU.

The *EU has* emphasised the benefits of economic, social and environmental policies complementing and reinforcing each other. Three priorities are highlighted in the new EU strategy for sustainable growth and jobs - *Europe 2020: A strategy for smart, sustainable and inclusive growth*. These are:

- Smarter growth – developing an economy based on knowledge and innovation;
- Sustainable growth – a more resource efficient, greener, and more competitive economy;
- Inclusive growth – fostering a high employment economy delivering social and territorial cohesion.

The EU foresees that environmental policy can create new demand for environmentally-friendly goods and services allowing companies to expand their business and take on new workers. Investment in education and skills will help workers adapt to the demands of new environmental technologies.

[35] Environment and Labour Force Skills – Overview of the links between the Skills Profile of the labour force and Environmental Factors, European Commission, DG Environment Report, 2008.

OECD

The OECD *'Green Growth Strategy'*, agreed in 2009, raised discussion around what exactly were 'green jobs'. It concluded that the definition of a green job was difficult to state i.e. whether someone who works in a plant that manufactures solar panels was a 'green-collar' worker or a blue-collar worker. In the short term, it is anticipated that jobs will shift from high-carbon activities to low-carbon activities. The net effect will be job creation, as low-carbon technologies tend to be more labour-intensive.

The OECD concludes that unlike many services sectors (computer services for example) environmental services do not constitute a distinct set of similar business activities[36]. Oil-spill remediation is very different from air pollution measurement and control, although both are environmental services. Differences can exist within the same sub-sector. For instance, collecting hazardous waste requires more sophisticated technologies and skills than collecting household refuse.

The standard (OECD/Eurostat) definition of this sector, sometimes called the 'eco-industry' includes: *"all activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use".*

United Nations Definition

The UN noted that while conventional industries are well captured in government and other statistics, for what can be characterised as green economy activities, employment data are available only for certain segments. While new industries – such as the renewable energy sector or energy auditing – can be relatively well defined, other changes that help develop the green economy are harder to define and capture – such as new technologies, business practices and shifts in professions and occupations, materials and water efficiency; methods and techniques to help minimise the generation of waste; or new structures and infrastructures. Many of these changes will occur in existing companies and industries, but are difficult to separate out.

A recent UN report defined green jobs as work in agricultural, manufacturing, R&D administrative and service activities that contribute substantially to preserving or restoring environmental quality[37]. Specifically, this includes jobs that help protect ecosystems and biodiversity; reduce energy, materials and water consumption through high-efficiency strategies; decarbonise the economy; and minimise generation of all forms of waste and pollution.

[36] OECD (2005) Policy Brief, Opening Markets for Environmental Goods and Services, OECD.
[37] United Nations Environment Programme (2008), Green Jobs: Towards decent work in a sustainable low-carbon world, UNEP, ILO,IOE, ITUC.

Green jobs span a wide array of skills, educational backgrounds and occupational profiles – especially true with regard to indirect jobs in supplier industries. Even for new industries like wind and solar power, supply chains consist largely of traditional industries – for instance, large amounts of steel are incorporated into a wind turbine tower.

The critical context is where to draw the line between efficient and inefficient practices. A low threshold will define a greater number of jobs as green, but may yield an illusion of progress. Also, given technological progress and the urgent need for improvement, the dividing line between efficient and inefficient must rise over time. In this context, 'green jobs' may be seen in a relative and highly dynamic context.

International Labour Office

The International Labour Office (ILO) '*Green Jobs Programme'* (2008) emphasises the benefits for achieving economic and social development that is also environmentally sustainable[38]. It highlights that investment in skills development is a key condition as is the need for policy coherence and coordination. The ILO consider that the concept of 'green jobs' will change over time and that its precise definition will depend on the country and the sectors concerned.

The ILO include in their definition of 'green jobs' direct employment in the manufacture, installation and operation of low emission renewable energy, and indirect jobs in making steel for gear boxes and windmill towers, composite chemicals for blades and concrete for the foundation of a windmill. The ILO conclude that the transition to a 'green economy' will create a demand for workers and that a greater share of future jobs are likely to be higher skilled – requiring an investment in skills development[39].

4.2 Types of 'Green' Jobs

An examination of the list of various occupations in the following table (compiled from several sources including international environmental organisations, career guides and recruitment websites), provides a valuable insight into the nature of 'green jobs'. A notable feature is that many of the occupations listed are not entirely new jobs. Many are from established domains such as ICT, engineering, or building trades. The types of occupations relevant to the main sectors and subsectors of the environmental goods and services industry provide an indication of the types of relevant skills and qualifications required in the 'green economy'.

[38] Reference: http://www.ilo.org/integration/themes/greenjobs/lang--en/.
[39] Reference: http://www.ilo.org/integration/themes/greenjobs/lang--en/.

Table 4.1 Examples of Types of 'Green Jobs'

Sector	Sub-sectors	Jobs
Renewable Energies	Renewables and ICT	Software development engineer, market data analysis, IT controller, hardware developer, turbine monitoring and diagnostic engineer, smart grid engineer, power systems software engineer.
	Marine (Wave and Tidal Energy)	Electrical engineer, process engineer, marine energy engineer, site development manager, marine operations manager, structural engineer, mechanical design engineer, wave scientist.
	Wind Energy	Turbine machinist, turbine sheet metal worker, turbine electrical engineer, farm electrical systems designer, turbine mechanical engineer, wind generating installer, operations manager, field service technician, power plant project engineer, environmental engineer.
	Solar Energy	Fabrication technician, lab technician, hot water heater manufacturing technician, Photovoltaic (PV) fabrication and testing technician, energy system installer, solar and PV installation roofer, installation electrician, engineering technician, PV solar cell designer, energy engineer, electrical engineer, electrician, welder, metal fabricator.
	Geothermal Energy	Heat pump machinist, electrical engineer, power generation mechanical engineer, plant installation technician, plant efficiency operator, operations engineer, hydro geologist, power plant structural engineer
	Bio Energy	Chemical engineer, chemist, chemical equipment operator, chemical technician, machine operator, agricultural worker, farm product purchaser, agricultural inspector.
Efficient Energy Use and management (including eco-construction)	Eco-Construction	Air sealing technician, insulation installer, machinist, welder, carpenter, electrical system installer, plumber and pipe fitter, service technician, roofing and skylight installer, refrigeration engineer, lighting engineer, architect & designer, structural design engineer.
	Energy Management/Efficiency Services	Residential, commercial, industrial field auditor, auditing service sales consultant, field energy consultant, conservation representative, energy manager and analyst, compliance specialist.
	Combined Heat and Power (CPH)	CHP energy generator engineer, instrumentation/design engineer, CHP operator (steam boiler background), CHP field technician, project engineer, technical services representative, maintenance supervisor, mechanical engineer, electrical engineer, service business manager.
Water and Waste Water Treatment	Leak control, monitoring and supply networks. Design-Build-Operation of plants. Processing wastewater sludge. Water analysis. Odour control.	Operations maintenance worker, wastewater engineer in refinery, wastewater plant civil engineer, water resource engineer, civil water engineer, technical sales consultant, water treatment application engineer, water treatment chemist, microbiologist.
Waste management, recovery and recycling	Waste collection, transfer and disposal Processing wastewater sludge. Waste-to-energy Recycling of organic waste Waste processing equipment.	Collections driver, hazardous materials removal specialist, materials regulation specialist, welding technology manager, hazardous waste project manager, recycling centre operator, operations maintenance worker, wastewater plant civil engineer, solid waste energy engineer.
Environmental Consultancy and Services	Environmental consultancy, Waste consultancy, Air pollution and control, Soil remediation.	Environmental sampling technician, climatologist, environmental scientist, environmental engineer, economist, chemist, environmental regulation environmental impact assessor, waste reduction consultants, air pollution specialist, soil conservationist.

Note: Listed occupations were compiled through several sources including international environmental organisations, career guides and recruitment websites.

4.3 Anticipated Employment and Skills Trends in the 'Green Economy'

The United Nations Environmental Programme (UNEP) report *Green Jobs: Towards Decent Work in a Sustainable Low-Carbon world*[40], provides an estimation of the likely effects on employment as economies are oriented toward greater sustainability. From a broad conceptual perspective, employment will be affected in at least four ways:

- Firstly, additional jobs will be created in several areas—such as in the manufacturing of pollution-control devices which are added to existing production equipment.
- Second, some substitution of employment will take place—such as the shift from fossil fuels to renewable energy sources, or from land filling and waste incineration to recycling.
- Third, certain jobs may be eliminated without direct replacement—as when certain packaging materials are discouraged or banned and their production is discontinued.
- Fourth, many existing jobs (especially plumbers, electricians, metal workers etc) may be altered due to the 'greening' of day-to-day skill sets, work methods and occupational profiles.

The specific skills associated with 'green' jobs are not seen as being entirely new skills – rather they may be either an 'add-on' of existing skills or amalgam of existing skills. Many people with qualifications in traditional domains have the potential to transfer into the sector with appropriate skills updates. Examples include a mechanical engineer working on wind turbines, an electrician installing solar panels or a sheet metal worker manufacturing components for marine energy technologies. Common candidate requirements for these jobs are the need for experience in the sector or an understanding and interest in environmental issues[41]. Some occupations may require specific qualifications relevant to the industries. Examples are environmental impact assessors, soil conservationists, design engineers, and environmental energy consultants[42].

Technological convergence is impacting on the skill requirements of professionals across different disciplines. Interdisciplinary knowledge and experience in disciplines like biology, chemistry, computer science, and cognitive science will be essential. Projects often require bringing together professionals from diverse backgrounds working together in multi-disciplinary teams - such as engineers, planners and architects with ecologists and inspectors. The *US Accreditation Board for Engineering and Technology* for example, emphasises the importance of teaching students to work in multi-disciplinary teams, creativity, innovation, team-working and communications are key competencies required for collaborative and interdisciplinary work.

Anticipated trends in future employment demand are presented in the following table. The difficulty in classifying new occupations that will emerge from the green economy means that the data collection on jobs in existence and their comparability across countries is difficult. There are also difficulties relating to the recognition of formal qualifications as countries may differ in their approach to the types of qualifications needed[43].

[40] United Nations Environment Programme (2008) Green Jobs: towards decent work in a sustainable low carbon world.
[41] Seattle Jobs Initiative (2008), A Growing Green Economy: Opportunities for Tomorrow.
[42] Reference EDF Green Jobs Guidebook 2008/2009 for specific information on listed jobs and qualifications requirements.
[43] Eurofound (2009), Greening the European Economy: Responses and Initiatives by Member States and Social Partners.

Table 4.2: Anticipated Employment and Skills Trends in the 'Green Economy'

Sectors	Anticipated Employment and Skills Demand Trends
Renewable Energy sources and Efficiency related components -Wind -Photovoltaic -Solar Thermal Energy -Geothermal -Modern Biomass -Hydropower	**Employment Trends:** It is estimated that there are currently 300,000 persons employed in the Renewable Energy Sector in Europe. Achieving the EU target of a share of 20% for renewable energies for electricity production in 2020 (double 2006 level) would mean almost a million jobs in the industry by 2020 – an additional 700,000 jobs[44]. Additional jobs are expected in manufacturing, installation and maintenance. Significant export market opportunities are envisaged in the sector. Wind power is expected to open up opportunities in a range of fields. Many professions in the renewable energy sector originate from the more traditional science and engineering or business and management fields[45]. Professions in the sector are transferable to and from other sectors and this can be achieved with relatively limited retraining. Some new professions have also emerged. **Skill Trends** ▪ Many positions will require highly skilled technicians, engineers and skilled trades. Jobs in biofuels processing require more technical skills. ▪ The demand for skilled workers in 'remote fault recovery and diagnosis' will increase. Customer skills re benefits of available systems will increase.
Buildings	**Employment Trends:** Due to the demand for green building components and energy-efficient equipment, 'green' manufacturing jobs will increase. **Skill Trends** ▪ Higher-skilled employment will arise due to energy-efficient equipment. ▪ Existing Jobs will be redefined in terms of new skills and certification. ▪ Potential will arise for highly skilled researchers and engineers. Extensive training needs are likely to be in (1) diagnostic techniques (ii) knowledge of renewable energy (iii) installation and (iv) organisational skills
Cement	**Employment Trends:** The shift towards energy-efficient plants will create construction jobs in the short term. **Skill Trends** ▪ Jobs in this sector will require higher levels of skills.
Electricity production and supply	**Employment Trends:** Due to energy savings it is expected that there may be small absolute job losses. Should see new jobs associated with micro generation and grid upgrade. **Skill Trends** ▪ Management skills will be required together with technical competences.

[44] Communication from the Commission to the European Parliament, the Council, the European Economic and social Committee and the Committee of the Regions 20,20, by 2020, Europe's Climate Change Opportunity.
[45] Source: Handbook for Career Advisors and Occupational Councillors.

Water Treatment and Recovery /Recycling	**Employment Trends:** Jobs in recycling are diverse in terms of required skills. **Skill Trends** ▪ Rapid technological change is increasing demand for new skills. ▪ Jobs in waste collection and sorting are mainly undertaken by relatively low skilled people.
Transport	**Employment Trends:** Car industry employment is expected to be stable given use of clean technologies and greater added value. Opportunities will arise through introduction of electric vehicles. **Skill Trends** ▪ Anticipated shortage of skilled workers in railway sector emerging.
Energy intensive industries iron/steel	**Employment Trends:** It is estimated that 50,000 out of 350,000 (20%) jobs in this sector within the EU could be lost.
Agriculture	**Skill Trends** ▪ Jobs for agricultural skilled workers will decrease. ▪ A demand for new skills in the agri-food sector due to need to generate more income from other sources as well as the enlargement of farms. ▪ Skills that are seen as being important are: entrepreneurial skills, coping with waste management and interdisciplinary skills.
Carbon Capture and Storage	**Employment Trends:** This refers to the technological process designed to capture CO_2 emissions and then store it securely away from the atmosphere. Many subsurface operations are likely to be operated by existing employment. **Skill Trends** ▪ Technically more complex operations will involve workers with a very different skills set.
Climate Change	**Employment Trends:** Adapting to climate change could generate employment **Skill Trends** ▪ Climate information and forecasting as well as R&D into crops adapted to new weather patterns will create specialised and high skilled employment.
Environmental Consulting	**Employment Trends:** Jobs in environmental consulting are undertaken by high-skilled people with a university degree.
Mining, Fossil Fuels	**Employment Trends:** Job losses are likely in these industries.

Source: Environment and labour Force Skills (2008), ECORYS, Report for European Commission: Rotterdam

Skills and Knowledge Requirements of Enterprises within the 'Green Economy'

A joint ILO /Cedefop[46] research programme currently underway includes an examination of new 'green collar occupations' types of skills and retraining needs in new and existing occupations. Preliminary work highlights the following points on skills needs and training /education provision[47].

Generic Skills for Green Economy	*Specific Skills for Green Economy*	*Role of Education and Training*
▪ Strategic /Leadership ▪ Adaptability ▪ System analysis ▪ Holistic approach ▪ Risk Analysis ▪ Co-ordination Skills ▪ Entrepreneurship	▪ Good grasp of sciences ▪ Relevant traditional skills ▪ Knowledge of sustainable materials ▪ Carbon 'foot printing' ▪ Environmental Impact Assessment skills	▪ Understanding of Market Needs ▪ Working in multi-disciplinary Teams ▪ Recognition of formal/non formal learning ▪ Internships ▪ Promotion of green awareness in education

4.4 Conclusions

The emerging 'green economy' can be viewed as a new skills paradigm that places greater emphasis on design and working in multi-disciplinary teams. Projects often require bringing together professionals from widely diverse backgrounds such as engineers, planners and architects with ecologists and inspectors. Generic skills such as strategic leadership, communication and adaptability will be very important in the green economy. The specific skills associated with greening are not considered to be entirely new skills. Rather, it is more generally the case that the skills are either an add-on of existing skills or amalgam of existing skills. Both white collar and blue-collar jobs will need retraining with relevant 'green' skills. The provision of both specific technological skills and generic training related to carbon auditing and management is seen as being equally important.

[46] Cedefop (European Centre for the Development of Vocational Training).
[47] Reference Material: Peter Szovics, Cedefop.

Chapter 5: Country Profiles-Developments within the 'Green Economy'

This chapter profiles developments across several countries within 'green economy' related areas of research, investment, jobs and skills training. The aim is to provide an insight into a range of experiences relevant to the development of the sector in Ireland.

5.1 UK

Narec (New and Renewable Energy Centre), based in Blyth, Northumberland, is the National Centre for the UK dedicated to accelerating the deployment and grid integration of low-carbon generating technologies, utilising wind, wave, tidal, Solar PV and thermal power. It works with major companies, SME's, start-ups and university spin-outs to commercialise their new technology ideas for the onshore and offshore wind, wave and tidal, distributed energy, micro-renewable and electrical network sectors.

The UK's first wind turbine training tower was opened at Narec in early 2010. The 27 metre high training facility is designed to allow education and training providers deliver academic and industrial training programmes for technicians working in the wind industry – both onshore and offshore. The tower is an open access facility operated through a collaborative training partnership between Northumberland College, Mainstream Renewable Power and Narec. This collaboration is aimed at increasing the number of wind technician's suitability qualified to install, operate and maintain new and existing wind farms. Potential skill gaps are a key issue for the UK as it seeks to ramps up its offshore wind generating capacity over the next ten years.

North-East England will also be home to the Nissan's European Centre of Excellence for battery manufacturing for electric vehicles. It will produce 60,000 battery units a year commencing in 2012 for both Nissan and Renault. It will be situated beside the Nissan Sunderland car factory which has also been awarded the contract to construct the Nissan Leaf electric vehicle. The combined value of both investments will be £420m. Clipper Windpower Plc are building a £25m 'green energy' factory in Newcastle which will make the world's biggest turbine blades.

British Gas have recently announced a plan to train over 1,300 unemployed people per annum at their newly opened '*Green Skills Training Centre'* in Tredegar South Wales. As well as British Gas own engineers, the centre will provide training and qualifications for unemployed persons as energy efficiency assessors and installers of new green technologies. The initiative involves the Welsh Assembly Government and skills and jobs agencies.

This is seen as being beneficial to British Gas as they are investing heavily in green tech, through the creation of thousands of smart meter and insulation jobs. Their intention is to help equip local people with the skills to deliver these technologies in the communities where they live.

5.2 Germany

The lack of availability of engineers in Germany has been cited as a main problem limiting the potential development of the environmental sector in Germany. As at June 2010, some 35,000 vacancies for engineers remained unfilled[48]. This is a result of declining graduation rates in engineering in recent years caused by a fall in the number of young people entering vocational education and training due to demographic change and also a decline in popularity of STEM subjects.

Linked to this is the fact that the age structure of German engineers is relatively older. For example while 49% of Irish engineers are under 34 years of age, the figure for Germany is 24%. This age structure means that replacement rates within engineering in Germany will be relatively high over the next decade compared to countries like Ireland.

An estimated 60,000 people are employed in the German wind energy sector – half of which can be attributed to the export market. In August 2009, Siemens opened a major training centre for wind energy in Bremen. *The Wind Power Training Centre* serves primarily as a training centre for service technicians. Prospective assembly workers are also offered theory courses covering the construction and operation of wind power plants and an opportunity to carry out practical maintenance. Repairs on the open sea cost about ten times as much as repairs on land – so simulation training is seen as essential. The centre houses a 2.3 MV wind turbine, a simulator for control technology, ladder constructions and scaffolding and crane and tower models. Relevant safety aspects are seen as equally as important as management and servicing. The training programme offers emergency exercises under real-life conditions – at a height of a hundred metres. Some 1,000 technicians, mostly from Central and Eastern Europe, the Mediterranean Region and the Asia-Pacific region will be trained in the centre as Siemens customers.

The *BZEE Education Centre for Renewable Energies* was founded as an association in 2000 by the *German Wind Energy Association*, the *Chamber of Industry and Commerce* in Flensburg and wind energy enterprises in northern Germany. BZEE's mission is to develop practice-oriented training programmes tailored to meet the qualification demands of the industry. In conducting its training courses, BZEE enrols instructors active in the industry and cooperates with a range of educational institutions. A full-time further education course is run twice a year for service technicians of wind energy plants. Training in safety and rescue is provided on-site and cater to the specific needs of manufacturers and operators. BZEE has recently developed a new focus providing a qualification programme for the service and maintenance of offshore wind farms.

5.3 Sweden

Energy research has played a key role in the long-term development of the Swedish Energy system - directed by policy towards a more efficient system fed with renewable energy. The Government has proposed ambitious energy policy goals consisting of a 40% reduction in climate gas emissions, an energy supply of at least 50% renewable energy and 20% more efficient energy use by 2020.

[48] Source: Dr W. Fuchs, Managing Director The Association of German Engineers (VDI) 2010.

District heating currently provides about half of the heating requirements for residential buildings and commercial premises. In 2006, the Swedish Energy Agency initiated an '*Energy, IT & Design*' research programme. Its main emphasis is to influence the everyday habits, values and behaviours of users in improving energy use efficiency. It has been calculated that the potential for improvement in the efficiency of electricity use in residential buildings is around 20-30%. In collaboration with a university consortium, the Agency operates an Energy Systems Course for postgraduate students – It provides a good knowledge of the Swedish energy system as well as international links. The Agency also runs a 'Passive Houses and Low Energy Buildings' demonstration programme with the aim of showing how future buildings can use a minimum level of heating energy, and by so doing to encourage the development of the necessary skills and awareness in the building industry.

5.4 Denmark

Denmark has a national renewable energy target of 30% by 2020 – compared to 17% in 2010. Danish offshore wind capacity is the highest per capita in Europe and accounts for the majority of electricity consumption produced from renewable sources. There are a range of supports within a 'carrot and stick' approach comprising a CO_2 tax on the use of fossil fuels, a tax for landfill usage and waste incineration; environmental premium payments for new offshore wind farms and fixed feed-in tariffs for wind, solid biomass and biogas. The combined heat and power plant in Copenhagen operated by DONG Energy, is one of the world's most efficient – capable of providing 1.3 million households with power. Wind currently accounts for 20% of overall electricity consumption. The wind sector employs around 20,000 people – many living in more remote areas of the country. The greatest challenge for wind power as an energy source is that of intermittent power supply. At present Denmark solves this problem through a co-operation agreement with Sweden and Norway whereby these countries trade their power on the Nordic power exchange. An MSC programme in Wind Energy, run by the Technical University of Denmark, focuses on the cross disciplinary electrical and mechanical aspects of wind power and power system integration. Its aim is to give students a general understanding of wind energy and an insight and knowledge in technologies related to wind energy. The programme offers a range of employment opportunities within technology providers such as wind turbine manufacturer and subcontractors, energy companies, utility companies, developers, consultancies and research companies. The prerequisite for the MSc Degree is a BSc degree in electrical engineering, mechanical engineering or another relevant academic background.

5.5 Switzerland

In Switzerland, water powered electricity provides 55% of total energy consumption while 40% comes from nuclear power plants. The greatest source of energy in Switzerland is mountain water, which is available in large volumes for the production of electric energy. Interestingly, there are examples of waste water from water treatment plants at higher altitudes being used to generate energy. There are also proposals for geothermal power plants to power steam turbines from water bearing aquifers at temperatures of 150 degrees centigrade. In terms of home heating from renewable sources, heat pumps have gained wide acceptance, with heat pumps now installed in 7%

of all new houses instead of oil or gas furnaces. Heat is drawn from the ground or ambient air and raised to the required temperature for heating purposes. A significant amount of heat also comes from exploiting the energy contained from municipal waste. Energy from garbage incineration plants is distributed through district heating installations. In addition bio-gas is produced from green waste, animal waste and fermented sewerage. It is estimated that if the potential for bio-mass in Switzerland were fully exploited, then 5% of households could be supplied with electricity and 8% of vehicles could be run on bio-gas. There is little solar power used in Switzerland due to its high costs and limited government subsidies. Also, there are few examples of wind power plants as wind is not sufficient and predictable except in remote mountain locations.

5.6 Netherlands

In the Netherlands a range of new programmes relating to the Environment and Climate change have recently been introduced. One such example is a new four-year *Climate and Environment Bachelor Degree Programme* at The Hague University of Applied Science. The main subjects centre on what can be done to reduce $C0_2$ emissions in Netherlands by 30% by 2020 and adaptations that will need to take place in relation to anticipated sea level rise and river flows. The programme curriculum was designed with the input of industry. Industry will also provide significant project – based learning internship opportunities for students. The programme allows for both a general education and specialisation in certain subjects. It is expected that some 2,000 to 3,000 job opportunities per annum in the Netherlands will arise in these areas of employment. The *Delft University Wind Energy Research Institute* (DU Wind) is an inter-disciplinary energy research body which also provides courses for students and professionals in the wind energy industry.

5.7 France

Frances' Stimulus package announced in December 2008, comprised €26 billion of which 20% was designated for green measures – comprised the highest 'green' investment component in the EU. The package included investment in energy efficiency buildings, low carbon vehicles, high speed rail, renewable energies and grid infrastructure. Along with this fiscal stimulus, the French Government announced a longer term 'Green Growth and Employment Plan'- notable for its emphasis on skills development including a goal of training 360,000 people in green technologies. A report to the French Government has identified a number of emerging specialisms (e.g. energy auditors and solar power installers) which are not currently well serviced by training institutions and face potential recruitment bottlenecks. Eco-design which is aimed at reducing the environmental impact of products throughout their life cycle (design, manufacturing, marketing, retail and final consumption) is a key priority within the French national sustainable development strategy. A vocational qualification in eco-design, energy and environment was created at the University of Nancy to address industry needs. The qualification has a broad scope in terms of competences for a range of job profiles such as project managers, consultants, waste managers and public authority managers.

5.8 United Arab Emirates

In the United Arab Emirates', a major landmark development is the development of Masdar City, which is planned to be the first city 100% powered by renewable energy. The city will accommodate 50,000 people when fully built. It includes the newly opened *Masdar Institute of Science and Technology* which is run in conjunction with the *Massachusetts Institute of Technology* (MIT). The Institute is a private, not-for-profit, research-driven institute. It offers Masters and (eventually) PhD programs in science and engineering disciplines, with a focus on advanced energy and sustainable technologies. Masdar City will be a global free zone where companies will pay no taxes. The aim is for Masdar City to become a global hub for renewable energy. The headquarters of the *International Renewable Energy Agency* (IRENA) will be located there. There are several distinct phases to the building of Masdar City. A main goal is to recycle 98% of all waste from landfill. An 'intelligent' ICT system will offer scope for saving and control of energy use. The system will monitor and control fluctuations in energy need and availability throughout the city. An integrated, zero carbon transportation system is also being built – powered by renewable battery powered modes.

5.9 South Korea

The South Korean Government has announced an '*Industrial Development Strategy for Green Growth*' to achieve a vision of low-carbon and green growth. This is to gain an 'early mover' advantage by moving towards new jobs and growth engines using green technology and clean energy and reducing the nation's high dependence on overseas energy sources. The strategy consists of:

i. '*Green innovation'*- for helping developing technologies to cope with global climate change and creating new markets with eco-friendly materials;

ii. '*Green restructuring'*- making energy-wasting industries low-carbon-oriented and developing a low-carbon-oriented, knowledge-based economy by creating a new market through the combination of IT, biotechnology and nanotechnology with key existing industries.

iii. '*Green value chain'*- that will bring green values into industries by setting green standards and making the most of IT technologies; introducing green efficiency into the intermediary stages of the value chain, including exports, marketing, distribution and logistics.

While South Korea is making the most strategic move of any country towards the use of '*green technology*', the ILO consider that it does not yet have a matching skills development programme required to successfully implement this strategy.

5.10 USA

A recent report by the *Taskforce on Americas Future Energy Jobs*[49] highlighted a concern that the United States is facing a critical shortage of trained professionals to maintain the existing electric power system and to design, build and operate the future electric power system. This relates to estimates that due to an ageing workforce profile, new workers will need to fill one third of 400,000 current electric power jobs over a five year period. This problem will be exacerbated by the fact that US students are not graduating at the same rates in the relevant fields and with the required

[49] Report by National Commission on Energy Policy's – Task Force on America's Future Energy Jobs , (2010)

qualifications as in the past. There is a concern that workforce bottlenecks could slow the transition to a low-carbon economy regardless of the commercial readiness of the underlying technologies.

In the US, several universities and colleges now offer a range of specialisations in various clean energy fields up to degree level. The *Center for Energy and Environmental Studies* in Boston University engages in education, research, and professional training in the fields of energy and environmental analysis. It offers Masters and Undergraduate educational programs which are run based on the philosophy that students need a solid training in traditional disciplines, as well as a set of integrated courses that expose students to the broad and systematic nature of environmental problems. It adopts a multi-disciplinary and problem-oriented approach.

Oregan Institute of Technology has a regional reputation for programs in the disciplines of engineering, technology and health professions. The Institute introduced the first *Bachelor of Science in Renewable Energy Systems* in North America in 2005. The programme focuses on the engineering principles graduates need to develop and implement sustainable energy technologies. It begins with a solid foundation of physics, chemistry and mathematics, which paves the way for coursework in electrical and mechanical engineering. 'Upper-division' courses are available in renewable-energy specific courses include photovoltaics, energy management and auditing, wind power, biofuels, renewable-energy transportation systems, green building and fuel cells. The *University of California, Berkeley, Energy and Resources Group* is an interdisciplinary academic unit which offers programs of study in energy and resources for students leading to MA, MS, and PhD degrees. The program helps students arrange internship opportunities. These are on-site work experience either directly related to a student's major field of study or their career interest. Internships can be paid or unpaid, and held during the summer or throughout the academic year.

Greenfield Community College is affiliated with the North American Board of Certified Energy Practitioners (NABCEP), which offers voluntary certifications for renewable energy professionals throughout North America. Greenfield Community College offers a range of certificate courses to suit those already employed in a trade to add new skills to their specialisation such as retrofitting for construction workers and photovoltaic's for electricians. Classes offer professional development and skill enhancement relevant to specific renewable energy/energy efficiency technologies, as well as broader understanding of the scientific, economic context of the industry. The courses provide all students the option to transfer into an associate degree or four-year programs.

5.11 Conclusions

Countries are responding to the transition towards a low carbon, knowledge intensive economy through skills development strategies which meet upskilling requirements within the workplace. A main feature of such initiatives are the close collaboration between enterprise and education and training providers in the shaping up, development and provision of relevant flexible and adaptable, accredidated programmes - both within the initial education and training system and for the professional development and upskilling of those at work or unemployed. Structured Internship opportunities are viewed as valuable means of providing students with real life work experience. Collaborative and interdisciplinary working is a feature of many programmes.

Chapter 6: Research into Enterprise Skills Requirements

6.1 Introduction

As part of this Study, an integral piece of research work was undertaken with a selected range of enterprises within different sub-sectors of the 'green economy' around their current and future skills supply requirements. Companies were drawn from IDA Ireland and Enterprise Ireland supported companies and SEAI project related companies. They comprised foreign-owned and indigenous companies of different sizes and include companies which export as well as those operating solely on the domestic market. Commercial state enterprises- ESB, Bord Gáis and Bord na Mona were also included. The companies interviewed comprised small, medium and large sized companies. Half employed less than 50 employees, 30% employed between 51 and 500 while 20% employed more than 500. Overall, 80% of the business turnover in companies surveyed was considered environmental. This percentage is expected to increase to 90% over the next 3-5 years - with increases anticipated within all sub-sectors.

The research work is mainly qualitative in nature and was designed to elicit companies' views around a range of key topic issues:

a) their current and anticipated emerging skills needs;
b) identification of any current and anticipated (3-5 year period) skills capability gaps / shortages;
c) how they were planning to meet their future (3-5 year period) skills requirements;
d) their views on the adequacy of the current nature, scale and quality of education and training provision to meet their skills requirements;
e) Recommendations on how their current and anticipated skill requirements could best be met.

The research work examines emerging job profiles, skill sets and competencies for each stage of the business process (from R&D through to repair and customer support) and comprised three main elements:

- Structured Telephone Interview Survey conducted with 40 companies – at senior company representative level based upon a structured topic questionnaire format - developed by the EGFSN Secretariat working with the Steering Group.
- Three workshops were held-two in Dublin and one in Cork, based upon a structured topic format. A presentation of preliminary findings to companies and a wider group of stakeholders took place. Views of the participants were incorporated into the write up of the research.
- Selected company visits were conducted comprising structured face-to-face interviews with six companies, for more in-depth case study work. The case studies were designed to explore skills gaps and future needs in greater detail.

The findings of the research are presented by sub-sector. The analysis firstly examines the profile of the companies that participated. This is followed by findings on any current and anticipated skill gaps and how companies are planning to meet future skills requirements. Views on the adequacy of the current education and training provision in meeting skills requirements are reported.

6.2 Renewable Energies

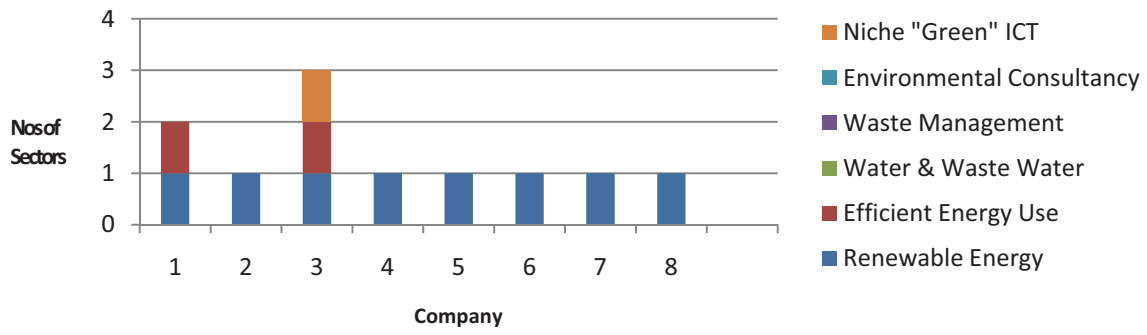
6.2.1 Introduction

The Government has announced a target for 40% of energy consumption in the electricity sector from renewable sources by 2020, 10% for energy consumption in transport and 12% for energy consumption in the heating sector. There is a target of 10% of all vehicles to be electrically powered by 2020. These targets require significantly more renewable energy capacity installed over the next decade.

6.2.2 Profile of Participant Companies

The number of people employed within companies in the sub-sector surveyed ranged up to several hundred employees. One company, part of a major multinational, was at the set-up stage

Figure 6.1: Participation in Sub-Sectors



Four of the companies exported – mainly to UK, USA and Canada and one company to Portugal. Exports comprised a small proportion of total turnover. 100% of the work of companies was environmentally related. The products and services of companies include the production of technology used by the sector (wind), designing and building plant (tidal and biomass), installing, commissioning and maintaining (wind) as well as generating and distributing electricity (renewable energy). Business areas where companies plan to be leaders are presented follows.

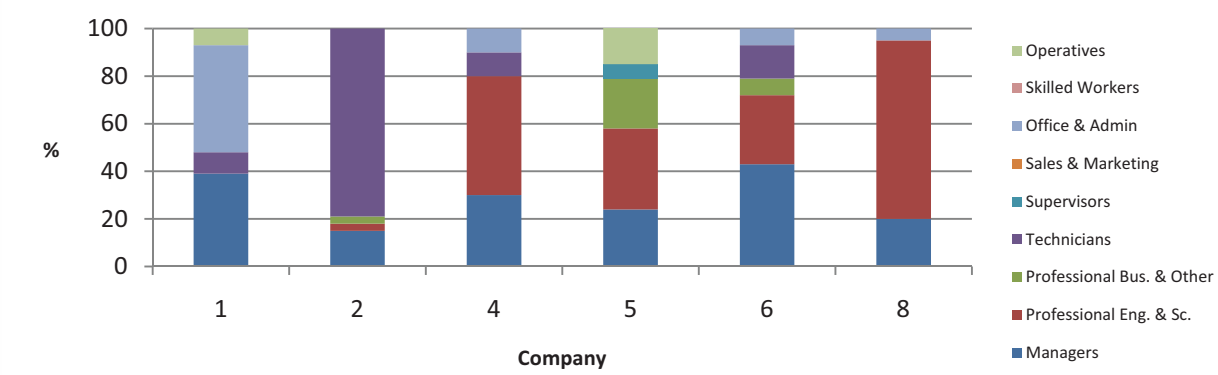
Table 6.1: Business Areas where companies plan to be a leader

Company	Business Areas
1	Home Energy Services; Energy utility
3	Smart networks; Renewables; Electric Vehicles
4	Bioenergy (solid biomass)
5	Tidal Energy
6	Distributed solar power generation / solar technology
7	Wave Energy development and operation
8	Wave Energy

6.2.3 Occupational Profile

Professional Engineers, Scientists and Managers account for the greatest proportion of employees in most companies- although in one company, the proportion of technicians was highest.

Figure 6.2: Occupational Profile



6.2.4 Core Skill Requirements

Core skill requirements of companies in the sub-sector differ depending on the nature of their business. For some, it is research, development and design whilst for others it is technical engineering and management. Technical skills combined with commercial and sales, communications and project management are core skills requirements across occupations in the sub-sector.

Table 6.2: Core Skill Sets/Competencies required across Occupations

Company	Core Skill Sets / Competencies
1	Technical combined with commercial and Sales.
2	Electro-mechanical.
3	Communications (people Management for engineers), cross disciplinary (technicians)
4	Finance, Commercial Sales/Marketing, Tender Writing, Project Management.
5	Project Management, Communications (remote)
8	Commercial Management / Engineering.

6.2.5 Anticipated Change in Employment

Professional Engineering and Science was the most frequently indicated occupational category likely to increase over the next 3 to 5 years – particularly within R&D, Piloting and Testing. Operatives were the second most frequently mentioned category within the Manufacturing/Generation, Operation & Maintenance and Repair and Customer Contact stages of the business process.

Table 6.3: Anticipated Skills Demand by Occupational Group by Stage(s) of Business Process

Stage of Business Process	Companies							
	1	2	3	4	5	6	7	8
R & D			-			(b), Phd. level	(b)(a) (c)	(a,b)
Pilot and Test			-		(b)	(b), (i)		(b)
Marketing and Sales			-	(b)	(f)	Full team		
Manufacturing / Generation		(d) (e)	-		(e) (i)	(b), (i)	(b)	
Delivery and Installation	(b)*		-	(b)		Outsource short term		**
Operation and Maintenance		(e)	-	Out-sourced	(h) (i)	Outsource short term	(b), (H)	
Repair and Customer Contact			-		(i)			

Notes: (a) Manager (b) Professional Engineering & Science (c) Professional Business & Other (d) Technicians (e) Supervisors (f) Sales & Marketing (g) Office & Administrative (h) Skilled Workers (i) Operatives
* Company 1 will also be outsourcing c. 100 gas installers /plumbers for installation
** Company 8 expects to increase employment beyond 5 year period.

6.2.6 Skill Gaps

Specific difficulties were cited relating to meeting the demand for electrical engineers, particularly for high-voltage power generation. Reasons given for this were that students on combined electrical engineering and electronic courses had tended towards electronic engineering in their placements and careers and that many graduates were also recruited by the utility providers. There is a demand for technician skills (combination of electrical, mechanical and electronic skill sets) to support their operation and maintenance of increasing numbers of wind turbines, solar energy and other renewable technologies. Engineers with mechanical and electrical engineering skills are required for marine renewable energy turbine design and connection to the grid.

6.2.7 Filling Skill Gaps

Companies utilise external recruitment sources and recruitment from the educational system and workforce continuing education and training as a means of building up skill sets. One company relied on outsourcing to provide many of their skills requirements but retained in house specialists. Three companies had recruited abroad - one for electrical engineers - another for an R&D and Production Director-and the third for specialist marine, hydraulic and mechanical engineers (it considered that such expertise was unavailable in Ireland at present). For those companies interviewed, starting salaries for new entrants (graduate level) engineers and scientists is approximately €35K whereas for graduates with 5 to 10 years of experience, it is in the region of €70K.

6.2.8 Skill Enhancement

Interviewees indicated that existing employees - Professional engineers & scientists and new graduates in particular need to enhance their business knowledge and soft skills. The specific non technical skills gaps cited are presented in the following Table.

Table 6.4: Non-Technical Skills Gaps

Skills	Description
Communication	Ability to present oral and written information and self presentation.
Teamwork	Working with others on projects
Problem Solving	Ability to identify problems and create innovative solutions.
Maths Proficiency	A key requirement across all occupations
Applying theory in practice	Ability to apply theory and concepts to real world situations.
Corporate Governance	Protect and enhance the company's reputation in emerging sectors.
Commercial Awareness	Understanding the costs and benefits of technical decisions.
Remote Working	Ability to work alone and working on sites in remote locations.

6.2.9 New & Emerging Skills Requirements

As wind turbines and an increasing number of solar energy and biomass technologies get up and running in Ireland and abroad, there will be an increasing demand for engineering and technician skills to support their operation and maintenance. There will be additional demand for technician skills for the operation and maintenance work areas.

6.2.10 Meeting Future Skills Requirements

Companies' anticipate that their future skills requirements will be met by external recruitment and from education providers. Workforce continuing education and training was cited as a means of building up skill sets particularly in the larger companies. Most of the training is funded from company resources with one company utilising some public funding through a Skillnet for the sector.

One Company relies on outsourcing to provide many of their skills requirements but retain in house specialists. Participation in Professional and Trade Bodies such as Engineers Ireland and Accountancy bodies is common for professional staff.

6.2.11 Enterprise views on Education & Training Provision

Irish graduates were generally well regarded for their technical competencies (with the exception of maths). However, weaknesses were highlighted in relation to their communication skills, commercial awareness, and application of theory in practice. It was considered that these skills gaps could best be addressed through well structured internships and in the way in which subjects are taught. A key theme was that the core disciplines of engineering and ICT should be emphasised going forward. Many of the career enhancement skills mentioned could be achieved through continuing professional development through Engineers Ireland or through Engineers' Skillnet.

6.2.12 Demand for Skills: Potential Risks

The demand for skills in the renewable energy sector is dependent on the number and pace of permissions relating to the building of on-shore and off-shore wind farms. The view was generally expressed that Ireland is relatively slow at granting permissions. It was stated that in Ireland, a

period of up to four years could be required to get permissions whilst in Germany the same process could take two years. Concern was expressed around the need to ensure high standards and quality products. The upgrading and improved access to the grid was cited by interviewees as being a limitation to the development of the sector and their businesses.

Case Study – ESB

Introduction

ESB Group has a turnover of close to €4 billion, 7,500 employees and incorporates a number of companies active across electricity generation, distribution and supply. As part of its Sustainability Strategy, ESB aims to be carbon neutral by 2035 and has outlined a €22 billion investment programme in renewable energy sources (including emerging 'green' technologies) and the development of the network to facilitate the deployment of renewables (smart metering and smart networks).

ESB's 2020 strategy is to achieve:

- World class sustainable networks
- A renewables business of scale
- Best practice generation portfolio
- Customer focused supply business
- Significant international presence

The largest proportion of the workforce comprises technicians with significant numbers of managerial staff, engineers and administrative staff. ESB view human resource planning as central to their business and conduct an annual Strategic Human Resource Planning process based on 1, 3 and 5 year time periods. The process includes four steps:

- Firstly, strategic scenarios are developed outlining possible futures for the business;
- Secondly, demand forecasting is conducted to assess the capability requirements in terms of both numbers, skills and competencies;
- Thirdly, supply forecasting based on current resources and skills and assumptions on attrition is carried out;
- Fourthly, the gap between demand and supply is then identified and finally a strategy to address this gap is developed, (including actions such as redeployment, upskilling and recruiting resources to meet future requirements).

Drivers for Changes in Skills Requirements

The first step in the Strategic Resource Planning process is to develop scenarios outlining two possible futures for the business which may impact on skills and resource requirements. The drivers for these scenarios may be internal, for example ESB's sustainability strategy, or external, such as increased competition in the electricity supply sector. Drivers and their impacts on future skills requirements are mapped against existing skills and any skills capability gaps identified.

Case Study – ESB

Skills Needs

ESB's core skills are in engineering and commercial expertise. Although the emphasis within these broad categories may change, these will remain the essential skills requirements. The ESB sees an ongoing supply of quality engineering resources as essential for the maintenance and growth of the business and delivery on strategic objectives. A deficit in these resources especially for power engineers has been identified. ESB is engaging directly to promote engineering as a career choice in primary and secondary education and has developed strategic partnerships with third level education providers to communicate their requirements, influence curriculum development and to promote their graduate recruitment programme. Apprentice scholarships have been initiated to provide apprentices with the opportunity of advanced entry into engineering education programmes.

Smart Networks

Ireland, as a largely island transmission and distribution system with a single system operator and a large wind and ocean energy resource is uniquely suited as a test bed for new smart network technologies. The development of the network into a smart network incorporating distributed generation as per ESB's sustainability strategy will require traditional electrical engineering skills and engineering skills combined with ICT and business systems skills.

Network technicians are the largest occupational group within ESB. For engineers, ESB has identified a need to promote maths and engineering at primary and secondary level education to ensure a future supply of skilled personnel. ESB has recently taken a number of initiatives to increase mobility and career progression opportunities within the organisation and increase the attractiveness of the role of network technician and of ESB as an employer.

In-Company Training

ESB provides extensive and wide ranging training to employees to develop skills within the organisation. Opportunities are provided and training and development is supported for all employees across all occupational groups. This includes continuing professional development, internal scholarships, upskilling crafts persons through higher level modules and programmes and their graduate development programme.

Strategic Resourcing

With the strong emphasis on long term strategic resourcing and actions to promote maths and engineering and liaison with third level institutions and professional bodies such as Engineers Ireland, ESB is taking a lead role in ensuring a future supply of appropriately skilled personnel to meet their strategic business needs.

Case Study - Open Hydro

Introduction

Open Hydro is an Irish based tidal energy technology development company that employs over 40 people between its office in Dublin and its technical centre in Greenore, County Louth. Since 2004, when Open Hydro secured the world rights to '*Open-Centre'* Turbine technology, the company has developed the technology towards commercialisation through continuous research, development and testing. The first commercial project was recently delivered with the installation of an Open Hydro Turbine in the Bay of Fundy, Nova Scotia, Canada in 2009. Earlier projects include installations in the European Marine Energy Centre in Orkney, where Open Hydro installed its first tidal turbine in 2006, and Alderney in the Channel Islands. Open Hydro plan to provide turnkey tidal energy installation and maintenance services to project developers and renewable energy generation companies throughout the world.

Energy Technology Export

Open Hydro as an Irish based international company is at the forefront worldwide in the development and commercialisation of ocean energy technologies with the first grid connected tidal turbine in the UK in 2008 and, more recently, one of the first commercial projects in the world. The company is currently active in the UK, France, Canada and the US with immediate prospects in other countries. While ideally placed to be a leading company in this area, Open Hydro is among a number of companies developing tidal and ocean energy technologies.

The future of ocean energy is likely to include a number of competing tidal and wave technologies and Open Hydro plans to be a leading supplier of tidal energy technology and turnkey projects in this developing sector.

Ireland has one of the most abundant ocean energy resources in the world and the potential to be at the centre of the development of commercial ocean energy technologies for export. Government policy supports this development through SEAI's Ocean Energy Development Unit and the target of 500MW of ocean energy connected by 2020. Perhaps paradoxically, Open Hydro does not currently have any turbines installed in Ireland but, subject to permitting, licensing and electricity purchasing arrangements plan to install tidal turbines in the future.

Skills Needs

As a technology development company, Open Hydro' core skills have been in cutting edge R&D and innovative engineering design to deliver a complex technology that is robust and simple enough to withstand the marine environment. As the company moves towards more commercial deployment of the technology there will be a need for additional manufacturing and operation and maintenance skills in the future. Operation and Maintenance skills for tidal energy installations will require high level cross disciplinary marine, electrical and mechanical engineering skills in engineers and technicians due to the remote and challenging nature of the work environment.

Open Hydro has recruited its personnel through advertisements on websites, their own website and

Case Study – Open Hydro

recruitment agencies. As a developing company they generally require complete skills in recruits and have sought candidates with the experience and qualifications to provide a full and exact match to their skills requirements. For this reason they have tended not to employ directly from initial education to date but have established contacts with a number of universities with a view to ensuring the supply of future skills needs.

Open Hydro has had difficulty in meeting their particular skills requirements from Irish candidates in the past and this is especially the case for electrical engineers both for turbine design and design of connections to the electricity grid. The company has recently initiated work placements for students and feel that this is an important route towards the development of graduates with the full skills required to immediately and productively enter the workforce. Core technical and engineering skills in conjunction with commercial awareness are emphasised rather than early specialisation in renewable energy sources.

Future Requirements

Open Hydro expects to increase employee numbers by 50% in the next three to five years with significant longer term growth as their technology is commercialised and as ocean energy in general becomes a viable source of renewable energy. This growth will be in highly skilled engineers, technicians and operatives both to maintain the current focus on R&D activity and to serve the growing need for personnel with manufacturing and operating and maintenance skills for commercial projects. These will be recruited as experienced personnel and as suitable candidates emerging from the education system.

6.2.13 Conclusions: Renewable Energy Sub-Sector

In the Renewable Energy sub-sector, there is a growing demand for engineers and technicians with expertise in emerging renewable technologies. A key requirement is the need to focus on the development of core engineering/ICT skills – with emerging technology areas such as wind, wave, solar and geothermal being provided for as 'add-on' specialism's within undergraduate programmes and/or through Masters Degrees and Postgraduate Diploma programmes.

The development of the electricity network into a smart network incorporating distributed generation requires a combination of engineering, ICT and telecommunications skill sets. There is a longer term demand for power engineers.

As increasing numbers of wind turbines, solar energy and other renewable technologies get up and running both here and abroad, there will be an additional demand for technician skills (combination of electrical, mechanical and electronic skill sets) to support their operation and maintenance.

Skilled workers and operatives will be in demand within the manufacturing, delivery and installation, operation and maintenance and repair and customer contact business stages.

6.3 Efficient Energy Use & Management

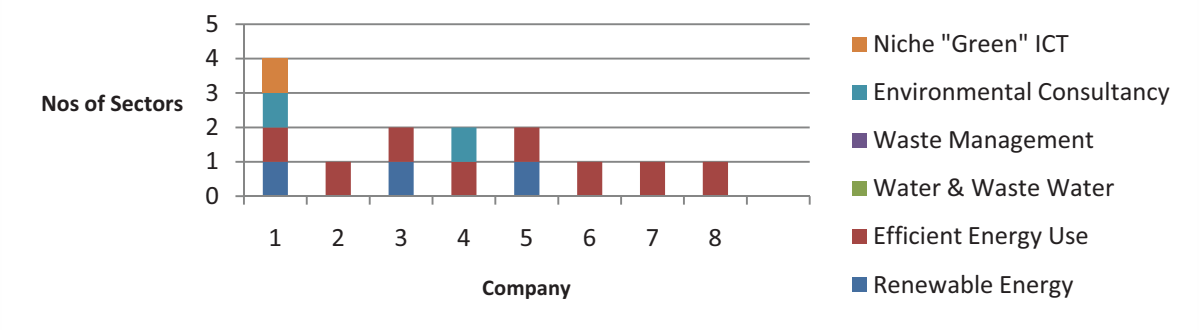
6.3.1 Introduction

The Government has committed to achieving, by 2020, a 20% reduction in energy demand across the economy compared to the 2001-2005 period. There is also a commitment to achieving a 33% reduction in public sector energy use. In addition to retrofit measures to improve energy efficiency, ICT devices and products inform managers about their energy efficiencies and CO_2 emissions.

6.3.2 Profile of Participant Companies

The eight companies surveyed in this sub-sector ranged in size from 5 to 650 employees. Almost all of their business is described as environmental. Five of the eight companies export particularly to the UK. Two companies also export to the EU market and another to Australia and the Middle East. Four of the eight companies are involved in sub-sectors other than efficient energy use and management.

Figure 6.3: Participation in Sub-Sector



Companies interviewed were involved in designing, manufacturing and fitting energy efficient products for both domestic and commercial markets and in energy generation and the maintenance of facilities. Some of the companies target specific sectors whilst others target multi sectors in Ireland and abroad. Some depend on new build homes whereas others target new and existing stock of houses. These companies plan to be leaders in areas as shown in the following Table.

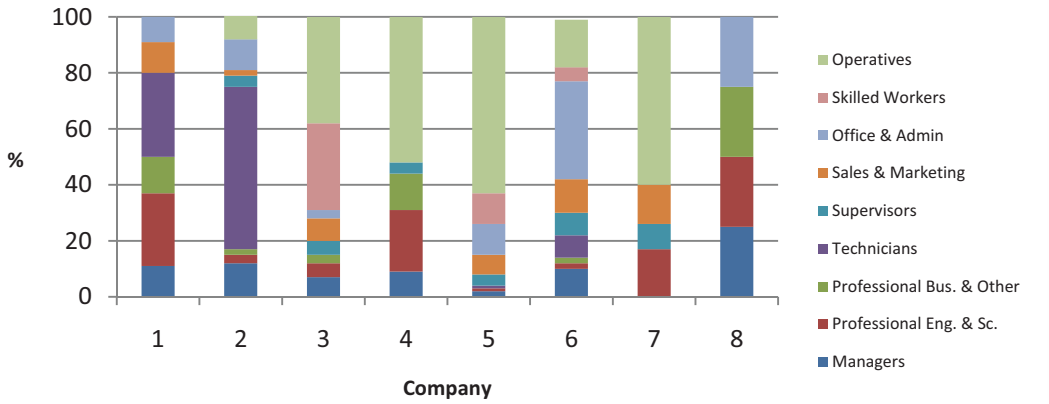
Table 6.5: Business Areas where companies plan to be a leader

Company	Business Areas
1	On site power generation and energy efficiency.
2	Energy Efficiency – demand side management.
3	Energy Efficient retrofit in domestic market.
4	Green Cement (Ground Granulated Blast furnace Slag). Zero emissions consulting.
5	Design and manufacture of energy efficient boilers (oil, wood pellet, liquid biofuel).
6	Manufacturing of Insulated products. Delivery of energy efficient buildings.
7	LED Lighting.
8	Zone control for domestic & small commercial buildings.

6.3.3 Occupational Profile

The proportion of professional and managerial staff depends on the nature of the business-whether it is design and development, or whether the balance lies with manufacturing and installation. For example, in three companies the percentage of non professional staff is highest given the importance of manufacturing and installation in their business whereas in two others, the reverse is true.

Figure 6.4: Occupational Profile



6.3.4 Core Skills Requirements

The core skills and competencies of companies are mainly in design, development and ensuring quality product and service for their customers. Core skills requirements across occupations include engineering combined with commercial skills, project management, communications and teamwork.

Table 6.6: Core Skill Sets / Competencies required across Occupations

Company	Core Skill Sets/ Competencies
1	Engineering with IT; Engineering with commercial sales.
2	Leadership; Teamwork; IT; Project Management.
3	Communication; Customer Interface; Project Management.
4	Project Management; Teamwork.
7	Commercial awareness across all occupations and particularly engineers. Electronic engineering with understanding of lighting.
8	Engineering and technical skills combined with sales and commercial awareness.

Professional Engineering and Science professionals are the most anticipated category of staff to be increased in the next 3 to 5 years. For six companies, additional staff are anticipated in the R&D, Piloting and Testing, Sales and Marketing stages of the business process. For two companies, engaged in retrofit and on site power generation, it is expected that there will be an increase in employment for other categories of staff.

Table 6.7: Anticipated Skills Demand by Occupational Group by Stage of Business Process (3-5 years)

Stage of Business Process	Companies					
	1	3	4	5	7	8
R & D		(a) (b) (c)	(b)	(d)	(b)	(b)
Pilot and Test	(b)(d)				(b)	
Marketing and Sales	(f)(b)(d)	(a) (b)(c)			(f)	(f)
Manufacturing/ Generation	(d)(e)(b)			(h)(i)		
Delivery and Installation	(d)(e)(b)(d)	(a)(b)(c)(h) (i) (g) (e)	(c)			
Operation & Maintenance	(d)(e)(b)	(a)(b)(c)				
Repair and Customer Contact	(b) (d)	(a)(b)(c)(h) (i)(g) (e)				

Notes: (a) Manager (b) Professional Engineering & Science (c) Professional Business & Other (d) Technicians (e) Supervisors (f) Sales & Marketing (g) Office & Administrative (h) Skilled Workers (i) Operatives

6.3.5 Skill Gaps

Current skills gaps are for energy engineers and sales staff with technical ability to sell overseas. Architects and professionals require enhanced skills around the integrated design and deployment of energy efficient products and providing advice on the optimal selection and installation of products. There is an upgrading skill requirement for insulation workers. Several companies outsource part of their business such as installation, deliveries and manufacturing. Where recruitment of staff from abroad occurred it was more to do with operating in export markets rather than being an issue of skills availability here. For the companies interviewed, graduate entry level salaries for engineers were approximately €35K with experienced staff (5 to 10 years) likely to be earning over €60K.

6.3.6 Skill Enhancement

Skilled staff are now working for shorter periods on many sites and interfacing more with the customer. This requires customer focus skills and also stronger ability for supervisors and managers to manage teams remotely.

Table 6.8: Non Technical Skills Gaps

Skills	Description
Leadership Skills	For senior managers including those with financial responsibility.
Customer Service	For Skilled Workers / Operatives working in dispersed sites.
IT Skills in new Software	Requirement for all occupations – especially sales & marketing.
Managing dispersed teams	For managers and supervisors.
Language Fluency Skills	For sales and marketing and engineers involved in exporting.

6.3.7 Meeting Future Skills Requirements

Companies plan to meet future skills requirements through recruitment from educational providers, external recruitment and the continuing training and development of their existing workforce.

Training was provided for all categories of staff in the larger companies interviewed, generally funded from own resources, although in three of the eight companies, this was supported with public funding (Skillnets). One Company also trained its product installers. Professional Engineers and Scientists participated most in technical and professional bodies - particularly in Engineers Ireland. Managers and Professionals participated in accountancy and representative bodies.

6.3.8 Demand for Skills: Risks

The credit crunch and economic recession has resulted in poor availability of finance for individuals and companies. Household and corporate expenditure tend to be on critical areas only. The drive for energy efficiency is also related to the cost of energy; as oil prices rise there is a renewed interest whereas with lower oil prices energy efficiency takes lower priority.

Case Study - Kingspan

Introduction

Kingspan Group is a leading international manufacturer of sustainable building solutions. The Group's principal activities comprise the manufacture of insulated panels, rigid insulation boards, raised access floors, steel frame and timber frame off-site solutions, environmental and renewable fuel and water storage solutions and hot water systems. Group turnover in 2009 was €1.1 billion with 7% of sales accounted for in Ireland. Kingspan Group has over 3,000 employees worldwide.

The Group's business model is to focus on higher growth and energy sensitive segments of the building industry. Innovation is the key to growth and Kingspan is aware of the importance of research and development to support market leading results. The core energy conservation qualities of many of the Group's products demonstrate Kingspan's ability to convert specifiers and end-users from traditional and less effective materials towards more modern solutions.

The Group's strategic focus is to pursue a broadening geographic footprint of sustainable building solutions, with market leading positions in regions where energy conservation and creative aesthetics are the priority. In support of this goal, significant internal resources and emphasis have been placed on nurturing a continuous flow of new and leading edge products and solutions to markets, produced in the most highly efficient manufacturing environment possible.

Kingspan operate 20 manufacturing units in Ireland and the UK, accounting for approximately 70% of the Group’s revenues in 2007. Kingspan’s headquarters are in Ireland, and a number of divisional management teams are also based here. Historically, the group’s roots have been in this area, with the first manufacturing plant outside Ireland/UK being acquired in 1996. Kingspan is now truly international with manufacturing facilities servicing markets throughout Europe, North America, Asia, and most recently Australia.

Case Study - Kingspan

Skills Requirement

The core skills to deliver Kingspan's business potential are in manufacturing a high quality product, and the technical design and manufacturing process skills required to deliver this, and in customer service – understanding customer's needs and providing a product to meet those needs. Skills in manufacturing quality and customer service are central to realising business potential.

In addition to internal skills for manufacturing and customer service, Kingspan's business requires skilled personnel in the construction trades to effectively deploy their products. A large skill base was built up during the high levels of construction activity in recent years and upskilling these personnel for energy efficient construction and retrofit techniques could be delivered through relatively short, targeted training programmes. Kingspan's principal concern is the loss of the core construction skill base through migration due to the current economic downturn. Kingspan have built a large knowledge and skill base in the organisation and recruit, develop and train staff to ensure that this base is retained and passed on to the next generation of managers, technicians and operatives. This is achieved through recruiting, training, developing and retaining staff. Kingspan operate both internship and graduate development programmes which are seen as central to the future supply of skills in the organisation by offering a defined career path to graduates to pass on the business skills to the next generation of Kingspan personnel.

Future Potential

Despite the recent challenging economic and business environment, Kingspan anticipates a potential for growth in the export market and in the energy efficient retrofit of existing buildings in the domestic sector. Key skills for the export market are in languages and understanding of the construction sector, typical construction techniques and building regulations in the target market. Kingspan generally recruits in the target country to acquire the required personnel and skills but there is potential for suitably skilled Irish personnel to service Kingspan's international markets.

Building regulations and the move towards lower energy and carbon buildings and the potential for retrofitting existing buildings are significant drivers for Kinspan's business and will require continuous development of products and within the manufacturing process.

6.3.9 Conclusions: Efficient Energy Use & Management Sub-Sector

The demand for skills in the sub-sector is related to factors such as the future cost of energy, potential export market opportunities, policies that drive energy efficiency and the continuation of government funding support for the retrofitting of buildings and the installation of energy efficient heating appliances. The current skills gaps are for energy engineers and sales staff with the technical ability to sell overseas. Architects and professionals also require enhanced skills in the integrated design and use of renewable energy efficient products. New and emerging skills are for energy auditors to assess the scope for energy savings in the industrial and commercial sectors. There is a requirement for the additional development of insulation workers for the upgrading of insulation in existing buildings. Skilled workers require systems knowledge of energy efficient appliances to ensure their optimal efficiency usage to the householder.

6.4 Water and Waste Water Treatment

6.4.1 Introduction

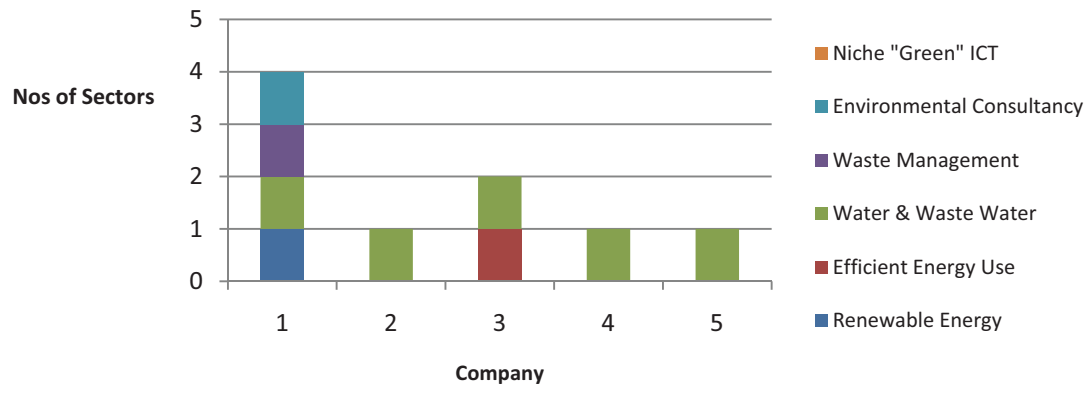
Local Authorities provide municipal water and wastewater services to the commercial, agricultural and domestic sectors. A key challenge facing municipalities is the identification and reduction of unaccounted for water leakage from public water networks. For example, 2008 data from Local Authorities shows that between 20% (South Dublin) and 53% (Cork City) of the water supplied was unaccounted for. There are plans to install and manage domestic water meters to over a million private residences. Private companies serving the sub-sector are active in:

- Designing, building and operating new wastewater treatment facilities;
- Water loss reduction;
- Construction of water mains and service pipes and of sewerage; and
- Consulting services across the range of associated activities.

6.4.2 Profile of Participant Companies

The companies that were interviewed had a combined turnover of €152m and employed a total of 670 staff. A small percentage of their turnover was from exports. The UK was the main destination of exports for the two companies exporting and one of those companies also exports to Poland. Two of the five companies were focused on water and waste water treatment, another two provide product and services related to the water network and metering. The fifth company is engaged in sludge management as well as wood based energy solutions.

Figure 6.5: Participation in Sub-Sectors



The companies interviewed design, build, operate and maintain water and waste water treatment facilities and networks. Many companies plan to be leaders in their sector based on the new and emerging technologies for metering and treatment process technologies. One company plans to become a leader in biomass energy in Ireland and the UK.

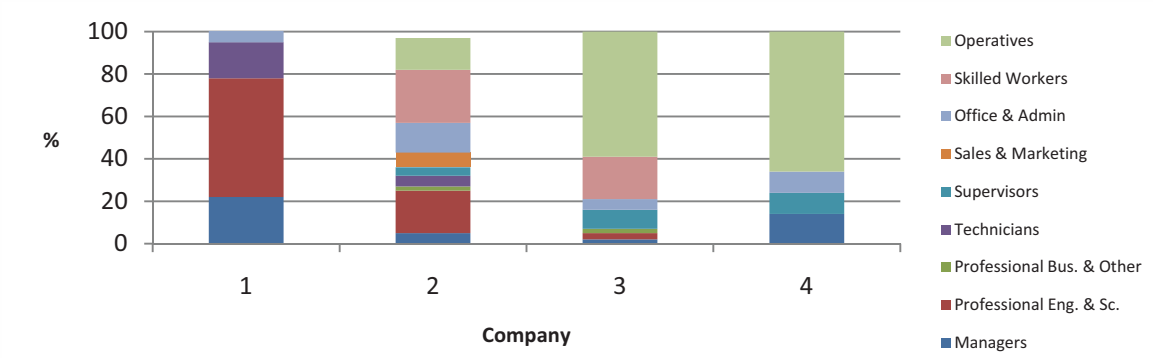
Table 6.9: Areas of 'green economy' where company plans to be a leader

Company	Business Area
1	Biomass Energy in Ireland and UK
2	Water & Waste Water Treatment process technology and operation and maintenance
3	Smart meters for gas, water, electricity, district heating
4	Installing, operating and maintaining water meters for domestic market
5	Operation and maintenance of water and wastewater treatment plants in municipal sector

6.4.3 Occupational Profile

Skilled Workers and Operatives account for a high proportion of current jobs. Companies 1 and 4 engage a large number of sub-contractors in their business (Company 1 has 20 subcontractors while Company 4 has 118 subcontractors - not included in the profile below).

Figure 6.6: Occupational Profile



6.4.4 Core Skill Requirements

Communications, commercial awareness, project management and teamwork were repeatedly cited as skills required across all occupations in this sub-sector.

Table 6.10: Core Skill Sets / Competencies required across all Occupations

Company	Core Skill Sets / Competencies
1	Project Management, Commercial / Legal, Thermo Engineering
2	Communications Project Management, IT, Teamwork
3	Communications, Project Management
5	Communications, Project Management, Commercial

6.4.5 Anticipated Change in Employment

The expected increase in direct employment in this sector is likely to occur for Skilled Workers and Professional Engineers and Scientists. These new roles are likely to be engaged in the delivery and installation of applications and services as well as in their operation and maintenance.

Table 6.11: Anticipated Skills Demand by Occupational Group by Stage of Business Process (3-5 years)

Stage of Business Process	Companies				
	1	2	3	4	5
R & D		(b)			(b)
Pilot & Test					
Marketing & Sales		(c)			
Manufacturing / Generation					
Delivery & Installation	(a) (b)	(d)	(h) (i)	(b), (h)	
Operation & Maintenance		(d) (e) (h)		(b)(h)	(h)
Repair & Customer Contact	(g)	(d)			

Notes: (a) Managers (b) Professional Engineering & Science (c) Professional Business & Other (d) Technicians (e) Supervisors (f) Sales & Marketing (g) Office & Administrative (h) Skilled Workers (i) Operatives

6.4.6 Skill Gaps

There are current skills gaps relating to design, planning, and installation and using modern technology in the operation and maintenance of water and waste water treatment facilities.

This includes project/construction managers for the development of high value water and waste water facilities, process engineers and environmental engineers. Also required are laboratory technicians for the testing of water and waste water and electrical and mechanical technicians for the servicing and maintenance of treatment plants. Non-technical competences emphasised include communication skills (with particular reference to engineers) and improved commercial awareness.

6.4.7 Filling Skill Gaps

In the main, companies utilise external recruitment and also invest in continuing training and development within existing employees. One company utilised outsourcing to meet its needs.

For the companies interviewed, salaries for new entrant graduates of engineering, science or sales are approximately €30K whilst they are likely to be €50K for those with 5 to 10 years experience.

6.4.8 New and Emerging Skills

When water meter installation for commercial, industrial and domestic users goes ahead, there will be a requirement for a dedicated team of professionals to manage these assets. The view was expressed that four local authorities (e.g. Dublin City & County) which account for 45% of the population will have sufficient scale to justify their own dedicated team - however, other Local Authorities will not have sufficient scale. Another emerging skills area is for plumbers for 'rainwater harvesting'- diverting rainwater off roof to be used for toilet flushing, gardening etc.

6.4.9 Meeting Future Skills Requirements

It is anticipated that future skills requirements will be sourced by external recruitment and the continuing training and development of employees. One Company intends to utilise subcontracting for the scaling up of general operatives. Education and training for employees to enhance their skills often relates to compliance with health and legislation requirements. One interviewee was keen to emphasise the higher standard of training related to water services in the UK and recommended at least benchmarking Irish training against this. Participation in technical and professional bodies was highest among engineering and science graduates and particularly in Engineers Ireland.

6.4.10 Demand for Skills: Potential Risks

Any delays in the implementation of the Water Services Investment Programme could result in 'stop go' effect which makes it difficult for companies to attract and retain skills. Skilled workers will migrate to where there is more consistent demand for their skills and services.

Case Study: Veolia Water

Introduction

Veolia is a major multinational corporation with a worldwide presence. The group is active in four main sectors focused on the provision of public services: water treatment, waste disposal, energy and transport. In Ireland, Veolia has over 1,000 employees active in all of these sectors. For instance, their subsidiary, Dalkia, is a market leader in the provision of energy services to business and the public sector. Their transport division operates the Luas in Dublin. Veolia Environmental Services has been providing solid waste management services in Ireland since 1990. Veolia Water Ireland provides a range of services to the municipal water and wastewater treatment segment. In the water sector, their subsidiary SEDE is active in sludge management solutions i.e. the management of sludge produced mainly from municipal wastewater treatment operations. Their subsidiary ELGA provides advanced solutions for process water for industry.

Product & Market Position

The services that Veolia Water Ireland offers include:

- Design & Build (DB) or Design Build and Operate (DBO) contracts for water, wastewater and sludge treatment for municipalities.
- Outsourced Operations and on-site service and maintenance for the same sector.
- Engineering support and services, typically on a consulting basis.
- Water metering: design, installation, maintenance, customer management billing and collection.

Veolia Water Ireland also serves the industrial waste water treatment sector and has provided services to the food and beverage, pharmaceuticals & chemical and oil and gas industries.

Recent Performance

The company has been successful in building up sales of approximately €40 million in the year 2009. Like most businesses in its sector it has been affected by the general slowdown in the economy. The design-build aspect of its business has been particularly hurt by the reduction in Government

Case Study: Veolia Water

spending on new projects and the uncertainty surrounding the Water Services Investment Programme (WSIP). However, due to the long term nature of its operation and maintenance services, the company is partially protected from the downturn. Veolia Water Ireland has approximately 153 employees with a rough split as follows:

Role	Proportion
Managers	10%
Professionals (including sales & marketing)	45%
Technician/Skilled Worker	21%
Operative	17%
Other	7%

Skills Needs

Veolia Water Ireland requires specialist skills in the following key areas:

- Mechanical, Electrical, Instrumentation and Process engineers for wastewater, water and sludge treatment plant design and construction;
- Project/Construction management with regards to mechanical, electrical and instrumentation;
- Plant Management for the operation of water and wastewater treatment plants
- Telemetry, automation and SCADA for remote monitoring/control of treatment plants and pumping stations;
- Customer Services Management for metering billing and collection;
- Laboratory technicians for the testing of water and wastewater;
- Electrical and mechanical technicians for service and maintenance of treatment plants.

Sales and marketing has primarily been in response to tenders. Ireland does not have a long history of private operations of water and wastewater infrastructure and there has been a shortage of experienced personnel with an operation and maintenance background. The company has addressed this by hiring people on the Irish market with good base skills and experience and developing them on the job. Approx 2.5% of labour cost is spent on the training budget and this is supplemented by extensive on-the-job training.

A crucial element of this has been the use of expatriate engineering experts seconded into the Irish company. They have brought their international best practice and have cross fertilised this with what the company regards as the good base skills of technicians and engineers available on the Irish market. At the peak, they had about a dozen such expat experts with currently about a quarter of that number in the Irish company. The company feels that third level education should have a role in devising training courses for water and wastewater operators such as the company provides for itself in its training campuses in 12 locations around the world including in Paris and the UK. This would benefit the overall sector and there are model courses available which could be drawn upon.

Future Developments

Like all private enterprises in the sector, they are closely monitoring the implementation of the

Case Study: Veolia Water

Water Services Investment Programme and associated public policy. While the WSIP is officially intact, substantial portions are being carried forward from year to year in the public budget leading to a reduction in activity in the market. In addition, Local Authorities may not in all cases be able to provide the matching funds (in the region of one third) for investment from the WSIP. Veolia Water would support the development of a national water body that would provide a joined-up thinking approach to the provision of water services nationwide, and facilitate regional improvement projects and offer economies of scale. In addition Veolia supports existing incentive schemes for investment in green technology including accelerated capital allowances and capital grants. Potential investments by industry in this area would be anaerobic digestion of wastewater leading to bio-gas generation for use in Combined Heat and Power engines. An important initiative being closely monitored is the proposed implementation of universal domestic metering. This activity is a core strength of the company and it is able to draw on a bank of expertise as well as technology. They are optimistic that they can quickly source all the necessary skills and transplant them quickly to their Irish operation. However, the timing and shape of this project is yet to be defined and this is an uncertainty facing the company and the market.

As regards the Design and Build market, the stop-start nature of the implementation of the WSIP risks inhibiting the development and retention of important skills built up in recent years. The size of the international organisation gives them a good chance either to redeploy these skills or at least to make sure that they are retained in the overall organisation. They would expect to be able to source good quality staff in Ireland for this part of their business. As regards the operation and maintenance of treatment plants, as and when this market becomes more active, they would expect the core base of skills they have built up in Ireland supplemented by short term technical support to be sufficient for their needs. In terms of the implementation of the WSIP, if Public Private Partnership projects in whatever models are required, or if the share of outsourced operations were to grow at a faster pace there would be a need for new skills in the market. The company would source this from elsewhere in the Group and could also set up the proper training forces in Ireland with the support of its Campuses organisation. More generally, as the Irish organisation matures, it could also be a source of expertise for other parts of the group and as such could start to export its know-how. It is already the case in one segment: the use of drying equipment for the treatment of waste water sludge.

6.4.11 Conclusions: Water & Waste Water Treatment Sub-Sector

There is a demand for skills related to the design, installation and use of modern technology in the operation and maintenance of water and waste water treatment facilities. This includes project / construction managers, process engineers and environmental engineers. Also required are laboratory technicians for the testing of water and waste water and electrical and mechanical technicians for the servicing and maintenance of treatment plants. Demand for skills in the sector is also dependent on domestic water metering going ahead. There will also be a requirement for a small number of professional experts to plan and manage water metering development. New and emerging skills are for plumbers specialising in rainwater harvesting – diverting rainwater off-roof to be used for toilet flushing, gardening and cleaning. Upskilling requirements for the sector should be designed and delivered to meet international standards.

6.5 Waste Management, Recovery & Recycling

6.5.1 Introduction

In Ireland, the level of waste recovery is increasing, with household waste diversion from landfill standing at 26% in 2008 compared to 19 % in 2004. *Changing Our Ways* set out targets over a 15-year timescale for the diversion of 50 per cent of household waste from landfill[50].Three waste incinerators have been licensed by the EPA (two for municipal waste, the other dealing with municipal and hazardous waste)-but have yet to commence operations. There is a requirement to develop adequate infrastructure to treat the large quantities of organic waste that must be collected separately and diverted from landfill to meet the Landfill Directive targets.

6.5.2 Profile of Participating Companies

Of the three companies interviewed two employed more than 500 employees and one between 50 and 500. Companies exported to European, USA and Asian markets, mainly of recovered waste for recycling. Companies interviewed collect, process (sort, separate, recycle) solid waste and operate landfills including managing gas generated from their own landfill sites as well as producing other energy products and related services. Their products and services are sold to domestic and business consumers of waste management services at home and abroad.

Figure 6.7: Participation in Sub-Sectors

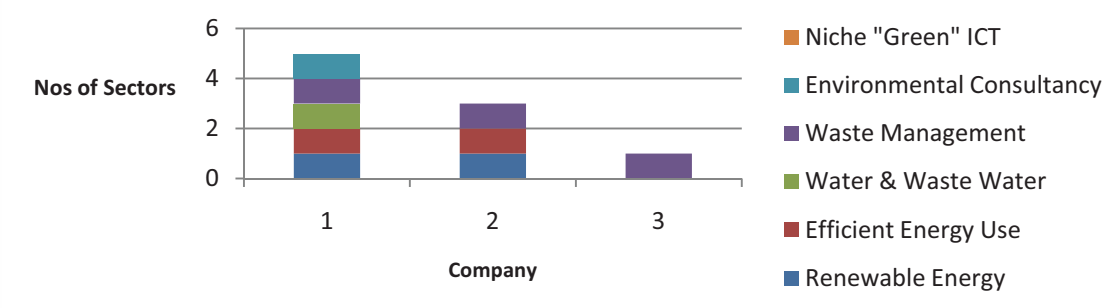


Table 6.12: Business Areas where companies plans to be a leader

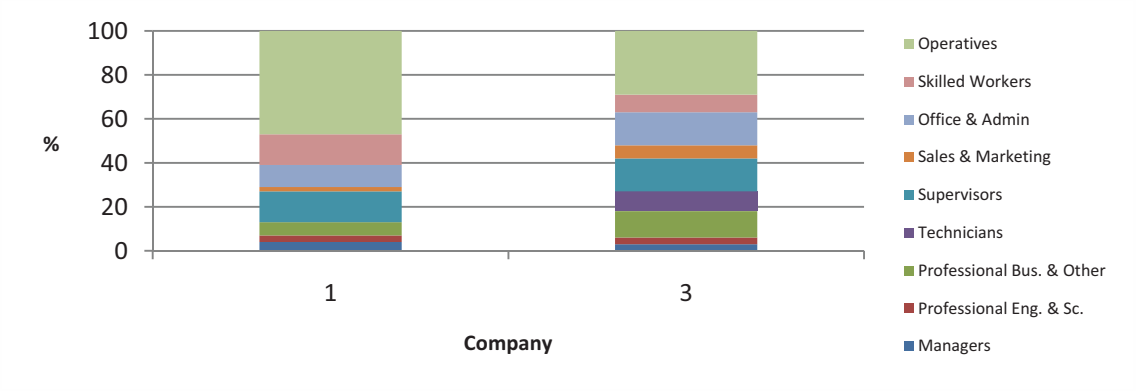
Company	Business Areas
1	Wind energy, organic waste and resource recovery
2	Solid waste management company in Ireland
3	Waste to energy and hazardous waste management

[50] Department of Environment & Local Government (1998) 'Changing our Ways'.

6.5.3 Occupational Profile

While a high percentage of staff are skilled workers and operatives, the core organisational skills cited are the professional engineering skills and commercial acumen of senior management. Communication skills, customer service and project management are key skill requirements across occupations. One company requires all staff to be expert in hazardous waste.

Figure 6.8: Occupational Profile



6.5.4 Anticipated Change in Employment

Expansion in employment is anticipated to be related to piloting and testing (particularly incineration) sales and marketing and delivery of services. Sales and marketing staff, professional engineers and scientists are the anticipated categories of staff to be increased.

Table 6.13: Anticipated Skills Demand by Occupation Group by Stages of Business Process (3-5 years)

Stage of Business Process	Companies		
	1	2	3
R & D	(b)		
Pilot & Test			(h, d, b, a)
Marketing & Sales	(c), (f)	(f), (b)	(f)
Manufacturing / Generation			
Delivery & Installation		(i), (c), (b)	
Operation & Maintenance	(d)		(c, g,)
Repair & Customer Contact			

Notes: (a) Manager (b) Professional Engineering & Science (c) Professional Business & Other (d) Technicians (e) Supervisors (f) Sales & Marketing (g) Office & Administrative (h) Skilled Workers (i) Operatives

6.5.5 Sourcing Skills

Training and developing existing staff combined with recruiting from outside the company were the main sources of recruitment. Only one company had recruited from abroad – for a Plant Manager with 10 years experience in incineration (as was required under licence). For the companies interviewed, starting salaries for graduates were approximately €30K and €40K for experienced professionals.

6.5.6 Skill Gaps

There were no major skills gaps mentioned. Odour control expertise was cited as a niche skills area.

6.5.7 New and Emerging Skills Requirements

It is expected that there may be ten commercial anaerobic digestor plants over the next 5 years and that each plant will require one manager, 2.5 technicians as well as one staff for administration. In addition there may be a number of small such plants based on farms. The quantity and quality of compost produced from household waste depends on the standard of sorting of brown bin waste and the mix of wet and dry materials in particular (in parts of Germany unemployed people were engaged and trained to educate the public on sorting household waste).

The design, planning and building of the incinerators will be done by specialist contractors. Furthermore these contractors will be responsible for the training of staff in the operation and maintenance of the facilities. Nonetheless the company involved in incineration had experienced difficulty in filling senior maintenance, logistic (moving hazardous waste) and facility manager (for transfer station) roles.

6.5.8 Meeting Future Skills Requirements

The training and developing of existing staff combined with external recruitment will be used to meet future skills requirements. Two companies had provided training to all categories of staff funded from own resources and occasionally from small grants. Managerial and professional staff are the main categories that participate in professional bodies (Engineers Ireland was the main body identified).

6.5.9 Demand for Skills: Potential Risks

The development or otherwise of incineration will have major impact on the skills required in the waste management and particularly in the Dublin region. This is not only related to incineration per se but also to transport logistics and pre-treatment of solid waste streams.

Case Study: Bord na Móna

Introduction

Bord na Móna (BnM) is a major publicly owned company active in energy, horticulture, fuels and environmental services. The total group employs over 2,000 people in Ireland with sales of €400 million. BnM regards itself as Ireland's leading environmentally responsible integrated utility service provider. In defining its *'New Contract with Nature'* business strategy, BnM is committed to continued growth through its customer service, quality and innovation, delivered through the excellence and commitment of staff. The company, through its subsidiary AES (Irl) Ltd provides waste management services to commercial and domestic customers in Ireland from its six main transfer centres. In addition it has a landfill facility at Drehid, Co Kildare as well as plans to implement other waste treatment technologies. The facility sits under the resource recovery division of the company. This case study regards both of these as a single unit and is referred to as BnM Resource Recovery.

Product & Market Position

AES is one of Ireland's leading waste management companies, with a particular focus on collection, segregation and recovery services. It provides services to domestic and commercial customers nationwide, operating through a network of six waste transfer centres focused on specific local markets. AES was acquired by BnM in 2007, itself having been the product of the merger and/or acquisition of 15 smaller waste management companies since its foundation in 1996. The Drehid landfill facility was opened in 2008 and can accept up to 360,000 tonnes of solid waste per annum. In addition to the functions of collection, segregation, recycling and disposal, the company offers specialist services including: facility management; waste management at public events; equipment supply; composting and biowaste treatment options; liquid and sludges recovery and disposal; WEEE services; site remediation; environmental/regulatory reporting; environmental consulting; environmental audits and recyclables trading. The company has a core of activity in the Midland Region and East of the country and is able to drive logistical efficiencies with this regional focus.

Recent Performance

The company has 55,000 domestic customers and approximately 5,000 commercial customers and annual sales between €50m - €60m. Like many companies in the sector, the quantity of waste collected has fallen due to the downturn in the economy. There has been a reduction in headcount due to natural attrition, non renewal of some contracts and a small number of redundancies. They have. Commercial customers account for approximately 65% of the tonnage collected. The company diverted 150,000 tonnes of paper and other recyclables from landfill in 2009. Although volumes of waste for collection have declined, volumes accepted from other waste companies for landfill have increased. Current annual volumes of waste being accepted for landfill are running at 200,000 to 250,000 tonnes per annum, approximately 65% of capacity.

Skills Needs

A total of 346 staff are employed within BnM Resource Recovery. The majority of the staff are operatives (66% of total), who work at transfer/recycling centres and as drivers. Twenty-three percent of staff are engaged in administration. Technical professional/skilled workers comprise 5% and managers /supervisors grades comprise 6% of staff. The waste management business is generally regarded as a potentially dangerous environment in which to work so there is a major focus on health and safety. The company invests significant sums into training in this area, well in excess of legal compliance requirements. There is an increasing focus in the company on improving the customer experience. The company has invested in new systems including GPS route planners and logistics management which allows a detailed and traceable management of the delivery of the services. In the past, telephone contact with domestic customers was dealt with at transfer stations but this was centralised at a new call centre in Newbridge in 2009.There was a significant training requirement which has borne fruit in terms of an improved and consistent customer experience. Another aspect of customer service has been providing training to drivers, not only in the systems they are using but also in dealing with customers and the public. The management team comprising 12 staff is small given the overall staff numbers but this reflects the nature of the business. There is a concentration of commercial, technical and leadership skills in this team. For domestic customers pricing is generally done on a standardised scale depending on location and the nature of the service. Due to the nature of the build up of the business (i.e. by acquisition, consolidation and organic growth), the company has developed a skill in the management of Transfer of Undertakings (TUPE) obligations. This is a focused skill that has assisted company growth. There has been a trend to move owner drivers to full employee status which the company regards as beneficial.

Future Developments

The main future challenges come from emerging technologies, new business systems and market dynamics. The key emerging technologies the company is considering include Mechanical Biological Treatment (MBT) and composting. It hopes to be able to implement these at its landfill site. It is difficult to estimate numbers to be employed if these technologies are implemented due to uncertainties about the market and planning process. It could be that the MBT facility would need 40-50 staff. They would require new skills in the company which it expects to address by way of hiring of suitably qualified personnel (or transferring from other parts of the business) and supplementing these hires with appropriate training. It has already hired specialists to guide the company through the planning process. The company has invested in new business systems which are now substantially in place (e.g. customer management, logistics management). However, it would expect to continue to invest in this area and new skills will be built up as systems are put in place. Market dynamics, including government regulation (especially green taxes and levies), competition and the potential for incineration give rise to some uncertainties. The company is monitoring these developments closely and will respond to obtaining the required skills when it gets sufficient clarity on these issues.

6.5.10 Conclusions: Waste Management, Recovery & Recycling Sub-Sector

Most of the growth in skills requirements will be related to the scaling up the delivery of services and the operation and maintenance of existing and new technologies. The greatest demand for skills required is for additional skilled staff. Anaerobic digestion is one such new technology where new skills will have to be learnt and developed over time. There is little experience in Ireland of incineration or managing hazardous waste. The training and development of skills for the operation and maintenance of an incinerator(s) is likely to be provided by the contractor engaged to design, plan and build same.

6.6 Environmental Consultancy Services

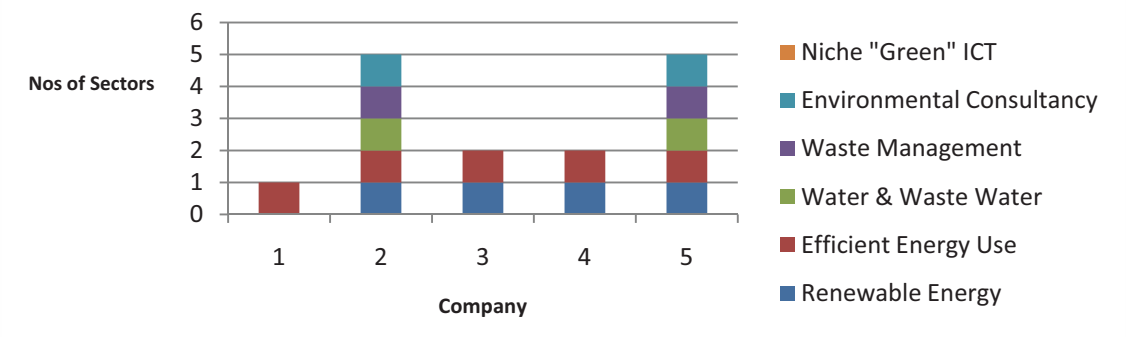
6.6.1 Introduction

While the focus of environmental consultancy in recent years has been on domestic opportunities, the sector is now more likely to focus on export growth while maintaining domestic capacity. New areas of business opportunity in renewable energies, energy efficiency and water & waste management are likely to increase in coming years.

6.6.2 Profile of Participant Companies

The combined turnover of the five companies interviewed is €64m. The smallest company has two employees and the largest 925. Companies export their services to near and far away destinations such as India. The two consultancy companies with most employees provide services in five sub-sectors and the others are focused on one or two sub-sectors. All of the companies provide consultancy services and one also provides project management engineering and CHP development services. Companies provide services to public and private companies (SME and Large blue chip).

Figure 6.9: Participation in Sub-Sectors



All companies plan to be leaders in one or a number of sub-sectors and subject matter experts in some areas such as Combined Heat Power or transport.

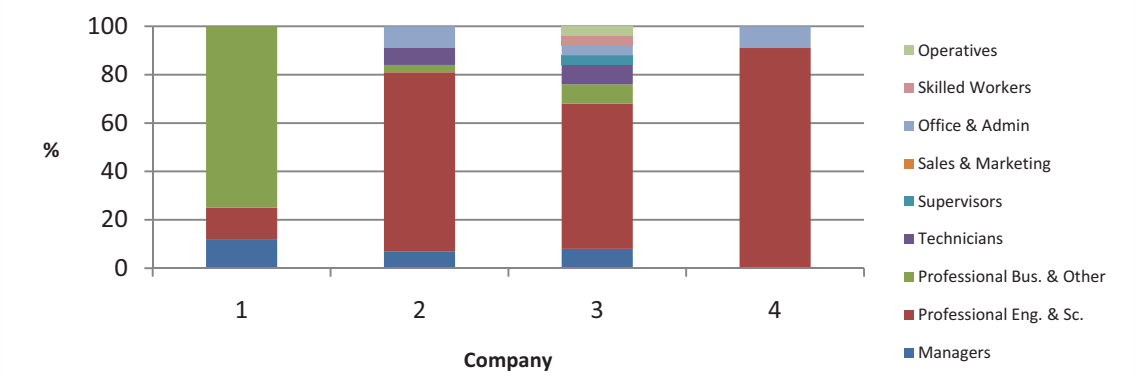
Table 6.14: Business Areas where company plans to be a leader

Company	Business Area
1	Transport Energy Management
2	Wind Energy Waste Management
3	Combined Heat Power
4	BER & building air tightness in Ireland
5	Waste Management Renewable energy, Water and waste water treatment

6.6.3 Occupational Profile

The majority of the staff within environmental consultancy comprise professional or managerial which reflects the nature of their business. Company 1 engages professional business and other staff on a contract basis.

Figure 6.10: Occupational Profile



6.6.4 Core Skill Sets / Competencies across Occupations

Communications, maths, science and commercial awareness and sales and marketing were identified as core skills requirements across all occupational groups.

6.6.5 Anticipated change in Employment

An increase in employment in participating companies is dependent on factors influencing the markets across sectors (such as general economy, investment programmes in water services and energy efficiency). Any increase in employment is likely to be for professional engineering and science and sales and marketing within the delivery and installation of applications and services.

Table 6.15: Anticipated Skills Demand by Occupation Group by Stage of Business Process (3-5 years)

Stage of Business Process	Companies				
	1	2	3	4	5
R & D			(a)	n/a	n/a
Pilot & Test			(b)	n/a	n/a
Marketing & Sales		(f)		n/a	n/a
Manufacturing / Generation			(d)	n/a	n/a
Delivery & Installation	(b, c)	(b)		n/a	n/a
Operation & Maintenance			(f)	n/a	n/a
Repair & Customer Contact				n/a	n/a

Notes: (a) Manager (b) Professional Engineering & Science (c) Professional Business & Other (d) Technicians (e) Supervisors (f) Sales & Marketing (g) Office & Administrative (h) Skilled Workers (i) Operatives

6.6.6 Skill Gaps

The demand for professional staff include energy engineers with knowledge of both UK and USA methods of building energy assessment, environmental engineers for the prevention, control, and remediation of environmental health hazards utilizing various engineering disciplines; and electrical engineers for consultancy in renewable energies. Specialist staff are required for the planning and modelling of drainage and water basins, electricity grid, and traffic management.

6.6.7 Filling Skill Gaps

Companies used various sources for recruitment. One engages staff mostly on a consulting/contract basis. Another engages specialist services e.g. archaeological. None of the companies have recruited from abroad recently. For the companies interviewed, entry level salaries for professional engineering and science graduates was €30K and for experienced staff approximately €50K.

6.6.8 Skill Enhancement

There is a need for enhanced written communications skills covering all aspects of work from preparation of tenders, client communications and report writing. This tends to apply to the engineers. Given the consultative nature of the work, there is a need to solve problems, think laterally and be innovative in the process. Maths and financial awareness skills were also identified as gap areas. More experienced consultants need to be competent in project management.

6.6.9 New & Emerging Skills

Expertise in new and emerging areas mentioned in previous sub sectors also apply in this sub-sector. The main requirement is for consultants to be adaptable and flexible to work across sub-sectors and move across various assignments from, for example, roads to buildings. Consultants in civil works need to be flexible in relation to working on assignments overseas.

6.6.10 Meeting Future Skills Requirements

Training and development of existing staff, along with external recruitment, and intake from education providers will all be used to meet future skills needs in the companies interviewed. Two companies use networks of independent consultants. Training is provided for managers and professional staff in most companies and is mainly funded from own resources with the exception of some public support through Skillnets. Professional Engineering and Science staff are most likely to participate in Technical and Professional bodies and Engineers Ireland was the most frequently listed body. A number of other bodies were also listed for various specialisations.

6.6.11 Demand for Skills: Potential Risks

Demand for consultancy will be affected by the level and pace of activity across sub-sectors in the Green Economy. Economic and financial factors influencing demand at home will also prevail on demand overseas as many countries have been negatively affected by the global credit crunch, a tightening of lending criteria and the wider economic slowdown. A reasonably steady stream of work from the public sector budget will also be important to retaining key skills areas already built up.

Case Study – RPS Consulting

Introduction

RPS is a large multinational multi-disciplinary consulting firm. It has over 4,500 staff worldwide with over 800 Engineering, Planning Environmental and Communications specialists employed in Ireland. Most of the staff are professional or technical grades.

Distribution of RPS Staff

RPS staff profile comprises 7% Directors / Management, 82% Professional and Technical and 11% Administrative & Support. Staff are employed in Ireland providing services in the following areas:

- Asset Management
- Energy
- Environment/Procurement and Project Management
- Resource and Waste Management
- Structural and Mechanical and Electrical Engineering
- Transport and Highways
- Town Planning and Infrastructure
- Planning
- Water and Wastewater

The company had a turnover in Ireland of €117 million in 2008 and is the largest consultancy delivering these services on an All-Island basis. RPS considers some 70% of its business to be in the Green Economy - in the areas of resource management and conservation, sustainable energy and delivery of appropriate and responsible infrastructure. Significant projects with which it has been recently involved include: Eirgrid Renewables Integration Development Project, Irish Scottish Links on Energy Study, CHANGE National Climate Change Campaign and various due diligence appointments in the area of renewable energy, waste and the environment.

Case Study – RPS Consulting

Skills Demand – Factors Influencing

Like most businesses of its type RPS has been affected by the general slowdown in the economy since 2008 but has shown resilience and strength, partly attributable to its loyal client base and diverse range of services offered. Some of the key challenges for the company in developing a best-fit skill-base in the current climate are a dearth of specialist skill sets in the market and uncertainty in certain sectors resulting from the downturn in the economy. For example, national targets and developer interest would indicate that a large demand will manifest itself in the short term for the planning, engineering, environmental and communication services required to deliver renewable energy projects. However, risk surrounding energy support mechanisms inter alia has made funding difficult to achieve resulting in low demand for services. A more gradual growth in renewable energy development – and predictability in supports and funding - would allow for the provision of cross-training to existing professionals and the integration of new graduates. A similar analogy can be drawn in water conservation and management, where implementation of policy has been stifled by a lack of available capital, resulting in a potential loss of key skills to the marketplace which will prove more difficult to fill when funding becomes available again.

A general trend towards more sustainable infrastructure and projects has been felt across all of RPS business streams. Recent successes have demonstrated the value of having 'sustainability' not just as an added service but as an inherent part of the service offering, consistently adding value to both projects and clients. The new 'Green Economy' will largely comprise of the same economy / sectors but with a leaner and greener tint than before. A number of specific markets have begun to open up. Many of these revolve around more sustainable behaviour with regard to both our resources and energy. Development in Renewable Energy, Grid Development, Energy Demand Management and Agri-Energy will provoke a growth in consultancy. Similarly, sustainable resource management in sectors such as water, waste management & recycling and logistics and smarter travel management will provide significant growth into the future.

Skills Needs

An essential component of this context is the ability to be flexible and to innovate for each client. This innovation and the ability to adapt to new technologies and methodologies in the delivery of greener and more sustainable services is no longer an exceptional demand but a pre-requisite with all clients. With specific regard to skills needs the ability for graduates and prospective employees to be more innovative and adaptable than ever is now critical in all service sectors. Specific skills needs that are immediately apparent at this stage include Electrical/Power Engineers, Grid Modellers and Planners, Wind Analysts, Technology Specialists, Traffic Planning specialists and Recycling/Recovery and Product Design professionals.

Meeting Skills Needs

In the current climate, RPS focus initially is on internal cross-training and up-skilling before employing externally. RPS have traditionally employed at all levels with both recent graduates and experienced professionals being part of the yearly intake. It is likely that specialist roles will be

Case Study – RPS Consulting

filled in the short to medium term, with a more conventional recruitment policy being re-started when the current economic climate ends. The company commits heavily to the ongoing professional training and development of its staff with dedicated training co-ordinators assigned to each functional area and both internal and external training being offered to staff. It is committed to its structured CPD programme, delivered alongside and through its Integrated Management System and which has been independently accredited by Engineers Ireland.

6.6.12 Conclusions: Environmental Consultancy Services sub-sector

Demand for consultancy will be dependent on the scale and pace of development in other sub-sectors. Opportunities in traditional consultancy services are more likely to emerge abroad and within new and emerging sub-sectors. Technological development in existing sub-sectors will create opportunities for consultancy. Consultancy will need to develop a capacity to adapt and diversify from their traditional consulting areas. Future consultants will require Masters level qualifications to be competitive.

6.7 'Green' ICT Applications & Software

6.7.1 Introduction

'Green' ICT applications and services can generate energy efficiencies within the ICT sector itself e.g. energy efficient server 'farms' or using virtualisation or cloud computing to reduce the amount of infrastructure required. 'Green' ICT solutions can also generate efficiencies in other industries e.g. software solutions for wind power management or for smart buildings or for efficient management of transportation, water supplies and water loss reduction.

One estimate is that the ICT sector is directly responsible for around 2% of global CO_2 emissions[51]. In addition it is recognised that ICT has a significant contribution to enable CO_2 reductions across other sectors. Product development that reduces power requirement of ICT devices can have a huge positive impact on energy savings. The development and improvement of the efficiency of existing ICT products and systems so that they require less power is the most direct way ICT can contribute to reducing CO_2 emissions. For example, data centres house the computing and communications equipment that businesses use to manage and organise their corporate data. Research has found that 60-70% of a Data Centre's power consumption is associated with cooling the IT equipment.

The following Table gives an indication of the magnitude of potential reductions across various sectors.

[51] http://www.gartner.com/technology/research.jsp

Table 6.16: Estimates of Incremental Potential for Green House Gas Emissions Reductions Enabled by IT by 2030 (metric tons of CO_2 equivalent)

	Low Estimate	Medium Estimate	High Estimate
Smart buildings – ICT in existing buildings	121	545	959
Smart buildings – ICT for planning and operating new buildings	46	439	832
Transport mode switching enabled by smart urban planning	38	190	380
Telecommuting and virtual meetings (smart work)	68	159	404
In vehicle ICT and intelligent transport infrastructures (smart vehicles and intelligent transport)	581	1,486	2,646
E-commerce and material efficiency	198	927	1,822
ICT for energy efficiency in industry (smart industry and plant and process design optimisation)	100	815	1,530
ICT in energy supply systems (removal of network constraints-2020)	17	59	128
Estimated total potential for CO_2 emission reductions	1,168	4,620	8,711

Source: Potential Global CO2 emission reductions from ICT use: identifying and assessing the opportunities to reduce the first billion tonnes of CO2 Emissions, WWF 2008.

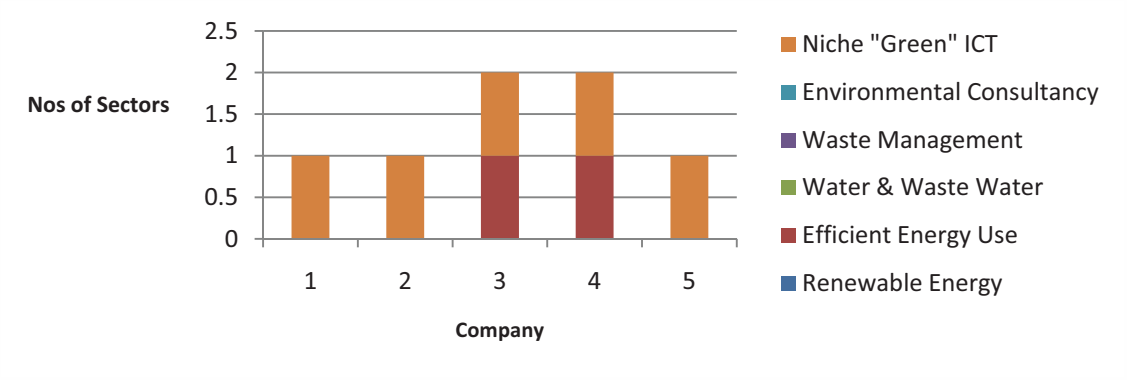
Some examples of how ICT can contribute to CO_2 reductions across other sectors are as follows.

- In existing and new buildings real time metering by utility companies will enable consumers to see real and immediate benefit from their energy saving actions and help reduce consumption.
- The growth in virtual offices and ability to access servers remotely reduces the number of commutes to the office. It also enables commuting to the office in off peak times.
- Web based marketing and sales and the process of substituting digital products for physical ones also help CO_2 reductions. Less paper consumption reduces deforestation which results in more forests being available to absorb CO_2 from other CO_2 producers.

6.7.2 Profile of Participant Companies

There was a mix of companies interviewed with some small (less than 50 employees), medium (50 to 250 employees) and large (over 250 employees). Most companies described the current percentage of their business derived from environmental sources as relatively small but anticipate that sustainability issues will pervade all ICT issues in the future. Exports are a major component of business in the companies interviewed and companies export to destinations all over the world.

Figure 6.11: Participation in Sub-Sectors



Two of the medium-size companies were also engaged in the energy and energy efficiency sub-sector. The companies interviewed are involved in research and development of technology innovations, provision of ICT products, services and business consulting and provision of software. Their products exported all over the world and are widely used for personal and business computing. Companies plan to be leaders in the 'green economy' as shown in Table 6.17.

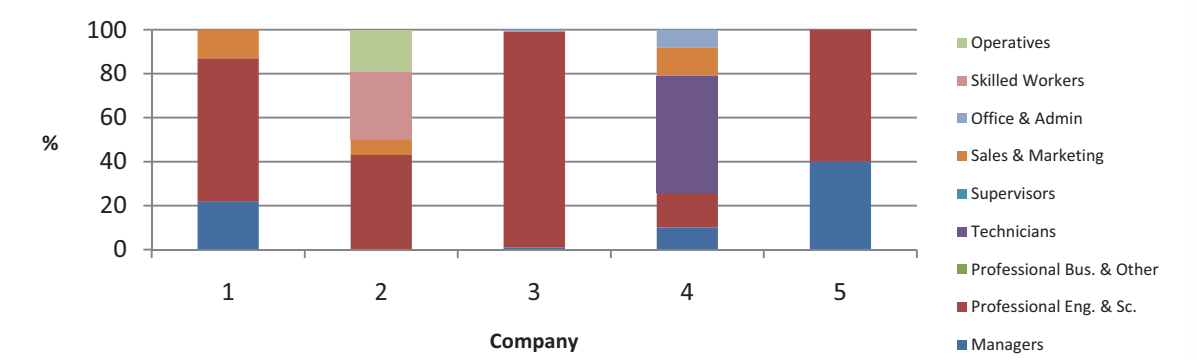
Table 6.17: Business Areas where company plans to be a leader

Company	Business Areas
1	Enterprise Process Data Management
2	ICT elements of energy, water, carbon management, intelligent utility networks
3	Sustainability of ICT
4	IT infrastructure power monitoring software
5	Wind operations management

6.7.3 Occupational Profile

As presented in Figure 6.14, Engineers and Scientists account for a high proportion of the workforce.

Figure 6.12: Occupational Profile



6.7.4 Core Skill Requirements

The core skills of companies in the sub-sector include software engineers, and subject experts educated to Masters and PhD level. Maths, Science, IT and communications skills are core competences required in occupation groups in the companies interviewed.

6.7.5 Anticipated Change in Employment

Professional engineering and science staff within the R&D and in the delivery and installation stages were the category most anticipated to increase over the next 3-5 year period. Sales and marketing staff were the second most frequently mentioned category of staff.

Table 6.18: Skills Demand by Occupation Group & Stages of Business Process (3 -5year period)

Stage of Business Process	Companies				
	1	2	3	4	5
R & D		(b)	(b)	(b)	(b, c)
Pilot & Test		(b)			
Marketing & Sales	(f)			(f)	(c)
Manufacturing / Generation					
Delivery & Installation	(b)			(b, d)	(a, c, g)
Operation & Maintenance				(d)	

Notes: (a) Manager (b) Professional Engineering & Science (c) Professional Business & Other (d) Technicians (e) Supervisors (f) Sales & Marketing (g) Office & Administrative (h) Skilled Workers (i) Operatives

6.7.6 Skill Gaps

The skill gaps identified in companies are for professionals in specialist areas such as in high-end IT disciplines, statisticians, mathematicians and business analysts experienced in renewable energies to work with software engineers. Also for professional engineering and science specialists in water management, energy management, smart grids and transport. Finally, there is a requirement for professionals and Principal Researchers to work in R & D to make research proposals, conduct research and translate an idea into a business case.

6.7.7 Filling Skill Gaps

Recruitment agencies and job websites were commonly used by most of the companies. However, in specialist areas, 'word of mouth' is important even for the bigger companies. Three of the five companies had recruited from abroad. For the companies interviewed, the range in salaries for new graduates in Professional Engineering and Science was €20K to €35K. Experienced professional engineering employees were paid between €40K and €60K.

6.7.8 Skill Enhancement

A main point emerging from this sub-sector is the need for business skills in combination with technical or research skills. For some companies their preference is for high level business skills

such as an MBA level qualification as well as professional technical skills and for others it is some business skills with a high level of research attainment e.g. PhD.

6.7.9 New and Emerging Skills Requirements

The general trend is for a shift from low to high end skills requirements in the sub-sector. There is likely to be an increasing requirement for higher level qualification of professionals and a diminishing requirement for lower end skills and qualifications.

6.7.10 Meeting Future Skills Requirements

The largest company plans to use both external and internal sources to meet their future skills requirements including the training of their existing workforce. Other companies plan to utilise external recruitment along with training mainly for professional engineers and scientists. Most in-company training is funded from own resources. Engineers and Scientists are the main category that participates in Professional and Trade bodies such as IBEC and the Irish Management Institute.

6.7.11 Demand for Skills: Potential Risks

A number of factors that may negatively affect the demand for skills in this sub-sector include the state of maturity of the other sub-sectors (the renewable sub-sector in particular) and the state of public sector finances which impacts on the level of public procurement of ICT products and services.

6.7.12 Conclusions: 'Green' ICT Sub-Sector

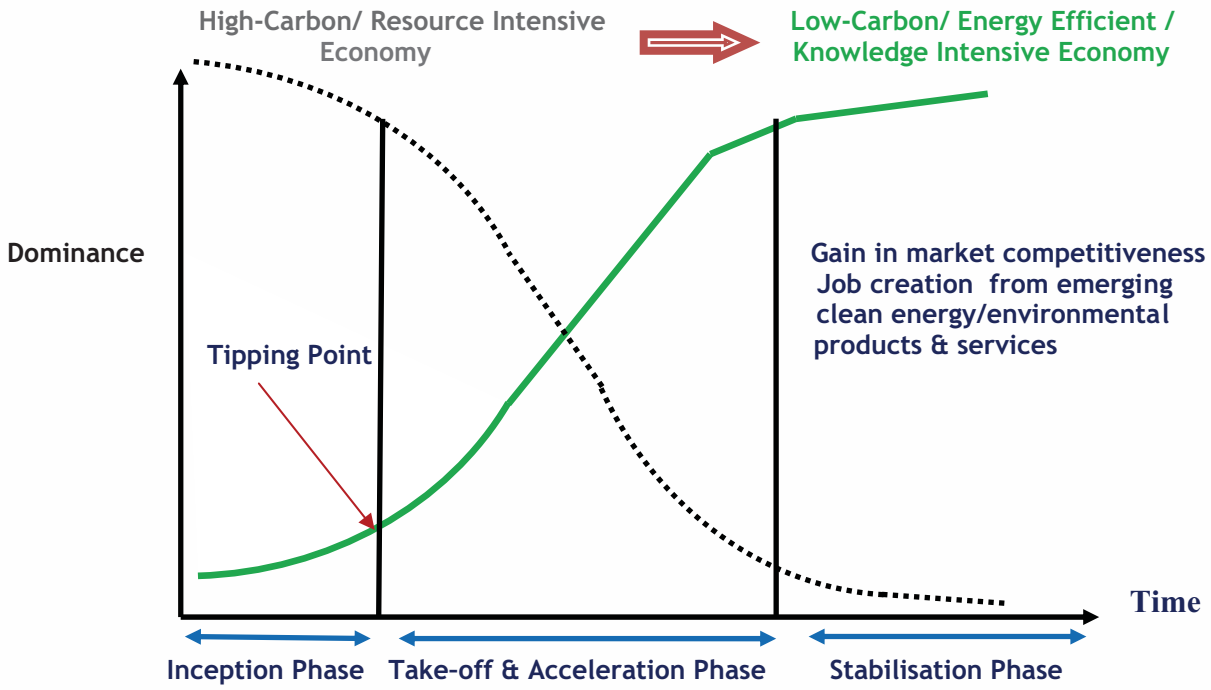
The Green Economy is a target market for 'Green' ICT and will be a key element of this sub-sectors future sales proposition. This will drive the development of existing and new products that will reduce the CO_2 emissions from the sub-sector, as well as improving energy efficiencies across other sub-sectors. Cross skilling technical staff with business skills is the preferred training and education for the sub-sector going forward. There will be an increasing requirement for high level skills in the sub-sector and a decreasing requirement for lower level skills.

Chapter 7: Assessment of Future Skills Demand

7.1 Transition towards a 'Smart Green Economy'

The Government's Infrastructure Investment Priorities Framework 2010-2016[52], contains a refocused set of priorities to assist in economic recovery and the transition to a smart green, low-carbon economy. The figure below[53] illustrates the business and employment growth opportunities that arise as economies move towards a low-carbon/energy efficient economy- while at the same time there are job losses within the 'high-carbon/resource intensive' economy. In the inception stage, improvements in energy efficiency, changes in consumption patterns and technological advances drive the movement towards the 'smart green' economy. Once the tipping point is reached, increasing opportunities arise from emerging clean energy/environmental products and services- both within domestic and export markets. This movement helps to minimise energy consumption, reduce greenhouse gas emissions and environmental pollution as well as creating new jobs [54]. Global supply chains are responding to changing regulatory and purchasing demands. There are 'first mover' competitive advantages for countries and companies in developing new clean tech/ environmental goods and services.

Figure 7.1: Transition towards a 'Smart Green Economy'

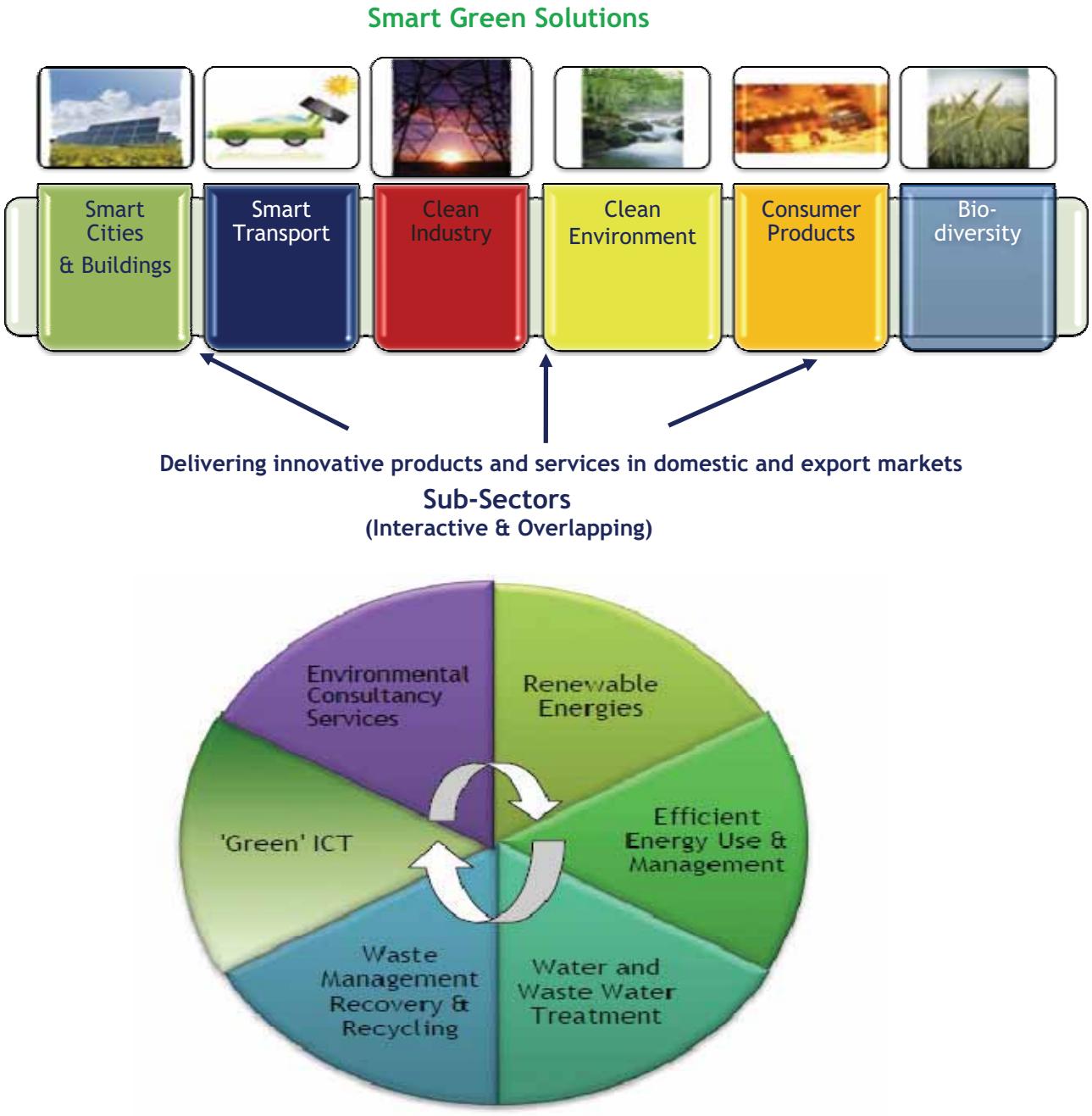


[52] Infrastructure Investment Priorities 2010-2016 – A Financial Framework (July 2010), Department of Finance.
[53] Adapted from illustration on Korean Strategy for Green Growth, (2009) Korea Science and Technology Policy Institute.
[54] As highlighted in EU 2020 : A strategy for smarter, sustainable and inclusive growth (2010).

7.2 Profile of Sector

An estimated 18,750 people are employed within the six sub-sectors included in the scope of this Study[55]. Of these, some 5,000 are employed in the business areas of retrofitting and energy efficient improvements of housing. These sub-sectors deliver products and services which provide 'smart green' solutions within buildings, transportation, industry, clean environment, consumer products which in turn deliver economic, social & environmental benefits.

Figure 7.2: Employment and Business Growth Potential

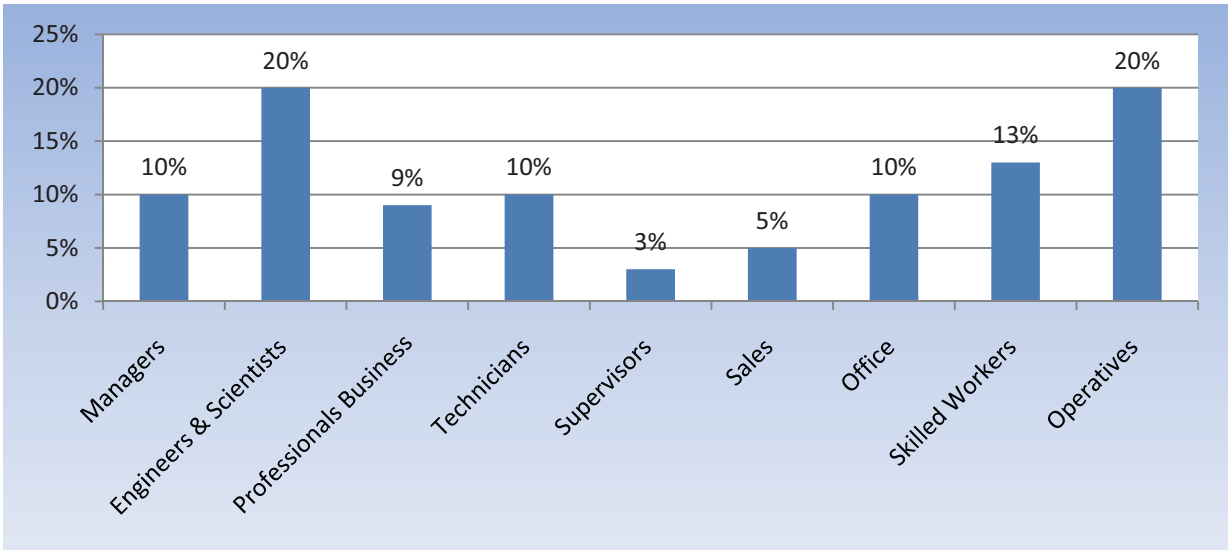


[55] Employment Profile built up from data provided by Enterprise Ireland, IDA Ireland , Sustainable Energy Authority of Ireland (retrofitting and energy efficient business areas) and on Commercial Semi-State companies from research work undertaken

7.3 Occupational Profile of Total Sector

The figure below provides an estimate of the current occupational profile of total employment within the sector[56]. There are significant differences at sub-sector level – with a relatively higher proportion of engineers, scientists and professionals within the renewable energies; environmental consultancy; and 'Green' ICT sub-sectors (the proportion of engineers and scientists being highest in 'Green' ICT). On the other hand there is a relatively high proportion of skilled workers and operatives within the energy efficiency & management; and waste management and recovery sub-sectors (the highest proportion of operatives is found within the waste management and recovery sub-sector). The proportion of professional business personnel is highest within the environmental consultancy sub-sector – while the proportion of technicians is highest within the renewable energies; and energy efficiency and management sub-sectors.

Figure 7.3: Estimated Occupational Profile 2010 – Total Sector



In terms of the future employment profile, it is expected that the workforce skills profile will increase over the next 3 – 5 years. It is anticipated that the proportion of engineers and scientists and technicians occupational groups share in total employment will increase. There is likely to be a smaller increase in the proportion of skilled workers. The proportion of managers and professional business is expected to remain the same. At the same time it is anticipated that the proportion of operatives will decrease – although employment opportunities for operatives will continue to arise resulting from both job expansion and replacement demand. As highlighted in this research there will be upskilling requirements for those in all occupational levels- from managers to operative level.

[56] Estimates were derived from analysis of research findings, taking into account company size and weighing according to employment levels between specific sub-sectors.

7.4 Future Skills Demand - Quality & Diversity of Skills

This section provides a review by sub-sector of the quality and diversity of skill sets and competences required by enterprise as identified in the work of the Study (including original research work undertaken with companies, workshops, case studies, consultations and international research and practice review). This is followed by a section which examines the future quantity of skills likely to be in demand by main occupational groups over the next five years.

7.4.1 Renewable Energies

As previously mentioned, there is an EU target of 20% energy consumption from renewable resources by 2020 - double the 2006 level. Ireland has set an individual target of 16% by 2020. This target is to be met by renewable energy providing 40% of energy consumption in the electricity sector, 10% of energy consumption in the transport sector and 12% of energy consumption in the heating sector by 2020. Increasing the production of renewable electricity is being assisted by 'feed-in' tariff prices for onshore and off-shore wind, ocean energy and biomass combined heating power. Ireland has some of the best wind and wave resources in the world - a potential competitive strength.

Key drivers of demand for skills in the renewable energy sub-sector are:

- Skills capability requirements to develop export market opportunities overseas;
- Installation, servicing and maintenance of renewable energy systems;
- The development of a distributed grid connection system incorporating small-scale and community-owned renewable power supplies;
- Development of smart network technologies including smart metering, ICT and electric cars.

Managers, professional engineers & scientists and technicians comprise the main occupational groups within the renewable energy sub-sector. The core skills of companies differ depending on the nature of their business. For some it is Research & Development and Test & Design – while for others it is technical engineering and management. Core skills across occupations in the sub-sector are for technical skills combined with commercial awareness, sales & marketing, financial awareness, communications skills, and project management.

Companies interviewed highlighted several skills gaps particularly within the engineering field. A key requirement for the supply of skills is the need to focus on the development of core engineering/ICT skills. Continuing professional development for those already in employment will be valuable, with the support of bodies such as Engineers Ireland and Engineers Skillnet. The development of the electricity network into a smart network which allows for energy and ICT / Telecommunication flows and incorporates distributed generation, requires a combination of engineering, ICT and telecommunications skill sets. There will be an ongoing requirement for power engineers for the development of the electricity grid into a 'smart distribution network' – requiring core engineering skills with a bias towards electrical engineering – combined with ICT business skills. The supply of electrical engineers should take into account future replacement demand from the major utility companies due to retirements as they have a more mature work force profile.

Table 7.1: Skill Gaps by Work Area

Occupation	Work Area
Power Engineers (Level 8)	HV Power System Design; Grid connection; Wind Power Generation.
Electro Mechanical Technicians (Level 7)	Operation and maintenance of renewable installations.
Marine Engineers (Level 8)	Cable laying, lifting and installing, use of equipment like sub-ploughs and knowledge of marine legislation.
Hydraulic Engineers (Level 8)	Concerned with the flow and conveyance of fluids
IT Systems Developer (Level 8)	Smart Metering, Smart Networking
Project Managers (Level 8)	Wind Energy.
Mechanical Engineers (Level 8)	Biomass/ Thermal Energy.
Mechanical Engineering Technicians (Level 7)	Operation and maintenance of biomass installations
Physicists (Level 8)	Analysis of wind movement.
Systems Engineers (Level 8)	Integrating systems comprising a range of technologies (mechanical, electrical, hydraulic, marine, instrumentation).
Nano Systems Engineers (Level 8/9)	Design, develop, the production of materials, devices, and systems of unique molecular composition.

Engineers with mechanical and electrical engineering skills are required for marine renewable energy turbine design and connection to the grid. As increasing numbers of wind turbines, solar energy and other renewable technologies get up and running here and abroad, there will be an increasing demand for technician skills (combination of electrical, mechanical and electronic skill sets) to support their operation and maintenance. There will also be a demand for technicians to install and service small scale renewable technologies. The growth in electric vehicle charging points (3,500 target by end 2011 and 6,000 end 2012) will give rise to demand for technician and skilled workers with a combination of electrical/electronic and mechanical skills.

Table 7.2: New and Emerging Skills

Occupation	Work Area
Wind Turbine Service Technicians (Level 7)	Operation and maintenance of installed wind capacity
Electro Mechanical Engineering Technicians (Level 7)	Operation and maintenance of renewable technologies systems including biomass
Smart Grid Technicians (Level 7) electrical technicians with enhanced ICT skills	Providing consumers with access to more accurate data and knowledge about electricity pricing.
Technicians and Skilled Workers (Levels 6/7)	Installation and maintenance of charging points for electric cars

Workforce continuing education and training was cited as a main means of building up skill sets, particularly within the larger companies. It was considered that many of the career enhancement skills could be achieved through continuing professional development with the support of Engineers Ireland or through Engineers Skillsnet. Irish graduates are generally well regarded by companies for their technical competences but are considered weaker in relation to maths, communication skills, commercial awareness and application of theory in practice. It was considered that these skills could best be addressed through well structured internships and in the way subjects are taught. Flexible, modular courses and distance learning provision were viewed as valuable for those in employment.

Growth Prospects

There is strong growth potential in renewable energies both in domestic and export markets - given the targets set across countries for increased renewable energy use. On-shore wind is the most developed of renewable energy technologies (at present, there are 143 wind farms operational in Ireland[57]), while marine and tidal energy is at an early development stage - moving towards commercialisation. There are proposals for Ireland to become a leader in 3rd generation solar photovoltaic's industry[58]. Over the next six years there is a planned €5 billion investment in electricity and gas networks by the ESB, BGE and Eirgrid[59]. Ireland also has some of the best wind and wave resources in the world - a potential competitive strength. Potential risks militating against the demand for skills are the need to improve time periods for granting permissions and permits in relation to the building of on and offshore wind farms, the need to upgrade and improve access to the grid and the importance of ensuring high standards and quality of products.

Companies anticipate an increase in employment for engineers and technicians with expertise in emerging renewable technologies within the R&D and Pilot & Test who can integrate systems involving mechanical, electrical, electronic and hydraulic systems. Demand for skilled workers and operatives are anticipated within the manufacturing, delivery & installation, and operation & maintenance business stages. Some companies plan to outsource work in the short term, while retaining in-house specialist expertise.

7.4.2 Energy Efficiency Use & Management

Across countries, buildings are the largest driver for both energy use and CO_2 emissions. The 160 million buildings within the EU, for example are estimated to use over 40% of Europe's energy and to create 40% of its carbon dioxide emissions. The Government has committed to achieving, by 2020, a 20% reduction in energy demand across the economy through energy efficiency measures.

Key drivers of demand for skills in the energy efficiency sub-sector are:

- Developing the skills capability base to take advantage of export market opportunities;

[57] Source: Irish Wind Energy Association (IWEA)- May 2010.
[58] Solar Industry Investment & Innovation Plan for Ireland , Dr Mazar Bari , Andre Fernon , July 2010.
[59] Source: Infrastructure Investment Priorities 2010-2016 – A Financial Framework (July 2010).

- Government commitment to achieving, by 2020, a 20% reduction in energy demand across the economy (compared to average energy use over period 2001-2005) through energy efficiency measures - including a 33% reduction in public service use.
- Energy efficiency improvement and retrofitting of commercial and public sector buildings;
- Leveraging and expanding existing skills in energy management gained through the early adoption of the Irish Energy Management Standard (IS393)[60], and for export services, the implementation of the recently adopted European Energy Management Standard EN16001[61].

Companies involved in this sub-sector are engaged in the design and development, manufacturing, retrofitting and fitting of energy efficient products in domestic and commercial markets. Companies interviewed export to the UK, EU, and Middle East. The staff profile of companies depends upon the nature of their business. Where the balance is more design and development, the proportion of professional staff is higher than for companies engaged within manufacturing, retrofitting and installation (where the proportion of office workers, skilled workers and operatives is higher).

Core skills and competences of companies are in design and development and ensuring quality products and customer service. Core skills requirements across occupations are for commercial awareness; project management (for capital projects) communication skills; and leadership and teamwork. There is a requirement for engineers with a good understanding of legal contracts and also financial capability. For supervisors, there is a growing requirement for managing dispersed teams of workers-many working in remote areas.

Current skill gaps identified by enterprise are for energy engineers with a good understanding of energy use in different industrial/commercial activities, the scope for energy efficiency and alternative energy opportunities, and most importantly the ability to implement these opportunities.

There is a requirement for technical sales staff with language skills and knowledge of sustainable construction techniques and regulations to sell overseas.

Architects and professionals require an improved understanding of sustainability requirements in relation to energy efficient design and retrofitting of buildings. For export markets this includes an understanding of overseas construction techniques and regulations (the UK Method of Building Energy Assessment (BREEAM) and the USA Method of Building Assessment (LEED). A more integrated approach is required towards the design and provision of related infrastructure development including transport, water and waste.

Skilled workers (such as electricians and plumbers) require improved systems knowledge of the range of energy efficient appliances to ensure their optimal efficiency usage to householder. These requirements can be met through relatively short external and in-house training. Maths skills

[60] Developed by Sustainable Energy Authority of Ireland in 2005.
[61] Adopted July 2009.

deficiency was mentioned as a barrier to electricians becoming 'energy technicians'. There is a requirement for the additional development of workers in the insulation business, for the upgrading of internal and external insulation in existing buildings to make them more energy efficient – and also within new build construction.

Table 7.3: Skill Gaps by Work Area

Occupation	Work Area
Energy Engineers (Level 8)	Design of energy efficiency installations. Identifying energy usage and efficiency improvements. Advising customers on ways to save energy.
International Sales (Level 7-8)	Technical selling into international markets – with language skills.
Architects (Level 8)	Understanding of sustainability – energy efficient design and retrofitting of buildings. Understanding of overseas construction techniques & regulations.
Insulation Workers (Level 4-5)	Perform a variety of activities to line and cover structures with insulating materials to upgrade insulation in existing buildings and make them more energy efficient (delivered through relatively short training programmes).
Skilled Workers (Level 5-6)	Require systems knowledge of energy efficient heating and lighting appliances to ensure their optimal efficiency usage to householders.

New and emerging skills for the sub-sector are for energy auditors to assess the scope for energy savings and the implementation of energy efficiency initiatives in the industrial and commercial sectors. Also for home energy consultants to assess energy efficiency in dwellings and advise householders on specific measures which can be implemented to improve efficiency. There is an emerging skill requirement for technician and skilled workers for the installation and servicing of small scale renewable technologies. Skilled staff who previously worked for a long period on one site are now working for shorter periods on several sites and interfacing more with the customer.

Table 7.4: New and Emerging Skills

Occupation	Work Area
Energy Auditors (Level 7)	Assessing the scope for energy savings and the implementation of energy efficiency initiatives in the industrial and commercial sectors.
Home Energy Consultants (Level 6)	Assessment of energy efficiency in dwellings and liaison with householder to specify and implement measures to improve efficiency.
Small Scale Installers & Technicians (Level 6)	Installing and servicing small scale renewable technologies.

The general view of graduates was positive but a number of specific issues were cited around the need for improved:

- understanding of industrial / commercial processes, typical energy uses and means of implementing alternative energy efficiency initiatives;

- understanding of sustainability design and building physics knowledge among architects;
- mix of technical, commercial and customer service;
- Maths proficiency and problem solving skills.

Larger companies provide both internship and graduate development programmes which are seen as vital to the future supply of skills within their organisation.

Excess Supply of Skills

A Building Energy Rating (BER) Certificate requirement was introduced for all new domestic dwellings from early 2007 and extended to all existing buildings offered for sale, rent or lease from early 2009. BER ratings were introduced for new non-domestic buildings from July 2008. It is clear from an assessment of the numbers trained to date that there is now an oversupply compared to demand in the numbers trained and certified to carry out BER assessment ratings. The numbers required are not as great as anticipated – not least due to the decline in the new building construction. There are now approx 2,050 BER trained and certified assessors registered with SEAI around the country.

Growth Prospects

Companies engaged within this sub-sector expect the environmentally related share of their business to grow over the next five years. The demand for skills will also be driven by factors including the cost of energy, policies and regulations that drive energy efficiency and government funding support for the retrofitting of housing and buildings and the installation of energy efficient heating appliances. The price of energy efficient products will be a key factor for consumers. The 2009 funding for SEAI's sustainable energy schemes was increased along with funding the low – income housing retrofit programme. This funding, (which also leverages additional private expenditure) and the employment it generates, is planned to be maintained within a new multi-annual National Retrofit Programme to be introduced in 2011. An Investment of €880m in energy efficient upgrades to residential, public and commercial buildings is planned between 2010 and 2016 [62]. It is estimated that one million residential, public and commercial buildings could benefit from these measures.

Professional engineering and science staff are the category that companies anticipate will be increased most over the next five years - across most stages of the business process. An increase in the number of skilled workers and operatives is anticipated within the delivery and installation; and the repair and customer service business stages.

[62] Source: Department of Communications , Energy and National Resources Capital Expenditure envelope , Infrastructure Investment Priorities 2010-2016 – A Financial Framework (July 2010).

7.4.3 Water and Waste Water Treatment

There has been a significant State investment in recent years in water and waste water treatment infrastructure, (both new plants and the upgrading of existing plants), to meet the requirements of the *EU Urban Wastewater Treatment Directive*. Between 2000 and 2009, some 480 water and wastewater schemes were completed. Key drivers of demand for skills in the sub-sector are:

- Skills capabilities required to win export market opportunities arising overseas;
- Proposals for water metering when implemented will requiring new skill sets ;
- Sludge management is an increasingly important area requiring attention;
- Major issues of groundwater protection, Geographic Information Systems (GIS) network management, specialist leak detection and repair;
- Extensive use of Design-Build-Operate and long term Operate & Maintain contract (i.e. private sector) for wastewater versus relative lack of private sector involvement in water treatment or water/wastewater network management.

Companies in this sub-sector design, build operate and maintain water and waste water treatment facilities and provide services to the water network. Domestic municipal and utility sectors and large scale industrial and service providers are the main target markets. Companies interviewed had a low percentage of their turnover generated by exports. Skilled workers and operatives account for a relatively higher proportion of employment. A number of companies in this sub-sector also employ large numbers of subcontractors. Core skills required are for mechanical/electrical engineers and technicians and process scientists. Skills requirements are for project management, commercial awareness, teamwork and communications. Ireland does not have a long history of private operations of water and wastewater infrastructure and there has been a shortage of experienced personnel with an operation & maintenance background. Companies such as Veolia Water have made use of expatriate engineering experts seconded into the Irish market to overcome this shortage.

Current skill gaps indicated by enterprise are for skills related to the design, planning, installation and use of modern technology in the operation and maintenance of water and waste water treatment facilities. These, while not large in numbers, are important for the development of the sub-sector. They include a demand for project managers for the development of high value treatment facilities and process engineers for the design and construction of treatment plants. There are also skill gaps in relation to professionals in Hydrology, Telemetry (for the remote monitoring and control of treatment plants and pumping stations), geographic information systems, laboratory technicians for the testing of water and waste water, environmental engineers and electrical and mechanical technicians for the servicing and maintenance of treatment plants.

Table 7.5: Skill Gaps by Work Area

Occupation	Work Area
Project Manager (Level 8)	Developing water and waste water facilities valued €5m to €50m.
Process Engineers (Level 8)	For the design and construction of wastewater, water and sludge treatment plants – mechanical, electrical and instrumentation skills.
Telemetry Skills (Level 7/8)	Maintains telemetry lines and related systems as well as applicable instrumentation used by water and sewerage departments.
Installers of Meters (Levels 6/7)	Install, repair, and maintain regulating and controlling devices, such as electric meters, gas regulators, thermostats, safety and flow valves.
Hydrologists (Level 8)	Research the distribution, circulation, and physical properties of underground and surface waters.
Geographic Information Systems (GIS) (Level 8)	Presenting geological and hydrological data in three dimensions and transforming this into hard data to be imported into a computer model.
Laboratory Technicians (Level 7)	For the testing of water and waste water.
Electrical and mechanical Technicians (Level 7)	For the servicing and maintenance of treatment plants.
Specifiers for water metering solutions (Level 8)	Persons (staff and consultants for local authorities) with responsibility to specify contracts for metering and related services.

Demand for skills in the sub-sector is also dependent on domestic water metering going ahead. If it does, the main demand will be for skilled workers certified for welding using polyethylene materials and installation of water meters[63]. There will also be a requirement for a small number of professional experts (asset managers of water meter systems and SCADA engineers for supervisory control and data acquisition), to plan and manage water metering development. New and emerging skills are for plumbers specialising in rainwater harvesting – diverting rainwater off-roof to be used for toilet flushing, gardening and cleaning. Multi-skilling and increased flexibility of working is also an increasing trend i.e. fitter/electrician with some process knowledge rather than solely a fitter.

Table 7.6: New and Emerging Skills

Occupation	Work Area
Asset Manager of Water Meter Systems (Level 8)	Following on from installation of domestic and commercial water meters, there will be a requirement to manage water assets.
SCADA Engineer (Level 8)	Evaluate, design, maintain and support highly technical and complex aspects of Process Control Network/SCADA communications and security as well as existing and proposed data and voice telecommunication systems.
Polyethylene Welders (Level 5/6)	Polyethynlene welders use specialised tools that require training.
Plumbers (Level 6)	Rainwater harvesting – diverting rainwater off roof to be used for toilet flushing, gardening and car cleaning.

[63] One estimate is that approximately 400 skilled workers will be required.

Generally Irish graduates are well regarded by companies in the sub-sector, with the exception of need for greater practical exposure and experience. It was suggested that third level education could have a more active role in devising training courses for water and waste water operators – such as that which Veolia Water provides at its training campuses around the world (the company has offered that it's module(s) could be drawn upon by third level education to provide training for the sector).

Growth Prospects

The Governments *Infrastructure Investment Priorities 2010 – 2016 Framework* envisages that €3.4 billion will be invested aimed at upgrading and expanding the national water services infrastructure over the next five years. Key priorities will be on facilitating proper planning and sustainable development and complying with national and EU environmental requirements for wastewater treatment and drinking water quality – as well as bathing and shellfish water standards. Demand for skills in the sector is also dependent on the roll-out of domestic water metering. Currently, the timing and shape of this project has yet to be defined and there is an uncertainty facing companies in the market. (One estimate is that if implemented as indicated that water metering could provide a domestic market worth €100m per annum for five years – apart from water metering installation opportunities currently available within the nearby UK market).

Risks include possible delays in the implementation of the *Water Services Investment Programme* which would result in a 'stop go' affect and make it difficult for companies to attract and retain skills. There is also a concern that 'fragmentation' in the entities providing services may impact on the development of a critical mass of skills required at technical expert or managerial level. It was suggested that the development of a national water body that would provide joined – up thinking approach to the provision of water services nationwide would offer economies of scale and facilitate regional improvement projects.

Anticipated increases in employment within the sub-sector are for professional engineers and scientists and for skilled workers and operatives. This increase is likely to take place within the delivery and installation and operation and maintenance stages of the business process. Some companies anticipate making use of outsourcing to meet their additional skills requirements.

7.4.4 Waste Management & Recovery

In Ireland, the use of landfill waste is decreasing while the use of waste recovery is increasing. Three waste incinerators have been licensed by the EPA (two for municipal waste, the other dealing with municipal and hazardous waste) but have yet to commence operations. There is a requirement to develop adequate infrastructure to treat the very large quantities of organic waste that must be collected separately and diverted from landfill in order to meet the Landfill Directive targets.

The key drivers of demand for skills in the sub sector are:

- Export business and services opportunities arising overseas;
- New skills required in recycling and reuse technologies (e.g. anaerobic digestion, incineration, mechanical biological treatment);
- Balance between municipal provision of services and commercial provision of services;
- Highly competitive nature of waste collection sector; and
- Changing dynamics of the market due to introduction of new technology e.g. incineration.

Companies engaged in this sub-sector collect, sort, separate and recycle solid waste and operate landfills. This also includes the handling of hazardous waste. Exports comprise mainly of recovered waste for recycling. Skilled workers and operatives comprise a relatively higher proportion of staff. The core competences are for managers and professional engineers and scientists. There is an increasing focus within companies to improve the frontline delivery of services to customers. Core skills across occupations include customer service skills (including for drivers), communications, teamwork and health and safety. The waste management business is generally regarded as a potentially dangerous place in which to work so there is need for a major focus on health and safety.

There were no major skills gaps noted in the companies interviewed. Odour control expertise was cited as a niche requirement. It was also mentioned that an increased volume of complex tenders had to be submitted for commercial and public sector clients – but it was considered that these skills could be learnt on the job. The future growth in skills requirements will mainly be related to the scaling up the delivery of services and the operation and maintenance of existing and new technologies. Anaerobic digestion is one such new technology where new skills will have to be learnt and developed over time. It is expected that there may be ten commercial anaerobic digestor plants established in Ireland over the next five years. There is little experience in Ireland of incineration or managing hazardous waste. The training and development of skills for the operation and maintenance of an incinerator is likely to be provided by the contractor(s) engaged to design, plan and build same. There are anticipated logistical transportation skills requirements relating to the movement of hazardous waste between waste transfer centres by road for incineration.

Table 7.7: New and Emerging Skills

Occupation	Work Area
Anaerobic Digestor Operatives (Electro Mechanical Technicians) (Level 6)	Operation and maintenance of larger commercial anaerobic plants.
Anaerobic Digestor Expert (Level 8)	Support commercial anaerobic digestor farms as well as smaller (50 kw) farm based plants.
Logistics Managers & Planners (Level 8)	Including GPS route planning and logistics management to planning the safest, most cost efficient collection and delivery of waste.
GPS route planners and logistics management (Level 7)	For the efficient and safe collection, transfer and delivery of waste by road.
Incinerator operator staff (Levels 6 to 8)	Operation of incinerators.
Mechanical Electrical Engineer (Level 8)	Managing all aspects of commercial biomass plants.
Waste Recycling Educators (Level 3/4)	Educate the population on the use of their brown bin to avoid contamination of waste.

Growth Prospects

The Governments' *Infrastructure Investment Priorities 2010 – 2016 Framework* indicates that over €100 m will be invested in important waste infrastructure over the next five years. The programme aims to deliver an integrated waste management strategy to ensure that various EU and domestic targets are met – in particular in relation to diversification from landfill. The Governments aim over the next five years is for significant advances in biodegradable waste being diverted from landfill - from a base of 43% in 2009, to 73% by 2016. The private sector is also planning significant investment in emerging technologies and new business systems.

Risks for skills demand in the sub-sector include that due to the downturn in the economy volumes of waste for collection have declined overall. There is uncertainty around government regulation (especially green taxes and levies) and the potential for incineration.

Companies interviewed anticipate a modest increase in employment mainly within professional engineers and scientists, professional business and sales and marketing staff – particularly within the piloting and testing (incineration) and sales and marketing stages of the business process.

7.4.5 Environmental Consultancy

The focus of the environmental consultancy sub-sector in recent years has been on the domestic market. Increasingly it is likely to be business opportunities in export markets while maintaining domestic capacity within housing, commercial property and publically funded infrastructure. While traditional areas of opportunity (such as in the housing market) are in decline, new growth areas of opportunity have emerged and are likely to increase – such as developments in renewable energy, grid development, energy demand management, sustainable resource management and waste transport logistics. Key drivers of demand for skills in the sub-sector include:

- Major focus on exporting of skills by international consulting – different behaviour sets are needed than for domestic consulting;
- New Business opportunities arising in growth energy areas such as renewable energies, water conservation, energy efficiency, waste recycling/recovery - at home and abroad.
- Smooth Implementation of the *Water Services Investment Programme*.

Companies in this sub-sector provide services both to public and private companies (both large multi-nationals and SME's). Most of the companies interviewed exported their services world-wide. Communications, maths and commercial awareness are core requirements within the sub-sector. More experienced consultants need to be competent in project management. Adaptability and flexibility in the undertaking of various assignments is the main attribute required for those working in environmental consultancy. Companies are making greater use of redeployment of staff within their organisation to ensure the most efficient use of existing skills and human resources.

Anticipated skills demand requirements are for energy engineers with knowledge of both UK and USA methods of building energy assessment; environmental engineers and electrical engineers for consultancy in renewable energies. Specialist requirements are for professionals skilled in modelling, design and planning related to the electricity grid, drainage and river basins, traffic management; and product design with regard to waste recycling/recovery. When a new project exposes a skills gap, companies most often seek to address this by training. This acquired skill is then leveraged by future projects thereby generating a return on investment in skills.

Table 7.8: Skill Gaps

Occupation	Work Area
Energy Engineers (Level 8)	UK method of building energy assessment (BREEAM) USA method of building assessment (LEED)
Environmental Engineers (Level 8)	Prevention, control, and remediation of environmental health hazards utilizing various engineering disciplines
Electrical Engineers (Level 8)	Consultancy in renewable energy (wind, tide and biogas)
Modelling Design & Planning (Level 8)	Relating to drainage and river basins, the grid and traffic management
Hydrology (Level 8)	Research the distribution, circulation, and physical properties of underground and surface waters.
Product Design (Level 7/8)	Recycling and Recovery.

Companies had a positive view of the quality of Irish graduates-apart from a weakness in their problem solving skills. It was considered that engineering graduates required an improved appreciation of financial issues.

Growth Prospects

The demand for environmental consultancy is highly dependent upon the scale and pace of development in other sub-sectors. While some traditional business (such as within domestic construction) has reduced in scale, new business opportunities are opening up in areas such as water and energy conservation and renewable energies - both within the domestic market and abroad. Ireland's recent experience with certain technologies in relation to civil works gives it a competitive advantage over other countries. A steady stream of work from the public sector and improved economic growth will be important in retaining built up key skills expertise. Future employment demand will be for professional engineering and science and sales and marketing staff.

7.4.6 'Green' ICT

ICT facilitates new business synergies within the knowledge-based, energy efficient, low-carbon society. This includes energy efficiency improvements within the ICT sector itself and for software solutions across other industries, such as for wind power management, smart buildings or for efficient management of water supplies and water loss reduction, waste management and transportation. The development of energy efficient data centres and cloud computing can also be included. Key drivers of demand for skills in the 'Green' ICT sub-sector are:

- Export business and services opportunities arising from growth in 'Green' ICT knowledge management opportunities world-wide;
- Providing the cross disciplinary understanding and skill sets to identify and realise opportunities for ICT applications to facilitate carbon management, smart electricity networks, automated energy monitoring and energy and environmental management software applications;
- Skill requirements for application developers taking account of need for an 'intelligent' pan-utility approach towards the provision of water, waste water, electricity and solid waste services.

Professional engineers and scientists account for a high proportion of the workforce in the sub-sector. Core skills for companies include software engineers and subject experts educated to Masters and PhD level. Engineers and scientists trained to Masters Degree level with commercial awareness skills are highly valued. Skills gaps identified were for business analysts experienced in the solar, wind power, environmental business to work with software engineers. Also for principal researchers/investigators with the cross-over business skills and ability to make research proposals, translate ideas into a business case and to deliver a product that can generate revenue. Other skills gaps identified are for professional engineering and science specialists with the commercial orientation required to realise opportunities related to energy efficiency and environmental sustainability, and the delivery of 'intelligent' pan utility services. There are also requirements for a number of specialist positions including statisticians, mathematicians and product management.

Table 7.9: Current Skill Gaps by Work area

Occupation	Work Area
Business Analysts (Levels 8 & 9)	Experienced in the solar, wind power, environmental business, smart buildings to work with software engineers
Principal Researchers/ Investigator (Level 10)	Research and Development – Make research proposals, conduct research, translate into a business case
Specialists in Water Management, Energy Management, Smart Grids, Transport (Levels 8 & 9)	Specialists (Professional Engineers & Scientist) with cross over skills in Professional Business
Exascale Computing (Level 10+)	Moving computing capabilities beyond the existing, successful petascale and achieving a thousand-fold increase over that scale.
Product Manager- Mechanical Engineer with IT (Level 9)	Product development and supporting infrastructure, hosting and managing for clients
Mathematicians (Levels 8 & 9)	Solutions to problems in various fields by mathematical methods
Statistician (Level 9)	Masters level to work as an analyst.
High-End IT Disciplines	Storage management products

The requirement will be for high-skilled professional engineering and science staff with a blend of business acumen and cross – disciplinary understanding to drive the development of innovative products and services. Team working and knowledge of interdisciplinary skills is an increasing main feature of this work. Companies in this sub-sector invest relatively more in internal training and development and provide for internship opportunities with Universities and Colleges.

From companies surveyed, it was generally considered that the education and training system is meeting the demand for people with ICT skills. Weaknesses cited related to the level of graduates mathematical proficiency and lack of 'real world' business acumen. Graduates with primary and postgraduate qualifications and experience compare well to USA and European graduates.

Growth Prospects

There are strong employment growth prospects within the 'Green' ICT sub-sector[64]. A recent OECD report noted that, notwithstanding the current economic crisis, activities such as 'Green' ICT applications and software are increasing employment as firms invest in this technology to remain competitive. Governments in several major countries are using their economic stimulus packages to promote investment in 'green' technologies. 'Green' ICT applications and services are seen by companies interviewed as major growth areas within their future business proposition. It is anticipated that there will be an increased focus on IT infrastructure management to improve energy consumption across all sectors and to provide for a pan utility approach to the provision of energy, water, waste and transport services. Anticipated increases in employment are for engineering and science professionals particularly within the research and development and the

[64] Deloittes 2009 survey on global trends in Venture Capital reports that 60% of surveyed venture capitalists anticipate an increase in their investment in clean technologies over the next three years - the highest percentage in all sectors surveyed.

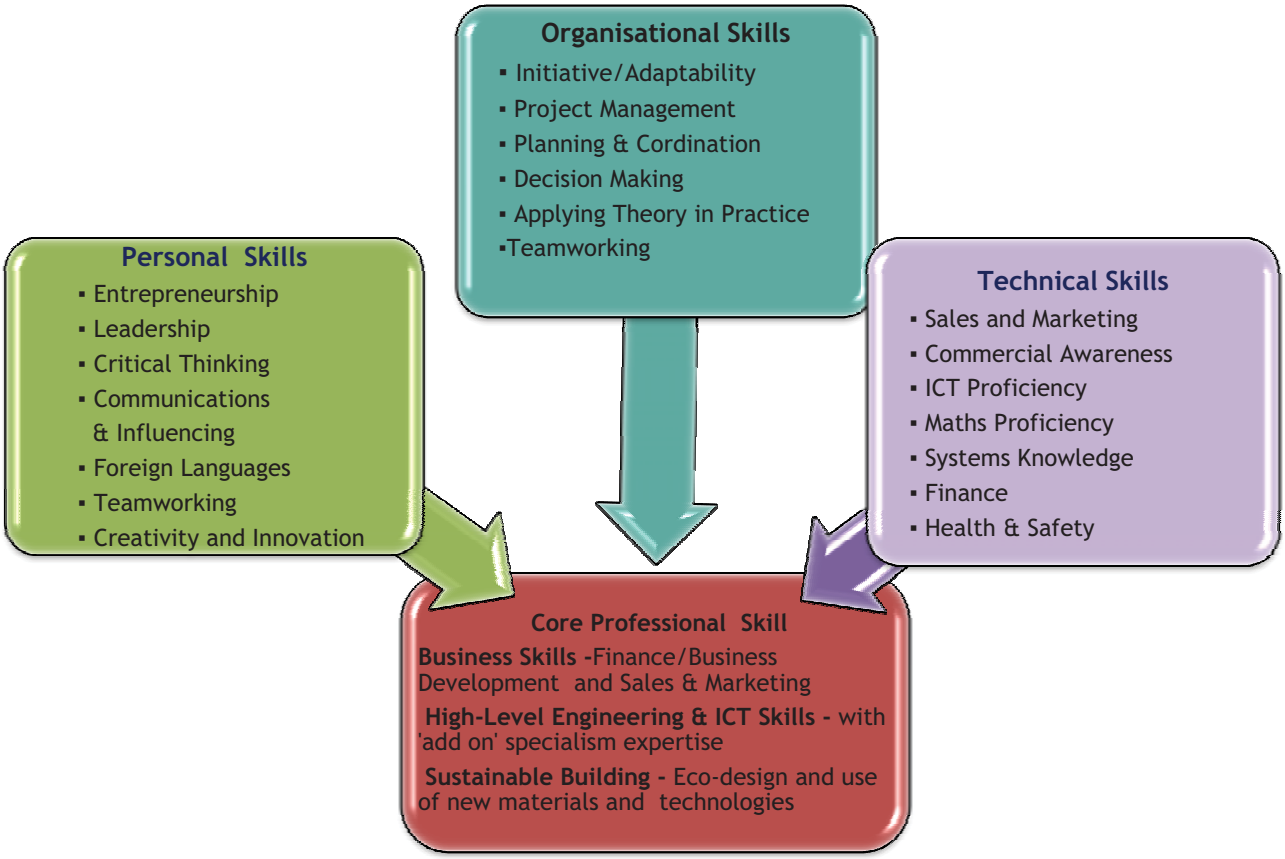
delivery and installation stages of the business process. Sales and marketing staff will also be required. There will be a decreasing requirement for lower level skills such as for operatives.

7.4.7 Key Skills Set Requirements across Sector

There are key skills set and competences relevant across the sector as a whole. These are grouped into four integral areas in the figure below. Business, Engineering and ICT skills are core professional skill requirements across occupations. Expertise in new and emerging areas can be acquired through add-on specialism modules within programmes or Masters Degrees / postgraduate diplomas.

Generic skills, including technical, organisation and interpersonal competencies are also required as part of an individual's skills portfolio. These should be integrated within initial education curricula and continuing professional development programmes. This can be supported through collaborative project-based work within initial education and training; through the availability of well structured internship programmes; and through personal development programmes within the workplace. Professional and technical skills requirements are greater for higher skilled occupational groups. Personal and organisational competency requirements are more similar across occupations.

Figure 7.4: Key Skill Sets and Competency Requirements across Sector



7.4.8 Skill Sets Requirements for Occupations within Sub-sectors

An overview of emerging key skill sets in different occupations is given in the following table. This information can be used for the planning of relevant education and training provision and the development of continuing professional development within companies. The following table summarises emerging skills requirements for occupational groups within sub-sectors.

Table 7.10: Occupational Groups – Summary of Emerging Skill Requirements

- Managers – Leadership, corporate governance, access to finance / business planning , marketing skills particularly for export markets, entrepreneurial skills, Intellectual Property
- Engineers & Scientists – core mechanical & electrical skills; commercial awareness and product knowledge; multi-skilling re knowledge of converging technologies; language skills (for exporting); software development; 'green chemists'.
- Professionals – project management; finance, environmental & regulatory skills; Geographic Information Skills; Sustainable buildings materials & standards; Carbon Monitoring & Accounting – understanding of carbon market.
- Technicians – mechanical-electrical skills for the operation & maintenance of renewable energy generators (ocean and wind), high voltage IT skills, servicing and maintenance.
- Supervisors – IT Skills in new software and management of teams working in dispersed locations.
- Marketing & Sales –technical sales, language skills, knowledge of green public procurement opportunities; legal skills re procurement/contracts.
- Skilled Trades – multi-skilling re installation, operation & maintenance; integration of systems i.e. energy upgrading & retrofitting of buildings, electricians could be given specialist training in energy efficient lighting.
- Operatives – operation & maintenance skills; health and safety.

A summary of anticipated changes in key skill sets for different occupational groups and sub-sectors is presented in Table 7.11.

Table 7.11: Key Skill Sets Requirements for Occupations in the next 3 to 5 years by Sector

	Renewable Energy	*Energy Efficiency*	*Water & Waste Water*	*Waste Management,*	*Consultancy Services*	*Niche "Green" ICT*
Managers	• Export Marketing • Leadership • Governance • Finance /Contracts • Project Management	• Export Marketing • Leadership • Governance • Finance /Contracts • Project Management	• Export Marketing • Leadership • Governance • Finance • Project Management	• Commercial Acumen • Leadership • Governance • Finance/contracts	• Project Management • Leadership • Governance • Finance / Business	• Pan-utility approach re provision of water, waste, electricity services • Business Planning
Professional Engineers & Scientists	• Smart Technology • Integrating Systems • Electrical Engineering • Marine & Tidal • Foreign Languages • 'Green Chemists'	• R & D • Power Generation • Product Knowledge • Home Energy • Foreign Languages • Energy Saving	• Project Management • Design & Installation of Infrastructure • Asset Managers– Water Meters • Foreign Languages	• New Technology • Anaerobic Digestion • Hazardous Waste • Incineration Tech • Mechanical/Biological Treatment	• Masters qualifications – business & technical • Grid planning • Tendering • Traffic Planning • Maths & Finance	• High end IT disciplines • Software applications • Cross – disciplinary skills- IT/Business • Researchers with commercial orientation
Professional Business	• Regulations & Standards • Contracts & tendering	• Sustainable buildings • Regulations & Standards • Contracts & Tendering	• Managing Water Assets • Regulations and Standards	• Transport logistics • Regulations & Standards	• BREEAM Assessment • LEED Assessment • Health & Safety	• Business Analysis • Mathematical & Statistical Skills
Technicians	• High Voltage Electrical • IT- Smart Grids • Wind Turbines • Marine/Tidal	• Installing and Servicing small scale renewable technologies • Retrofitting	• Increased multi-skilling	• Anaerobic Digestion • Thermal Treatment of Municipal Waste	Not applicable	Not applicable
Supervisors	• Managing Dispersed Teams • IT skills new software	• Managing Dispersed Teams • IT skills new software	• Increased multi-skilling	• Managing dispersed teams	Not applicable	Not applicable
Sales & Marketing	• Technical Sales • Foreign Languages • 'Green' public procurement	• Technical Sales • Foreign Languages • Green public procurement • Building Regulations	• 'Green' public procurement • Foreign languages	• Green public procurement • Foreign Languages	• Foreign Languages • 'Green' public procurement	• 'Green' public procurement • Foreign Languages
Office Admin	• ICT Skills	• ICT Skills	• ICT Skills	• ICT Skills	• ICT Skills	• ICT skills
Skilled Workers	• Operation & Maintenance • Customer Service	• Systems knowledge • Retrofitting/ Insulation • Customer pay-back advice	• Installation of meters • Operation & Maintenance	• New Technology • Thermal treatment of municipal waste	Not applicable	Not applicable
Operatives	• Health & Safety • Customer Service	• Retrofitting • Health & Safety • Customer Service	• O&M • Health & Safety • Meter installation	• Health & Safety • Customer Service	Not applicable	Not applicable

7.5 Anticipated Level of Skills Demand

In relation to the level of future skills requirements, it is anticipated that job opportunities (job creation as well as job maintenance) will arise within domestic and export markets from:

a) New jobs in 'Clean Tech' space –from new enterprise start-up;

b) Additional jobs arising from companies 'going green' as a result of changing processes and products in response to market demand – and retrofitting of private and public buildings;

c) Existing Jobs profiles being modified requiring new skill sets/competences;

d) Where substitution of employment may take place.

It is also important to consider the level of 'replacement' demand (resulting from retirements, people leaving the workforce for various reasons etc) as well as 'expansion' demand. Utilising comparable replacement data information an estimate of around 3.5 % per annum may used for the sector. This figure is based on a consideration of comparable average replacement rates both in Ireland and abroad[65]. (The figure is likely to be higher for major utility companies such as the ESB where there is a more mature workforce profile).

In terms of the level of future skills demand, two future Scenarios are presented, based on drivers and trends outlined in the report and on the opinions of key informants in the sector. Both Scenarios provide indications of employment growth – albeit at different levels. The underlying drivers of business growth – at home and abroad, as well as feedback from enterprise and the opinion of key informants, suggest that this sector is an area of potential business and employment growth. There are uncertainties around the actual level of this growth based on different assumptions that may be made around key sector specific drivers. There is also the difficulty that the sector as such does not fit within existing NACE classification system[66] – and it is not possible for example to project forward from past trends.

The two Scenarios are based on different assumptions made on key sector specific drivers – classified as external or internal – depending upon the ability for the sector's stakeholders and policy makers to influence them. The two Scenarios are:

a) 'Realising Potential Scenario'

This Scenario is based on an anticipated increase in employment of between 8% – 10% per annum over the period 2010-2015. The set of assumptions under this Scenario are given in Figure 7.6.

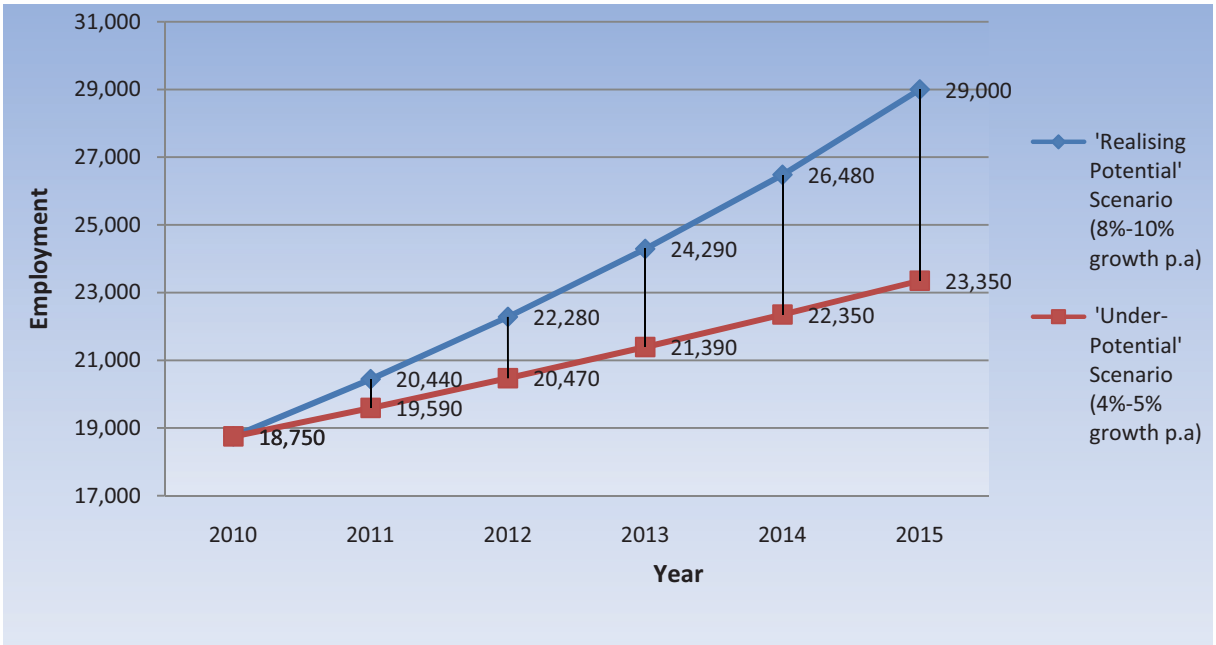
b) 'Under-Potential Scenario'.

This Scenario also anticipates an increase in employment over the period 2010-2015 – but at around 4% to 5% - half the level of the 'Realising Potential' Scenario. The set of assumptions under this Scenario are given in Figure 7.8.

[65] Prospective des Metiers et des Qualifications, Ministère de l'emploi de la Cohésion et du lodgement, France.
[66] NACE – European Industrial Activity Classification System.

Figure 7.4 below provides indicators of anticipated total sector employment under the two Scenarios. Both start from 18,750 for 2010 with employment under the 'Realising Potential' Scenario rising to around 29,000 by end 2015 and with the 'Under Potential' Scenario, employment rising to 23,400 by end 2015.

Figure 7.4: Anticipated Total Sector Employment under the two Scenarios



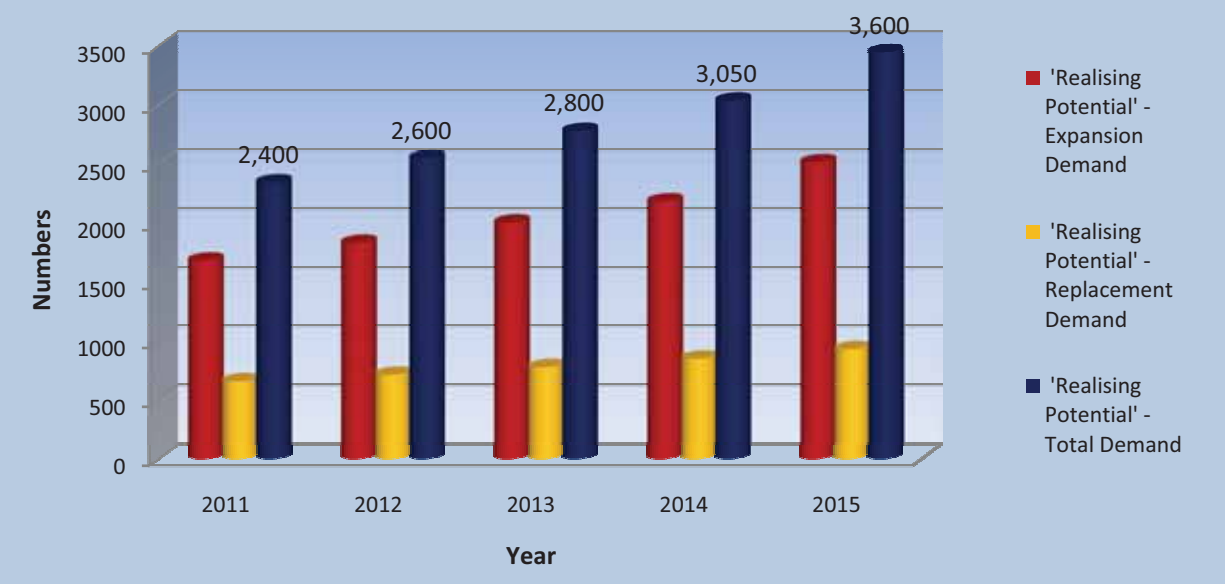
The above figure presents two Scenarios for the level of future employment within the sector. As can be seen, both provide anticipate employment growth – albeit at different levels. These relate to different assumptions made around both external and internal drivers of business and employment growth. In this regard, the influencing of the internal drivers is within the scope of domestic policy makers and the enterprises themselves. This is a challenge to be met for potential business and employment growth to be realised.

It is clear from the findings of the Study that there will be an increasing movement towards a higher level skills profile within companies engaged within the sector – towards managers, professional engineers and scientists, technicians and skilled workers. At the same time the skill sets and competences of those working in the sector are changing - driven by the continuous improvements required within all stages of the business process – from research & development though to installation and servicing. The emerging skill sets requirements are both for business, engineering and IT skills as well as non-technical skills such as communications, problem solving and team work. The demand for skills is also being driven by the requirements within overseas markets – as growth will only be achieved if the level of export sales generated by indigenous companies increase over the next five year period.

‘Realising Potential’ Scenario

This Scenario is based on an anticipated increase in employment of between 8% – 10% per annum over the period 2010-2015. The set of assumptions under this Scenario are given in Figure 7.6. Under this Scenario, employment rises to around 29,000 by end of 2015. This gives an average increase of 2,000 per annum over the period (1,700 in Year 1 rising to 2,500 in Year 5). A replacement rate of 3.5 % per annum is used – giving an average 800 per annum replacement demand over the five year period. Total Skills Demand (expansion demand plus replacement demand) over the five year period averages 2,900 per annum, - (2400 in Year 1 rising to 3,600 in Year 5).

Figure 7.5:‘Realising Potential’ Scenario-Anticipated Total Skills Demand



Assumptions

The following Figure 7.6 outlines the set of assumptions made under ‘Realising Potential’ Scenario. These relate to both external and internal drivers of business and employment growth (sector and sub-sector specific).

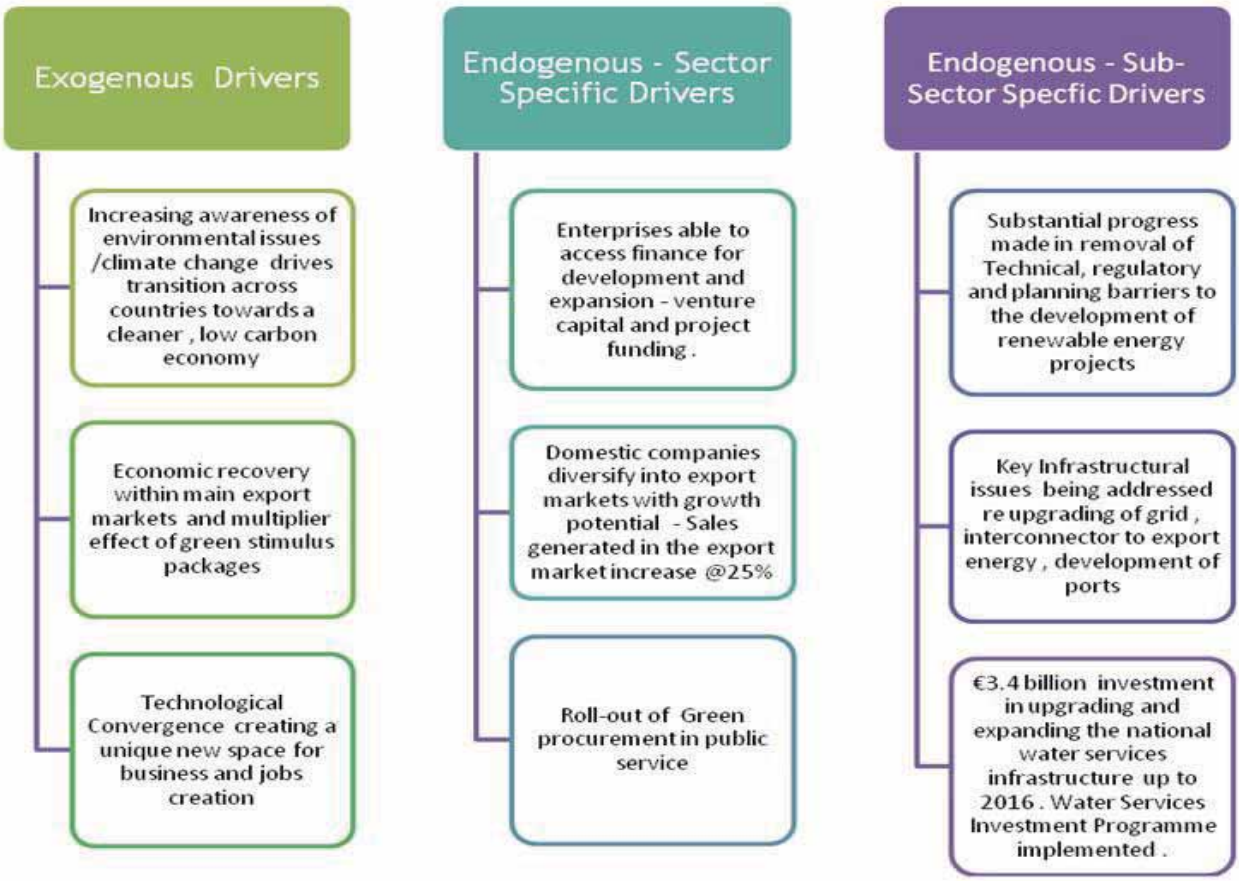
Under this Scenario, in terms of external sector- specific drivers, there is a continuing drive towards a cleaner low-carbon economy across countries-thereby increasing both domestic and export market potential[67]. This is accompanied by continuing recovery in Irelands main export markets – and the development of new business opportunities in newer markets such as China, Saudi Arabia etc. The pace of advances in science and technology gives rise to synergies in key sectors such as ICT, biotechnology, nanotechnology and cognitive sciences leading to new product and service business opportunities.

[67] This would be in line with the estimated 7.7 % annual growth in global environmental goods and services market as estimated within the ‘High Expenditures Scenario’ of recent Global Environmental Goods and Services Demand Study undertaken by the German Institute for Economic Research on behalf of the German Federal Environment Ministry in 2009.

Looking at internal sector specific drivers, enterprises access to finance necessary for their development and expansion improves. Also domestic firms perform well in export markets (given improved cost competitiveness) with over 25% of their sales generated in export markets – compared to 20% at present.

It is assumed that green public procurement within the public service is successfully rolled out - the cost of Irish public sector procurement is €16 billion p.a. In relation to sector specific drivers, under this Scenario there is positive progress towards removing the technical, regulatory and planning barriers – particularly in relation to the development of renewable energy projects. Also, key infrastructural issues are being addressed – particularly regarding the upgrading of the grid, interconnector to export energy and the development of ports – important for off-shore marine and wind power. Finally, that there is a smooth implementation of the water investment programme and the introduction of water metering.

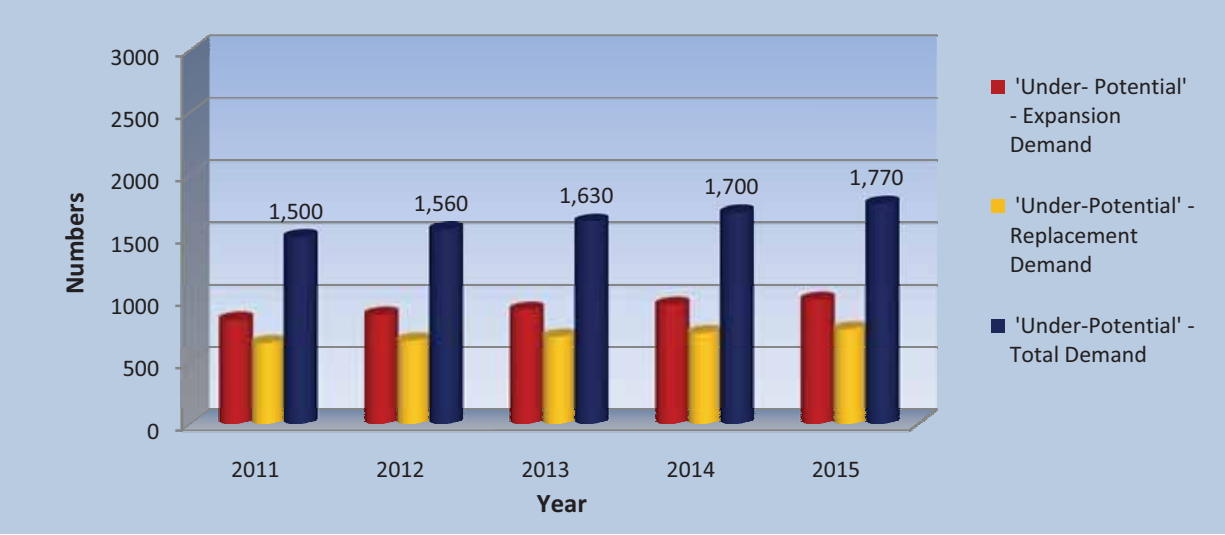
Figure 7.6: 'Realising Potential' Scenario Assumptions



'Under Potential' Scenario

This Scenario also anticipates an increase in employment over the period 2010-2015 – but at around half the level of the 'Realising Potential' Scenario. The set of assumptions under this Scenario are given in Figure 7.8. Under this Scenario, employment rises up to 23,400 by end of 2015. This gives an average rise of 900 per annum over the period (850 in Year 1 rising to 1,000 in Year 5). A replacement rate of 3.5 % per annum is used – giving a 700 average per annum replacement demand over the five-year period. Anticipated total skills demand (expansion demand plus replacement demand) over the period averages 1,600 per annum (1,500 in Year 1 rising to 1,800 in Year 5).

Figure 7.7: 'Under-Potential' Scenario - Anticipated Total Skills Demand



Assumptions

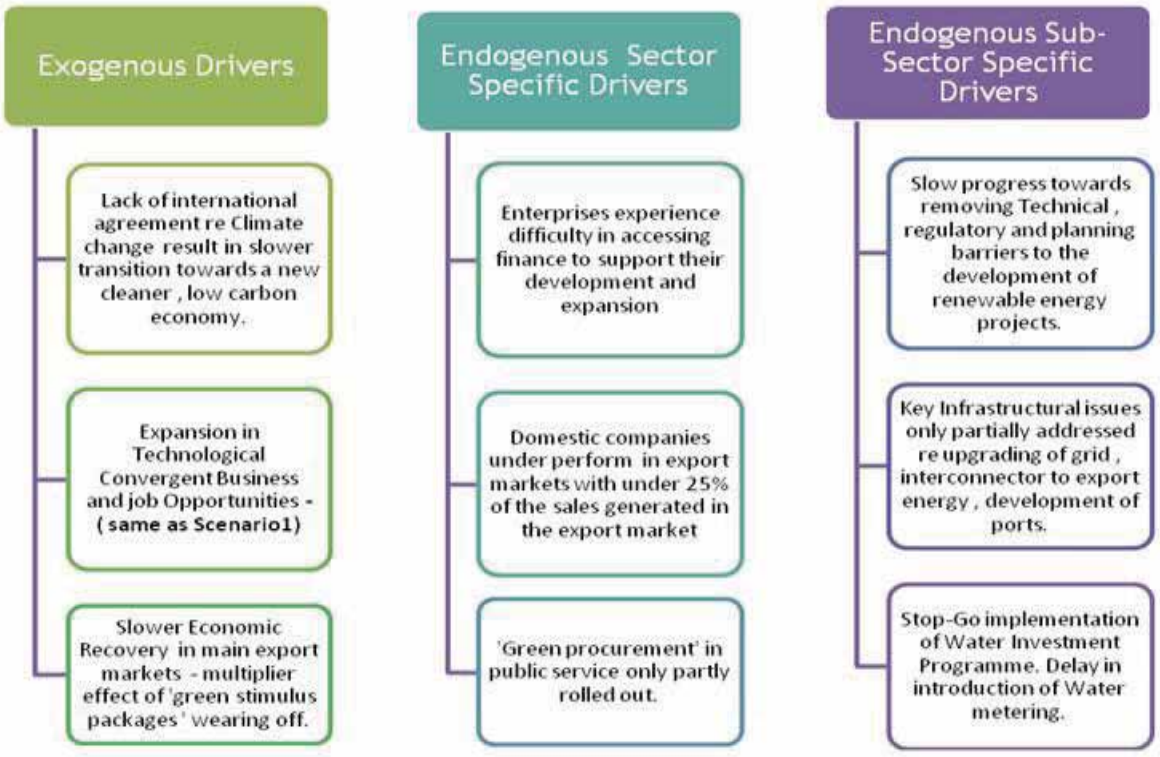
A different set of assumptions are made under the 'Under Potential' Scenario. These are outlined in figure 7.8 and relate to both external and internal drivers of business and employment growth (sector and sub-sector specific).

In this Scenario, looking at external drivers, there is a slower transition towards a cleaner/low-carbon economy across countries- thereby lowering export market potential. This is accompanied by a slower recovery in Irelands main export markets. On the positive side, it is assumed that there will continue to be growing potential within convergent technology products and applications markets such as for wind and wave energy technologies, the development of 'smart' grid technologies, solar energy conversion and improving energy efficiency.

Assumptions made under internal drivers, are that enterprises have continuing difficulty accessing the necessary finance for their development and expansion. Also domestic firms under perform in export markets with between 20%-25% of their sales generated in export markets – compared to 20% at present. It is also assumed that green public procurement in the public service is only partially rolled out.

It is also assumed that there is slower progress towards removing the technical, regulatory and planning barriers – particularly in relation to the development of renewable energy projects. Also, key infrastructural issues are only partially addressed regarding the upgrading of the grid, interconnector to export energy and the development of ports – particularly important for off shore marine and wind power. Finally, a 'stop-go' implementation of the water investment programme and delay in the introduction of water metering affects business and employment growth.

Figure 7.8: 'Under Potential' Scenario Assumptions



7.6 Conclusions – Future Skills Demand

In terms of future skills demand this chapter considers the quality, diversity and quantity of skills required. Within companies, there is a move towards a higher workforce skilled profile. Irish graduates are generally well regarded by companies, with the exception of a need for greater maths proficiency, problem-solving skills and business acumen. In terms of the level of future quantity of skills demand, two possible future Scenarios are presented. The first is termed the 'Realising Potential' Scenario – and is based on assumptions that identified barriers to the development of the sector are removed. In this regard, the Scenario is considered challenging but realisable. The second, which is termed the 'Under Potential' Scenario, also anticipates a rise in the employment level – but at half that of the 'Realising Potential' Scenario. Assumptions under this Scenario include that there is slow progress towards the removal of identified barriers to the development of the sectors. In terms of the level of future skills demand, both the issue of 'expansion demand' and 'replacement demand' are considered - the two together comprising total demand for the sector.

Chapter 8: Assessment of Supply of Relevant Skills

8.1 Introduction

This chapter outlines the education and training provision relevant to the supply of skills to the green economy. This provision can be divided into 'traditional' business science and technology courses and those specifically designed to meet the knowledge and skills needs of the 'green economy'.

While many education/training providers are modifying their curricula of traditional science and technology courses (that form the knowledge foundation for careers in all areas of science, engineering and technology) to include aspects of 'green' technology on the courses they offer, there has been considerable growth in the number of programmes developed specifically towards meeting the needs of the 'green economy'.

While the primary focus of this chapter is on courses that are specifically related to 'green' technologies and environmental studies, it also provides a brief overview of the skills emerging from the education/training system in the areas of science (including computing, engineering and business), given their overall contribution to 'green' skills supply.

The chapter covers two main sectors:

- Higher Education and Training: including course title, National Framework of Qualifications (NFQ) qualification level, key areas of study and possible career opportunities for graduates.
- Further Education and training (FET), covering two main areas:
  a) FÁS provided training which, for green economy skills, is made up predominantly of short courses lasting between one and twelve days. The information presented includes the name and duration of the course, key course modules and certification levels
  b) Post Leaving Certificate (PLC) courses which are offered at colleges of further education; the information presented provides the certification level and key course modules.

Higher Education Programmes

Undergraduate courses in higher education span levels 6 to 8 on the National Framework of Qualifications. Level 6 programmes usually require two years of full-time study and lead to a Higher Certificate award. Level 7 programmes are typically three years in duration and lead to the award of Ordinary Bachelor Degree. The duration of a Level 8 programme varies from 3 years to 5+ years but all lead to an Honours Bachelor Degree award. The majority of Level 8 programmes relevant to this study are of four years duration[68].

[68] Many level 8 degrees in the arts and humanities are three years in duration as are some of the newer engineering degree programmes that were introduced post-Bologna Decree (e.g. BSc in civil and structural engineering at UCD); other honours bachelor degree programmes are five or more years (e.g. dentistry, medicine).

The Institutes of Technology (IOT's) also offer a ladder system of progression: a student who graduates with a Level 6 award may progress to an ordinary bachelor degree programme and obtain a Level 7 award. They may then further progress to an honours degree programme and obtain a Level 8 award. The majority of honours degree programmes are *ab-initio* programmes where the student applies (usually through the CAO) for a place on a four-year programme. There are also *add-on* degree programmes which are usually one year in duration and open only to Level 7 award (or equivalent) holders.

Postgraduate courses in Ireland range from Levels 8-10 on the NFQ. Higher diploma awards are placed at Level 8 while postgraduate certificates and diplomas and master degrees (either taught or research) lead to a Level 9 Award. Doctoral awards have been placed at Level 10. Almost all post-graduate level courses lead to Level 9 awards.

Further Education and Training (FET) Programmes

Further Education and Training awards span levels 1-6 on the National Framework of Qualifications (NFQ). FETAC is the national awarding body for further education and training in Ireland and all FÁS training programmes outlined in this document lead to FETAC certification. Awards on the NFQ, including FETAC awards, can be major, minor, special purpose or supplemental. In this study, the majority of FET programmes discussed are provided by FÁS or the VEC sector (PLC courses). In addition, the appendices include details of other education and training outside of the formal education system (i.e. work based learning, private education/training provision).

Structure

The chapter provides an overview of the total number of awards made in further and higher education and training in Ireland in 2008/2009. Additional information on key subject areas of science, engineering and business is also included. For presentation purposes, all courses that were identified as being related to green skills were categorised under five main headings.

- Renewable Energies
- Efficient Energy use and Management (including eco-construction)
- Waste Management, Recovery and Recycling
- Water and Wastewater Treatment
- Environmental Consultancy Services

It should be borne in mind that several courses may be classified under two or more of these headings. For each of the above identified sectors, higher education programmes are first presented (by college and by level). This is followed by an outline of the further education and training provision relevant to each sub-sector.

8.2 Science, Engineering and Business Awards Overview

8.2.1 Overall Awards

This section outlines the total number of awards from the further and higher education/training sectors for 2009. It compares output in key disciplines within the overall number of awards. The aim is to show the magnitude of the skills supply that is potentially available to work in the economy – including the 'green' sub-sectors which are the subject of this Study. There is a considerable volume of awards in areas not directly related to the green economy, but which nonetheless form a vital skills base with the potential for graduates to specialise later either through employment in the relevant sector or through upskilling.

The Table below shows that there were over 84,000 further and higher education & training awards made in 2009 – a 4% increase on the preceding year. At more than 22,200 awards, social science, business and law made up over a quarter of all awards; engineering awards accounted for 15% while science awards made up 8%. All told, these three disciplines amounted to approximately one half of all awards in 2009 (almost 42,000 awards). When compared to 2008, this distribution is broadly similar. While there were increases for the number of awards in social science business and law (+3%) and science (+9%), the number of awards in engineering/construction declined. This decline occurred at Level 6 and is related to the decline in the construction industry.

Table 8.1: Summary of Further and Higher Education and Training Awards by Field of Education, 2009

Field	NFQ 1-2	NFQ 3	NFQ 4	NFQ 5	NFQ 6	NFQ 7	NFQ 8	NFQ 9/10	Total 2008	Total 2009
General	270	2,280	380	30	-	-	-	-	1,580	2,960
Education	-	-	-	-	250	140	1,570	2,630	4,390	4,590
Humanities & Arts	-	-	20	2,130	530	1,240	4,810	1,870	10,680	10,600
Social Science, Bus.& Law	-	220	400	4,640	1,720	2,460	8,520	4,990	22,220	22,950
Science	-	-	-	690	590	910	3,380	1,830	6,710	7,400
Engineering & Construction*	-	-	80	390	5,320	2,050	2,850	850	12,380	11,540
Agriculture & Vetineary	-	-	120	890	630	290	270	70	1,910	2,270
Health & Welfare	-	-	-	7,300	780	1,040	4,170	2,590	14,620	15,880
Services**	-	-	680	1,360	1,880	1,050	570	360	6,290	5,900
Total	270	2,500	1,680	17,430	11,700	9,180	26,140	15,190	80,780	84,090

*Includes manufacturing ** Includes, for example, courses in catering, security, etc.
Note: Awards from higher education relate to 2008 (the latest available) and 2007
Source: FETAC (Major Awards); HEA

8.2.2 Focus on Science, Engineering and Technology (Higher Education)

This section looks at the inflows and outflows of higher education in science, engineering and technology disciplines. CAO acceptance data is used as an indicator of inflows, although not all people who accept a CAO offer will ultimately enrol in higher education. Graduate output is used as an indicator of the supply of skills emerging from the higher education sector.

Undergraduate inflows and output (NFQ 6-8)

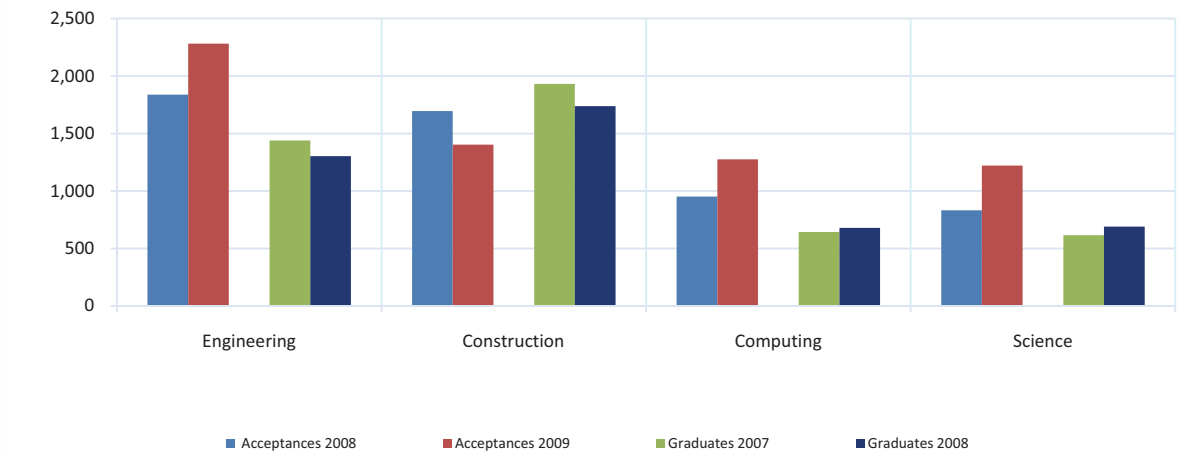
Figures 8.1 and 8.2 present the number of CAO acceptances and graduates for three technology related subjects:

- **Engineering**: CAO acceptances increased across all levels between 2008 and 2009; the decline in graduate output at Level 8 that occurred between 2006 and 2007 seems to have halted in 2008 and may even be reversed in the medium term due to the 16% rise in CAO acceptances for this discipline over the period 2008-2009.

- **Computing:** CAO acceptances increased significantly at Levels 7 and 8 in 2009. There were small increases in graduate output at Levels 6 and 7 and while graduate output at level 8 declined by 11% year-on-year, it was not as severe as the previous year (20%). The growth in CAO acceptances observed in recent years indicates that a reversal of this trend is likely in the short-medium term.

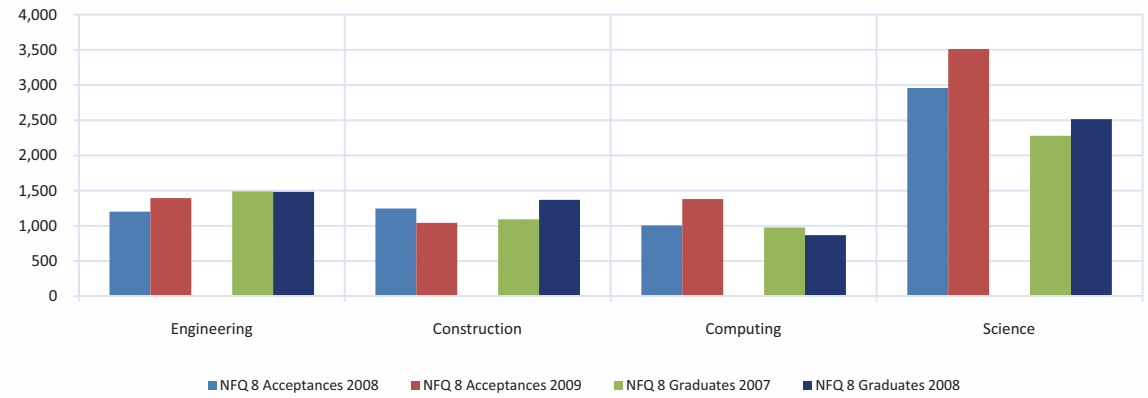
- **Science:** CAO acceptances increased across all levels between 2008 and 2009, particularly at Levels 7 and 8. Graduate output at Level 8 increased by 10% in this discipline between 2007 and 2008, reversing the downward trend of previous years; the 40% increase in the number of CAO acceptances between 2006 and 2009 indicates that this upward trend is likely to continue into the medium term.

Figure 8.1: Level 7/6 Science & Technology CAO Acceptances and Graduate Output



Source: CAO & HEA

Figure 8.2: Level 8 Science & Technology CAO Acceptances and Graduates



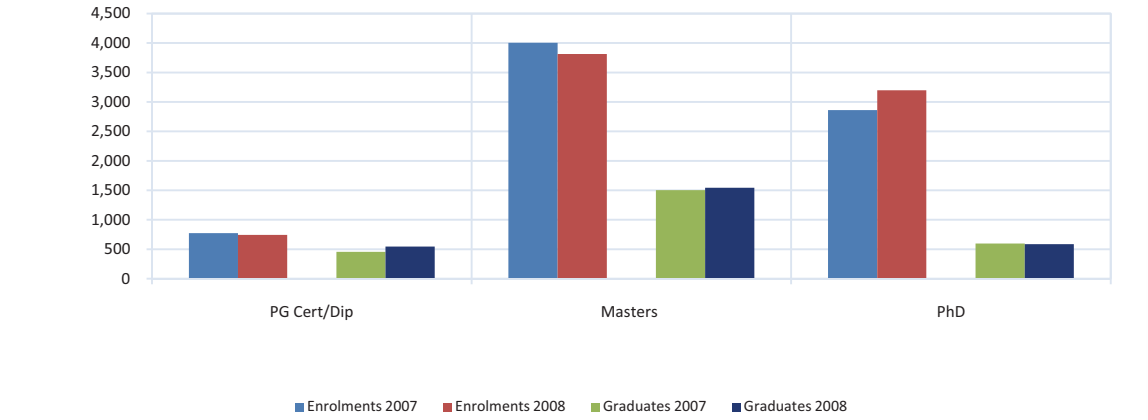
Source: CAO & HEA

Postgraduate Qualifications (NFQ 9/10)

The inflows and outflows from science and technology programmes at postgraduate level are presented in Figure 8.3 below.

- **Postgraduate Certificates/Diplomas:** Between 2007 and 2008, enrolments declined by 4%.This is likely to halt the growth in graduations at this level in the short-term. Enrolments declined for most disciplines within this category.
- **Masters Degrees:** Technology enrolments overall declined by 5% and may indicate that further growth in Master's level output is unlikely in the short-term. However, computing enrolments grew slightly over the period (by 3%) which may in turn lead a continuation of the increased graduate output observed for computing courses between 2007 and 2008.
- **PhD:** More than half of all enrolments in this category are for technology programmes. Enrolments increased for all science and technology related subjects over the period 2007-2008. This should lead to further growth in the number of PhD awards in the medium term.

Figure 8.3: Level 9/10 Science & Technology Enrolments and Graduates

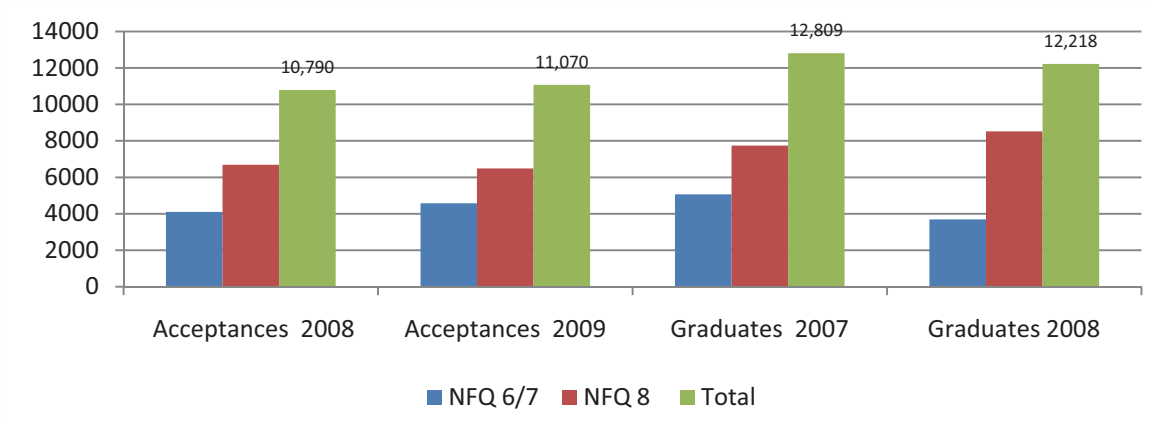


Source: HEA

8.2.3 Focus on Business Courses (Higher Education)

Business courses fall into the major category of social science business and law. Of the 133,600 undergraduate enrolments in higher education in 2008/09, 30,300 were for business courses which made up almost a quarter (23%). Figure below shows the number of CAO acceptances and graduates for social science, business and law courses. For the first time since 2005, modest increases in CAO acceptances were observed across Level 7/6 courses. Level 8 acceptances continued to increase. Graduate output declined by 44% at Level 7/6, but increased at Level 8.

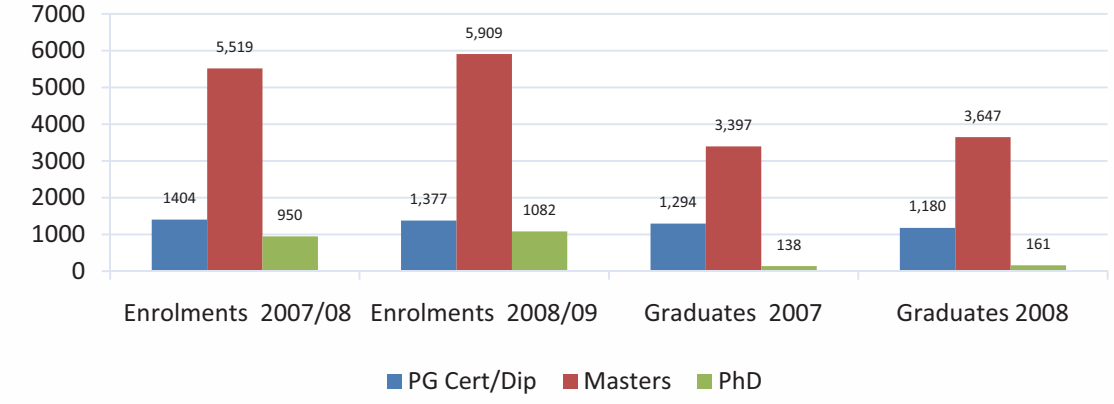
Figure 8.4: Undergraduate Social Science, Business & Law CAO Acceptances & Graduates



Source: CAO & HEA

Enrolment data is used as an indicator of postgraduate inflows to higher education (CAO acceptance data is for undergraduate entry only). This data is presented in Figure 8.5. Enrolments for social science, business and law students increased for master degree and PhD programmes (+7% and 14%) respectively; although the numbers enrolled on postgraduate cert/diploma courses declined, the numbers involved were small (<50) and were more than compensated for by the increases in the other two programme types. The number of postgraduate cert/diplomas awarded was outweighed by a 7% increase in Master Degree awards.

Figure 8.5: Postgraduate Social Science, Business and Law Enrolments and Graduates



Source: CAO & HEA

8.3 'Green' Skills Related Programmes

For presentation purposes, courses that were identified as being related to 'green skills' were categorised under five main headings.

- Renewable Energies
- Efficient Energy use and Management (including eco-construction)
- Waste Management, Recovery and Recycling
- Water and Wastewater Treatment
- Environmental Consultancy Services

In total some ninety-one Higher Education courses were identified. A detailed outline of these courses is given in Appendix 6. The majority of these courses related to Environmental Consultancy, followed by Renewable Energies, Efficient Energy Use & Management and finally Water and Waste Water Treatment. There were no related courses identified for the Waste Management, Recovery and Recycling sub-sector. However, several courses (mostly at Level 8) contain modules that may provide the skills to meet the needs associated with this sub-sector.

Figure 8.6: Total Number of 'Green Skills' Courses (Higher Education) by Sector

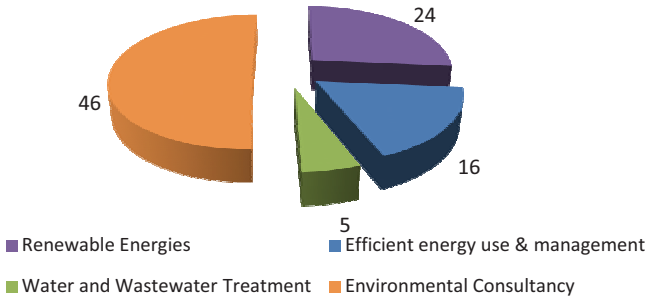


Table 8.2 provides a breakdown of 'green' skills related programmes by NFQ level.

Table 8.2: Total Number of 'Green Skills' Courses (Higher Education) by Sector & NFQ Level

	NFQ 6	NFQ 7	NFQ 8	NFQ 9	Total
Renewable Energies	3	5	8	8	24
Efficient Energy Use & Management		7	6	3	16
Water and Wastewater Treatment			2	3	5
Environmental Consultancy	1	7	25	13	44
Total	4	19	41	27	91

Table 8.3 presents information on the number of acceptances for 'green skills' courses as defined. As can be seen the numbers have increased - particularly for Level 8.

Table 8.3: CAO Acceptances for Green Skills Courses (NFQ 6-8)

NFQ Level	2005	2006	2007	2008
Level 6 Total		25	24	32
Level 7 Total	106	84	86	144
Level 8 Total	382	394	415	533
Total	488	503	525	709

Source: CAO

8.3.1 Renewable Energies

Higher Education

Higher Education provision for skills relevant to renewable energies is available at both undergraduate and postgraduate level. At undergraduate level, there are currently 24 courses offered at 15 Universities and Institutes of Technology. These comprise two courses at Level 6; five courses at Level 7, and eight courses at Level 8. The first intake of students on two of the programmes is scheduled for September 2010 (the Level 7 and 8 courses at IOT Tralee) while the Level 8 add-on programme at Galway-Mayo IOT is expected to be introduced to coincide with the emergence of the first graduates from the recently launched Level 7 programme in energy engineering at the same college. Finally, the Open University also offers students one distance learning course in energy for a sustainable future; it is broadly comparable to a Level 6/7 course module on the National Framework of Qualifications[69].

At postgraduate level, there are eight courses: five at Institutes of Technology with the remainder at NUI Maynooth, UCC and UCD.

Further Education and Training

Many of the FÁS provided training programmes dealing with energy from renewable sources pertain mostly to their application and installation. There are, however, two courses in development in wind micro-generation and photovoltaic micro-generation installation to be run at FÁS training centres in Finglas and Galway. There are also two PLC courses – both offered at Cavan Institute.

8.3.2 Efficient Energy Use and Management (including Eco-Construction)

There are 16 Higher Education programmes related to efficient energy use and management in Ireland which span Levels 6-9 on the NFQ. Of these, three are essentially construction courses, but with a focus on the 'green economy' (i.e. courses at the Institutes of Technology in Letterkenny, Athlone and Carlow). Seven programmes lead to a Level 7 award; six to a Level 8 award and three to a Level 9 award.

[69] http://www.nqai.ie/docs/publications/UK_comparison_guide.pdf

There are 17 FÁS short training courses. There is also one course in development in passive house design. Development has been proposed for an additional five courses. Finally, there are six PLC courses offered at five PLC colleges throughout the country.

8.3.4 Waste Management, Recovery and Recycling

The research did not identify any higher education courses that specifically deal with waste management, recovery and recycling. However, there are several courses (mostly at Level 8) which contain modules that may provide the skills to meet the needs associated with waste management, recovery and recycling. These courses are dealt with in greater depth in other sections - primarily in Environmental Consultancy and Services.

There are six FÁS training programmes in the area of waste management, recovery and recycling. They range in duration from one to twelve days. A further two courses are provided in the PLC sector.

8.3.5 Water and Wastewater Treatment

There are five Higher Education courses which have a particular emphasis on water and/or wastewater treatment. Three of the courses lead to a Level 9 award with the remaining two leading to a Level 8 award. In the further education and training sector, there are 7 FÁS training programmes in the area of water and wastewater treatment. There is one PLC course offered in this area.

8.3.6 Environmental Consultancy & Services

There are 45 Higher Education courses related to environmental consultancy services: in Higher Education, there is one course at Level 6; eight at Level 7; 24 at level 8 and twelve at Level 9. This figure also includes an honours bachelor degree offered to students in environmental science.

In terms of further education and training, there is one FÁS course (5 days) in environmental inspection skills and five PLC courses

8.4 Conclusions – Assessment of Supply of Relevant Skills

This chapter includes summary information on the supply of third level education business, science and engineering graduates – as well as those which can be defined as having been specifically developed for the 'green economy'. A main conclusion is the need for Universities and IOT's to strengthen collaboration and links with business around the development and delivery of modules on emerging skills topics.

This supply of third level education business, science and engineering graduates is relevant to the economy as a whole – as well as the 'green economy' sector. There are core business, engineering and ICT skills requirements within companies operating across all sub-sectors – as outlined in

Chapter 7. The main focus of courses should be on the development of such core skills expertise. Additional expertise in new emerging areas such as wind, marine, solar, geothermal could best be acquired through the provision of add-on modules within undergraduate courses and Masters Degree / Postgraduate Diploma provision – particularly important for those at work[70].

In relation to those courses specifically developed for the 'green economy' there has been a significant ramp up in supply within a relatively short time period. The nature of this provision needs to be re-aligned towards meeting the skills requirements of enterprise as identified within the Study. Expertise should be build up within specific universities and colleges for the design and development of modules and qualifications around emerging areas such as renewable energies. Modules could then be shared across institutions as required. The focus of programme delivery should be on provision which is flexible, modular, accredited and accessible via distance learning.

Further education and training provision is regarded as valuable. It includes the upskilling of skilled workers (including those made unemployed from the construction sector) in new business areas such as energy efficiency assessments, energy efficient lighting, installation of energy efficient appliances in houses and buildings, upgrading insulation in housing and buildings and reducing air permeability.

On specific sub-sectors there are currently no programmes around waste management & recovery. In relation to Water and Waste Water Treatment it has been suggested that education could draw upon modules developed by enterprise for the training and development of their own staff – and that this could be utilised to support the development of the sub-sector as a whole.

A main improvement in graduate education, identified by companies, is the need for improved maths proficiency, business acumen and problem solving skills. An increase in the supply of Internship opportunities linked to the award of qualifications would assist graduates develop these skills. So too would more project based work being incorporated into the curriculum of courses – and in this regard enterprise would be able to offer 'real world' examples.

[70] Examples of Master Degree level provision here in Ireland are the MSC in Renewable Energy Systems, Dundalk Institute of Technology and the MSC Energy Management Degree, Dublin Institute of Technology. Both are available full time and part time. An example from abroad is the Executive MBA in Energy offered in partnership between the Norwegian School of Management, Nanyang Business School in Singapore and IFP School on France.

Chapter 9: Conclusions and Recommendations

9.1 Introduction

The aim of the Study is to identify the future skills requirements of enterprise engaged with the 'green economy' in Ireland and to propose a range of proactive measures to ensure these needs are met. The overarching vision set by the Steering Group for the Sector is:

'For Ireland to be the benchmark 'smart green' economy for population centres under 20 million by 2015 - and to have the skills base and talent to drive innovative and high value products and services and maximise future business and employment growth potential'.

Six sub-sectors are considered within the scope of this Study. These were identified in various reports as having significant business and employment growth potential. The market size of the Environmental Goods and Services sector in Ireland is estimated at €3.5 billion. The global market is estimated at approx €1,100 billion. Enterprises within the sector deliver innovative products and services solutions across the areas of housing, environment, transport, industry, agriculture and consumer products. These solutions generate significant economic, social, and environmental benefits and returns to enterprises, consumers and society.

Key strengths Ireland has in terms of capturing environmental goods and services business opportunities include:

- Ireland's location is one of the most favourable for wind and ocean energy in the world;
- Ireland's indigenous R & D base is capable of competing at an international level;
- Ireland has strong science & technology, finance, and food sectors;
- Ireland's significant investments in improving environmental performance and creating the infrastructure and capabilities can be leveraged to support green enterprises; and
- Ireland's strong reputation as a 'Green Island' can be built upon.

9.2 Drivers of Change

Several external and internal drivers of change are impacting on the productivity and growth of the sector. These main environmental, economic and technological drivers are:

- Climate change and rising energy costs pressures are resulting in behavioural change by consumers, enterprises and governments.
- Domestic target have been set for 16% of all energy consumption to come from renewable resources by 2020, including 40% for electricity, 12% of heat consumption and 10% for transport.
- EU and Domestic Environmental Directives and Regulations need to be complied with.
- Export opportunities arising from green economic stimulus initiatives across economies.
- Global supply chains are responding to changing regulatory and purchasing demands.

- Technological convergence is generating new products and services business opportunities.
- There is a domestic platform of private and public R&D investment with a focus on the commercialisation of sustainable energy and energy-efficient products and services.
- Domestic Public and Private Investment Programmes are providing business growth opportunities.
- Domestic Public Funding is being made available for energy efficiency and retrofitting of housing.
- Introduction of green public goods & services procurement criteria will boost business growth.

The size of overseas markets in environmental goods and services is growing, given major economies' 'green' stimulus packages and moves by many countries towards a cleaner, low-carbon economy. The global market for environmental goods and services was estimated at approx €1,100 billion. There are varying estimates of future market size with for example German-based Roland Berger Strategy consultants estimating a value of €2,200 billion by 2020. Another recent study conducted by the German Institute for Economic Research commissioned by the German Federal Environment Ministry anticipates that global spending could reach €1,900 billion by 2020[71] (of which 33% of expenditures would be in Europe, 34% in North America, 27% in Asia and 6% in the rest of the world).

Whatever the actual scale, it is anticipated that the level of business growth for environmental goods and services will be significant and will provide opportunities for growth and employment in technologically advanced and export – orientated countries. Export markets with high potential include eco-construction products and services; energy efficiency, resource based technologies in renewable energies, water and waste; 'green' ICT and environmental consultancy services.

In this regard, the level of export sales generated by indigenous companies, at 20% of total sales, will need to be increase. Key considerations for exporting firms include access to market intelligence, forming of relationships with strategic partners and clients, legal, contractual and intellectual property knowledge and awareness of the cultural differences. Enterprise Ireland's export marketing programme for firms is valuable in this regard.

With the anticipated growth in world markets in environmental goods and services, there are opportunities for inward investment at the high end of the value chain through IDA Ireland. In this regard Ireland is an excellent investment location given its strong science and technology sector, its indigenous R&D base investment and strong supply of high-skilled graduates (in contrast to other EU countries such as Germany where the numbers of graduates in STEM disciplines is in decline due to demographic trends etc).

[71] Under a 'High Environmental Protection Expenditure Scenario'- Study commissioned by the German Federal Environmental Ministry in which various global development paths were developed, DIW Berlin Weekly report No 20 / 2009.

There are 'first mover' competitive advantages for companies and countries providing new clean tech / environmental goods and services. Countries are responding to the transition towards a low carbon, knowledge intensive economy through skills development strategies to meet the skills requirements within the workplace. A main feature of such initiatives are the close collaboration between enterprise and education and training providers in the shaping up, development and provision of relevant flexible and adaptable, accredidated education and training programmes - collaborative and interdisciplinary working is a feature of many programmes.

9.3 Supply of Appropriate Skills and Talent

A main finding of the Study is that companies view the supply of appropriate skills and talent as central to meeting their strategic business needs and long term productivity and competiveness – within both domestic and export markets. This finding relates to all companies regardless of size. Future skills supply is important in terms of the right quality, diversity and quantity of skills required.

An immediate requirement is to ensure that the current and planned level of relevant education and training provision is aligned to meet the quality and diversity of skills requirements of enterprise as identified in this Study while making optimum use of existing funding and expertise.

From the research work undertaken, 60% of the companies surveyed stated that they had skills gap and 40% had experienced a difficulty in filling some positions. Around one third of companies had recruited abroad, mainly for smaller numbers of specialist staff with experience within the Renewable Energies and 'Green' ICT sub-sectors. In terms of the quality and diversity of skills, the Study identifies several skills gaps within sub-sectors relating to business, engineering and ICT skills as well as non-technical skills. These arise from the need of companies to generate export sales and business growth, develop more high-value, innovative products and services, utilise new and emerging technologies; and ongoing productivity improvements in work organisation to achieve a flexible and adaptable organisation. These developments are being driven by customer demand – both in export and domestic markets.

Half of the companies surveyed had a human resources development plan. The majority of those that did not were smaller sized firms. Several companies were in the process of developing a plan. This progress needs to continue for companies to be able to plan for their future skills needs and communicate their requirements to education and training providers. In relation to companies surveyed, staff training mainly focussed on professional and technical staff. Training for skilled workers and operatives mostly related to meeting regulatory and health & safety requirements and acquiring knowledge of the operation of specific pieces of equipment/processes. Funding for training came from a mixture of sources including internal, public and equipment suppliers.

For the companies surveyed, 80% of employment was male and 20% female. This ratio results from the low numbers of women studying engineering disciplines and apprenticeships. This is not just an

issue in Ireland, as women are underrepresented in the engineering across most countries[72]. Around 14% of engineers in Ireland are female compared to 16% in Germany, 17% in France and 26% in Sweden. Companies within the sector could do more to communicate the attractive professional careers opportunities on offer - particularly towards women. Employer Representative Bodies and Technical and Professional Bodies should continue to provide valuable support in this regard.

9.4 Anticipated Level of Skills Demand

An estimated 18,750 people are currently employed in the sub-sectors within the scope of this Study. Of these, some 5,000 are employed in the retrofitting and energy efficient improvements of housing and buildings. It is anticipated that future job opportunities will arise within domestic and export markets including:

- New jobs arising in the 'Clean Tech' space from new company start-ups;
- Employment creation within existing firms – through increasing the proportion of their existing environmentally related business within domestic and export markets.
- Additional jobs arising from companies outside the sector at present 'going green' as a result of changing processes and products in response to market demand;
- Where substitution of employment may take place.

It is also important, in terms of future skills demand, to consider the level of 'replacement' demand (resulting from retirements, people leaving the workforce for various reasons etc) as well as 'expansion' demand. Utilising comparable replacement data information an estimate of 3.5 % per annum is used to calculate replacement demand.

Scenarios of Anticipated Level of Skills Demand

The Study outlines two Scenarios in terms of the level of future skills demand. Both Scenarios anticipate levels of employment growth within the sector – on the basis of strong international and domestic drivers of growth, feedback from companies and the opinion of key informants. There are some uncertainties however around the actual level of this growth. The two Scenarios are based upon different assumptions made around external and internal drivers of business and employment growth.

The first Scenario is termed the 'Realising Potential' Scenario – on the basis that it would be possible to meet these stretch targets if identified barriers to the development of the sector are addressed. In this regard, the Scenario is considered challenging but realisable. This Scenario is based on an anticipated increase in employment of between 8% – 10% per annum over the period 2010-2015. Under this scenario employment rises to around 29,000 by end of 2015. Total skills demand (expansion demand plus replacement demand) over the period averages 2,800 per annum (2,350 in Year 1 rising to 3,400 in Year 5). The growth assumptions within this scenario would also align with the estimated 7.7 % annual growth rate in the global market for environmental goods and

[72] Source: European Engineering Report (2010), The Association of German Engineers in co-operation with the Institut der deutschen Witschaft Koln.

services over this period (under higher expenditures scenario) in a recent study undertaken by the German Institute for Economic Research on behalf of the German Federal Environment Ministry.

The second Scenario termed the 'Under Potential' Scenario, also anticipates a rise in the employment level within the sector – but at half that of the 'Realising Potential' Scenario. Assumptions under this Scenario include that there is slower progress towards the removal of identified barriers to the development of the sector. The outturn of this Scenario would mean that the sector has under - performed in terms of its future potential. Under this Scenario, employment rises to 23,400 by the end of 2015. Anticipated total skills demand (expansion demand plus replacement demand) averages 1,600 per annum (1,500 in 2011 rising to 1,800 in 2015).

In terms of the future employment profile, it is anticipated that there will be a movement towards a higher skilled workforce profile over the next 3 – 5 years with the proportion of engineers and scientists, technicians and skilled workers occupational groups increasing. At the same time it is anticipated that the proportion of operatives in total employment will decrease - although because of their current employment share, job opportunities will continue to arise resulting from both job expansion and replacement demand.

9.5 Skills Demand - Quality and Diversity of Skills

In terms of the quality and diversity of skills, the Study identifies several skills gaps for business, engineering and ICT skills as well as non-technical skills. These skills gaps are a result of new and emerging areas of business based on renewable energies, energy efficiency and use of continually changing ICT applications and services. The skills gaps and emerging skills needs of enterprise were detailed in Chapter 7. The workforce profile of companies is also becoming more highly skilled. A summary outline of skills requirements by sub-sector is outlined as follows.

Renewable Energies

The development of the electricity network into a smart network incorporating distributed generation requires a combination of engineering, ICT and telecommunications skill sets. There will be an ongoing requirement for power engineers for the development of the electricity grid into a 'smart distribution network' – requiring core engineering skills with a bias towards electrical engineering – combined with ICT business skills. The continuing professional development of those at work is valuable, with the support of bodies such as Engineers Ireland and Engineers Skillnet. Demand for skilled workers and operatives are anticipated within the manufacturing, installation, and the operation and maintenance business stages. Some companies plan to outsource work in the short term while retaining in-house specialist expertise. Potential risks militating against the demand for skills are the need to improve time periods for granting permissions in relation to the building of on and offshore wind farms, the need to upgrade and improve access to the grid and the importance of ensuring high standards and quality products and services.

Energy Efficiency Use and Management

Identified skills gaps are for energy engineers and sales staff with the technical ability to sell overseas. Architects and professionals also require enhanced skills in the integrated design of sustainable building and use of renewable energy efficient products. New skills demands are for energy auditors to assess the scope for energy savings and efficiency initiatives in the industrial and commercial sectors. Also, for home energy consultants to advise householders on specific measures to improve efficiency. There is a requirement for the upgrading of workers for the external and internal insulation of existing buildings and within new build construction. Skilled workers (such as electricians and plumbers) require systems knowledge of energy efficient heating and lighting appliances to ensure their optimal usage by householders. The level of the demand for skills is related to potential export market opportunities, the future cost of energy, policies and regulations that drive energy efficiency and measures to support the retrofitting of housing and buildings and installation of energy efficient heating appliances. The price of energy efficient products to consumers will be a key factor as well as the economic returns that arise. In relation to the training of persons to carry out Building Energy Rating assessments, it can be concluded that the numbers now trained and certified are sufficient to meet current demand in the immediate future (there are fifteen BER assessment training providers listed with SEAI).

Water and Waste Water Treatment

In recent years, there has been a significant investment in waste water treatment infrastructure, both for new plants and the upgrading of existing plants. Skilled workers and operatives account for a relatively large proportion of the workforce. Demand for skills relate to the design, planning installation and use of modern technology in the operation and maintenance of water and waste water treatment facilities. This includes project/construction managers for the development of high value water and waste water facilities, process engineers and professionals in hydrology, telemetry,

Environmental engineers and laboratory technicians are required for the testing of water and waste water and electrical and mechanical technicians for the servicing and maintenance of treatment plants. Demand for skills in the sector is also dependent on domestic water metering going ahead. When it does, the main volume of skills required will be for skilled workers for welding using polyethylene materials and installing water meters. There will also be a requirement for a small number of professional experts to plan and manage water metering development. New and emerging skills are for plumbers specialising in rainwater harvesting – diverting rainwater off-roof to be used for toilet flushing, gardening and cleaning.

Waste Management, Recovery & Recycling

There were no current major skills gaps identified for the sector- apart from odour control as a niche area. Most of the skill requirement demand will be related to the scaling up the delivery of services and the operation and maintenance of existing and new technologies – particularly for additional skilled staff. Anaerobic digestion is one such new technology where new skills will have to be learnt and developed over time. There is little experience in Ireland of the incineration or managing of hazardous waste. The training and development of skills for the operation and maintenance of incinerator(s) is likely to be provided by the contractor engaged to design, plan and build same – but it should be a requirement considered by higher education institutions.

Environmental Consultancy

In the Environmental Consultancy sub-sector, the focus now is on export growth business opportunities while maintaining domestic capacity within housing, commercial property and publically funded infrastructure. Communications, maths, finance, science and commercial awareness are key requirements. Experienced consultants need to be competent in project management. Adaptability and flexibility in the undertaking of various assignments is the main attribute required for those working in environmental consultancy. Companies are making greater use of the redeployment of staff within their organisation to ensure the most efficient use of existing skills and human resources. Anticipated skills demand requirements are for energy engineers with knowledge of both UK and USA methods of building energy assessment; environmental engineers for the prevention, control and remediation of environmental health hazards; and electrical engineers for consultancy work in renewable energies.

'Green' ICT

There are strong business growth prospects for this sub-sector in terms of ICT infrastructure management to reduce energy consumption in buildings and industry and for an intelligent 'pan – utility' energy efficient approach towards the provision of water, energy, waste, transport etc. Professional engineers and scientists account for a high proportion of the workforce. The 'green agenda' is seen by enterprise as a main part of their future sales proposition. For example, IBM has launched its own supplier conduct principles which request suppliers to adopt the international green operating standard, ISO 14000[73]. Core skills for companies include software engineers and subject experts educated to Masters and PhD level. There will be a movement towards a higher skills profile within the sub-sector. The requirement will be for high-skilled professional engineering and science staff with the commercial awareness required to drive the development of existing and new products. Cross skilling technical staff with business skills is the preferred training and education route for the sub-sector.

9.6 Implications for Education and Training Provision

The main focus within initial education and training and continuing professional development should be on the development of core business, engineering and ICT skills capability. Additional expertise in emerging areas such as wind, marine, solar, geothermal could best be acquired through the integrated provision of 'add-on' specialism modules such as within third and fourth years of undergraduate courses or through Masters Degree/ Postgraduate Diploma provision – particularly important for continuing professional development[74]. Training programmes aimed at unemployed persons should take account of the qualifications/competences individuals already possess and then providing additional upskilling in the specialism area required to obtain employment. There are

[73] This requires IBM supplier companies to (1) define and deploy an environmental management system, (2) measure existing environmental impacts and establish goals to improve performance (3) publically disclose their metrics and results (4) cascade these requirements to any suppliers that are material to IBM's products.

[74] Examples of Master Degree level provision here in Ireland are the MSC in Renewable Energy Systems, Dundalk Institute of Technology and the MSC Energy Management Degree, Dublin Institute of Technology. Both are available full time and part time. An example from abroad is the Executive MBA in Energy offered in partnership between the Norwegian School of Management, Nanyang Business School in Singapore and IFP School on France.

also a range of technical and non-technical generic skills important across occupations including entrepreneurship, commercial awareness, maths proficiency, critical thinking, problem solving, ICT, foreign language fluency, creativity, customer service, finance, initiative/adaptability, project management, communications/influencing and teamwork.

From the research work with companies, Irish graduates are generally well regarded for their technical skills and competences – but specific weaknesses were cited in terms of their maths proficiency, business acumen, communication skills and problem-solving capability. Education and training provision should have a strong practical dimension. In this regard, enterprise can help by collaborating with education in the shaping up and development of project-based course work. Companies consider that well structured internship programmes would enhance graduate employability and benefit both the student and employer[75]. Internships should have identified learning goals and outcomes with credits awarded towards the achievement of a qualification award. Smaller companies could come together within a locality to offer a graduate internship opportunity between them. The use of an agreed template for managing work placement would be a valuable support. The Dublin Institute of Technology, *Placement Experience Partnership* has developed a 'best practice framework' for managing work placement (outlined in Appendix 5).

A substantive number of programmes are underway around 'green skills' education and training provision (approx €25m – €30m per annum). In total some ninety-one Higher Education courses were identified. The majority of these courses related to Environmental Consultancy, followed by Renewable Energies, Efficient Energy Use & Management and finally Water and Waste Water Treatment. There were no related courses identified for the Waste Management, Recovery and Recycling sub-sector. However, several courses contain modules that may provide the skills to meet the needs associated with this sub-sector. The supply of high-level skills from business, computing and engineering disciplines are also valuable for the sector as they are for the wider economy.

There is much scope for improving the coherence and alignment of current education and training provision towards meeting the skills needs of enterprise within the sector, while optimising the use of existing funding and expertise. It is also more feasible to have one centre build up expertise within an emerging specialism area, and then share the module(s) across the system – than for several institutions to be engaged in similar work. This approach should include drawing in valuable learning from the design and provision of relevant curricula and learning approaches in other European and USA institutions. The criteria for identifying a centre of expertise should include the quality of its research and teaching capabilities and its level of engagement and collaboration with enterprise and other institutions. This approach would enable Universities and IOT's to strengthen collaboration and links with business around the development and delivery of modules on emerging skills topics.

[75] This is a feature of the higher education system in the Netherlands where there is a high level of business involvement in the design and delivery of programmes. Research work in Ireland under the REAP project identified 411 courses from 23 Higher Education Institutes that provided placement/ internship opportunities. 10,600 undergraduate students undertook placements in 2008/09. The highest numbers were in the science and computing disciplines. Numbers were highest in UL, UCC, DCU and DIT. Three quarters of placements took place in the third year and these were of 21.5 week average duration.

9.7 Recommendations

The following recommendations are made in terms of ensuring that enterprise skills needs are met over a 3-5 year time period in terms of providing:

- the quality of skills required to drive business growth in the sector;
- the diversity of skills to reflect the complexity of business; and
- a sufficient quantity of skills to fill employment opportunities arising in the sector.

(1) Align Education and Training Provision to Enterprise Needs

A substantive number of programmes are underway/or planned around 'green' education and training provision (approx €25m – €30m per annum). The supply of high-level skills from business, computing and engineering disciplines are also essential for the sector as they are for the wider economy. There is significant scope for improving the alignment and coherence of this provision towards meeting the skills needs of enterprise while optimising the use of existing funding. The following recommendations are made in this regard.

- Focus education and training provision for the sector on the development of core business, engineering and ICT skills with knowledge of emerging areas being acquired by way of 'add-on' specialism modules in the third and fourth year of undergraduate programmes and through Master Degrees and Postgraduate Diplomas. Programme delivery should be flexible, modular, accredited and made available via blended learning techniques and distance learning.
- Strengthen collaboration between Universities and IOT's with business around the development, design and delivery of specialism modules on emerging skills topics. Expertise should be built up within specific Universities/Colleges for the design and development of new modules and qualifications, drawing upon curricula already developed by other European and USA institutions. These modules should then be shared within the system. The criteria for identifying a centre of expertise should include the quality of its research and teaching capabilities. A similar approach should apply to further education and training provision which are of shorter duration.
- Further education and training programmes including those for unemployed should take account of the relevant competences individuals already possess and provide upskilling in the additional specialism area(s) required to help them avail of employment opportunities in the sector.
- Integrate the development of generic skills/competencies into curricula at all levels – including entrepreneurship, commercial awareness, sustainability, critical thinking, problem-solving, self-directed learning, maths, finance, ICT, foreign languages, creativity, communications and teamwork. Opportunities should be provided within the learning process for collaborative interdisciplinary project work.
- Ensure the continuing professional development of staff in third level and further education and training in new emerging skills topics and flexible teaching/delivery methods.

Responsibility: HEA, Universities, Institutes of Technology, FÁS, Skillnets, VECs, Enterprise.

(2) Enhance Management Development (NFQ Levels 7-9)

There are significant potential business opportunities for the export of environmental goods and services. At present, an average 80% of the sales of indigenous companies in the sector are generated in the domestic market compared to 20% from exports. For business to grow, Irish companies in the sector need to be more successful in internationalising their business. Key considerations for companies are access to business market intelligence, awareness of cultural differences and forming strong strategic business and client relationships. The level of human resource planning within smaller sized enterprises needs to improve to ensure that their skills base will drive business growth.

- Build on existing support within Enterprise Irelands Leadership 4 Growth and International Selling & Transform programmes for indigenous companies to internationalise their business. Key skill requirements are for export marketing and sales, market specific knowledge, finance, managing partnerships, foreign language fluency, project development, environmental standards and regulations (BREEAM and LEED for building energy assessment, EN16001/ ISO4000 for global supply chain opportunities, legal/contracts, Intellectual Property and understanding of cultural differences. Provision should be benchmarked against best practice in competitor countries. *Responsibility: Enterprise Ireland*
- Incorporate key competences into management development programmes for the sector including export marketing and sales, business development, leadership, eco-design of products and processes, corporate governance, Lean Six Sigma, finance and human resource planning (the later particularly within smaller sized companies) - provision should be flexible, modular, accredited and accessible via distance learning.

  Responsibility: Enterprise Ireland, IBEC, ISME, SFA, Engineers Ireland, Skillnets.

(3) Build Engineering and Business Skills Capability (NFQ Level 8 & 9 &10)

Key skill requirements for Engineers and Scientists across sub-sectors are for core business, engineering and ICT skills capability with commercial awareness and product knowledge. Additional knowledge of new emerging areas could be build upon core skills in an integrated way. There is also a demand for related ICT skills and telecommunications skills - relating to the upgrading of the grid and connection of renewable energy sources.

- Focus professional engineering programmes on the development of core engineering skills, which offer specialism 'add-on' modules - wind, wave, solar, geothermal, biomass energy.
- Meet requirement for power engineers – requiring core engineering skills with a bias towards electrical engineering – combined with ICT business skills.
- Meet demand for business analysts experienced in renewable energies to work with software engineers on solutions for environmental problems. Also for principal researchers/investigators who can help translate research ideas into a commercial business proposal.
- Meet skills demand needs for professionals requiring knowledge of sustainable building design and energy efficiency requirements including carbon management and accounting and knowledge of overseas construction techniques and regulations - UK Method of Building Energy Assessment (LEED) and USA Method of Building Assessment (BREEAM) – and for an integrated approach towards the design and provision of related transport, water and waste services.

  Responsibility: HEA, Universities, Institutes of Technology, Enterprise.

(4) Develop Technicians Skills Capability (NFQ Level 7)

Technicians are a key occupational group across sub-sectors- particularly within the renewable energies and energy efficiency sub-sectors. There is a high demand for technicians with skills and experience in renewable energies for the installation, servicing and maintenance of on-shore wind turbines and other renewable energy power sources.

- Meet strong demand for technician's skills within education and training provision. A main emerging skill will be for wind turbine service technicians with electro-mechanical skills; for technicians with high-voltage ICT skills (electrical technicians with enhanced ICT Skills); for skills re the installation and servicing of small scale renewable technologies; installation of electric car charging points; and the operation and maintenance of biomass installations. Telemetry skills are required around the remote control of water/waste water plants.
  Responsibility: Enterprise, Institutes of Technology, Skillnets

(5) Develop Sales & Marketing Staff Skills Capability (NFQ Level 5-6)

Sales and marketing staff skills are essential for helping companies generate domestic and export business growth. Around 5% of staff within companies are engaged in sales and marketing positions.

- Provide for the upskilling requirements of marketing and sales staff around opportunities that will arise through the introduction of green public procurement especially on the concept of life -cycle costing – the requirement will be for short updating programmes.
- Meet demand for technical staff to sell internationally. Technical knowledge, foreign language skills, legal awareness regarding tender/contracts and ICT skills are important requirements
  Responsibility: Enterprise, Education, Skillnets.

(6) Develop Skilled Workers Capability (NFQ Levels 5-6)

For skilled workers there is a move towards multi-skilling in areas of installation, operation and maintenance work. There is also a requirement for the upskilling in the energy upgrading and retrofitting of buildings Requirements are high in numbers but for short training periods. In relation to the training of persons to carry out Building Energy Rating Assessments, the numbers now trained and certified are sufficient to meet demand in the immediate 2-3 year period.

- Ensure skilled workers gain system integration knowledge around optimum energy efficiency lighting and heating systems installations for housing and buildings and advising consumers on their economic paybacks- large numbers are involved but the upskilling period is short.
- Anticipate training demand that will arise from the planned installation of domestic and commercial water meters (Polyethylene pipe laying and service laying, water meter and boundary box installation). There could be 400 additional jobs engaged in such work.
  Responsibility: Institutes of Technology, FÁS, Skillnets, VECs
- Anticipate demand for skills required for the maintenance of electric vehicles.
  Responsibility: Institutes of Technology, FÁS, Skillnets, VECs
- Sustainable Energy Authority of Ireland to monitor and communicate the oversupply compared to demand in relation to the numbers now trained and certified to carry out Building Energy Rating Assessments.
  Responsibility: SEAI

(7) Develop Operatives Skills Capability (NFQ Levels 3-4)

Demand for operative skills will be linked to the scaling up of the manufacturing, operation and maintenance business stages of renewable energies and with the level of continuing investment in the retrofitting of housing and buildings. Another area of demand will be within the water and waste water sub-sector and in the thermal treatment of municipal waste. Given the work environment there is a need for health and safety training.

- Meet demand for insulation workers to perform a variety of activities in upgrading internal and external insulation in existing and new buildings. Customer service skills are important. Retrofit techniques can be delivered through relatively short, targeted training programmes.
- Anticipate demand for between 100-150 skilled operators for anaerobic digestion.

Responsibility: FÁS , VECs

(8) Increase Structured Graduate Placement and Internship Opportunities

The employability of students at third-level could be enhanced through practical business project work as part of their course. Internship opportunities are valuable in this regard. Graduates can benefit from technical and business skills experience acquired through structured graduate placement with companies.

- As part of the process of enhancing innovation in domestic SMEs, focussed support for graduate placement should be examined by Enterprise Ireland, including the development of a funding mechanism which would be flexible and responsive to the companies needs. A funding support of 50% of salary for the first year could be considered.
  Responsibility: Enterprise Ireland
- Increase availability of structured internship opportunities for students within companies at home and abroad (including through Enterprise Ireland's recently introduced *Graduates for International Growth* programme). Learning should be linked to the awarding of qualifications.
  Responsibility: Business, HEA, Universities, IOT's, Engineers Ireland, ICT Ireland.
- Support the development of networks of smaller companies who could provide an internship opportunity between them - to overcome the difficulty of smaller companies lacking the capacity to provide internship opportunities.
  Responsibility: Enterprise, IBEC, ISME, SFA, Engineers Ireland.

(9) Communicate Career Opportunities on offer within the Sector

Companies anticipate that they will increase their employment level over the next five years – particularly for higher skilled staff – in line with the changing skills profile of their workforce (although there will be continuing employment opportunities for operatives given their current proportion in total employment).It is important that the sector will be able to draw upon a quality supply of science, engineering and technology (STEM) skills – at all levels to meet anticipated 'expansion' as well as 'replacement' demand requirements. A relatively low proportion of the workforce in the sector were female (in the companies interviewed 20% were female).

- Communicate the attractive professional career opportunities on offer within this growing sector. Encourage uptake of STEM subjects particularly more women into engineering disciplines.
  Responsibility: Enterprise, Engineers Ireland, ICT Ireland, Software Ireland.

(10) Enhance Mathematical and Science Skills of the Workforce

Mathematics and science skills are key competency requirements across all occupations. The view of companies is that while the mathematical proficiency requirements of the workplace have gone up, the mathematical standards of those leaving the educational system have remained the same.

- Improve the level of mathematical and science proficiency at all levels of education. Incorporate 'real life' examples from business into curricula (companies can provide examples). Increase the numbers of students taking Higher Level Leaving Cert Maths.
- Develop mathematical knowledge skills modules to meet requirements of workers across occupations- including for electricians who qualified several years previously. A suite of mathematical skills modules at various NFQ levels could be developed to be drawn upon by individuals, adult education and business.

Responsibility: NCCA, Education, FETEC, NALA, VECs

(11) Develop Skills within Enterprise across the economy

Environmental concerns will impact on enterprises and organisations across the economy, around how they can make savings through improved resource usage and energy efficiency in buildings and manufacturing processes, reduce waste through use of new materials and production processes, and how they can gain market share through responding to consumer demands for more environmentally friendly, low emissions products and services. There are skills requirements arising for enterprises both private and public that have been identified through the work of this Study. These are:

- Improve energy and resource efficiency awareness within companies and homes through measures to highlight the benefits and savings that can be achieved at all levels.

  Responsibility: Sustainable Energy Authority of Ireland
- Promote an eco-design approach with enterprises aimed at the reducing the environmental impact of products throughout their life cycle across the product cycle in design, manufacturing, marketing, retail and final consumption.

  Responsibility: Enterprise
- Upskill procurement staff within the public service implementing green public procurement procedures – particularly the concept of life-cycle costing.

  Responsibility: Sustainable Development Unit, Department of the Environment, Heritage and Local Government

Appendix 1: Terms of Reference of Study

Aim of Project

The aim of the project is to determine the future skills requirements of enterprises engaged within the 'green economy' and the actions required to ensure that their future skill base will sustain innovative, high value products and services and maximise employment and growth potential- both for foreign inward investment and indigenous enterprises. It will enable education and training providers and learners to anticipate the demand for skills arising in enterprises engaged within the green economy.

Background

The 'green economy' has been identified as an area of potential business and employment growth across many countries – including Ireland[76] - although the sector as such is not well defined. There is no exact boundary around the sector and it may include companies created specifically to service the environmental goods and services market as well as companies within more traditionally defined sectors (such as engineering) that are diversifying in response to growing market opportunities .The High Level Group on Green Business Opportunities has identified several sub-sectors with substantial employment and growth potential. These are (a) Renewable Energies; (b) Efficient Energy Use & Management; (c) Water & Waste Water Treatment;(d) Waste Management, Recovery & Recycling; and (e) Environmental Consultancy Services. 'Green' ICT applications/software can also be added as an area of increasing potential (as identified by OECD[77]). These sub-sectors are overlapping and interactive- with a high degree of technological convergence. Enterprises may be engaged both within and across these sub-sectors.

There are growing business opportunities for innovative high value products and services – for the home and export markets - which provide new 'smart green' solutions within housing; environment; transport; industry; and consumer products and agriculture. These new solutions help promote sustainable development and deliver economic, social and environmental benefits. The skills and competencies required by enterprises within the 'green economy' may be either new or modified skill sets – or an amalgam of existing skills. Projects often require bringing together professions and skilled workers from different disciplines to work in multi-disciplinary teams. As well as specific technical and professional skills there are requirements for generic competences such as leadership, creativity, innovation, team working and communication skills. Occupations may work within different stages of the business process.

The study will assess the skills requirements emerging at each stage of the business process for enterprises – starting with research & development through to customer support - and what this means for changing job profiles, skill sets and competencies. These will be compared with current and planned provision from initial education and training and continuing professional development to identify any future skills capability gaps or shortages. The report will make recommendations

[76] Building Ireland's Smart Economy: A Framework for Sustainable Economic Renewal (2008).
[77] OECD (2009),The impact of the crisis on ICT and ICT related employment.

aimed at upgrading the skills base and talent available to boost business potential and competitiveness.

Scope of Work

The specific project objectives will be to:

- Determine the current size (market value and employment) and skills profile of enterprises engaged within the green economy.
- Identify the main economic, social and environmental drivers of change impacting on the productivity and growth of enterprises within the 'green economy' and assess their likely influence on future business growth and employment trends.
- Estimate future skills demand for each stage of the business process for occupational groups - management, professional, technical, sales and marketing, skilled trades and operative - both quantitative and qualitative. This will include both changing skills demand arising from skills profiles in existing jobs being modified (job maintenance) as well as new skills requirements arising from additional jobs being created.
- Assess the adequacy of (a) the current and planned supply of relevant skills from the education and training system (b) the pool of skills within the workforce (c) potential for recruitment - which together can help meet anticipated skills demand.
- Identify any anticipated enterprise skills capability gaps/ shortages likely to arise (including from technological convergence).
- Put forward recommendations on proactive action(s) required to ensure that the supply of skills will be sufficient to meet the future skills base needs of enterprise engaged within the 'green economy'.

Recommendations will focus on the use and redirection of funding aimed at upskilling the workforce and will include Initial education & training, continuing professional development and training programmes for the unemployed. The time periods for consideration of implementation and impact of recommendations will be:(a) short term (1-2 years),(b) medium term (3-4 years) and (c) long term (5 years +).

Methodological Approach

The methodological approach will include a review of domestic and international research and literature and an identification of best practice examples in comparator countries. A concise piece of mainly qualitative research work will be undertaken with a sample of representative enterprises engaged within the 'green economy' around their current and anticipated skills demand. Also, on the adequacy of the supply of relevant skills – and any skills capability gaps or shortages that are / may arise – and their views around how these could be addressed. A number of case studies will be considered. There will also be in-depth consultations around these issues with relevant key bodies- both public and private.

Appendix 2: Steering Group Membership

George Bennett, Head of Clean Technology Division, IDA Ireland - Chairperson
Robert Mc Carthy, Business Development Manager, IBM
Mazhar Bari, CEO, SolarPrint Ltd
Pat Gilroy, MD, Dalkia Ltd
Anna Pringle, Group Strategic HR Director, NTR plc
Andrew Parish, CEO, Wavebob Ltd
Marina Donohue, Department Manager, CleanTech and Paper, Print and Packaging, Enterprise Ireland
Brian Motherway, Deputy CEO, Sustainable Energy Authority of Ireland
Alan Nuzum, CEO Skillnets
Liz Carroll, Training and Development Manager, ISME
Brendan Tuohy, ex Secretary General Department of Communications, Marine and Natural Resources
Marie Bourke, Forfás
Gerard Walker, Forfás
John McGrath and Nora Condon, FÁS SLMRU, assisted the work of the Secretariat

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Appendix 4: Regulations and Directives

- Kyoto's Emissions targets.
- EU Climate Change and Energy Package Dec 2008 .This contains three new legally binding targets to be achieved by 2020. These are:
- 20% reduction in greenhouse gas emissions based on 1990 levels
- 20% of final energy consumption to be produced by renewable energy resources[78]
- 20% improvement on energy efficiency
- EU Water Framework Directive 2000.
- EU Urban Waste Water Directive (amended 1998)
- EU Waste Framework Directive 2008 .This requires to be transposed into national law within two years. It sets new recycling targets to be achieved by 2020 including recycling rates of 50 percent for household and similar waste and 70 percent for construction and demolition waste and places an obligation on member States to develop national waste prevention programmes. (Irelands programme which covers the period 2009-2012 was launched in 2009).
- Waste Electrical and Electronic Equipment (Weee Directive).
- Integrated Pollution Prevention Control.
- EU Energy Performance of Buildings Directive (EPBD) –for improving building energy efficiency.
- Building Energy Rating (BER) Certificate – for prospective buyers or tenants – a standard calculation of a buildings energy performance – a measure of how much energy and carbon a building will use or produce over a year.
- EU Renewable Energy Directive (2009/28/EC)
- EU Transfrontier Shipment Regulations.
- EU (Parliament and Council) Directive Biofuel Target[79] - 10% mix of biofuels in petrol and diesel consumption by 2020 maintained that it was essential to develop second generation biofuels that do not affect food supply.
- EU Maritime Strategic Framework Directive (protection and conservation of the marine environment).
- National Emissions Ceiling Directive.
- Emissions Trading Directive.
- Ireland: National Hazardous Waste Management Plan 2008 – 2012.
- United Nations Framework Convention on Climate Change.

[78] Ireland's target under this directive is for 16% of total energy consumption to come from renewable resources by 2020. In 2008, Ireland set a target of 40% for renewable electricity's share of electricity consumption. The amount of renewable electricity generated increased from 4% in 2003 to around 15% - 20% in 2008.

[79] Irish Government Biofuel Regulation, 2009 requires that from mid 2010, Irish fuel suppliers will have to include an average of 4% biofuels in their annual sales. This includes a requirement that the biofuels used must produce less than 35 % less greenhouses gases than fossil fuel.

Appendix 5: Dublin Institute of Technology Framework for Managing Work Placement

Key Criteria	Higher Education Institute	Student	Host Organisation
Learning & Development	Assist student to identify learning objectives/personal goals/ skills to be achieved.	Identify learning objectives/personal goals/ skills to be achieved.	Assess learning objectives/personal goals/ skills to be achieved.
Preparation	Assist student to prepare for interview. Assist student to prepare for induction.	Actively participate in interview process. Actively participate in induction process.	Offer interview process. Offer Induction process.
Placement Agreement	One placement agreement signed by all three parties.	One placement agreement signed by all three parties.	One placement agreement signed by all three parties.
Communication	Regular feedback with student and host organisation.	Regular feedback with industry mentor and HEI mentor.	Regular feedback with student and HEI mentor.
Monitoring & Evaluation	Organise debrief session.	Participate in debrief session.	Participate in appraisal of student
Assessment	Assess student.	Participate in all elements of assessment.	Contribute to assessment of student.
Support & Resources	Provide adequate support and resources	Avail of all support and resources	Provide adequate support and resources.
	Adhere to Framework.	Adhere to Framework.	Adhere to Framework.

Appendix 6: Higher Education Course Summary Tables

Renewable Energy Related Courses

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
LYIT	6	HC	Engineering (Wind Energy)	Wind energy technician	6 months	16	N/A
CIT	6	Certificate	Sustainable Energy Systems	Energy management, auditing, system installation and testing	-	-	N/A
Open University	6/7	Credit	Energy for a Sustainable Future	-	-	-	-
AIT	7	BEng	Mechanical Engineering & Renewable Energy	Energy management & BER; design & management of renewable energy projects	-	-	255
GMIT	7	BEng	Energy Engineering	Energy audit/analysis (e.g. domestic BER)	-	48	360
IT Tallaght	7	BEng	Energy and Environmental Engineering	Contribution as energy system designers; system developers or operators; energy auditors	-	-	250
IT Tralee	7	BSc	Renewable Energy and Energy Management	Install renewable energy devices; energy management & auditing; design of energy systems for buildings	-	20	215
LIT	7	BSc	Renewable and Electric Energy Systems	Wind turbine installer; system integrator; renewable energy consultant	-	-	335
AIT	8	BEng (Hons)	Sustainable energy engineering	Sustainable energy engineer; consulting engineer (renewable energy ; BER)	-	-	Add-on
CIT	8	BSc (Hons)	Electrical Power Systems	Generation, distribution & utilisation of electrical energy; design & maintenance of renewable energy sources (e.g. wind energy; fuel cells)	-	-	Add-on
DKIT	8	BEng (Hons)	Sustainable Design Engineering	Sustainable design engineer; solar electrical engineer, energy component design	-	26	Add-on
GMIT	8	BEng (Hons)	Energy Engineering	Energy modelling/analysis (commercial buildings); passive building design; environmental management	-	48	Add-on

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
IT Tralee	8	BSc (Hons)	Renewable Energy & Energy Management	Course to be introduced in Sept 2012	-	-	-
NUIG	8	BE (Hons)	Energy Systems Engineering	Design of sustainable energy technology; construction of power plants and renewable energy systems	5 months	20	445
UCC	8	BE (Hons)	Energy Engineering	Design of renewable energy devices; construction of power plants; design of energy systems for buildings	5 months	-	520
UL	8	BSc (Hons)	Energy	Roles in energy production (wind, wave, solar, bio fuel); energy costs	-	-	435
GMIT	9	MSc/PgDip	Environmental Systems	Design engineers; waste managers, pollution officers	-	-	PG
CIT	9	MEng	Research Masters in Engineering		-	-	PG
DIT	9	ME	Sustainable Electrical Energy Systems	For graduate engineers wishing to continue their studies and engineers in the electrical/electronic industries	No. But work-based projects encouraged	-	PG
DKIT	9	MSc /PgDip	Renewable Energy Systems	Manager (e.g. energy systems, R&D or product plant); technical sales director (energy systems); energy consultant; senior product engineer	No. But aimed at those with prior experience		PG
UCC	9	MEngSc	Sustainable Energy	Energy engineers; sustainable energy systems engineers			PG
UCD	9	ME	Energy Systems Engineering	Roles in research, design & development in companies in the energy sector			PG
NUIM	9	ME	Electronic Engineering (Renewable Energy Systems)	Course to be introduced Sept 2010			PG
WIT	9	MSc	Sustainable Energy	Facilities management; energy auditing & energy management			PG

Efficient Energy Use and Management (Including Eco-Construction) Related Courses

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
AIT	7	BSc	Sustainable Construction	Work with building contractors, architects; in the technical sales area dealing with equipment or supply of specialist materials	-	-	N/A
DIT	7	BTech	Electrical Services Engineering	Work in an electrical design office for a consulting engineer; technical sales support; environmental control	-	-	260
DIT	7	BEngTech	Electrical & Control Systems (Electrical Energy systems option)	Engineering technologists in manufacturing and electrical power industry	-	40	185
DIT	7	BSc	Industrial and Environmental Physics	Partially relevant to green economy: careers as technicians or research assistants in renewable energy and sustainability	-	15	225
GMIT	7	BSc	Physics and Instrumentation	Energy instrumentation technicians	-	-	280
ITB	7	BSc (Hons)	Sustainable Electrical and Control Technology	Technician level roles with renewable energy contractors; electricity generation & supply companies	-	-	All Qualified Applicants
LYIT	7	BEng	Building Energy, Services and Design Engineering	BER energy assessor for new dwellings	-	30	130
CIT	8	BEng (Hons)	Sustainably Energy Technology	Energy management; energy systems design; systems engineering and power engineering	-	-	380
DIT	8	BSc (Hons)	Electrical Services and Energy Management	Energy environment and management	-	-	Add-on
GMIT	8	BSc (Hons)	Physics and Instrumentation	Energy instrumentation technicians	-	-	N/A
IT Carlow	8	BSc (Hons)	Sustainable Architectural Technology	Assisting architects in eco-construction design & technology	-	-	330
LIT	8	BSc (Hons)	Sustainable Energy Management	Building energy management and control; commercial BER			
IT Carlow	8	BSc (Hons)	Construction - Facilities and Energy Management	BER; space management; energy conservation in design of buildings	-	10	310
DIT	9	MSc	Energy Management	Managers of environmental technology with an in-depth awareness of resource management under financial and environmental constraint	-	-	PG
DIT	9	MSc	Sustainable Development		-	-	PG
IT Sligo	9	MSc/PgDip	Energy Management	Energy management; facilities management; BER	-	-	PG

Water and Wastewater Treatment Related Courses

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
TCD	8	BAI (Hons)	Environmental Engineering	Wide variety, including designing installations for wind turbines	-	170 (common entry engineering)	410
NUIG	8	BE (Hons)	Environmental Engineering	Environmental scientist; design consultant; graduate engineer - surveying	-	10	415
DKIT	9	MSc	MSc (research) Environmental Science		-	20	PG
TCD	9	PgDip	Environmental Engineering	Provides civil engineers and other graduates with knowledge of current practice in environmental engineering. relevant for local authority engineers	-	-	PG
UCD	9	MSc	Applied Science (Environmental Science)		-	-	PG

Consultancy Services Related Courses

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
IT Tralee	6	HC in Science	Biological and Environmental Studies	Jobs in marine and freshwater resources and ecosystems; wetlands;	-	20	235
GMIT	7	BSc	Applied Freshwater and Marine Biology	Environmental management; Environmental protection	-	32	275
GMIT	7	BSc	Agriculture and Environment Management	Employment in agriculture or environmental sectors	3 months	32	290
IT Carlow	7	BSc	Analytical and Forensic Science		-	10	210
IT Sligo	7	BSc	Environmental Protection	Jobs in environment and waste divisions of local authorities the environmental protection agency	-	-	235
IT Tralee	7	BSc	Pharmaceutical Analysis with Environmental Science	Laboratory technician; technical sales & support; environmental analyst	-	16	255
LIT	7	BSc	Environmental and Chemical Analysis	Environmental analysis; employment in chemical, pharmaceutical, food and biotechnology industries	-	-	All Qualified Applicants

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
UCD	7	BSc	Environmental Biology		-	-	Common entry to science
IT Sligo	7	BB	Tourism & Green Event Management	developing, managing and promoting green events within the ecotourism & mainstream tourism industry	4 months	50	New Programme for 2010
DCU	8	BSc (Hons)	Environmental Science and Health	waste management; pollution control, environmental monitoring	-	-	350
DIT	8	BSc (Hons)	Planning and Environmental Management	Environmental impact statements; waste management, water, air and soil	-	40	330
DIT	8	BSc (Hons)	Forensic and Environmental Analysis	Monitoring environmental pollution; chemical analysis	6 months	-	340
DKIT	8	BSc (Hons)	Environmental Biology	Jobs in industry, environmental consultancies, local authorities	-	-	Add-on
GMIT	8	BSc (Hons)	Applied Freshwater and Marine Biology	Environmental management and protection	-	16	300
IT Carlow	8	BSc (Hons)	Industrial Environmental Science	Analytical services; local authorities (in technical services and waste management regulations);	-	-	N/A – New 2010
IT Sligo	8	BSc (Hons)	Environmental Science	Soil, water and air testing; management of pollution control facilities	-	-	285
IT Tralee	8	BSc (Hons)	Pharmaceutical Analysis with Environmental Science	Laboratory technicians; technical sales & support; environmental analyst	-	16	330
IT Tralee	8	BSc (Hons)	Wildlife Biology	Jobs in marine and freshwater resources and ecosystems; wetlands;	-	-	300
LIT	8	BSc (Hons)	Environmental Analysis & Management	Identification of environmental pollutants and pharmaceutical compounds	-	-	N/A
NUIG	8	BSc (Hons)	Earth and Ocean Sciences	Environmental site surveyor; geologist	-	17	360
NUIG	8	BSc (Hons)	Environmental Science	Environmental scientist; ecologist/agricultural planner; environmental technician	-	30	365
TCD	8	BA (Hons)	Earth Sciences		-	-	470

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
TCD	8	BA (Hons)	Environmental Science		-	-	Common entry Science
TI	8	BSc (Hons)	Environmental and Natural Resource Management		-	20	210
UCC	8	BSc (Hons)	Environmental Studies/Management	Environmental impact assessments; air and water monitoring and management; waste management	-	-	-
UCC	8	BSc (Hons)	Environmental and Earth Sciences	Jobs in environmental consultancy companies; EPA; industrial monitoring and environmental compliance	-	25	400
UCD	8	BSc (Hons)	Environmental Biology		-	-	Common entry Science
UCD	8	BE (Hons)	Biosystems Engineering		-	-	305
UCD	8	BA (Hons)	Geography, Planning and Environmental Policy		-	-	415
UCD	8	BSc (Hons)	Climate and Earth System Science		-	-	390
UCD	8	BAgrSc (Hons)	Agri-Environmental Sciences		-	-	350
UL	8	BSc (Hons)	Environmental Science	Jobs in chemical & biotechnology based industry; energy generation; EPA	8 months	-	365
Open University	8	BSc (Hons)	Environmental Science	-	1 week residential school	-	-
AIT	9	MSc	Environmental Health & Safety Management		-	-	PG
IT Sligo	9	MSc/PgDip	Environmental Protection	Environmental consultant; Environmental Impact Assessment scientist; jobs in water resources	-	-	Pg
NUIG	9	MSc (research)	Environmental Science		-	-	Pg
TCD	9	MSc/PgDip	Biodiversity and Conservation	Various careers in biodiversity and its conservation	-	-	Pg
TCD	9	MSc/PgDip	Environmental Science	Intended for admin and scientific workers , new graduates with an biological/earth science background	-	-	Pg

HEI	NFQ	Award	Course Title	Possible Career Opportunities	Internship/Work Placement	No of Places	CAO Points (2009)
UCC	9	MSc	Applied Science (Marine Biology)	Assess the sustainability of exploitation; knowledge of marine flora and fauna; research skills (field & lab)	-	-	Pg
UCC	9	MSc	Applied Science (GIS & Remote Sensing)	Employment in the environmental sciences as reliance on digital spatial data increases	-	-	Pg
UCC	9	MSc	Applied Science (Ecological Assessment)	Personnel skilled in methods of ecological assessment	-	-	Pg
UCC	9	MSc	Applied Science (Environmental Analytical Chemistry)	Jobs in methods of environmental chemical analysis, - instrumental analysis; laboratory reports	-	-	Pg
UCD	9	MSc/HDip	Rural Environmental Conservation and Management		-	-	Pg
UCD	9	MSc (Agr)	Environmental Resource Management		-	-	Pg
UCD	9	MSc	Bioresource Technology	Environmental technologist (air, water & waste management) for food and pharmaceutical companies; jobs in the area of bioenergy	-	-	Pg
UCD	9	PgCert	Green Technology	Jobs in the emerging environmental industries in areas of air, water and waste management and in the development of sustainable energies	No, but aimed at those with prior experience	-	Pg

Appendix 7: Further Education and Training Course Provision in Green Economy Skills

Table: FÁS Courses – Current Provision

Efficient Energy Use and Management (including Eco- Construction)
Air Tightness Installation
Biomass Installation
Building Energy Rating
Carbon Footprint Reduction
Domestic Heat Pump Installation
Domestic Thermal Insulation
Energy Efficiency and Renewable Technologies
Installation of Insulation in Dwellings
Installation of Domestic Photo voltaic Systems - SC
Gas Installation Safety (GIS)
Gas Installation Domestic (GID)
Radon Gas Remediation and Prevention
Smart/Intelligent Building Systems
Packaging Optimisation/Waste Reduction
Waste Facility Operative
Water and Wastewater Treatment
Inspection, Instillation & Maintenance of On Site Waste Water Treatment Systems
Laboratory Procedures
Site Suitability Assessment for Earth-Lined Stores
Site Suitability Assessment for On-Site Waste Water Treatment Systems
Wastewater Treatment Plant Operation
Water Protection & Nutrient Management Planning
Water Treatment Plant Operation
Environmental Consultancy and Services
Waste Management
Environmental Inspection Skills
Waste Management, Recovery and Recycling

Selected Skillnets run courses (FET outside of FÁS/PLC sector)

Course List	# Trainees	Duration	Training days 2010	Accreditation
Ber FETAC	6	5	30	Fetac Level 5
BER Assessor refresher course	22	2	44	none
Best Environmental Practice Hospitality	16	2	32	none
Construction Safety	8	3	24	Fetac Level 5
Eco Home Design,	3	10	30	none
Energy Efficient Passive House Design	12	11	132	Passive House Institute
Energy Insulation	5	8	40	TBC
Energy Mgt, Benchmarking, Energy	1	21	21	none
Environmental Good Practice	2	24	48	none
Green Business, Lean Business	4	8	32	none
Green Project Management	1	8	8	none
Heat Recovery ,Ventilation, Distribution	2	8	16	TBC
Low Energy Domestic Refurbishment	1	8	8	none
Passive House Design	10	10	100	Passive House Institute
Reducing your costs, greening your licensed/food premises	16	1	16	none
Retrofitting: Low Carbon Housing	14	2	28	RIAI
Small Scale Wind Generation Design	5	12	60	none
Waste Management	1	10	10	none

Table: PLC Course Provision

	Renewable Energies	
Cavan Institute	Renewable Energy & Control Systems	5
Cavan Institute	Renewable Energy & Control Systems - Advanced	6
	Efficient Energy Use and Management (including Eco- Construction)	
Cavan Institute	Sustainable Energy & Construction Technology	5
Colaiste Dhulaigh	Renewable Energy Practices	5/6
Galway Technical Institute	Construction Technology - Environmental Studies	5
St. John's Central College	Sustainable Energy Building Systems	5
	Waste Management, Recovery and Recycling	
Colaiste Stiofain Naofa CFE	Process Chemistry	5
St. John's Central College	Environmental Science - Waste Management	5
	Water and Wastewater Treatment	
Cavan Institute	Environmental Science - Water & Waste Management	5
	Environmental Consultancy and Services	
Archbishop McHale College -	Applied Ecology	5
Ballsbridge College	Business & Environmental Management	5
Colaiste Stiofain Naofa	Process Chemistry	5
Dun Laoghaire College	Conservation and Sustainable Technology - Advanced Certificate	6
Kinsale College	Permaculture - Practical Sustainability	5
Monaghan Inst	Ecology - Applied	5
Whitehall College	Applied Ecology	5

Source: Qualifax

*Refers to year 1 and, where applicable, year 2 student enrolments; the vast majority of PLC courses cited here are 1 year duration

Source: Department of Education and Skills

Table: PLC Enrolments (Selected Green-related courses)

Total PLC Enrolments	2005	2006	2007	2008	2009
Applied Science - Laboratory Techniques	166	126	162	219	268
Construction Technology	264	266	271	287	339
Non NCVA Science Course	156	262	275	356	535
Grand Total	586	654	708	862	1,142

Appendix 8: Other Courses for 'Green' Skills Provision[80]

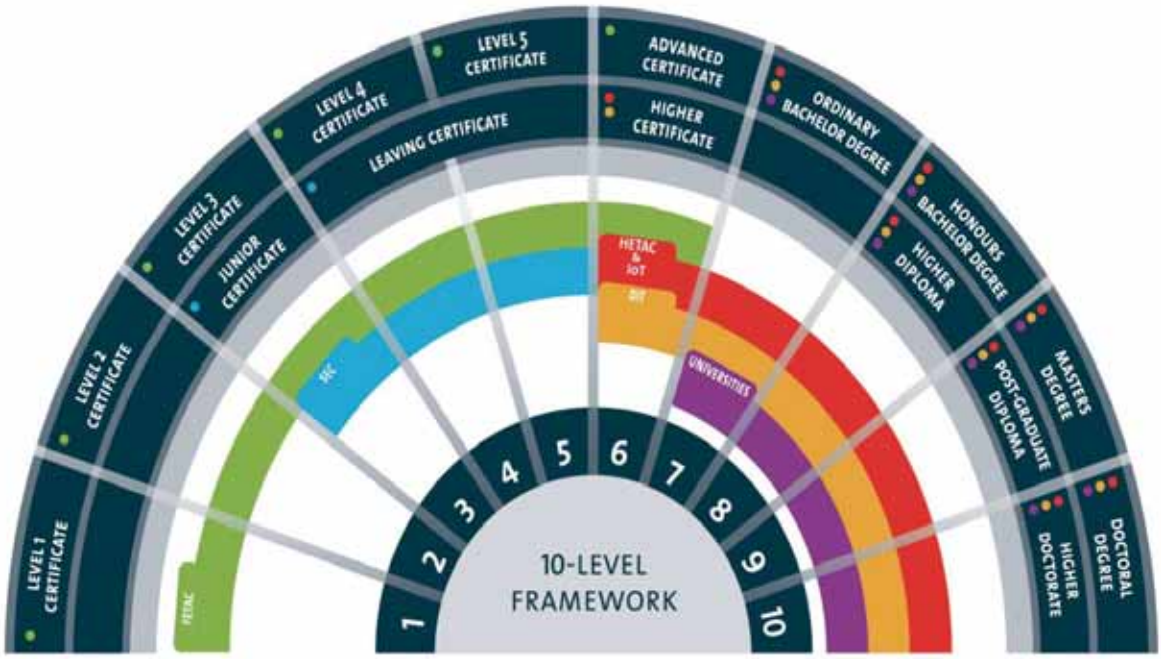
Table: Private Education/Training Provision

Provider	Course Name	Certification/award	Duration
SQT Training	Energy Management - Green House Gas Accounting and Verification	N/A	3 days
SQT Training	Certified Energy Manager	Association of Energy Engineers	6 days
SQT Training	Home Insulation Installer	N/A	3 days
SQT Training	Introduction to Energy Management/Auditing	N/A	1 day
SQT Training	Hazardous, Chemical and Spillage Control	N/A	N/A
Portobello Institute	Environmental Management	Cert. issued by ILM. Dip issued by college	6 months/3hrs per week
CMSE	Certified Energy Manager	Awarded by Association of Energy Engineers	N/A
CMSE	Renewable Energy Training	N/A	N/A
CMSE	Introduction to Energy Management	The Certified Energy Manager (CEM®) credential has become widely accepted and used as a measure of professional accomplishment within the energy management field	2 days
CMSE	ISO 14064 courses	Canadian Standards Association	N/A
Eirdata	Certified Energy Manager	Awarded by Association of Energy Engineers	6 days
Eirdata	Understanding Electrical Energy from an efficiency perspective	N/A	N/A
Eirdata	Efficient Operation of Waste Water Treatment Plant Training (with CSME)	N/A	N/A
Eirdata	Introduction to Energy Management	Jointly offered by Eirdata and CMSE	2 days
Chevron Training & Development Ltd	Internal Environmental Auditor Training	N/A	2 days
Sustainable Energy Ireland (SEI)	IS393 Energy Management System Training Courses	Certificate of attendance	N/A

*N/A: information not available

[80] Not an exhaustive list.

Appendix 9: National Framework of Qualifications



Awards in the Framework

There are four types of awards in the National Framework of Qualifications:

Major Awards: are the principal class of awards made at a level

Minor Awards: are for partial completion of the outcomes of a major award

Supplemental Awards: are for learning that is additional to a major award

Special Purpose Awards: are for relatively narrow or purpose-specific achievement

Appendix 10: EGFSN Membership

Una Halligan (***Chairperson)***	Director, Government and Public Affairs for Ireland, Hewlett Packard
Inez Bailey	Director, National Adult Literacy Agency
George Bennett	IDA Ireland
Marie Bourke	Head of Secretariat and Department Manager, Human Capital and Labour Market Policy, Forfás
Liz Carroll	Training and Development Manager, ISME
Terry Corcoran	Director of Planning and Research, FÁS
Ned Costello	Chief Executive, Irish Universities Association
Margaret Cox	Managing Director, I.C.E. Group
Tony Donohoe	Head of Education, Social and Innovation Policy, IBEC
Brendan Ellison	Principal Officer, Department of Finance
Anne Forde	Principal Officer, Department of Education and Science
Pat Hayden	Principal Officer, Department of Enterprise, Trade and Employment
Garry Keegan	Director, Acumen
Enda McDonnell	Sectoral and Enterprise Development Policy, Enterprise Ireland
John Martin	Director for Employment, Labour & Social Affairs, OECD
Dermot Mulligan	Assistant Secretary, Department of Enterprise, Trade and Employment
Frank Mulvihill	Former President of the Institute of Guidance Counsellors
Dr Brendan Murphy	President, Cork Institute of Technology
Alan Nuzum	CEO, Skillnets
Muiris O'Connor	Higher Education Authority
Peter Rigney	Industrial Officer, ICTU
Martin Shanahan	Chief Executive, Forfás
Jacinta Stewart	Chief Executive, City of Dublin VEC

Appendix 11: Publications by the Expert Group on Future Skills Needs 2005-2010

Report	Date of Publication
Future Skills Requirements of the Biopharma-Pharmachem Sector	November 2010
Monitoring Ireland's Skills Supply - Trends in Education and Training Outputs 2010	July 2010
National Skills Bulletin 2010	July 2010
Future Skills Needs of the Wholesale and Retail Sector	May 2010
The Expert Group on Future Skills Needs Statement of Activity 2009	April 2010
Future Skills Requirements of the Food and Beverage Sector	November 2009
Skills in Creativity, Design and Innovation	November 2009
Monitoring Ireland's Skills Supply: Trends in Education/Training Outputs 2009	November 2009
National Skills Bulletin 2009	July 2009
A Quantitative Tool for Workforce Planning in Healthcare: Example Simulations	June 2009
The Expert Group on Future Skills Needs Statement of Activity 2008	June 2009
A Review of the Employment and Skills Needs of the Construction Industry in Ireland	December 2008
Statement on Raising National Mathematical Achievement	December 2008
National Skills Bulletin 2008	November 2008
All-Island Skills Study	October 2008
Monitoring Ireland's Skills Supply: Trends in Education/Training Outputs 2008	July 2008
The Expert Group on Future Skills Needs Statement of Activity 2007	June 2008
Future Requirement for High-Level ICT Skills in the ICT Sector	June 2008
Future Skills Needs of the Irish Medical Devices Sector	February 2008
Survey of Selected Multi-National Employers' Perceptions of Certain Graduates from Irish Higher Education	December 2007
The Future Skills and Research Needs of the International Financial Services Industry	December 2007
National Skills Bulletin 2007	November 2007
Monitoring Ireland's Skills Supply: Trends in Educational/Training Outputs	June 2007
Tomorrow's Skills: Towards a National Skills Strategy	March 2007
National Skills Bulletin 2006	December 2006

Future Skills Requirements of the International Digital Media Industry: Implications for Ireland	July 2006
Careers and Labour Market Information in Ireland	July 2006
Skills at Regional Level in Ireland	May 2006
SME Management Development in Ireland	May 2006
Monitoring Ireland's Skills Supply: Trends in Educational/Training Outputs	January 2006
Data Analysis of In-Employment Education and Training in Ireland	December 2005
National Skills Bulletin 2005	October 2005
Skills Needs in the Irish Economy: The Role of Migration	October 2005
Languages and Enterprise	May 2005
Skills Requirements of the Digital Content Industry in Ireland Phase I	February 2005

Notes

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