

# Ireland's Sustainable Energy Supply Chain Opportunity





**Report prepared by:**

Jim Scheer, Sarah Stanley and Matthew Clancy  
(Energy Modelling Group, SEAI)

Market research by Ricardo-AEA  
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# CEO foreword



A coordinated approach to supporting sustainable energy supply chains will promote economic growth and create thousands of jobs in Ireland.

The sustainable energy economy has grown strongly in Ireland in recent years. As examples, over 250,000 homes have undergone energy efficiency upgrades since 2009, and deployment of wind energy now has Ireland placed fourth in the world for the proportion of wind electricity generation on the system. It is estimated that between €1.4bn and €1.6bn is being invested in sustainable energy technologies and services in Ireland annually. This activity and investment is supporting thousands of jobs.

Further growth is expected as we approach 2020. The Government's commitment to 2020 energy efficiency, renewable energy and greenhouse gas reduction targets, and longer-term goals for deep decarbonisation of Europe by 2050 will continue to expand Irish markets for sustainable energy technologies and services. The EU market, estimated at between €155bn and €190bn per annum, provides further incentive to develop sustainable energy supply chains here to enable Irish companies to export skills and expertise honed on the Irish market to customers across the EU and further afield.

As the sustainable energy transition continues to gather momentum, Ireland must position itself to capture the economic benefits available. Opportunities abound for companies to provide products and services from preliminary project stages such as feasibility studies, planning and permitting, to design, manufacture, installation, and finally quality assurance and operations and maintenance. Diverse skillsets are required, as well as technology-specific knowledge – characteristics that Ireland's flexible and well educated workforce are ready to provide.

As we develop as a green energy location, Ireland will add sustainable energy expertise and access to secure, clean energy to the list of attributes that have been so successful in attracting foreign companies to base in Ireland.

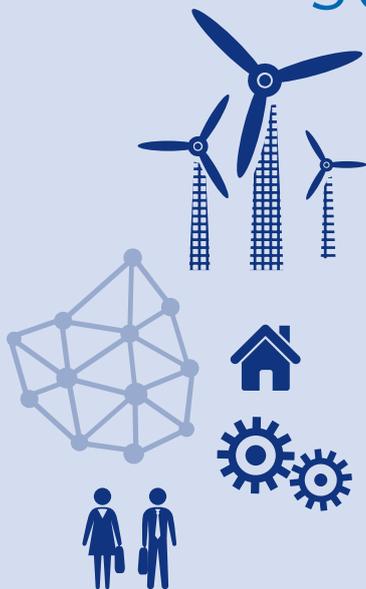
A small selection of the many businesses that are already capitalising on the expanding sustainable energy markets here and across the world is provided in this report. Reading their stories in the context of the vast opportunities available suggests to me that, with the coordinated action of SEAI and the enterprise agencies, we will keep expanding the list of Irish success stories in sustainable energy, as well as laying the foundation to attract further inward investment in the sector.

The detailed look at supply chains provided by this report will enable us to focus on priority areas to ensure that Ireland is best positioned to capture the opportunities in industries where we are already strong, and to build capacity in strategic areas of focus for future growth.

This report is an output of a collaborative process. I would like to give my particular thanks to Enterprise Ireland, IDA Ireland and Forfás for their valuable inputs and insights. We look forward to continuing to work with them and other key stakeholders to ensure that together we make the most of this unmissable opportunity.

Dr Brian Motherway  
**Chief Executive**  
Sustainable Energy Authority of Ireland

# Executive summary



This report is the first to examine in detail how well the Irish supply chain is positioned to capture new business as a result of the anticipated investment in the sustainable energy related products and services needed to meet Ireland's renewable energy and energy efficiency targets for 2020.

To highlight the potential for supply chain growth in Ireland, this report identifies:

- *The potential size of the Irish market for selected sustainable energy products and services across eight areas of investment<sup>1</sup>*
- *The likely size of the EU market to 2020 and beyond*
- *Areas of the supply chain where Irish manufacturing, construction and services businesses could capture a significant share of this expanding market, immediately or in the future*
- *The barriers and constraints to growth that Irish companies face*
- *Areas where efforts are already being made to develop the Irish supply chain*
- *The potential for further foreign direct investment (FDI) in Ireland in the sustainable energy sector*

This report was developed by the Sustainable Energy Authority of Ireland (SEAI) in consultation with Enterprise Ireland, IDA Ireland and Forfás. The market research was carried out by environmental economics consultants at Ricardo-AEA.

The purpose of the report is to initiate discussions and debate so as to focus stakeholder efforts on maximising the sustainable energy supply chain opportunity to 2020 and beyond.

## The Irish sustainable energy market

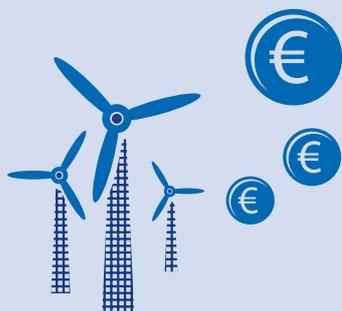
At the national level, the total estimated expenditure to 2020 across the range of technologies considered in the study could amount to between €2.2 billion and €2.9 billion per year. Around 45% of the total investment is anticipated to be in energy efficiency technologies and associated services, 40% in renewables and the remainder in electricity transmission<sup>2</sup>. This average annual level of investment represents an increase on current levels of expenditure estimated at between €1.4 billion and €1.6 billion.<sup>3</sup>

Government is continuing to expand the policy package aimed at increasing the rate of deployment of sustainable energy technologies and services. Recent announcements include the opening of a €70 million National Energy Efficiency Fund, which is expected to leverage €300 million of investment. This is further supported by an Energy Efficiency Obligation Scheme (EEOS) that requires energy suppliers to achieve energy savings targets with final consumers between 2014 and 2020.

<sup>1</sup> Offshore wind and wave energy investments are considered in a post 2020 (longer term) perspective.

<sup>2</sup> When the total proposed investment in the grid is included, i.e. that required for a safe, secure and affordable electricity supply as well as facilitating renewable energy deployment.

<sup>3</sup> Average of the last three years



There is additional potential in the business and public sectors, which are currently being supported by SEAI's programmes for business, including the Large Industry Energy Network (LIEN), SME supports and the Public Sector Programme. The upcoming Bioenergy Strategy will detail the Government's plan to increase deployment in this high-potential area, while the Renewable Energy Feed-In Tariff (REFIT) will continue to drive the necessary deployment of wind energy.

These policies and measures will drive increased investment. When combined with targeted enterprise support, they will enable Irish companies to both capture the benefits of investment in Ireland and gear them for capturing the potential in overseas markets.

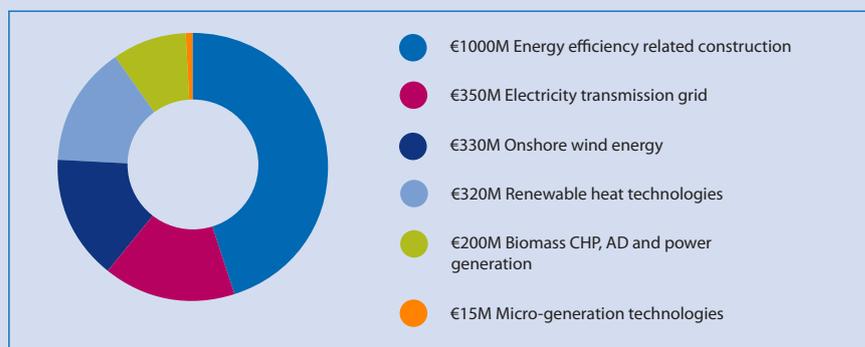
Many companies are already actively developing technologies and associated services in these areas, and have Ireland well positioned to capture a significant proportion of the investment. When the total estimated expenditure is split by economic sector (see graph), it is evident that Irish organisations in most sectors are well positioned to capture much of the anticipated investment.

### Position of Irish organisations to capture investment

Over 70% of the total anticipated expenditure is estimated to be within areas of the supply chain where Irish organisations are very well positioned or well positioned to capture investment in goods and services markets. The existing Irish supply chains in these areas do not foresee any significant barriers to expanding their business as the market grows. However, some support may be needed to help them maintain competitive advantage; for example, continued RD&D supports, financial supports, investment in training, and support for export market development such as that provided by Enterprise Ireland.

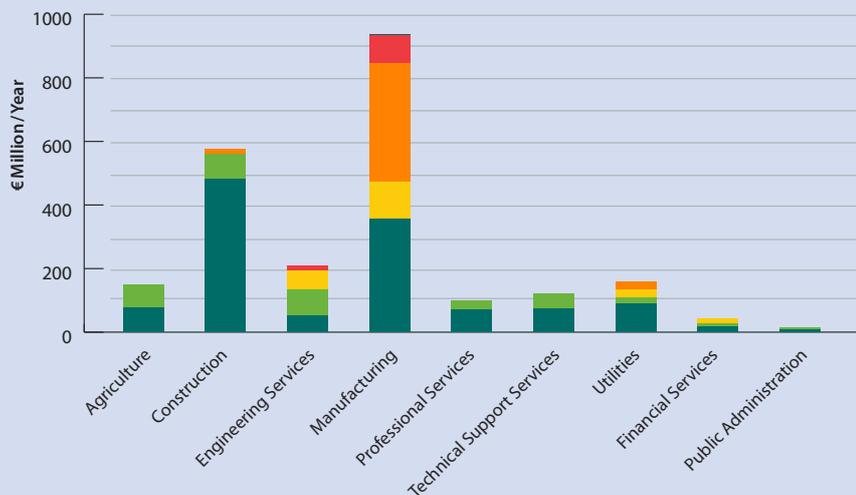
Around a quarter of estimated expenditure is in areas where Irish organisations are *averagely positioned or less well positioned*, primarily in the manufacturing sector. To capture an increased share of investment in these areas, action is needed to forge new business development partnerships that could lead to investment and innovation in new products or services. Wide-ranging support is needed particularly for innovation, new product development, training and knowledge-sharing partnerships, and technology licensing.

Potential Irish market size (average €/year to 2020)



Capturing investment – position of Irish organisations by economic sector

- No local supply chain at present - longer term action needed
- Less well positioned - concerted action required to reinforce supply chain
- Averagely positioned - action is needed to develop capacity and exploit local factors
- Well positioned - some barriers affecting capacity to scale need to be addressed
- Very well positioned - no significant barriers to address



The annual investment needed to develop a competitive low carbon EU economy with a sustainable, affordable and secure energy supply is between €155 billion to €190 billion per year

### The EU market potential

Beyond the estimated investment in Ireland, significant markets are developing with our closest trading partners across Europe, in the US and further afield. According to the European Commission, the annual investment needed to develop a competitive low-carbon EU economy with a sustainable, affordable and secure energy supply is between €155 billion and €190 billion per year. The International Energy Agency (IEA) estimates that a similar level of investment may be expected in North America.

The growth of the sustainable energy sector internationally offers a substantial export opportunity for Irish suppliers of sustainable energy products and services. A number of suppliers are already reaping the rewards of expanding into Europe – many with the help of Enterprise Ireland (some examples are highlighted in this report).

### Ireland – an ideal place for sustainable energy business

International companies have long recognised the benefits of doing business in Ireland. In addition to the well-established factors promoted by IDA Ireland, summarised as ‘the four Ts’ (talent, track record, taxation, technology) and ‘the four Es’ (education, European market, English-speaking, ease of doing business), Ireland can add a fifth E: energy.

Ireland is among the best locations in Europe for wind power as it is situated on the western edge of Europe and is exposed to high winds from both the Atlantic Ocean and Irish Sea. Wind-power capacity factors tend to be higher in Ireland relative to other countries; in other words, the wind blows stronger and for longer in Ireland. Wave and tidal energy also offer significant longer-term potential.

In addition to the country’s natural resources, policy commitments, leading pools of talent, and centres of excellence in core disciplines – such as engineering, IT, sales & marketing, design, and research, development & demonstration (RD&D) – have contributed to the country’s success in attracting FDI. Many of the aspects of Ireland that have attracted FDI in the past also apply to the energy sector.



Realising more of the sustainable energy supply chain opportunities in Ireland will require coordinated action

## Maximising the supply chain opportunities

Realising more of the sustainable energy supply chain opportunities in Ireland will require coordinated action. Current supply chain actors, interviewed as part of this study, highlighted the following six areas as priority focus areas:

- *Need for adequate skills*
- *Protection of intellectual property (IP)*
- *Requisite sales volume to sustain supply chain*
- *Efficient procurement practices*
- *Critical mass for supply chain establishment*
- *Condition of key infrastructure*

Many actions are already being taken across government in support of sustainable energy supply chain development, including many in the identified priority focus areas.

This report summarises a selection of these. For example:

- *SEAI is supporting research prioritisation, development and deployment of energy efficiency and renewable energy technologies and services through a range of financial, networking, training and promotional supports*
- *Enterprise Ireland offers a range of business development services to Irish companies looking to expand internationally*
- *IDA Ireland focuses on promoting and developing high-quality FDI in Ireland, and sustainable energy has an increasing place on its agenda*
- *As Ireland's policy advisory board for enterprise, trade, science, technology and innovation, Forfás provides analysis of employment and skills data related to the sustainable energy sector (among others) and plays a key role in delivering the Action Plan for Jobs (2014) which highlights the contribution the sustainable energy sector can play in delivering employment in Ireland*

## What next?

Substantial investment in renewable energy and energy efficiency is already happening in Ireland and internationally. This report is the start of a process that will seek to capture some of this opportunity in Ireland. The commentary and analysis presented represent the start of a new, focused conversation aimed at maximising the potential for growth of sustainable energy product and service supply chains in Ireland. The case studies included throughout the report highlight businesses already active in the sector and illustrate what is possible with coordinated action between business and government.

Feedback on the report is most welcome<sup>4</sup>. Comments received will inform the ongoing discussions and debate facilitated by key stakeholders – initially SEAI, Enterprise Ireland, IDA and Forfás. In cooperation with enterprise, SEAI will continue to support Irish supply chains to deliver a sustainable energy future for Ireland and a healthy economy based on growth in long-term, sustainable markets.

<sup>4</sup> Comments and suggestions should be sent to [emg@seai.ie](mailto:emg@seai.ie).

# The sustainable energy supply chain opportunity

The way energy is generated, distributed and used by society must change. The imperative to reduce greenhouse-gas (GHG) emissions is clear, and governments are coming to terms with the sustained effort required. Achieving the emissions reduction goal set by the European Union for 2050 (80% reduction compared to 1990 levels) will require major investment to deploy sustainable energy technologies and services across all sectors of the economy.



In addition to the well-recognised strengths and competitive advantages that make doing business in Ireland attractive, we also have significant natural energy resources of wind and ocean energy.

The current plans for adopting sustainable methods of generating energy and deploying energy-efficient technology and services are not only essential for Ireland to play its part in reducing GHG emissions, they also provide an opportunity for suppliers to develop new products and services that can then be exported worldwide – generating future growth and job-creation opportunities.

Estimates of the annual investment needed to develop a competitive low-carbon EU economy with a sustainable, affordable and secure energy supply range between €155 billion and €190 billion per year. This large expenditure offers Irish suppliers of sustainable energy products and services a substantial business opportunity – to export products into a growing international market.

Ireland's attractiveness as a place for foreign companies to do business is well established, in particular through the work of IDA Ireland. The large-scale European sustainable energy technology and services markets highlighted in this report are very accessible from Ireland and offer another opportunity for growth of the sector in Ireland. In addition to the well-recognised strengths and competitive advantages that make doing business in Ireland attractive, we also have significant natural energy resources of wind and ocean energy.

The scale of the Irish sustainable energy sector (illustrated in the next section of this report) highlights the potential for Irish-based companies to establish themselves in growing markets for a range of energy efficiency and renewable energy technologies and services. A strong local market is seen as crucial for showcasing Irish products and services and to enable companies to establish revenue streams. In this way, the local market becomes a springboard for export to wider markets.



The estimated total average annual investment required in sustainable energy technologies and services up to 2020 in Ireland is between €2.2 billion and €2.9 billion

### Purpose of this report

The report is the first to examine in detail how well the Irish supply chain is positioned to capture new business arising from the anticipated investment in the sustainable energy-related products and services needed to meet Ireland's renewable energy and energy efficiency targets for 2020. It is intended to initiate discussion and debate so as to focus stakeholder efforts on maximising the sustainable energy supply chain opportunity to 2020 and beyond.

The sections of the report that follow indicate the potential size of the Irish market for selected sustainable energy products and services up to 2020 across eight types of investment. Estimates of the EU market size to 2020 and beyond are provided to highlight the potential if Irish-based companies access the large markets on Ireland's doorstep. The attractiveness of Ireland as a place to do business is further highlighted. Barriers to supply chain growth are identified and actions to remove these barriers are outlined. Finally, a series of supply chain maps are presented for eight technology areas to provide a disaggregated view of where expenditure might occur along the various supply chains, from preliminary project stages (feasibility and planning) to design, procurement, material supply, installation, quality assurance and operations & maintenance phases.

### Total Irish market potential

Table 1 outlines the size of the Irish market for a range of sustainable energy supply chains. It shows the estimated average annual total expenditure for the entire Irish market (i.e. not simply government contributions) over the period to 2020. The estimated total average annual investment required in sustainable energy technologies and services up to 2020 in Ireland is between €2.2 billion and €2.9 billion.

**Table 1: Size of Irish market for sustainable energy supply chains**

| Industry / Technology <sup>5</sup>     | Capital expenditure (€m/year) | Operations & maintenance (€m/year) | Average market size (€m/year) |
|--|-------------------------------|------------------------------------|-------------------------------|
| Energy efficiency-related construction | 1,000– 1,200                  | -                                  | 1,000 – 1,200                 |
| Onshore wind energy                    | 280 – 480                     | 55 – 70                            | 335 – 550                     |
| Renewable heat technologies            | 150 – 200                     | 160 – 190                          | 310 – 390                     |
| Biomass CHP, AD and heat generation    | 60 – 75                       | 140 – 165                          | 200 – 240                     |
| Electricity transmission grid          | 290 – 350                     | 45 – 70                            | 335 – 420                     |
| Small-scale generation technologies    | 20 – 60                       | 1 – 5                              | 20 – 65                       |
| <b>Total</b>                           | <b>1,800 – 2,365</b>          | <b>400 – 500</b>                   | <b>2,200 – 2,865</b>          |

Around 80% of the expenditure is anticipated to be capital expenditure, with the remainder associated with operations & maintenance. Between €1 billion and €1.2 billion of total annual expenditure is expected to be in the energy efficiency and construction sector, €865 million to €1.2 billion in renewable energy technologies and €335 million to €420 million in development of the electricity grid infrastructure.<sup>6</sup>

<sup>5</sup> The project team also examined the off-shore wind and wave energy supply chains. It is assumed that significant deployment will not occur until after 2020 for these technology areas. Detail is provided in the technologies section on a per MW deployed basis.

<sup>6</sup> When the total proposed investment in the grid is included, i.e. that required for a safe, secure and affordable electricity supply as well as facilitating renewable energy deployment.

These average annual estimates represent an increase of current levels of annual expenditure – estimated at between €1.4 billion and €1.6 billion. Current government supports across these technology groups are detailed in the National Renewable Energy and the National Energy Efficiency Action Plans.<sup>7</sup> Government is continuing to expand the policy package aimed at increasing the rate of deployment of sustainable energy technologies and services. Recent announcements include the opening of a €70 million National Energy Efficiency Fund, which is expected to leverage €300 million of investments. This is further supported by an Energy Efficiency

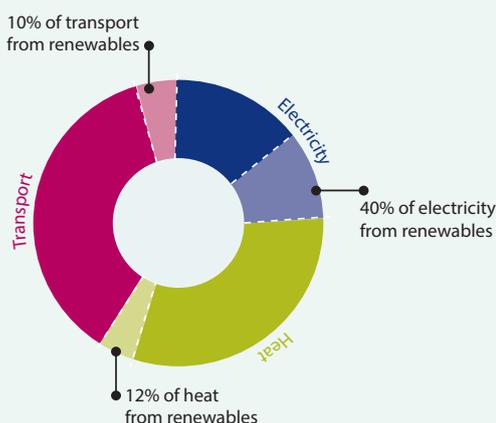
Obligation Scheme (EEOS) that requires energy suppliers to achieve energy savings targets with final consumers between 2014 and 2020. There is additional potential in the business and public sectors, which are currently being supported by SEAI's programmes for business, including the Large Industry Energy Network (LIEN), SME supports and the Public Sector Programme. The upcoming Bioenergy Strategy will detail the Government's plan to increase deployment in this high-potential area, while the Renewable Energy Feed-In Tariff (REFIT) will continue to drive the necessary deployment of wind energy.

*EU and national sustainable energy targets – Driving expenditure*

The first step in the sustainable energy transformation is well underway. EU member states are implementing National Renewable Energy Action Plans (NREAPs) and National Energy Efficiency Action Plans (NEEAPs) that will reduce EU GHG emissions by 20% by 2020. A 40% reduction in EU GHG emissions by 2030 is now under discussion and a target is expected to be agreed in 2015.

At the national level, Ireland is subject to a binding target of 16% renewable energy share of (gross) final energy consumption in 2020. Total energy demand can be divided into electricity, heat and transport; 2013 demand is illustrated in the pie-chart below. Achieving 40% renewable electricity, 12% renewable heat and 10% renewable transport equates to renewable energy having a 16% share of total demand.

**Total Energy Demand and Renewable Energy Shares**



The Irish Government's commitments on renewable energy and energy efficiency are detailed in the NREAP and NEEAP, respectively. These plans form the basis of the Irish renewable energy and energy efficiency technology and service market estimates in this report.

These policies and measures will drive increased investment. When combined with targeted enterprise support, they will enable Irish companies to both capture the benefits of investment in Ireland and gear them for capturing the potential in overseas markets.

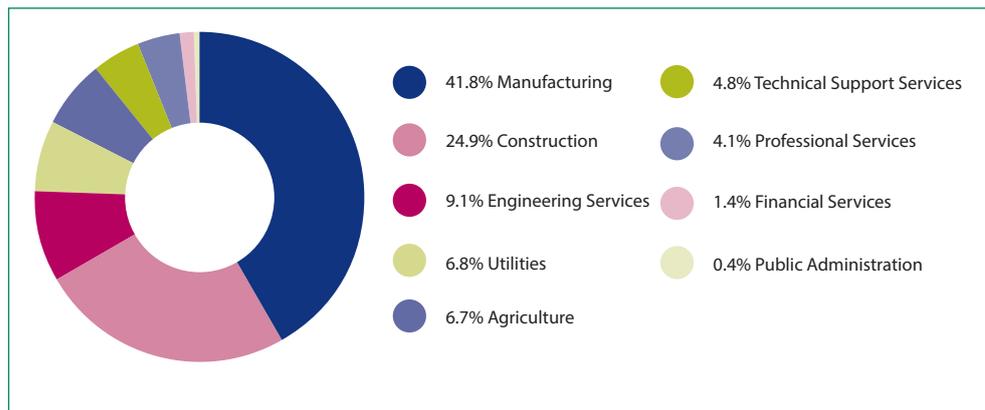
<sup>7</sup> Available at <http://www.dcenr.gov.ie/>

A strong local market is crucial for showcasing Irish products and services and establishing revenue streams. Once established, this can provide a springboard to export

### Breakdown of expenditure

Published data on project cost breakdown from Ireland and other EU countries for each technology has been used to map the likely investment flows in each of the sustainable energy supply chains. For example, in the case of wind turbines, total costs can be divided into component parts (foundations, towers, blades, gearboxes, etc) and considered together with the associated services (engineering design, planning, etc.) and operations & maintenance costs, to give a full supply chain perspective. This detailed analysis was used to estimate the likely breakdown of expenditure by product/service category, as shown below in Figure 1.

**Figure 1: Expenditure by product / service category**



Of total expenditure associated with achievement of Ireland's targets, substantial expenditure can be expected in manufacturing, construction and related services (engineering and other professional services). This will provide opportunities to develop and test new products that can then be exported to the rest of the EU and into the wider global market. It will also help sustainable energy supply chain companies to grow their businesses and to support job creation.

### *Construction industry growth expectations*

"We are expecting to see a strong increase in construction activity during the course of the coming year.

"Given the number of factors in play that will generate activity during the coming year, we predict that the sector will grow by approximately €1 billion on a national level. This will bring the overall value of the sector to an estimated €11 billion."

"We've seen already how a small increase in construction activity can create a lot of employment so we believe that an additional 10,000 jobs will be generated in the sector over 2014."

Tom Parlon, Director General, Construction Industry Federation

A strong local market is crucial for showcasing Irish products and services and establishing revenue streams. Once established, this can provide a springboard to export.

### Irish market share and position to capture further investment

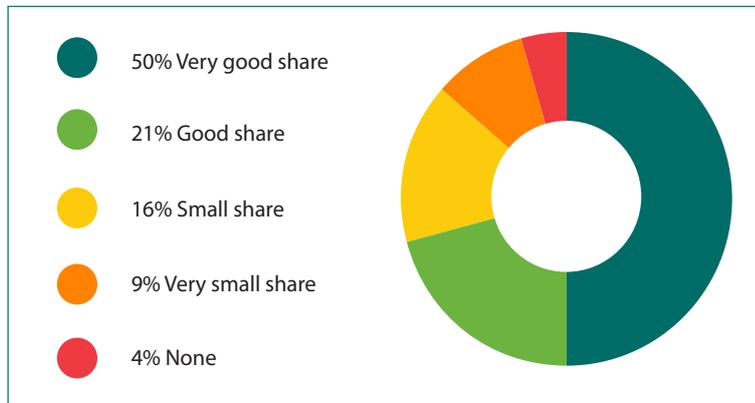


The extent to which Ireland plays an active role in the national supply chains for each technology has been assessed, together with how well Irish organisations in the relevant supply chains are positioned to capture indigenous and international investment.

For the supply chains investigated, over 70% of estimated expenditure is estimated to be in areas of the supply chain where Irish organisations have a good (21%) or very good (50%) share of the goods and services market (Figure 2). This was particularly the case for the energy efficiency construction sector, renewable heat, biomass and the electricity transmission grid.

Around a quarter of estimated expenditure was in areas where Irish organisations had a small (16%) or very small (9%) share. Examples of these areas include wind turbines, generators, power cables, transformers, switch gear and domestic heating boilers.

Figure 2: Percentage of supply chains currently supplied by Irish firms



The assessment to determine how well positioned Irish organisations are to capture anticipated investment across each sustainable energy category highlighted:

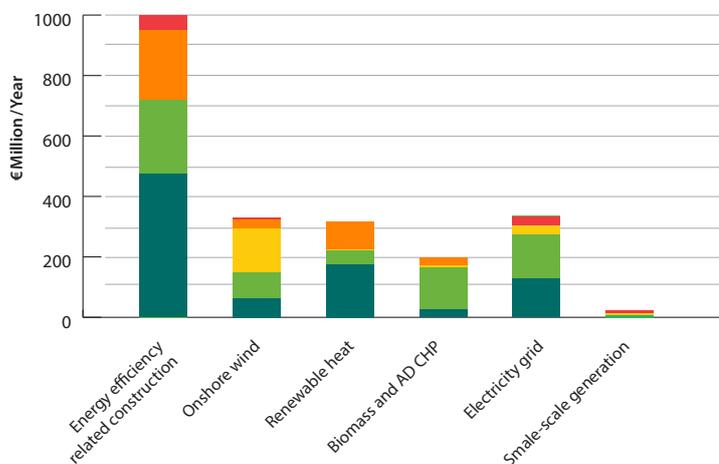
- *Equipment and services that Irish businesses are well positioned to supply now*
- *Areas where Irish organisations are well positioned to capture the anticipated future expenditure in the sustainable energy market*

Figure 3 (overleaf) shows a breakdown of how well positioned Irish organisations are to capture the estimated investment per supply chain industry.

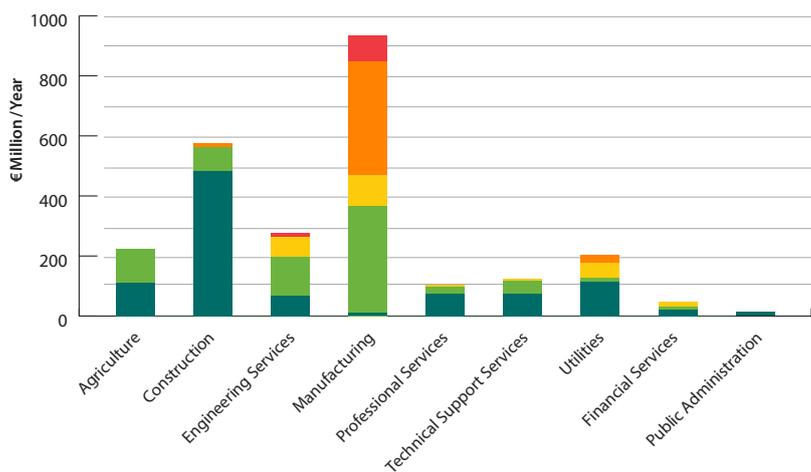
- **'Very well positioned'** indicates that there are no significant barriers to address
- **'Well positioned'** indicates that some barriers affecting capacity to scale need to be addressed
- **'Average'** indicates that action is needed to develop capacity and exploit local factors
- **'Less well positioned'** indicates that concerted action is required to reinforce supply chain
- **'No local supply chain at present'** indicates that longer-term action is needed to establish Irish presence

For the very well and well-positioned categories, it is anticipated that the existing Irish supply chain could capture most of the investment. No significant barriers to expanding their business as the market grows are foreseen. However, some support may be needed to help these organisations to maintain competitive advantage (e.g. RD&D, financial supports, investment in training, support for export market development) and gain market share.

**Figure 3: Position of Irish organisations to capture investment – by sustainable energy technology**



**Figure 4: Position of Irish organisations to capture investment – by economic sector**



- No local supply chain
- Less well positioned
- Averagely positioned
- Well positioned
- Very well positioned

Average and less well-positioned industries tend to be small and focused on less developed markets. Action is needed to develop new products and service offerings that can compete on the international stage. Broader-scale support is required to capture the value in these areas, including, for example, investment to bring new ideas from the research base to market training and knowledge-sharing partnerships, and technology licensing.

The same data split by economic sector (Figure 4) shows that Irish organisations in most sectors are well positioned to capture the vast majority of the anticipated expenditure in their areas. The main exception is the manufacturing sector where 51% of the products needed between 2013 and 2020 are in areas where Irish organisations are less well positioned to capture investment (40%), or where there are currently no local supply chains that could capture investment (21%).

Most of the expenditure that Ireland's economy is currently less well positioned to capture relates to the importation of manufactured products, particularly for energy efficiency retrofits, electricity generation and electricity transmission.



## The EU market opportunity

The scale of European markets is important to both Irish companies looking to export their products and services and foreign companies considering establishing themselves in Ireland to access local, EU and US markets.

Table 2 indicates the scale of the anticipated annual investment in the EU's sustainable energy market for 2020, 2030 and 2050. These figures are drawn from the latest estimates published by the European Commission, International Energy Agency, European trade bodies and research reports.<sup>8</sup>

**Table 2: Anticipated annual investment in EU sustainable energy market: 2020, 2030 and 2050**

| Industry / Technology                  | 2020<br>(€billion) | 2030<br>(€billion) | 2050<br>(€billion) |
|--|--------------------|--------------------|--------------------|
| Onshore wind energy                    | 16.4               | 8.4                | 9.3                |
| Offshore wind energy                   | 10.6               | 18.8               | 20.7               |
| Wave energy                            | 0.8                | 13.3               | 10.8               |
| Biomass CHP, AD and power generation   | 5.5                | 0.6                | 0.8                |
| Electricity transmission grid          | 33.7               | 41.6               | 48.0               |
| Energy efficiency-related construction | 59.5               | 59.5               | 31.2               |
| Micro-generation technologies          | 9.1                | *                  | *                  |
| Renewable heat technologies            | 19.1               | 46.9               | 43.3               |
| <b>Total</b>                           | <b>154.7</b>       | <b>189.0</b>       | <b>132.7</b>       |

\* No estimates of annual market size were identified for this technology in the relevant year

The estimated total average annual investment in sustainable energy technologies and services up to 2020 in the EU-27 member states is expected to be around €155 billion per year

The estimated total average annual investment in sustainable energy technologies and services up to 2020 in the EU-27 member states is expected to be around €155 billion per year.<sup>9</sup>

To 2020, around €60 billion per year of this investment is expected to be in energy efficiency-related construction and €62 billion per year in renewable energy technologies. The remaining €34 billion per year is associated with development of the electricity grid infrastructure.

These figures illustrate that the scope for Irish sustainable energy supply chain companies to export new products and services is very large; the EU market is likely to be 60 to 70 times the size of the Irish market. In addition, there is scope to sell new products in the North American

market for sustainable goods and services, which is likely to be of a similar size to the EU.<sup>10</sup>

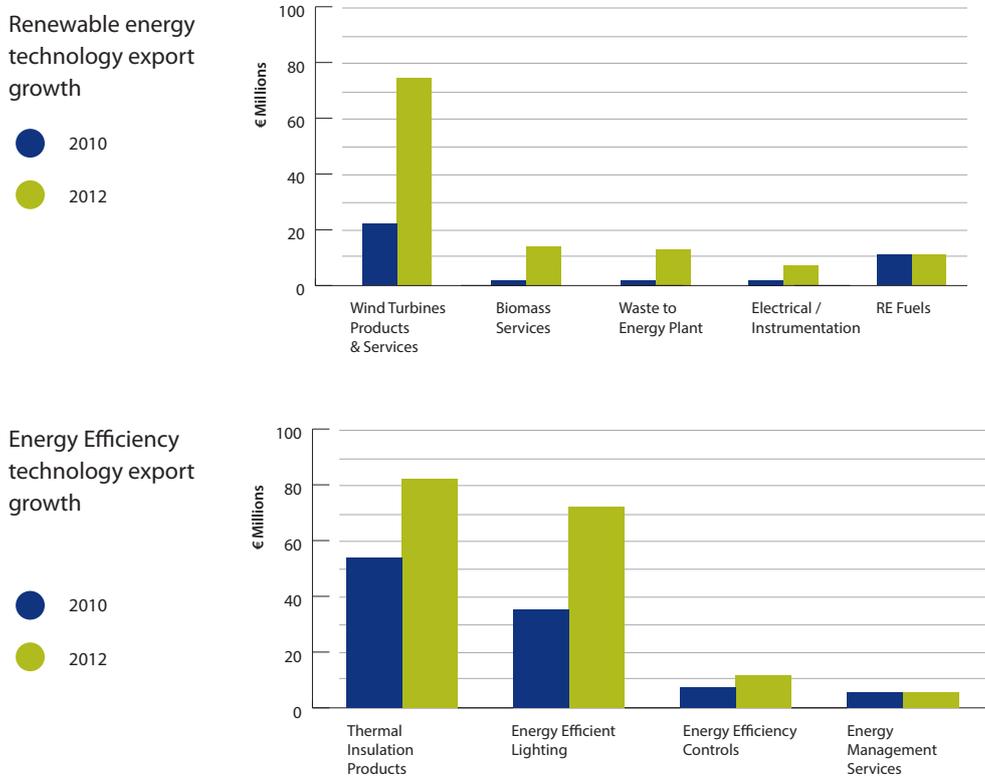
Irish companies supported by Enterprise Ireland are already capturing an increasing share of the export potential. Exports of renewable energy technologies more than trebled between 2010 and 2012 to over €100 million. Most of the growth was associated with wind-turbine products and services, while biomass services also grew. Exports of energy efficiency-related products increased from around €100 million in 2010 to over €170 million in 2012 (66% increase). This growth was focused on thermal insulation products and energy-efficient lighting.

<sup>8</sup> Details of the sources of market-size estimates for each industry or technology are provided in the technical report available at [www.seai.ie](http://www.seai.ie). Estimates represent the mid-point of available estimates on the investment needed to reduce GHG emissions by 80% by 2050.

<sup>9</sup> European Commission and DC Clima, 'EU Roadmap for moving to a competitive low carbon economy in 2050'.

<sup>10</sup> Based on market size estimates in 'Technology Roadmap: Wind Energy', International Energy Agency (IEA) (2013).

Figure 5: Irish exports of renewable energy and energy efficiency technologies: 2010 and 2012



### *Beyond Europe: The growing global sustainable energy markets*

The global market for environmental goods and services (EGS) was previously estimated by Forfás at approximately €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 expenditure 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 Information and Communications Technology (ICT) and Life Sciences.

#### The global market in numbers:

- 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 AUD\$5.7 billion and Canada CAD\$2.8 billion
- South Korea has focused its significant stimulus package on development and use of green technologies
- In the Middle East there are substantial export opportunities for water, wastewater and environmental consultancy services and supply of equipment



In addition to Ireland's strengths as a place to do business, it has the distinct advantage of natural resource potential in the form of both onshore and offshore wind, and ocean energy (tidal and wave)

## FDI in sustainable energy: Business case Ireland

Access to the EU market from Ireland represents a strong opportunity for global companies. Ireland has a number of strengths and competitive advantages that make doing business here attractive:

**Talent:** Our predominantly young workforce is capable, adaptable and mobile. The median population age is 35, the lowest in the EU.

**Track record:** Over 1,000 multinational companies have already chosen Ireland as their strategic European base.

**Taxation:** Ireland provides tax credits for research, development and innovation (RD&I) activities and has an extensive double-tax treaty network with 45 countries. Ireland's corporation tax rate is 12.5%.

**Technology:** State investment in R&D helps to keep Ireland at the forefront of technological innovation.

**Education:** Ireland leads in the technology skills 'race' in so far as it has a higher percentage of third-level graduates than the UK, the US the OECD average. An EU Benchmarking Competitiveness Report ranks Dublin as the best city in the world for human capital.

**European market:** Companies located in Ireland benefit from barrier-free access to over 500 million consumers in Europe, one of the largest markets in the world (c. 22% of global GDP).

**English-speaking:** English is the universal spoken language, while Ireland is highly developed and multicultural, and a leading member of the Eurozone.

**Ease of doing business:** Ireland has been ranked No. 1 place to do business in Europe (Forbes, 2011).

The more than 1,000 international companies with operations in Ireland are involved in a wide range of activities and sectors, including technology, pharmaceuticals, biosciences, financial services and manufacturing. The attraction of Ireland as an investment location can be attributed to successive Irish governments' promotion of inward investment, its membership of the EU, a favourable corporate tax regime and a skilled, flexible labour pool.

Benefits to Ireland extend beyond the initial macroeconomic stimulus from the actual investment. For example, FDI influences growth by increasing the rates at which new technologies are adopted nationally and, more generally, the efficiency of resource use in the economy. This works through three channels: the linkages between FDI and foreign trade flows, the spillovers and other externalities vis-a-vis the host country business sector, and the direct impact on structural factors in the economy.

In addition to Ireland's strengths as a place to do business, it has the distinct advantage of natural resource potential in the form of both onshore and offshore wind, and ocean energy (tidal and wave).

## Energy – the fifth E

In addition to 'the 4 Ts' (talent, track record, taxation, technology) and 'the 4 Es' (education, European market, English-speaking, ease of doing business), Ireland has a fifth E: Energy.

Ireland is the best location in Europe for wind power as it is situated on the western edge of Europe and is exposed to high winds from both the Atlantic Ocean and Irish Sea. Wind-power capacity factors tend to be higher in Ireland relative to other countries – with a 10-year average capacity factor (percentage of total potential, or rated, output) of 31.7%<sup>11</sup>.

<sup>11</sup> EirGrid (2013), 'Generation Capacity Statement 2013–2022': [http://www.eirgrid.com/media/All-Island\\_GCS\\_2013-2022.pdf](http://www.eirgrid.com/media/All-Island_GCS_2013-2022.pdf)

Wave and tidal energy offer significant potential in the long term, in the order of 29 GW to 2050.<sup>12</sup> Ireland has a strong combination of attributes that are of particular benefit to the renewable energy sector. In addition to the country's natural resources, policy commitments and leading pools of talent, centres of excellence in core disciplines such as engineering, sales

& marketing, design and RD&D have contributed to the country's success in attracting FDI. In their decisions to locate operations, international firms are increasingly emphasising a desire for access to secure, clean energy. Businesses preparing for higher fossil and carbon prices are seeking locations and skills that fit their changing activities.

### Intel – Recognising the Irish advantage

Intel Corporation, founded in 1968 and headquartered in Santa Clara, California, is one of the largest semi-conductor chip makers in the world, with over 100,000 employees worldwide.

Ireland is Intel's centre of manufacturing excellence in Europe. Intel first moved to Ireland in 1989 when it set up a processing unit in Palmerstown, Co. Dublin. In 1989 the company expanded its operations to include a manufacturing plant in Leixlip, Co. Kildare. Since then, Intel has invested €9 billion to turn the Leixlip facility into Intel's most technologically advanced, high-volume manufacturing site outside the United States.

Over 4,500 people are employed in the Leixlip campus. An additional 5,000 construction workers were employed over the last three years to upgrade the site, with Intel investing a total of €3.6 billion. Intel Shannon, Intel's communications centre in Europe, employs a further 200 people, as does Intel Belfast. McAfee, a wholly owned subsidiary of Intel, employs 300 people in Cork; Havok, another subsidiary, employs 40 people in Dublin.

The Leixlip plant produces a high volume of advanced 300mm wafers on multiple-process technologies. A silicon nano-electronics research department collaborates extensively with research institutes such as the CRANN Nanoscience Research Centre in Trinity College Dublin, the Tyndall National Research

Institute in Cork, and other companies across Ireland and Europe. Intel's Innovation Open Lab engages in open research and innovative technology solutions, focused on Energy & Sustainability, and Dependable Cloud & Services research.

Intel Ireland is used as an exemplar of energy efficiency improvements for dissemination across Intel worldwide. Intel was among the founding members of SEAI's Energy Agreements Programme which led Leixlip to be the first Intel site globally to implement ISO 50001 Energy Management Standard. The company has an extensive programme of energy efficiency actions and has voluntarily invested over €20m in recent years from intelligent lighting to waste heat recovery that provides heating for the cleanrooms in Leixlip.

Intel has announced plans to test more than 200 'gateways' around Dublin, to make it the first fully sensed global city: Intel's Irish-developed Quark system will be used to gather and monitor data on the environment, including air quality and noise, via gateways with up to six sensors, which can be teamed with the existing open data provided by Dublin City Council on real-time traffic. "Cities are the nexus for the explosion of Internet of Things technologies," said Intel president Renee James. "We imagine Dublin can be a global reference for how technologies might transform cities."

# Case Study



<sup>12</sup> SEAI Ocean Energy Roadmap 2010–2050: [http://www.seai.ie/Renewables/Ocean\\_Energy\\_Roadmap.pdf](http://www.seai.ie/Renewables/Ocean_Energy_Roadmap.pdf)

Almost 70% of suppliers considered Ireland a good place to grow their business. One in four identified areas of their businesses where jobs could be created in the future

Implementing coordinated policy measures, engaging government and supply chain stakeholders, will reap the greatest rewards

## Barriers to growth

To capture more of the anticipated growth in sustainable energy markets, focus must be given to overcoming barriers to supply chain growth. A survey of leading Irish suppliers of equipment and services was used to gather further market data in areas identified as being well-positioned to capture the anticipated sustainable energy investment.

Suppliers identified a range of barriers to growth, including the lingering effects of the economic downturn on business finance and the ongoing transition away from publicly funded incentives and grants, which have been effective in driving market growth, to more market-based mechanisms. Six key factors are identified as crucial to unlocking growth:

- *Need for adequate skills*
- *Protection of intellectual property (IP)*
- *Requisite sales volume to sustain supply chain*
- *Efficient procurement practices*
- *Critical mass for supply chain establishment*
- *Condition of key infrastructure*

Despite the barriers to growth identified, almost 70% of suppliers surveyed considered Ireland a good place to grow their business, and one in four identified areas of their businesses where jobs could be created in the future.

## Overcoming barriers – a coordinated approach

The range of barriers identified can be addressed through a number of key enablers to support supply chain development. These range from supporting RD&D and stimulating market uptake using innovative financial mechanisms and consumer information, to developing networks or clusters for knowledge-sharing, specialisation of skills, knowledge and relevant infrastructure.

A coordinated approach to addressing barriers will reap the greatest rewards. International experience highlighted in later sections of this report highlight that countries implementing coordinated policy measures engaging government and supply chain stakeholders will reap the greatest rewards.

The key enablers identified in Table 3 seek to promote innovation and thus drive efficiencies in the supply chain that in turn improve competitiveness. The types of measures available to support the sustainable energy sector seek to:

- *Stimulate demand and create active supply chains*
- *Reduce input costs by promoting competition (rivalry) between firms*
- *Enhance knowledge-sharing*
- *Promote the development of specific resources such as infrastructure, standards, knowledge and innovative ownership models*

**Table 3: Irish barriers and needs – key enablers**

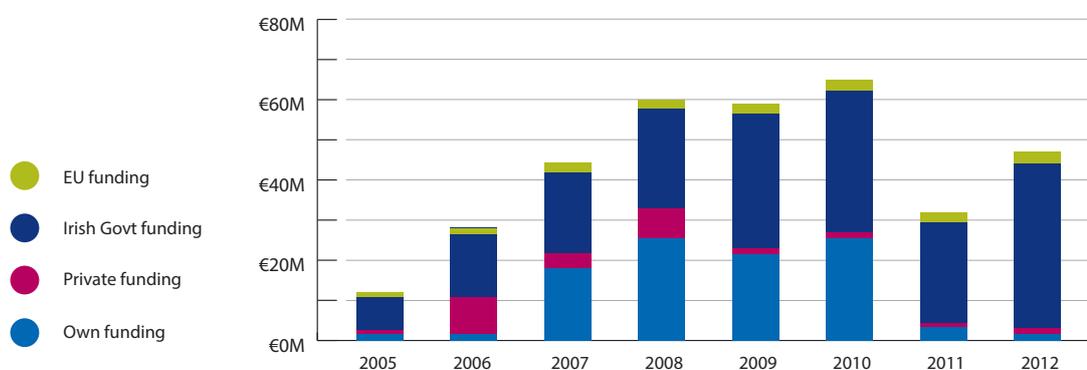
| Barrier / need                                 | Measures / key enablers   |
|--|---|
| Need for adequate skills base                  | Development of training and qualification standards to promote a skilled workforce                      |
| Protection of intellectual property (IP)       | Continued support for IP and brand management including legal, licensing, IT and financial management   |
| Requisite sales volume to sustain supply chain | Stimulation of markets via incentives, low-cost loans, and consumer information                         |
| Efficient procurement practices                | Development and promotion of clear procurement rules  |
| Critical mass for supply chain establishment   | Development of clusters of related and supporting industries  |
| Condition of key infrastructure                | Upgrades to electricity, road, telecom and other relevant infrastructure supporting supply chain actors |

### Maximising the supply chain potential

Selected measures already addressing some of these barriers in Ireland are highlighted below. These provide a snapshot of efforts being made by a range of government departments and agencies, and other actors (e.g. educational institutions, industry groups, etc) across many sectors. As the discussion on maximising the sustainable energy supply chain potential continues, a more comprehensive assessment of relevant actions can be made and priority gaps identified.

#### Excellence in RD&D

SEAI has a number of actions underway that seek to improve the coherence of Irish energy research. SEAI's RD&D inventory database records information related to energy projects in categories covering energy efficiency, renewable energy, energy storage, emerging technologies such as hydrogen and fuel cells, and cross-cutting technologies and research. Data collected in 2012 reported expenditure on energy research, development and demonstration (including deployment) in the Republic of Ireland of almost €47 million. This came from a number of sources, as illustrated in Figure 6 which shows total RD&D funding per annum since 2005.

**Figure 6: Total energy RD&D funding 2005–2012**



In 2013 the Irish Government committed €200 million towards seven world-class Science Foundation Ireland (SFI) Research Centres, the largest-ever co-funded research investment programme in Ireland. The initiative will be funded over a six-year period, with co-investment of €100 million coming from over one hundred industry partners connected to the centres. The programme will directly support 800 top-class researcher positions and target new-era initiatives of national importance such as 'big data', food, health and renewable energy. The IDA has welcomed this investment in science and technology as enabling the creation of a vibrant research community in Ireland.

In 2012 Ireland was given special mention in the scientific journal Nature as one of the five 'up and coming' destinations for high-level research based on the quality and quantity of research being carried out. Such a world-class research-led focus in Ireland has encouraged a stream of technology-based start-ups across emerging sectors.

According to Forfás, the challenge for Ireland is to develop a small number of world-class centres for research and development in niche green areas. RD&D in the Irish green sector is now better coordinated through the actions of SEAI and others. However, in some areas, additional scale is required to make it internationally competitive.

### *Research leadership in Cork: Beaufort Research and the IERC at the Tyndall National Institute*

- *Research collaboration is a particular strength in Ireland. For example, Beaufort Research combines the excellent track record of the Hydraulics and Maritime Research Centre (HMRC) and the Sustainable Energy Research Group (SERG) at University College Cork under one brand and hosts the SFI Charles Parsons Energy Initiative for Ocean Energy. Beaufort Research maritime and sustainable energy expertise covers energy supply technologies, including the marine renewable energy sectors of wave, tidal and offshore wind; onshore wind energy, biomethane production, energy storage; energy end use (intelligent efficiency) and cross-cutting research (energy policy and modelling, control engineering and power electronics). This, together with Beaufort's extensive maritime governance, marine ecology, ICT and geospatial technology expertise, gives Marine Renewable Energy Ireland (MaREI) a unique position at the epicentre of global maritime development and knowledge*
- *The International Energy Research Centre (IERC) is one of 15 industry-led research centres in the Government-funded Technology Centres Programme, a joint initiative of Enterprise Ireland and IDA Ireland. It is an industry-led, world-leading, collaborative programme of research and innovation in integrated sustainable energy system technologies. The IERC brings together international companies and researchers in the energy space, leveraging research capabilities and technologies to find commercial solutions to the global energy demand challenge. It is located at the Tyndall National Institute in Cork*
- *The Tyndall National Institute at University College Cork is particularly renowned for its ICT research and expertise. It has a track record of involvement in and coordination of numerous FP7 projects. With expertise in microsystems and nanoelectronics, for example, Tyndall is currently coordinating three FP7 projects. These projects are exploring photonics applications in low-power telecommunications (a potentially important and lucrative field as green ICT becomes increasingly attractive)*



Ireland needs to develop one or more green zones in order to create an environment that can support the development of green enterprise and be used to market Ireland overseas

The progression from research to commercialisation is a central theme in structured energy research programmes and is an important step in supply chain development. A register of opportunities for commercialisation from Ireland's energy research groups and industry clusters could prove beneficial.

### Industry clusters

Clusters can be defined as "geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in industries, and associated institutions (e.g. universities, standards agencies, trade associations) in a particular field that compete but also cooperate"<sup>13</sup>. Clusters can help to promote innovation and improve competitiveness through driving efficiencies and facilitating information-sharing between cluster participants.

The Green Way, established in Dublin in 2010, is an example of such a cluster. It includes a number of key regional stakeholders collaborating to encourage green economic growth through the stimulation of the cleantech sector in Dublin. The term cleantech encompasses industries and companies involved in sustainable development, eco-innovation (products, services, processes) and resource efficiency. The Green Way and Energy Cork (Cork's Energy Cluster) recently secured a place in the EU Climate Knowledge Innovation Community (Climate KIC) Outreach Programme, which includes €250,000 in direct support for Irish organisations innovating in the low-carbon sector. It is hoped that successful collaboration in the coming years will lead to further opportunities.

Ireland can be characterised as having both a policy-push and bottom-up approach to cluster formation. A number of government-funded initiatives seek to promote the establishment of clusters, and a number of clusters have been established as a result of Ireland's successful FDI policies. We have benefited from a focus on high-growth sectors such as IT and bio/pharmaceuticals, as well as the leverage of 'first-mover advantages' whereby a major company in a target sector is attracted to Ireland, thus making it easier to entice its sub-suppliers to do likewise.

As highlighted in a recent Forfás report, the green economy in Ireland remains highly dispersed across various sectors (e.g. ICT, engineering, finance, energy, waste, water, etc) and across various supporting state organisations (e.g. infrastructure and service suppliers, education and research institutions, government, etc). Ireland needs to develop one or more green zones in order to create an environment that can support the development of green enterprise and be used to market Ireland overseas (Forfás, 2009).

<sup>13</sup> Porter, Clusters and Competition, Harvard Business School Press, 1998.

### *Finnish energy research and development coordination*

- *Ireland's world-class ICT and light-engineering base offers an exciting opportunity to develop cutting-edge renewable energy clusters as practised in other European countries, enhancing the competitiveness of our domestic supply chain*
- *West Finland's Vaasa Energy Cluster provides a useful example of a policy approach to developing research clusters aimed at promoting local energy technology products. A national strategy for the development and long-term support for R&D clusters in energy and clean technologies has been in place in Finland since 1994. The Vassa energy cluster was developed in a region with an energy-related manufacturing base, which made it easier to attract complementary businesses*
- *The cluster encompasses 140 companies, employing 10,000 people with an aggregate annual turnover of €4.4bn. The country also hosts a joint research centre for science, innovation and technology in energy and environmental technology. A total of 1% of public procurement (€350m) is committed by the State to clean-technology solutions, in conjunction with annual investment from members in energy-related R&D increasing from €63m in 2005 to €140m in 2010. These energy clusters demonstrate that, given the right mix of financial support and international collaboration, they can support a substantial number of jobs, and stimulate the development of new products with considerable export potential*
- *Ireland's ICT and light-manufacturing expertise puts us at a similar advantage when developing clusters in this area. A strategic effort was made to establish Finland as the location for the best-known cleantech brands and build networks to promote exports abroad. Today, Finland boasts five regional centres of excellence in energy technologies, all of which are active participants in international energy networks*
- *Although Science Foundation Ireland's Strategic Research Cluster Programme (which includes sustainable energy partnerships) was established relatively recently in comparison to the Vassa cluster, it has the potential to have similar success if it is part of a long-term investment strategy*
- *Enterprise Ireland already facilitates the promotion of clean Irish technology overseas as a means of stimulating demand for Irish products and services, while the IDA offers substantial support in attracting international companies interested in co-locating research, development and manufacturing facilities close to an expanding energy cluster*

### Promoting a skilled workforce

A skilled workforce is essential to supply chain development and securing jobs in Irish supply chains. A range of actions are already contributing to the development of skills and promotion of minimum standards across a number of relevant supply chains.

#### Technology deployment

BUILD UP Skills is a strategic initiative under the Intelligent Energy Europe (IEE) programme. The aim is to increase the number of qualified workers across Europe to deliver renovations offering high energy performance as well as new, nearly zero-energy buildings. The Build Up Skills for Ireland (BUSI) Consortium, coordinated by the Limerick Institute of Technology, has brought together key players with project management, education and training, consultation and networking skills. The initiative addresses skills in relation to energy efficiency and renewables in all types of buildings.



Increased coordination of effort across the relevant government departments, agencies and other stakeholders will yield the greatest results for Ireland

SEAI maintains a Renewable Installers Register that provides the details of suitably qualified installers of small-scale biomass boilers and stoves, solar photovoltaics, solar thermal systems (solar water heating), shallow geothermal systems and heat pumps. The objectives of the register include providing assistance to homeowners in selecting suitably qualified installers and building market capacity and competence by driving contractor training standards.

A separate registered contractor list for the Better Energy Homes grant scheme is also maintained by SEAI. Registered contractors must meet specific levels of minimum qualifications to be included on the register. Codes of practice and technical specifications have been developed to ensure installations are done to minimum energy performance standards. Together with an audit and inspection programme, including 'accompanied inspections', SEAI is driving quality installations and helping to develop a skilled retrofit workforce.

In further support of the retrofit market, the Department of Communications, Energy and Natural Resources (DCENR) together with the Department of the Environment, Community and Local Government (DECLG), SEAI and the National Standards Authority of Ireland (NSAI) have recently developed the SR54 code of practice (COP) which addresses the energy refurbishment of post-1940s low-rise dwellings. The main purpose of the COP is to provide technical guidance on the design and installation of retrofit measures to improve energy efficiency while maintaining building integrity and safety and ensuring healthy internal environments. The intended users are designers, specifiers, contractors, installers and property managers working on energy efficiency refurbishment projects for dwellings.

#### Business sector supports

SEAI provides a range of innovative training programmes on energy management developed specifically for SMEs and the public sector. The courses provide a comprehensive, structured approach to energy management. Programmes are delivered in cooperation with partners (market actors) who host the training and undertake much of the marketing and administration for the courses. SEAI registers market interest for training in specific sectors and across geographical areas, and tailors courses accordingly. Programme participants range from small local enterprises to organisations with regional and national presences. Enterprise Ireland actively promotes the courses among its client companies.

#### Working together

Efforts to maximise sustainable energy supply chain development in Ireland to capture more of the Irish, European and worldwide markets may be seen as strong but dispersed. In light of the major opportunity outlined in this report, increased coordination of effort across the relevant government departments, agencies and other stakeholders will yield the greatest results for Ireland. Further work is needed to develop a comprehensive mix of measures across government, industry and educational institutions that contribute to supply chain development.

## Supply chain mapping and analysis

The following sections present maps for each supply chain considered, identifying:



- *The high level project stages from preliminary investigations to procurement, materials supply, installation and quality assurance, and finally operations & maintenance (level 2 on the maps)*
- *The distinct project lifecycle phases including (where applicable) feasibility, planning, design, manufacturing, installation quality assurance, operation and decommissioning (level 3)*
- *Main types of suppliers of equipment or services in each area of the supply chain (level 4)*
- *The equipment and professional service components they are responsible for (level 5)*

An estimated breakdown of the annual capital investment and operating & maintenance expenditure in each major part of the supply chain is presented in the maps.

The starting-point for the analysis was estimating the breakdown of total expenditure into technology and service components for each supply chain selected for review. Expert knowledge of the equipment supply chain was then used to allocate each major cost element against one of 61 economic sectors.

A qualitative assessment was undertaken by a panel of experts to derive the Irish share of the market in each supply chain area. The assessment, based on the experts' knowledge of the industry, was cross-checked against published research reports, suppliers' directories and websites, and discussions with the experts' contacts.

These 'first pass' estimates are provided to begin debate on our relative strengths and weaknesses and to refine our understanding of the key opportunities.

A traffic-light assessment of how well positioned Irish supply chain companies are to capture the investment needed to meet the national targets for 2020 is included. This review focused on the six identified needs highlighted above: intellectual property protection, adequate skills base, sufficient sales volume to sustain supply chain, transparent and practical procurement practices, critical mass and requisite key infrastructure.

International examples of measures taken by other EU countries to improve the competitiveness of domestic supply chains are highlighted where relevant, to offer further examples of the application of innovative ideas for maximising supply chain development in Ireland. These are:

- *Biomass supply chain development in Upper Austria*
- *Germany's KfW programme of funding energy efficiency retrofits*
- *The offshore wind supply chain initiative in Scotland and the UK generally*
- *Energy Vaasa – a large supply chain initiative in west Finland*
- *Lombardy Energy Cluster (Italy) – power generation, transmission and distribution*
- *The Green Deal Supply Chain Initiative (UK)*

The analysis was supplemented by a market survey of suppliers of sustainable energy-related goods and services, to gather a wider range of views on how well positioned Irish organisations are to capture investment.

Following an introduction of the current state of play for each technology area, estimates are provided for both the Irish and EU supply chain potential. Feedback on the maps may be provided to SEAI via [emg@seai.ie](mailto:emg@seai.ie). Thus feedback will be collated and used to reassess the maps where appropriate to build a more accurate representation of each sector over time.



# Technologies

# Energy efficiency related construction



Over the last five years, Better Energy: the National Upgrade Programme has resulted in an average investment in energy efficiency-related construction of around €230m a year. Since 2009, over 250,000 homes have been upgraded under the Better Energy Homes and Warmer Homes schemes, while 340 projects have been completed under the Better Energy Workplaces programme in business and the public sector. The total value of energy savings from technologies deployed through these schemes to date is over €100 million per year.

Further investment is made outside the current grant programmes, including that associated with new-build construction, based on increasingly tight building energy performance standards.

In addition, SEAI is working with over 150 of the largest industrial energy users in Ireland (responsible for around 60% of industrial energy use), facilitating networking, energy-saving projects and information-sharing on energy-saving technologies and techniques, so as to maximise energy savings and maintain the competitiveness of Irish business.

Improving energy efficiency is an essential part of Ireland's sustainable energy policy. The Government has committed to achieving a 20% reduction in energy demand across the economy through energy efficiency measures by 2020.<sup>14</sup>

A national target of 20% equates to 32 TWh per year saved. Since Government must lead by example, a target has been set to achieve energy savings in public-sector energy usage equivalent to 33% by 2020.<sup>15</sup>

The estimates of annual investment in energy efficiency-related construction are based on programme data collected by SEAI and forecasted estimates of building upgrades required to 2020. These figures could reduce if energy savings in other sectors, e.g. transport, or by other measures, such as the carbon tax, lead to energy savings greater than anticipated.

**Table 4: Estimated annual investment in energy efficiency-related construction**

| Technology                             | Average capital investment by 2020: (€m/year) |
|--|---|
| Energy efficiency-related construction | 1,000 – 1,200                                 |

<sup>14</sup> Based on average historic energy demand over the period 2001 to 2005. Refer to Ireland's National Energy Efficiency Action Plan for details.

<sup>15</sup> Based on average historic public-sector energy demand over the period 2001 to 2005.

## Crowley Carbon

Crowley Carbon is a new type of energy services company that installs cutting-edge energy efficiency products and provides solutions to reduce an organisation's energy costs by up to 30%. Established in 2009 by entrepreneur Norman Crowley, Crowley Carbon was one of Enterprise Ireland's High Potential Start-Up companies of 2010 and is growing at a rate of 300% a year, with predicted annual revenues of €25-€30 million. Based in Co. Wicklow, it has overseas offices in Britain, Australia and Dubai. Clients of Crowley Carbon include companies such as Vodafone, Dawn Meats, Pfizer and Johnson & Johnson.



Crowley Carbon designs innovative energy-efficient solutions tailored to each client through examining their processes and equipment in order to improve energy efficiency and recover waste heat. Its engineering intelligence offers

a unique complexity of solutions ranging from energy-efficient lighting solutions and high-performance waste heat to hot-water systems.

Savings in energy costs and carbon emissions are increasingly viewed as an essential driving force behind any growth industry.

The Irish firm has invented and licensed over 80 of its own products to address energy usage in all areas of business. One such leading product is C<sup>3</sup> – the world's first Carbon Control Centre, located at the Crowley Carbon offices in Powerscourt, Enniskerry, Co. Wicklow. The facility enables Crowley Carbon to monitor, control and alert clients to any event that is causing their equipment to consume more energy than should be required. C<sup>3</sup> customers receive 24/7 monitoring from a team of engineers who constantly review up to 800 energy-consuming points throughout a client's site. The centre is the first to integrate the energy efficiency market with Intel's Internet of Things research platform, which enables devices ranging from domestic fridges to industrial chillers to communicate and be controlled over the internet. The project was supported by Enterprise Ireland.

A breakdown of the anticipated Irish market according to how well positioned Irish organisations are to capture the investment is provided in the table.

**Table 5: Current position of Irish supply chain for energy efficiency-related construction**

| Rating | Position to capture investment   | Anticipated average market size 2013-2020 (€m/year) |
|--------|----------------------------------|---|
| 0      | No local supply chain at present | 44  |
| 1      | Less well positioned             | 235   |
| 2      | Averagely positioned             | -   |
| 3      | Well positioned                  | 236   |
| 4      | Very well positioned             | 485   |
|        | <b>Total</b>                     | <b>1000</b>   |

In general, most areas of the supply chain are considered to be well positioned to capture growth. Less well positioned are those areas where there is no significant manufacturing base (e.g. lighting).

# Case Study

## Hanley Energy – reducing energy costs at home and abroad

Hanley Energy Ltd is an Irish-owned and managed company specialising in the design, supply, installation and support of customised energy and critical power management solutions for a diverse range of business sectors, including datacentres and other energy-intensive businesses. It helps clients to reduce energy costs and ensure 100% 'up-time' – and thereby maintain their competitiveness.

In 2013 Hanley Energy announced the creation of 10 new positions by 2015, expanding their operational capacity at their new business premises in the City North Business Park, County Meath. Offices have also been opened in Austin, Texas and Frankfurt, Germany, to enable Hanley Energy to service its growing international client base.

Hanley Energy has joined the Smart ECO Hub, Ireland's largest energy cluster to use the collaborative network provided by the cluster to develop further opportunities. In November 2013 Hanley was announced as overall winner of the Cleanweb/IT category in the Global Cleantech Cluster Association 2013 Awards, announced in Lahti, Finland.



## EU market size for energy efficiency-related construction

The estimated EU market size for energy efficiency-related construction is derived from publications by the Building Performance Institute of Europe (BPIE) and Renovate Europe (a study commissioned by Copenhagen Economics).<sup>16</sup>

Table 6 presents a range of estimates based on 'medium' and 'deep' retrofit profiles, the second of which meets the EU ambition for CO<sub>2</sub> savings

(80% reduction) by 2050. Higher initial rates of investment reflect the assumptions that older buildings are renovated first, the cost of technology reduces as the volume of activity increases and the market matures, and there is a need for a rapid increase in deep renovation measures in the first decade.

**Table 6: Estimated EU market size for energy efficiency-related construction**

|                                     | 2020      | 2030    | 2050      |
|-------------------------------------|-----------|---------|-----------|
| Total estimated expenditure (€b)    | 252 – 477 | –       | 551 – 937 |
| Annual capital investment (€b/year) | 28 – 53   | 23 – 42 | 18.5 – 31 |

<sup>16</sup> The average of medium-deep retrofit scenarios has been used.



The European Commission and DC Clima Energy Roadmap 2050 Impact Assessment and Scenario Analysis estimated total investment across the entire EU economy of €4.25 trillion to 2050 in order to reduce CO<sub>2</sub> emissions by 80% and reduce energy consumption

by 30% compared to (projected baseline) 2050 levels. DC Clima's annual estimate for energy efficiency of buildings is higher than the BPIE results referenced above – at €75 billion per annum (average over the period to 2050).

### Saint-Gobain Group

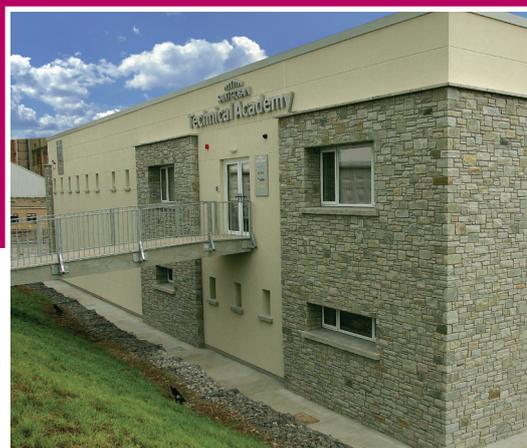
Saint-Gobain, a French multinational corporation founded in 1665, is a world leader in construction, design, manufacturing and distribution of building materials. The company operates in 64 countries and employs 191,500 people across four sectors: construction products, innovative materials, building distribution and packaging. Saint-Gobain's strategic position provides a habitat and construction supply chain which supports innovative and high-performance solutions to meet growing demand for energy efficiency and environmental protection.

In the Irish and UK markets, the group commands over 30 businesses, 80 manufacturing plants, 400,000 products and over 1,000 distribution sites. It employs 16,750 staff and has annual sales of over £3 billion. In Ireland, Saint-Gobain employs over 1,050 people, all within the built-environment industry. Many of Ireland's well-known companies in the sector such as Gypsum Industries (Gyproc), Weber, Solaglas, Saint-Gobain Glass, Echopon and Isover are part of the Saint-Gobain group.

Gyproc is the market leader in plaster, plasterboard and dry-lining systems. The company has been manufacturing in Ireland since 1936. Gypsum rock is mined from a deposit at Knocknacran, Co. Monaghan. From this raw material, an extensive range of plasterboards

and plasters are manufactured at the company's production facility in Kingscourt, Co. Cavan. Isover, a leading insulation provider worldwide with a presence in over 50 countries, has been providing high-performance, fire-safe, thermal and acoustic glass mineral wool insulation to the Irish market since 1974. Isover insulation is made from up to 86% recycled glass, making it one of the most environmentally friendly materials on the market. In 2014, Isover hosted the International Energy Efficiency Awards in Dublin to recognise the most energy-efficient buildings across renovation and new-build projects worldwide in residential and commercial sectors. The event brought together 120 delegates from around the world.

# Case Study



### *Building markets with innovative financing – international lessons*

Similar to the current situation in Ireland, between 1995 and 2006 the number of jobs in the German construction industry shrunk by almost two-thirds and turnover declined by more than 30%. To combat the shortage of demand in construction, the German government pursued an ambitious KfW funding programme for energy efficient retrofit of buildings to high performance standards. The initiative was supported by new obligations, R&D programmes, pilot projects, subsidies and loans. Since the introduction of these policies in 2006, the number of jobs has increased by almost 15% and the number of companies by almost 10%. The growth applies to both new builds and retrofitting, and there is now an expected shortage of up to 90,000 builders. The KfW energy efficiency programme created and supports 200,000 jobs, and stimulated many energy efficiency-related patent applications. Financing the energy-efficient retrofit of buildings through grants and loans could be applied in Ireland, resulting in many new jobs in the construction industry. However, the approach is capital-intensive.

Alternatively, the UK's Green Deal Initiative could provide a template for accelerating Ireland's energy efficiency retrofit programme. It shifts the funding for residential energy efficiency measures to individuals via their energy bills. Local authorities are responsible for providing Green Deal solutions to local residents and businesses, and for establishing local supplier partnerships. A total of £50m has been spent by the government to help local authorities to set up pilot schemes and on supplier training. However, the approach has not yet gained traction among home owners so it is difficult to gauge how much additional private finance investment it will deliver.

The Irish Government is currently investigating alternatives in this area. Details of the actions underway may be seen at <http://www.dcenr.gov.ie/energy/>. An energy efficiency fund of €70 million was recently launched by Energy Minister Pat Rabbitte to finance energy efficiency projects across all sectors of the economy. The work is being supported by SEAI through a range of policy delivery and support mechanisms.

The estimated average expenditure in the construction-related energy efficiency market between 2013 and 2020, overlaid on the supply chain map, is shown in Figure 7, for shallow retrofit, and Figure 8, for deep retrofit measures. The breakdown has been estimated using Irish sources, including reports and analysis by the Institute of International and European Affairs (IIEA), the Society of Chartered Surveyors Ireland and SEAI programme data related to residential, commercial and public-sector projects supported through Better Energy grant schemes.



### Figure 7: Energy Efficiency Shallow Retrofit - Capacity to capture investment

Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.

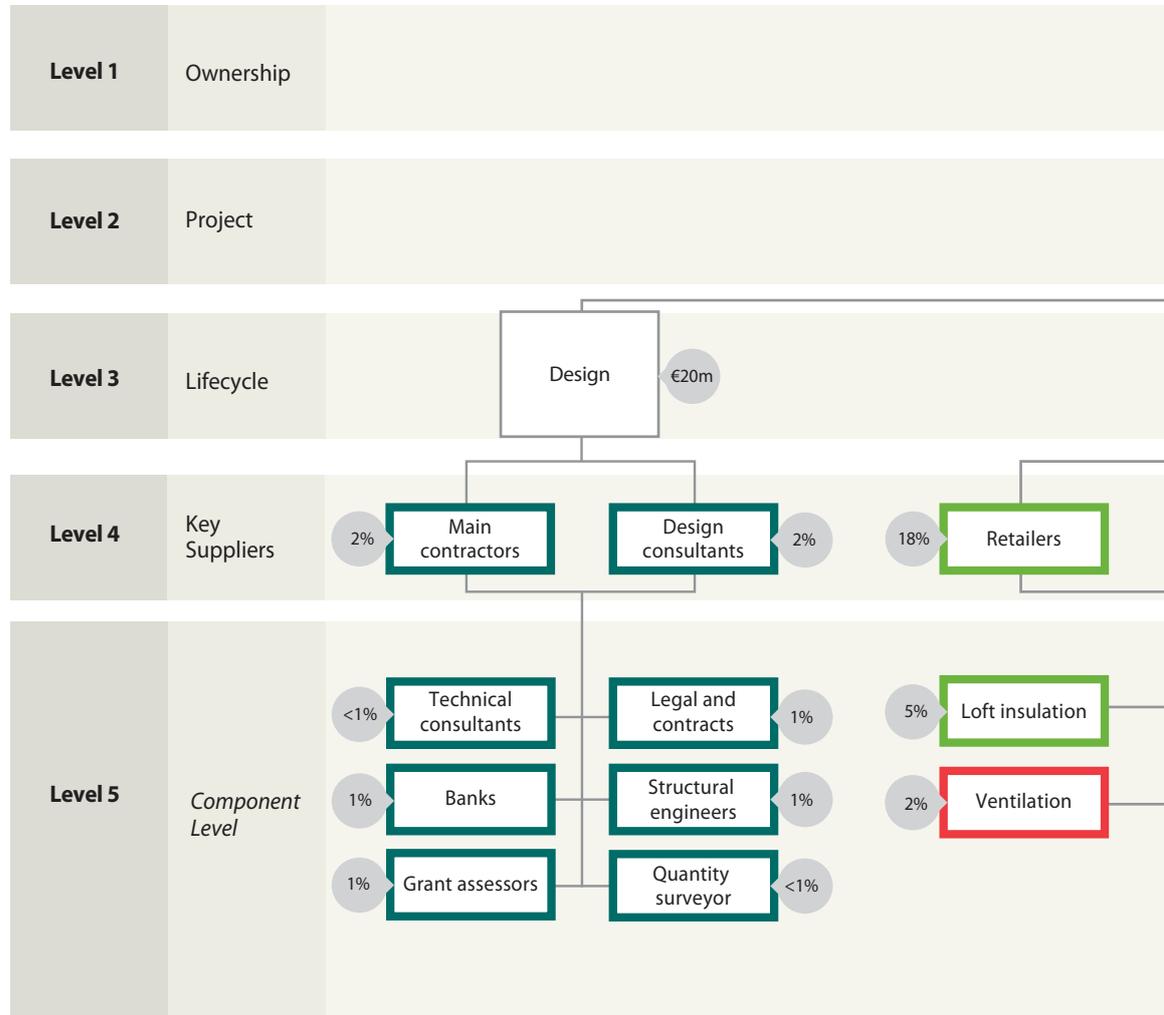
All €m figures are per year averaged (2013-2020).

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them.

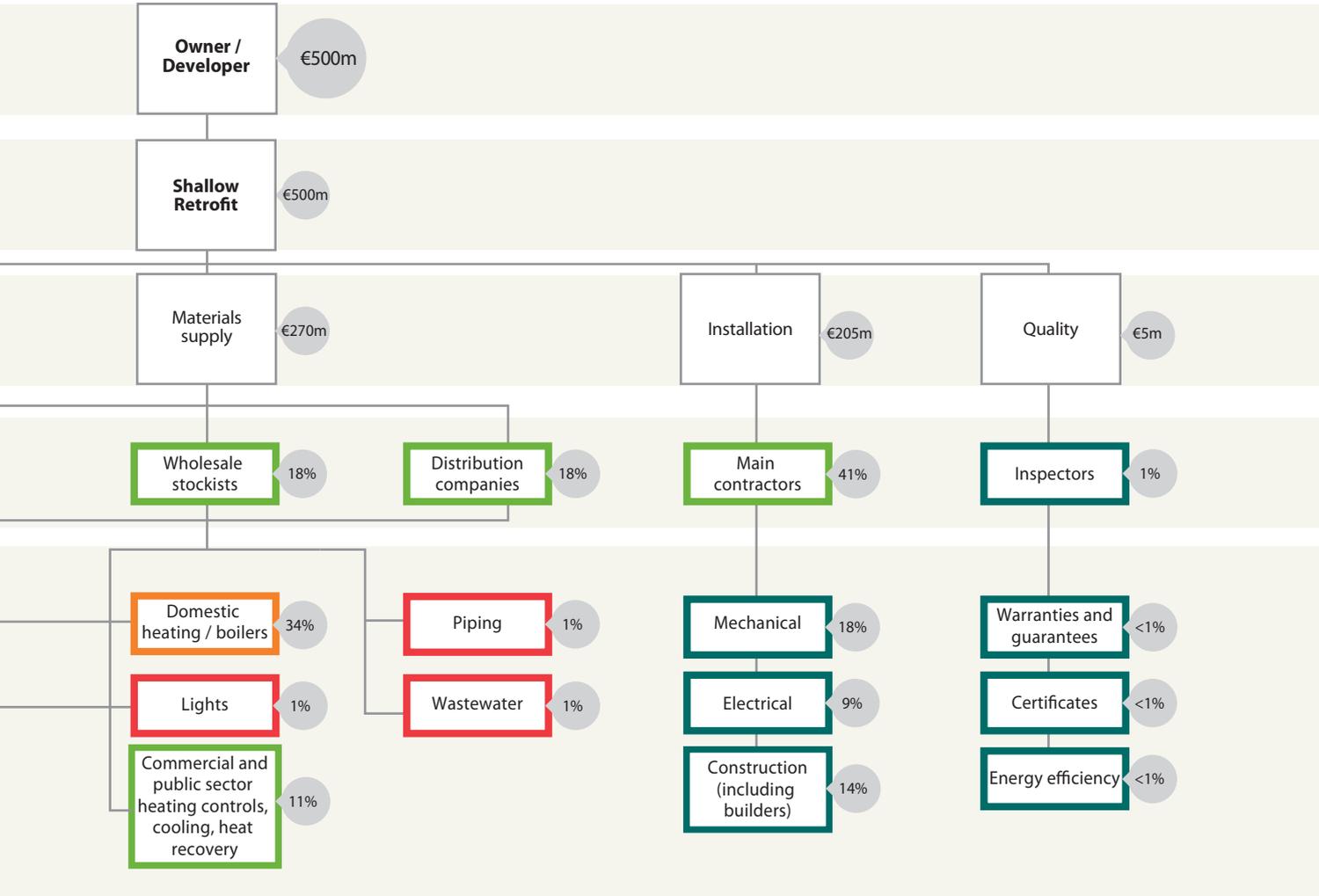
Percentage breakdown of CAPEX (light grey) totals are provided for Level 4 and below. Some rounding has occurred.

The majority of the investment in energy efficiency retrofits is spent on the supply and installation of materials.

Specialist products like boilers, lighting, wiring, and piping are expected to be imported from abroad given the small manufacturing base for these products in Ireland. However, given Ireland’s strong competency in architecture and construction the remaining investment in the energy efficiency supply chain is likely to be supplied by Irish industry.



**'Very well positioned'** - no significant barriers to address  
**'Well positioned'** - some barriers affecting capacity to scale to be addressed  
**'Average'** - action is needed to develop capacity and exploit local factors  
**'Less well positioned'** - concerted action required to reinforce supply chain  
**'No local supply chain at present'** - longer term action needed to establish Irish presence



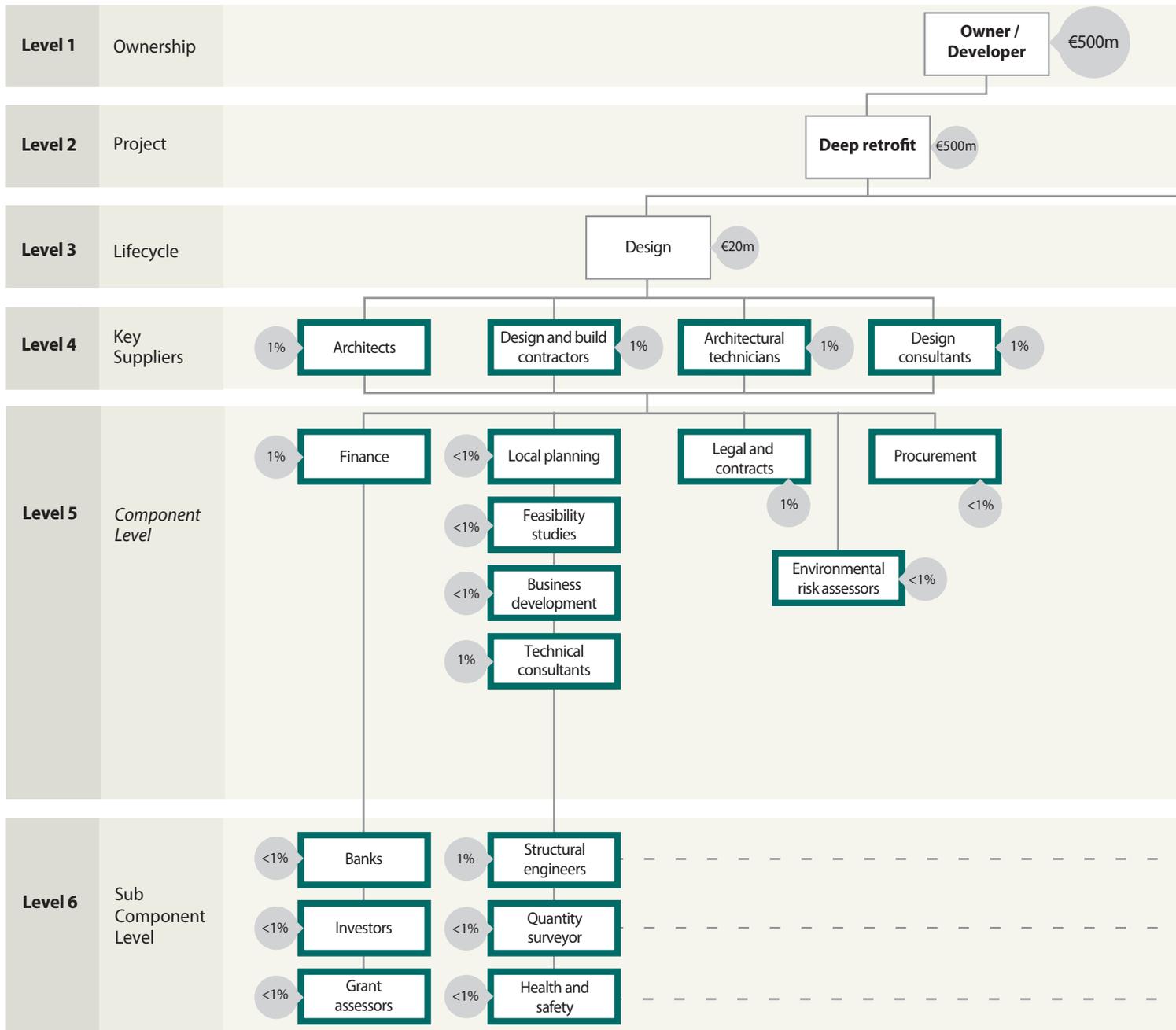
### Figure 8: Energy Efficiency Deep Retrofit - Capacity to capture investment

Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.

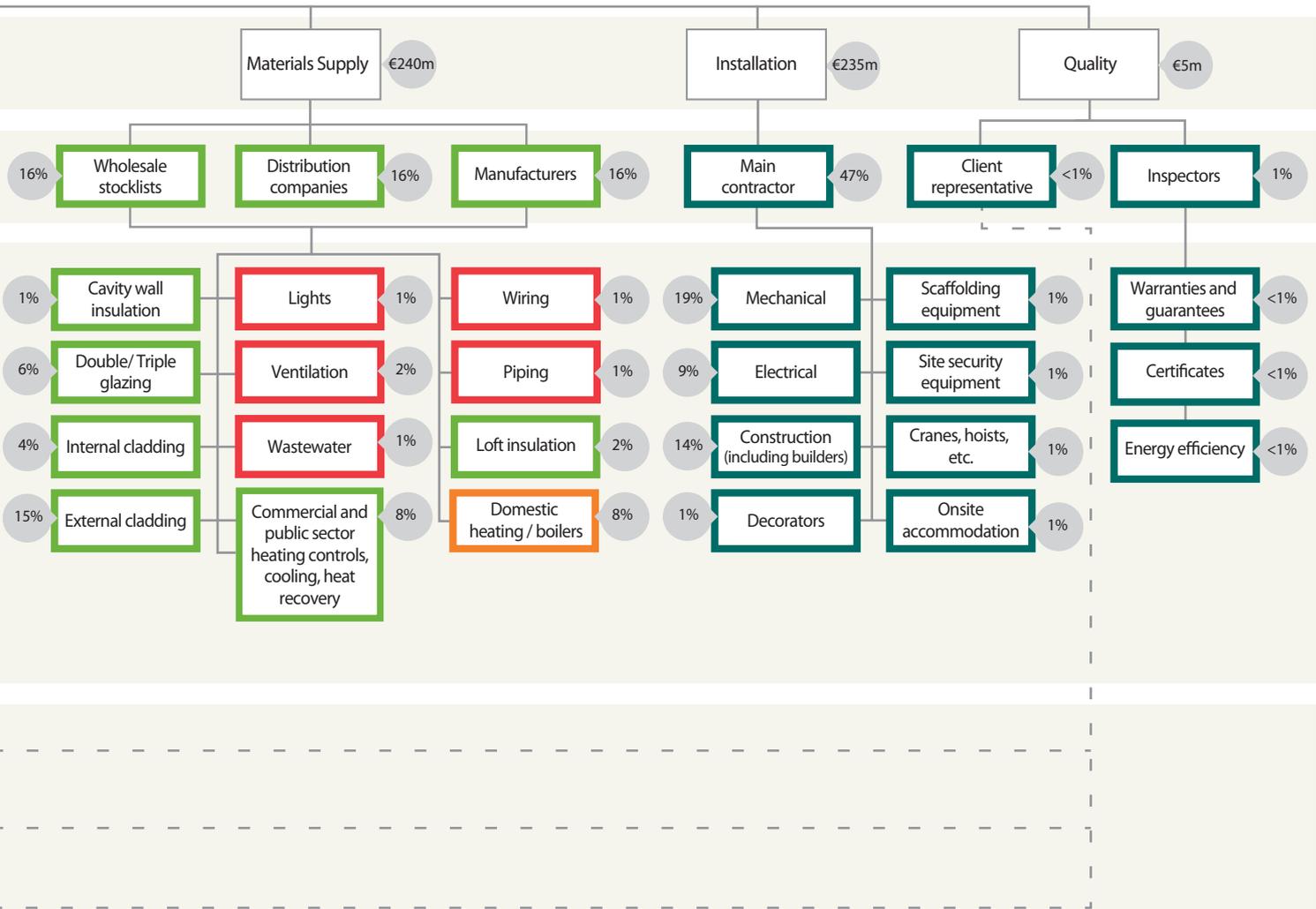
All €m figures are per year averaged (2013-2020).

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them.

Percentage breakdown of CAPEX (light grey) totals are provided for Level 4 and below. Some rounding has occurred.

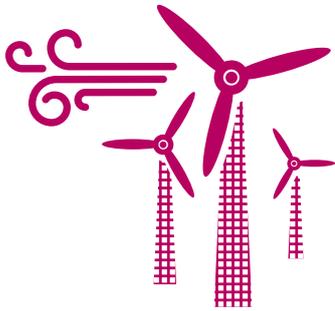


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While shallow retrofit generally comprises an element of insulation, draught proofing and perhaps a boiler change, deep retrofits are characterised by a full package of measures including fabric upgrades, replacement of existing heating and ventilating systems and, in some cases, the installation of a renewable energy supply.

In comparison to shallow retrofits, installation accounts for a greater share of the total costs. All of the phases of installation of deep retrofits are very well placed to be domestically supplied. However, manufactured lights, ventilation, wastewater, wiring and piping materials are generally imported from abroad.



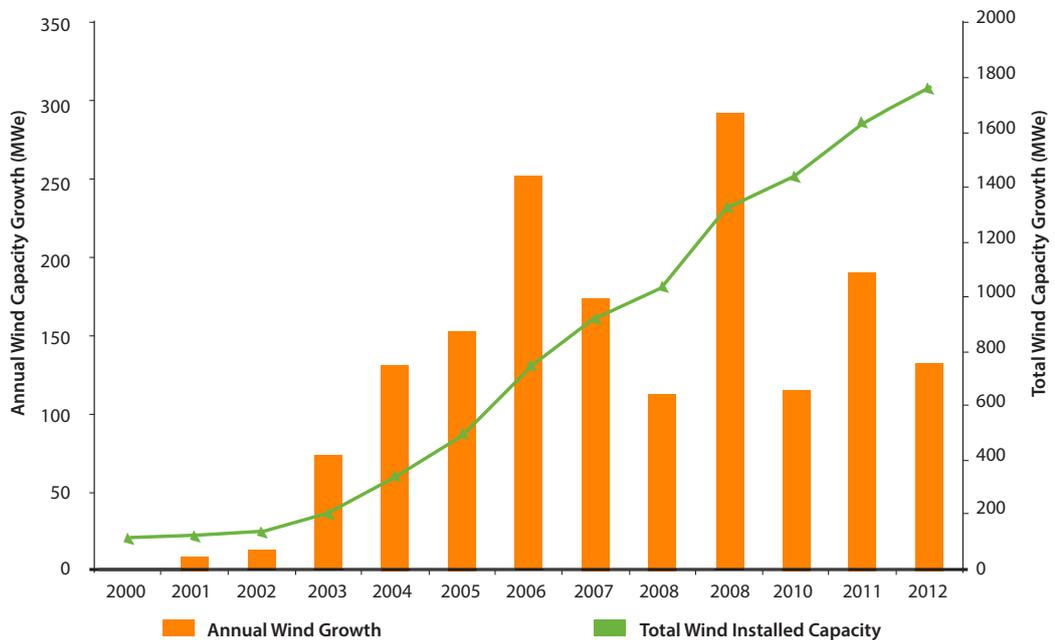
# Onshore wind energy

Increased deployment of onshore wind in recent years has driven the growth in renewable electricity on the Irish grid. Ireland is currently fourth in the world for the proportion of wind electricity generation on the system.

Deployment has been driven by the combination of the high-quality wind resource, leading to faster development cost paybacks, and a supportive policy framework, most saliently in the form of the Renewable Energy Feed-In Tariff scheme (REFIT) which provides market support to electricity from renewable energy sources via the tariff.

Improvements in the grid connection and planning application processes, including the group processing of generation applications via the Gate process, and targeted tax reliefs have also facilitated increased deployment.

Figure 9: Installed wind generating capacity 2000–2012



Source: Eirgrid

# Case Study

## Siemens – a powerhouse of innovation in Ireland

Siemens AG is a global powerhouse in electronics and electrical engineering, operating in the fields of industry, energy and healthcare as well as providing infrastructure solutions, primarily for cities and metropolitan areas. It is active in 190 countries, has annual revenues of €75.9 billion and has 362,000 employees worldwide.

Siemens Energy Sector is the world's leading supplier of a broad spectrum of products, services and solutions for power generation in thermal power plants, using renewables, power transmission in grids, and the extraction, processing and transport of oil and gas. In fiscal 2013 (ended September 30), it had revenues of €26.6 billion, received new orders totalling approx. €28.8 billion and posted a profit of around €2 billion.

Siemens has been operating in Ireland since 1874 when it built the first direct transatlantic telegraph cable between Ireland and Canada. In 1925 Siemens Ltd was established in Ireland. Commencing with the Shannon Hydroelectric Scheme, the company has pioneered many of the key energy infrastructure projects in the country, including the Turlough Hill Pumped Storage Station, the Moneypoint power plant, the Poolbeg power plant and, more recently, the supply of wind turbines to wind-farm developers such as Airtricity and Bord na Móna. Siemens has been involved in the installation of around 15% of the renewable base in Ireland, enough to power around 250,000 homes.

The Irish branch of the company employs 550 people, over 50 of whom are employed in the renewable energy division. The company has offices in Dublin, Swords and Letterkenny. In 2013, Siemens spent approx. €130 million on goods and services in the Irish economy and posted over €200 million in revenue.

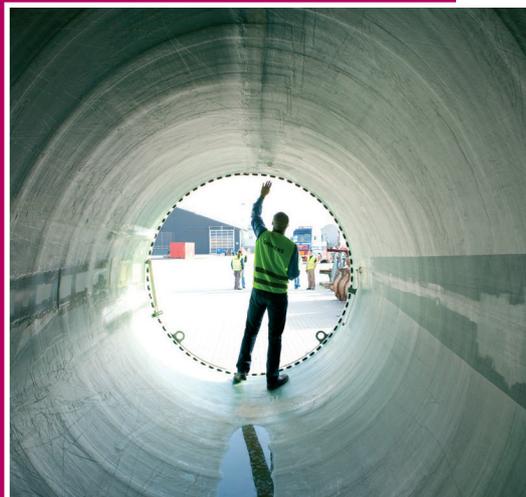


Table 7 presents the range of estimated annual expenditure (capital expenditure and operation & maintenance expenditure) for Ireland's onshore wind sector over the period to 2020. The estimates of annual increase in installed capacity are based on detailed forecasts of supply and demand in Ireland, within the constraints of the EU and national targets for renewable energy and energy efficiency in 2020.

**Table 7: Estimated annual investment in onshore wind power in Ireland**

| Annual increase in capacity (MW) | Total installed capacity in 2020 (MW) | Average capital investment 2013-2020 (€m/year) | Average O&M expenditure 2013-2020 (€m/year) |
|----------------------------------|---------------------------------------|--|---|
| 230-400                          | 3,660 - 5,200                         | 280 – 480                                      | 55 - 70                                     |

Based on capital expenditure of €1.2m / MW and O&M expenditure of 1.5% – 2% of capital expenditure.

A breakdown of the anticipated Irish market according to how well positioned Irish organisations are to capture the investment is shown in Table 8. Further detail is provided in the supply chain map that follows (Figure 10).

**Table 8: Current position of Irish supply chain for onshore wind sector**

| Rating | Position to capture investment   | Anticipated average market size: 2013-2020 (€m/year) |
|--------|----------------------------------|--|
| 0      | No local supply chain at present | 3  |
| 1      | Less well positioned             | 40   |
| 2      | Averagely positioned             | 135  |
| 3      | Well positioned                  | 85   |
| 4      | Very well positioned             | 70   |
|        | <b>Total</b>                     | <b>333</b>   |



Many high-value niches in the onshore wind supply chain are being captured by Irish companies

Most professional and engineering services are expected to be locally sourced, although some technical specialists are likely to be drawn in from neighbouring countries. In general, the areas of the supply chain that are less well positioned to capture investment are those where there is no significant manufacturing base in Ireland. Those identified as offering potential for the future relate to equipment repairs, where manufacturers may set up local service centres if the market is large enough to sustain them.

Due to market size and lack of heavy engineering infrastructure, Ireland may be at an initial disadvantage with regard to stimulating manufacture of large wind-turbine components, but there are many high-value niches in the onshore wind supply chain. There are opportunities for companies that have developed and refined their business model in the Irish wind energy sector to expand their business to other markets. Examples of companies that have done this are wind-farm development companies such as Airtricity, Mainstream Renewables, meteorological monitoring company Wind Measurement International, and specialist ICT companies such as ServusNet.

It may be difficult for Ireland to capture the full wind energy supply chain, but the potential for creating employment through the international expansion of companies that were initially fostered by support for Irish wind-energy production should not be underestimated. A specific industrial strategy to foster development of best-in-class practice in the wind energy sector may position Irish industry players to take advantage of international growth opportunities.



### ServusNet – Irish Innovation in Operations & Maintenance

ServusNet, founded in 2007, is based in the National Software Centre in Cork. Its infrastructure and data-analytics expertise is derived in part from the ServusNet team’s experience in the mobile telecoms industry. The company’s Operational Intelligence Platform is designed to address the unique challenges in managing distributed generation assets. Its solution isolates meaningful key performance indicators for wind turbines and provides analysis to identify those factors that most affect overall performance and availability.

ServusNet’s web-based service, hosted on servers in Ireland, currently enables wind-farm operators to pursue predictive O&M strategies on 900 MW of wind power in the US mid-west and Pacific north-west. Automated reporting and analysis as well as bespoke investigations centred on the major milestones in the lifecycle of a wind-farm (e.g. commissioning, end-of-warranty,

turbine upgrades) provide advantages over reactive and preventative O&M strategies.

With support from Enterprise Ireland, ServusNet initially focused on the US wind market, which provided a strong concentration of medium-sized, independent wind-farm owners and operators.



As the grid penetration rates for distributed renewable generation continue to increase, ServusNet is rolling out advanced features to enhance the predictability of wind and solar generation. The ability to accurately model and predict the energy production hours and days ahead unlocks value, not just at the generation stage but right along the energy value chain, including the grid integration, energy trading and demand management stages.



ServusNet is also pursuing customers in Europe where, with impending new energy regulations, operators are seeking to further improve asset use and energy predictability.

Irish companies are in a good position to capture around half of the investment in onshore wind energy, particularly during the planning, installation and quality-assurance stages. However, due to the lack of a heavy manufacturing base in Ireland, 13% of total investment in onshore wind is expected to be associated with manufactured imports. The remaining proportion of investment (€110 – €193 million p.a.), which covers areas such as operations & maintenance, insurance and manufacture of smaller components such as controls, gearboxes, transformers and generators, has the potential to be captured if support is given to developing capacity and exploiting local advantages.

Suppliers surveyed estimated that, when the Irish market for new wind-turbines grows to around 1GW a year, this will encourage the establishment of local manufacturing facilities for key components.

### Identified skills needs – Forfás report

A workforce with the necessary skills is needed so that Ireland can capture investment in the wind energy supply chain. Forfás has published a comprehensive document which outlines our current capacity to meet the demand for key skills in the green energy sector: *Future Skills Needs of Enterprise within the Green Economy in Ireland, 2010*.

A total of 20% of suppliers surveyed for this report indicated that they had problems recruiting sufficient engineers and numerate graduates with experience in sustainable energy technologies, and also reported a shortage of 'home-grown' technical specialists and competent contractors. Specific needs for better training in technical report writing and business management skills were also highlighted.



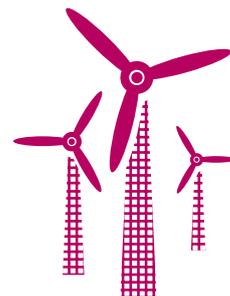
### EU market size for onshore wind generation

The Irish market for onshore wind up to 2020 represents around 2% of the EU market. The large size of the European market provides an attractive scale for both established Irish companies looking to export and to global companies interested in locating in Ireland in order to access the larger EU market.

Table 9 shows the estimated EU market size for onshore wind generation up to 2050. The figures are based on data from the European Commission, European Wind Energy Association and International Energy Agency (IEA).<sup>17</sup>

**Table 9: Estimated EU market size for onshore wind power generation**

|                                  | 2020   | 2030   | 2050   |
|----------------------------------|--------|--------|--------|
| Annual increase in capacity (MW) | 18,000 | 10,000 | 10,886 |
| Annual capital investment (€m)   | 16,380 | 8,400  | 9,252  |



<sup>17</sup> Full reference lists will be provided in the technical report online at [www.seai.ie](http://www.seai.ie).

### Figure 10: Onshore Wind - Capacity to capture investment

Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.<sup>1</sup>

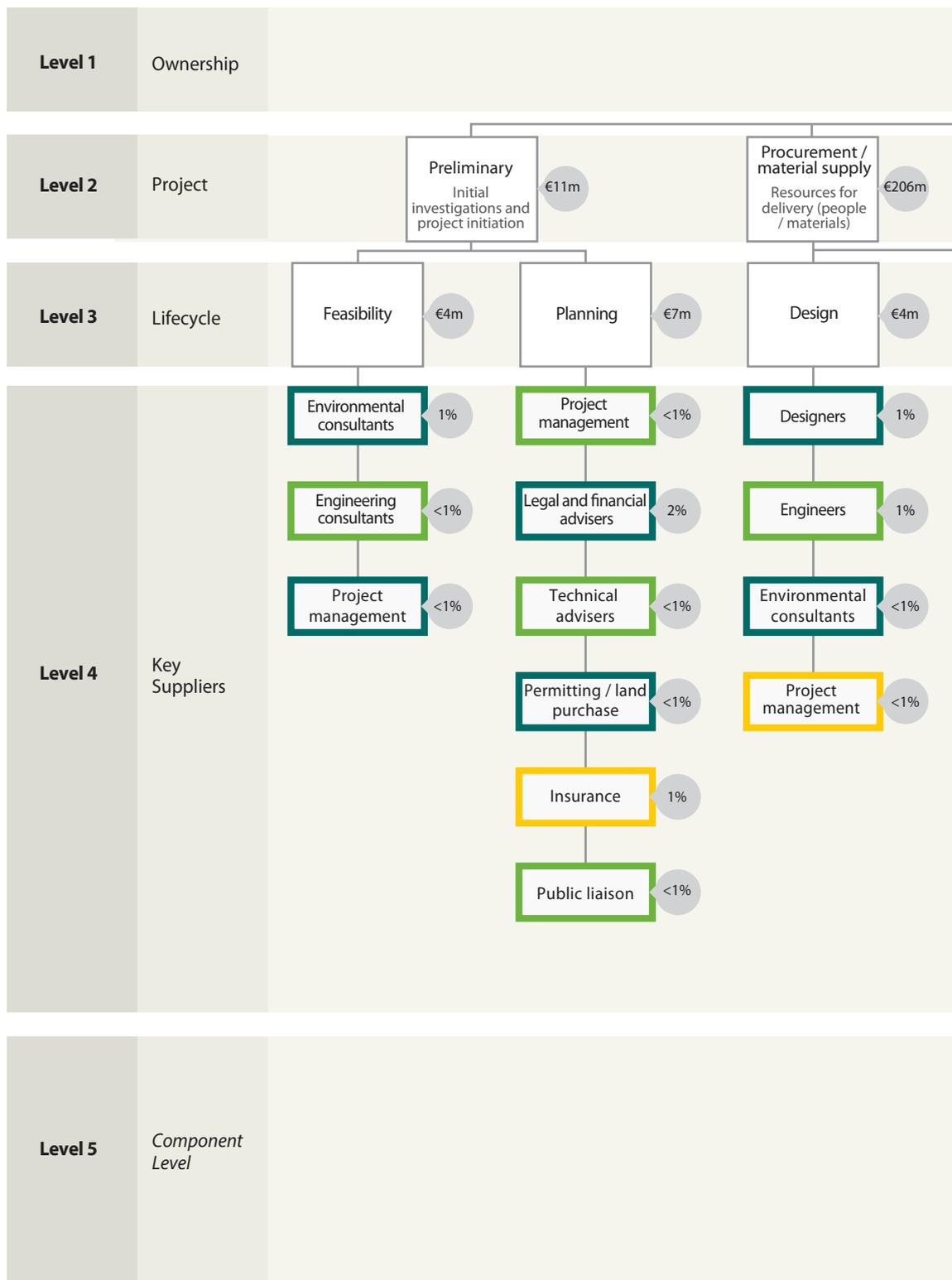
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Ireland is best placed to capture investment during the planning and installation of onshore wind, boosted by strong expertise in engineering.

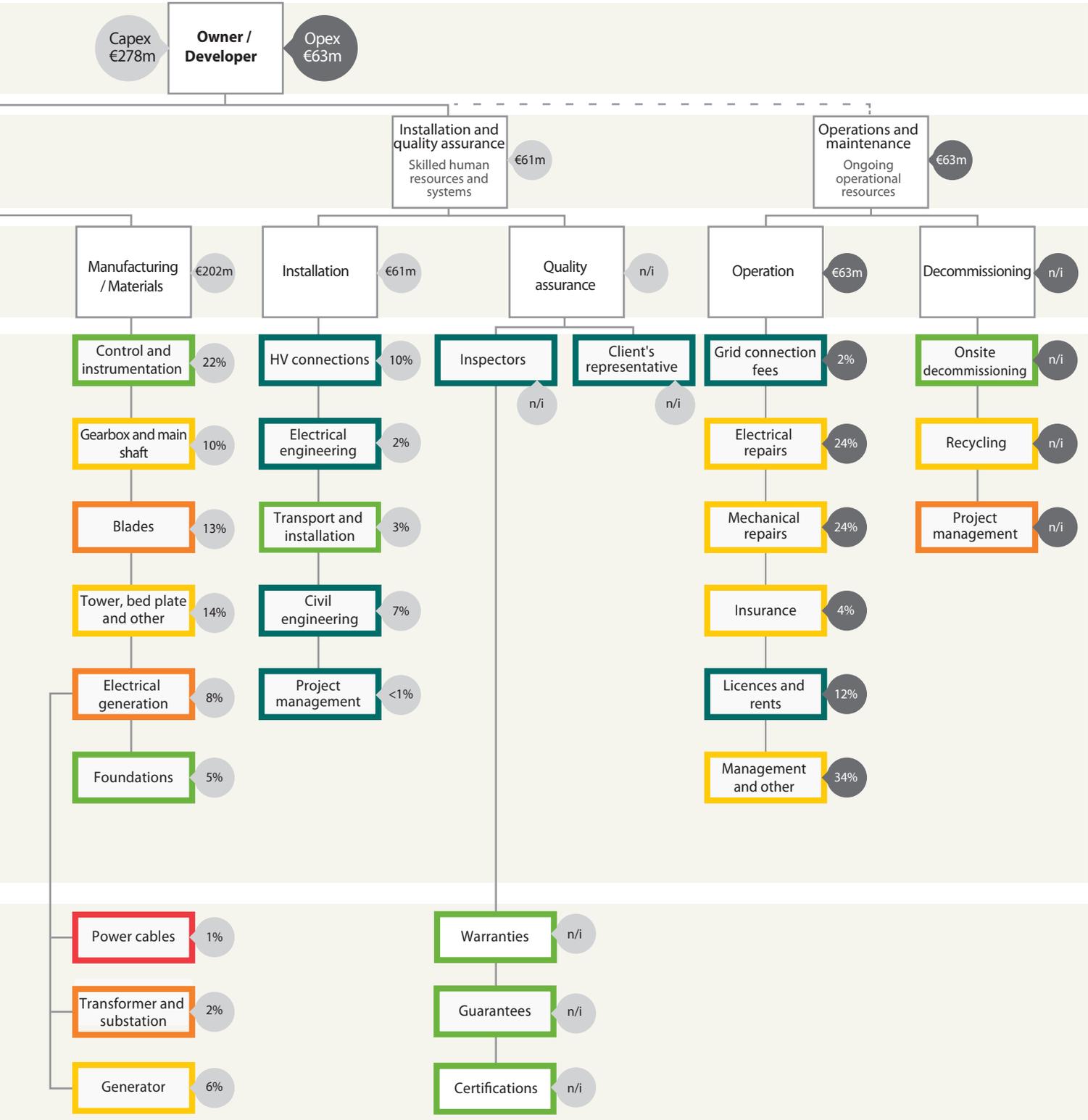
**There are many high value niches within the onshore wind supply chain being captured by Irish companies.**

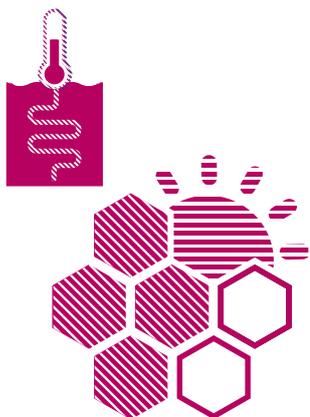
With sufficient critical mass, Irish companies have the skills and knowledge base to supply manufactured controls and instrumentation, comprising a substantial 22% of total Capex (approx. €44m per year).



<sup>1</sup>The published estimates did not include all supply chain divisions. These have been displayed as not included (n/i), and will be updated when data becomes available.

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# Renewable heat

The renewable heat technologies covered in this section are Anaerobic Digestion, Biomass CHP & Biomass Boilers, Solar Thermal and Heat Pumps. Separate supply chain maps are provided for each technology grouping.

The main expenditure in the biomass-fired CHP and heat generation supply chain is fuel (feedstock) supply, representing almost 70% of ongoing operational costs

Up to half of the renewable energy produced in Ireland by 2020 is expected to come from bioenergy. Biomass materials come from a wide variety of sources and can be used to produce energy for heat, electricity and transport. The SEAI Bioenergy Supply Curves<sup>18</sup> show that Ireland can supply its domestic requirements for bioenergy in heat and electricity, with potential to supply some of our transport needs.

Electricity and heat production from bioenergy can come from the direct combustion of woody biomass and organic materials or through the processing of the raw materials into biogas or biofuels. At present the direct combustion of biomass materials produces most bioenergy, but policy support for renewable electricity production in the Renewable Energy Feed-In Tariff (REFIT) scheme differentiates between technology types and seeks to expand the uptake of biogas production through anaerobic digestion.

The heat sector is responsible for over one-third of Ireland's energy demand. Most renewable heat energy comes from the combustion of biomass; a growing share is provided through solar thermal and heat pumps. Bioenergy for heat is predominantly used in large-scale applications to produce process heat where biomass boilers are competitive with oil. A significant portion of space heat requirements, particularly in larger buildings, is met by biomass. Heat pumps are providing an increasing share of the space heating requirement in homes and businesses.

<sup>18</sup> [http://www.seai.ie/Publications/Energy\\_Modelling\\_Group/Energy\\_Modelling\\_Group\\_Publications/BioEnergy\\_Supply\\_Curves\\_for\\_Ireland\\_2010\\_-\\_2030.pdf](http://www.seai.ie/Publications/Energy_Modelling_Group/Energy_Modelling_Group_Publications/BioEnergy_Supply_Curves_for_Ireland_2010_-_2030.pdf)



Increases in solar hot-water heating are being driven by the building regulation requirements in new homes and by grant support in older premises. Table 10 presents the estimated annual investment in Ireland in biomass combined heat and power (CHP) generation.

Table 11 shows the investment required to achieve the renewable energy target in the heat sector.

The main expenditure in the biomass-fired CHP supply chain is fuel (feedstock) supply, representing almost 70% of ongoing operational costs.

**Table 10: Estimated annual investment in biomass CHP and anaerobic digestion CHP in Ireland**

| Technology                    | Average capital investment by 2020: (€million/year) | Average O&M expenditure (€million/year) | Fuel supply (€m/year) |
|-------------------------------|---|---|-----------------------|
| Biomass CHP & Heat Generation | 53 – 66   | 130 – 154                               | 85 – 100              |
| Anaerobic Digestion (AD) CHP  | 5 – 9   | 11–12                                   | 0.5                   |

\* Fuel supply is a sub-set of O&M expenditure

**Table 11: Anticipated Capital Investment in Renewable Heat Technologies within Ireland 2013-2020**

|                                      | Total Capital Investment (€m) 2013 - 2020 | Average annual investment (€m) |
|--------------------------------------|---|--------------------------------|
| Domestic heat pumps (ASHP & GSHP)    | €25 - €40                                 | €4.5                           |
| Domestic solar thermal               | €825 – €1,240                             | €150                           |
| Biomass boilers                      | €90 - €135                                | €16                            |
| Commercial heat pumps (ASHP & GSHP)* | €70 - €105                                | €17.5                          |
| Commercial solar thermal             | €1.3 - €2.0                               | €0.3                           |
| <b>Total</b>                         | <b>€1,011 - €1,522</b>                    | <b>€187.3</b>                  |

\* Air Source Heat Pumps (ASHP), Ground Source Heat Pumps (GSHP)

Biomass fuel use represents the largest proportion of ongoing expenditure in the supply chain. SEAI's study of bioenergy supply indicates that the requirements for heat and electricity production could potentially be sourced domestically. Upfront capital cost expenditure is focused in the solar and heat pump sectors.

Fuel supply represents the largest ongoing expenditure and the Irish supply chain is well positioned to capture a proportion of this. International trade in biomass products will compete with domestic sources and biomass users must have confidence in the ability of local supply chains to deliver the required resource.

A breakdown of the anticipated Irish market according to how well positioned Irish organisations are to capture the investment is provided in Table 12 (biomass CHP) and Table 13 (renewable heat).

**Table 12: Current position of Irish supply chain for biomass CHP**

| Rating | Position to capture investment   | Anticipated average market size - 2013-2020 (€m/year) |
|--------|----------------------------------|---|
| 0      | No local supply chain at present | -   |
| 1      | Less well positioned             | 24  |
| 2      | Averagely positioned             | 10  |
| 3      | Well positioned                  | 135   |
| 4      | Very well positioned             | 32  |
|        | <b>Total</b>                     | <b>201</b>  |

**Table 13: Current position of Irish supply chain for renewable heat technologies**

| Rating | Position to capture investment   | Anticipated average market size - 2013-2020 (€m/year) |
|--------|----------------------------------|---|
| 0      | No local supply chain at present | -   |
| 1      | Less well positioned             | 98.5  |
| 2      | Averagely positioned             | 3   |
| 3      | Well positioned                  | 46  |
| 4      | Very well positioned             | 174   |
|        | <b>Total</b>                     | <b>321.5</b>  |

# Case Study

## Astellas – Replacing oil with Irish biomass

Coillte is a state-owned commercial enterprise involved in forestry, land-based businesses, renewable energy and panel products. The company was established in 1998, owns over 445,000 hectares of land (about 7% of the land cover of Ireland) and employs around 1,000 people. Coillte is playing a key leadership role in delivering renewable energy technologies and climate-change mitigation by providing biomass energy solutions to Irish industry. It offers evaluation of the technical and commercial viability of biomass technology to its clients, and long-term, secure biomass fuel supply contracts.

Astellas Ireland Ltd is a pharmaceutical plant that serves the worldwide market as the production base for the formulation and packaging of organ rejection drugs used in transplant surgery. About 300 people are employed at its plant. In line with its sustainability

and social responsibility programme, Astellas installed a new 352m<sup>2</sup> utilities building comprising a 1.6 MW biomass boiler and ancillary biomass fuel store. The wood-chip boiler was designed to supply the base steam demand for the facility, with the existing oil-fired boiler acting in standby/assist mode. Design and build was directly managed by Astellas and the project was successfully commissioned in February 2012.

Coillte was selected as the preferred biomass fuel supplier for the project due to its ability to underpin a long-term, secure and competitive fuel supply contract. Wood-chip prices are not exposed to the price volatility associated with fossil fuels, and can be fixed for long periods. Biomass feedstock is sourced from forest resources in the Kerry region.



## HDS and Aurivo – an all-Irish biomass project

HDS Energy, based in Kells, Co. Meath, is a leading European designer and manufacturer of industrial boiler plant and ancillary equipment. It excels in the customisation and engineering of turnkey energy projects to international standards. It has over thirty years' experience in the design, manufacture and installation of bespoke boiler solutions for large energy and power projects for clients in Europe and North Africa as well as Ireland.

Aurivo is the new face of Connacht Gold, rebranded in 2013. In 2012, the company merged with Donegal Creameries plc to become the largest milk processor and cooperative in the West, supplied by 1,000 dairy farmers in the surrounding regions. Turnover increased to €400 million and the number of employees rose from 570 to over 700.

These two Irish companies recently delivered a new biomass boiler at the Aurivo plant at Ballaghaderreen, Co. Roscommon. The €5.5m biomass plant – designed, manufactured, installed and commissioned by HDS Energy – will use 30,000 tonnes of woodchip per annum, obtaining its fuel locally from sustainable forestry and waste-wood processing materials sourced in the West and North-West. The 12 MW biomass boiler will result in the annual displacement of almost 5m litres of imported fuel oil and cut carbon emissions in half.

HDS Energy has capitalised on its continuous research and development programme by designing a biomass energy system that is capable of the retrofit of a CHP module so that the energy system can produce both electricity and steam for the dairy's utility demand. By 2016 Aurivo plans to export energy into the national electricity grid. The biomass plant, the first of its kind in the West, will make Aurivo the first large-scale milk processor in the country to switch to biomass as a source of energy.

Aurivo strives for continuous improvement and has found that the implementation of structured management systems helps to drive this improvement. In 2011 Aurivo Dairy Ingredients obtained certification for the international energy management standard ISO 50001 – an effort supported by SEAI. Since the implementation of the system, energy consumption has decreased dramatically, and has also led to reduced waste generation and chemical consumption, thus improving the organisation's overall environmental performance.



## EU market size for biomass-related power generation

The estimated EU market sizes for biomass-fired CHP and power generation up to 2050, and for AD CHP for 2020, respectively, are based on data from EU member states National Renewable Energy Action Plans (NREAPs), the International Energy Association technology Roadmap – Bioenergy for Heat and Power, and other EU data sources.

**Table 14: Estimated EU market size for biomass CHP, AD CHP & renewable heat technologies**

|  | 2020          | 2030            | 2050            |
|--|---------------|-----------------|-----------------|
| Biomass CHP and heat <sup>19</sup>               | 1,512         | 576             | 792             |
| Anaerobic Digestion (AD) CHP                     | 2,258         | -               | -               |
| Heat pumps (ASHP & GSHP)                         | 2,042         | -               | -               |
| Biomass boilers                                  | 2,856         | -               | -               |
| Solar thermal                                    | 14,212        | 46,900          | 43,300          |
| <b>Total annual capital investment (€m/year)</b> | <b>22,800</b> | <b>(47,746)</b> | <b>(44,092)</b> |



### *Packaging policy supports help make Austria a biomass leader*

Austria is a prime example of the economic potential from biomass development. In conjunction with reducing CO<sub>2</sub> emissions and improving energy security, the Austrian government focused on biomass to diversify and add value to the long tradition of sustainable forestry in the country and a longer-term vision to use bio-energy for the economic development of farmers. The state provided long-term support to all aspects of biomass boiler deployment, including legal obligations for use in large buildings, minimum standards for boiler emissions, financial incentives and public education programmes for potential end-users. New professional qualifications were introduced for installers and advisors. The supply chain invested €37m in 110 R&D projects, €7.4m of which was provided through a system of grants. Such initiatives have made Upper Austria one of the leading biomass regions in Europe and worldwide.

The approach used in Upper Austria could be used to develop the Irish biomass supply chain, particularly in the area of anaerobic digestion, with scope to market Irish solutions in overseas markets. Growth in the domestic market and public investment would support the development of new technology.

In comparison to Ireland, however, Austria has a natural advantage in the supply of solid bio-fuel as 47% of its total land area is covered in forests, compared to only 11% in Ireland. While the physically available biomass resource may expand in Ireland in the future, this will depend on the market price for bio-energy. At present, wide availability of biomass for import into Ireland is likely to lower the price for domestic bio-energy, thus discouraging local production. More detail is available in *Bioenergy Supply Curves for Ireland (SEAI, 2013)*.

<sup>19</sup> Based on capacities supported by REFIT 3

The estimated average expenditure market between 2013 and 2020 relating to renewable heat technologies included in this study is overlaid on the supply chain maps that follow. Separate maps are provided for Biomass CHP & Boilers, Anaerobic Digestion, and Solar and Heat Pumps (aggregated map). A range of Irish, UK and EU publications were referenced to estimate the breakdown.<sup>20</sup>



Biomass fuel represents the largest proportion of ongoing expenditure in the supply chain, while solar and heat pumps represent the largest proportion of capital expenditure.

In general, most supply chain areas in the biomass sector are in a good position to capture the anticipated investment over the coming years. Specialist manufactured products such as air-filtration equipment are more likely to be imported, but most professional and engineering services are expected to be locally sourced. According to our survey of leading industry members in renewable energy, one-third of the suppliers indicated that market scale was needed to grow their business and that further government action could help stimulate this, particularly in the biomass and CHP areas.

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<sup>20</sup> Full reference lists are provided in the technical report which will be made available online at [www.seai.ie](http://www.seai.ie).



### Figure 11: Renewable Heat - Capacity to capture investment

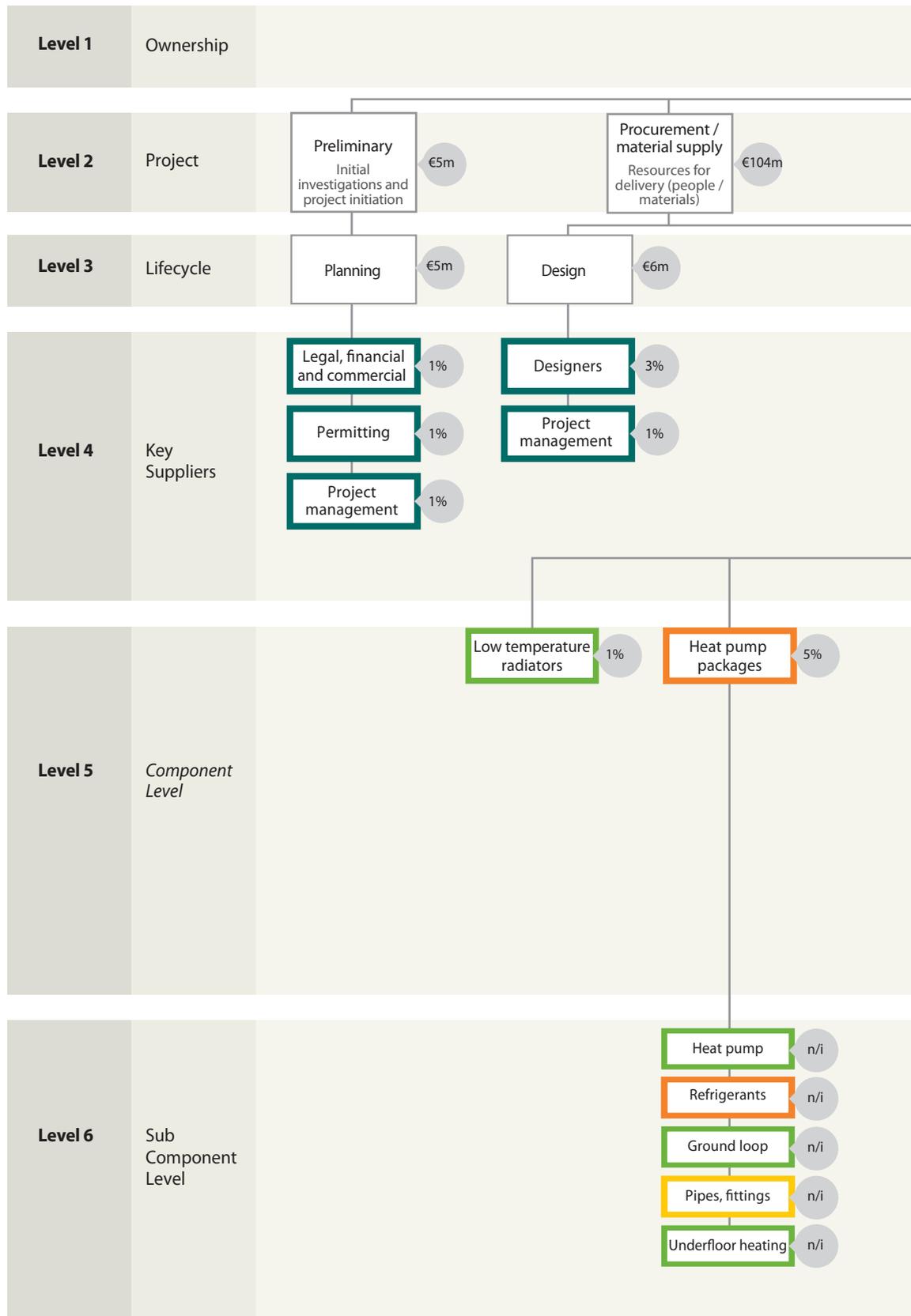
Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.<sup>1</sup>

All €m figures are per year averaged (2013-2020).

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them. Percentage breakdown of CAPEX (light grey) and OPEX (dark grey) totals are provided for Level 4 and below. Some rounding has occurred.

Current building regulations require that a proportion of energy consumption in new dwellings is provided by renewable energy sources. Solar thermal panels are a popular approach to satisfying this requirement, estimated to account for 53% of total projected annual capital expenditure on renewable heat up to 2020. Solar panels tend to be manufactured outside of Ireland and installed by domestic distributors. Specialised biomass boilers are also likely to be imported, however the pipes and controls are domestically available and Ireland is well placed to provide the skills required for the design and installation of biomass boiler systems.

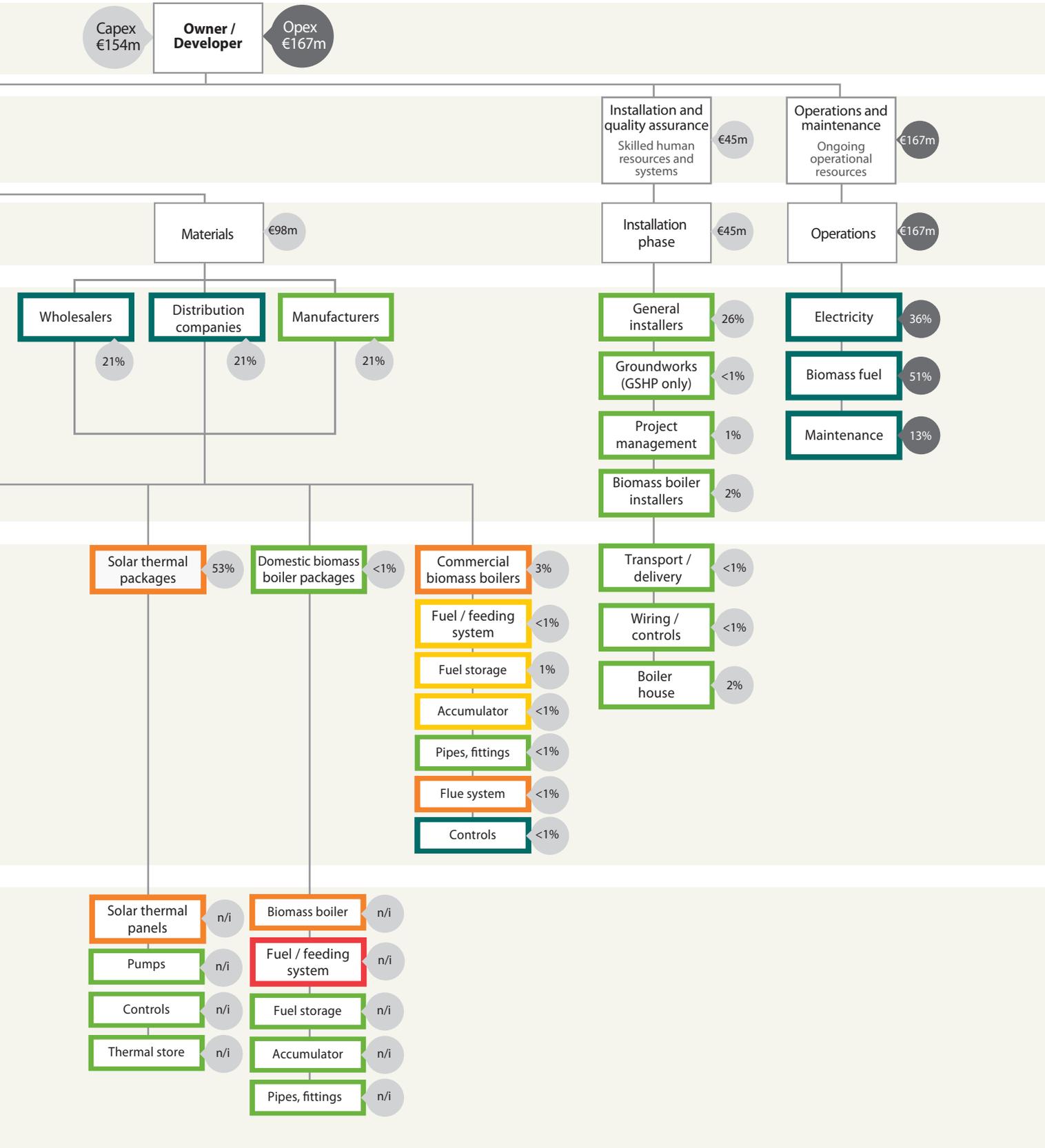
The majority of expenditure on ongoing operations costs in the renewable heat sector is on fuel for biomass boilers. There is already established activity in this area in Ireland with significant existing expertise, although some barriers affecting capacity to scale may need to be addressed.



<sup>1</sup> The published estimates did not include all supply chain divisions.

These have been displayed as not included (n/i), and will be updated when data becomes available.

**'Very well positioned'** - no significant barriers to address  
**'Well positioned'** - some barriers affecting capacity to scale to be addressed  
**'Average'** - action is needed to develop capacity and exploit local factors  
**'Less well positioned'** - concerted action required to reinforce supply chain  
**'No local supply chain at present'** - longer term action needed to establish Irish presence



### Figure 12: Biomass CHP and heat generation - Capacity to capture investment

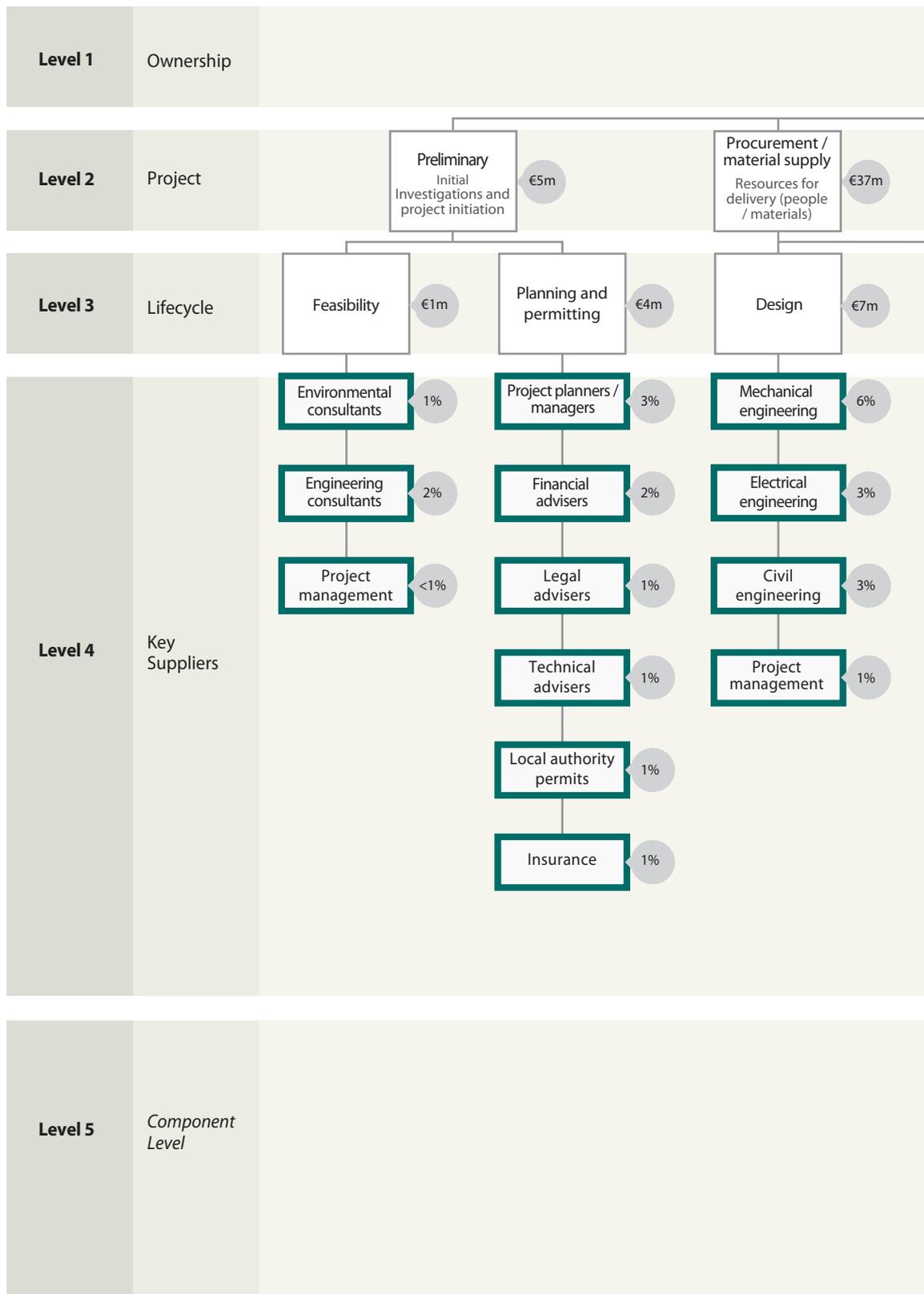
Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.<sup>1</sup>

All €m figures are per year averaged (2013-2020).

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them. Percentage breakdown of CAPEX (light grey) and OPEX (dark grey) totals are provided for Level 4 and below. Some rounding has occurred.

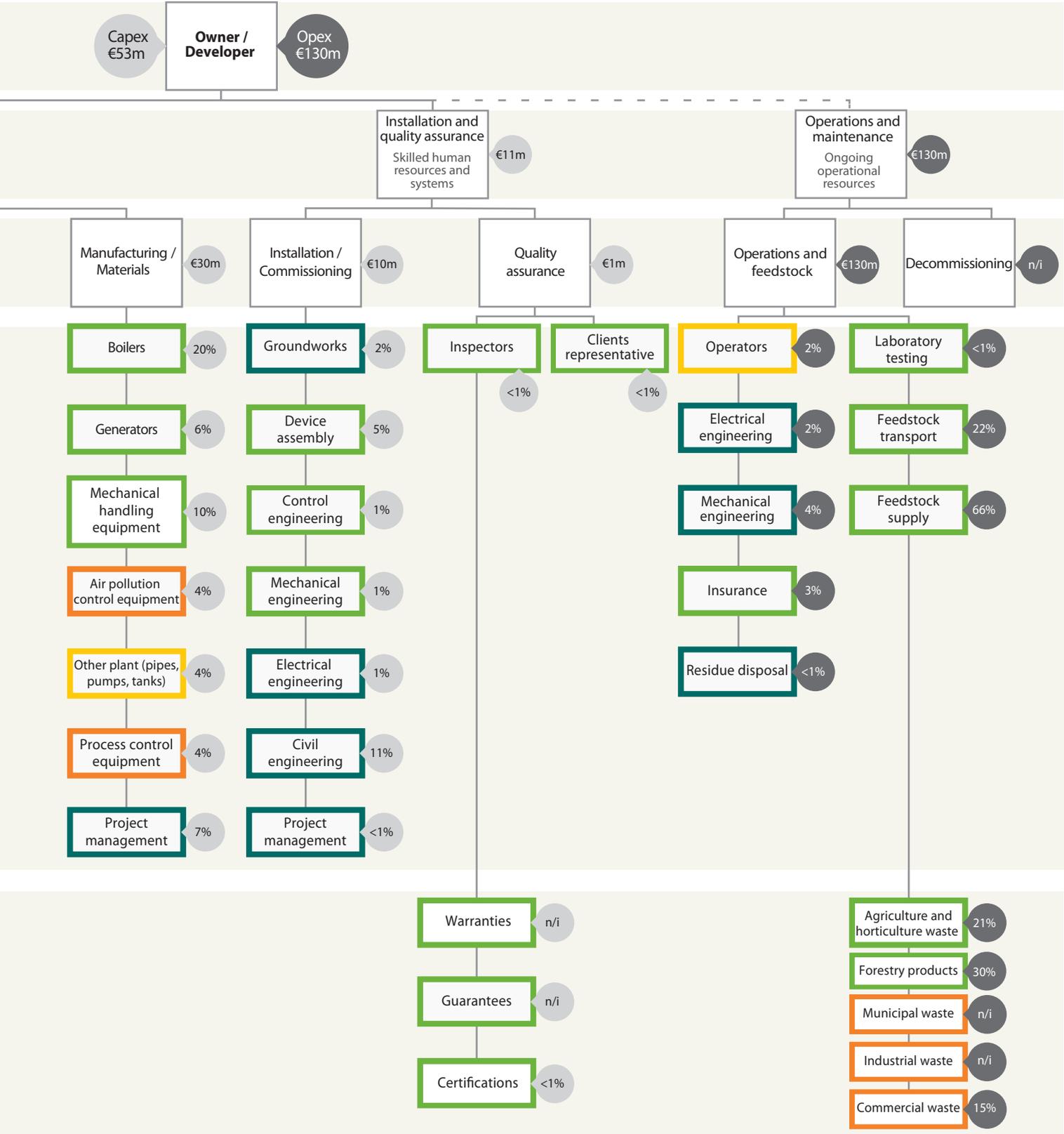
The majority of the necessary factors for development of an indigenous biomass supply chain already exist in Ireland, with the exception of speciality manufacturing such as air pollution/control equipment and process control equipment which is protected by intellectual property rights.

However, most areas in the biomass sector are already well served by the Irish supply chain, only somewhat limited by procurement agreements in place between large key players. Greater integration of the Irish market is expected as investment continues to grow.



<sup>1</sup>The published estimates did not include all supply chain divisions. These have been displayed as not included (n/i), and will be updated when data becomes available.

**'Very well positioned'** - no significant barriers to address  
**'Well positioned'** - some barriers affecting capacity to scale to be addressed  
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**'Less well positioned'** - concerted action required to reinforce supply chain  
**'No local supply chain at present'** - longer term action needed to establish Irish presence



### Figure 13: Biomass AD - Capacity to capture investment

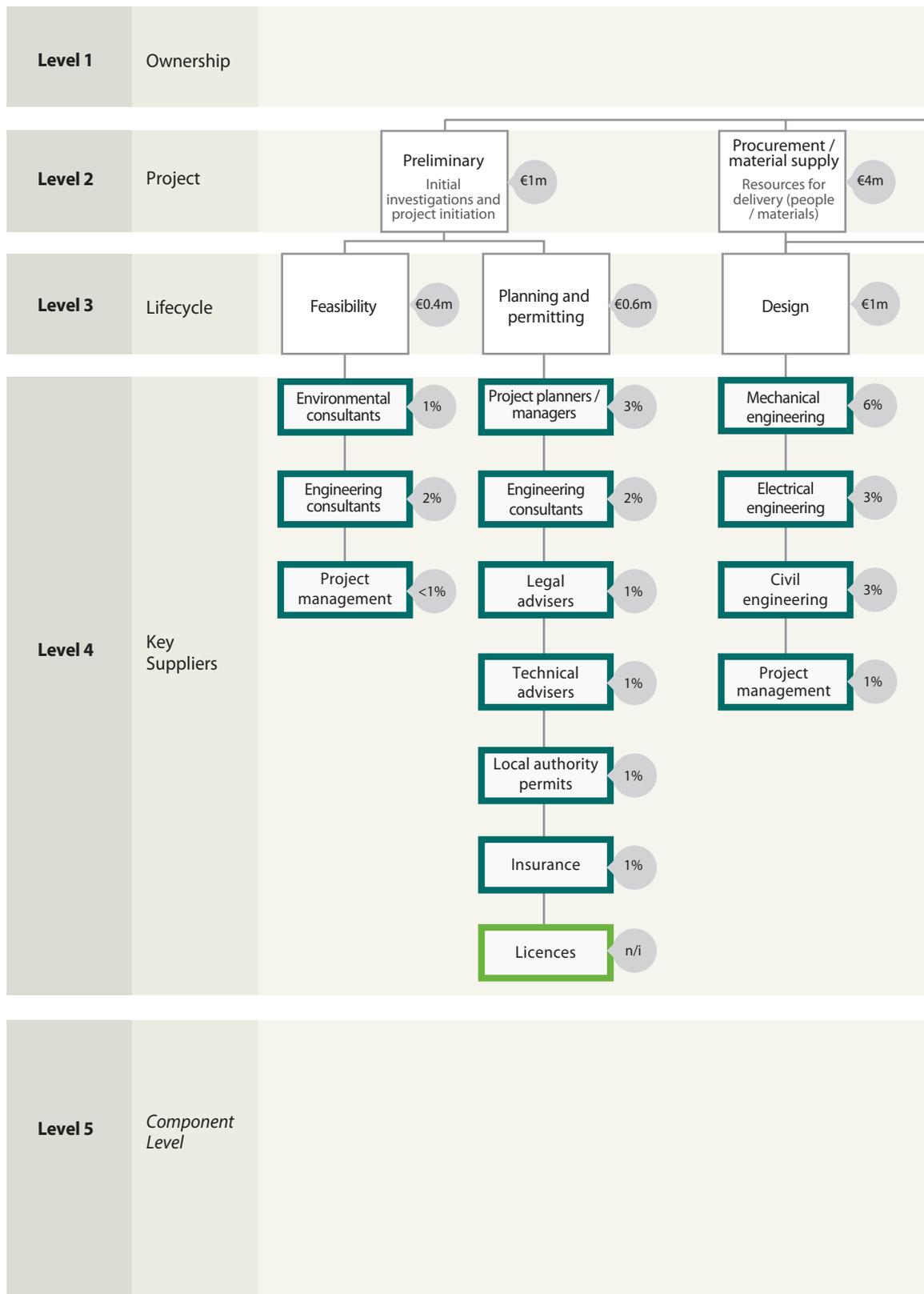
Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.<sup>1</sup>

All €m figures are per year averaged (2013-2020).

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them. Percentage breakdown of CAPEX (light grey) and OPEX (dark grey) totals are provided for Level 4 and below. Some rounding has occurred.

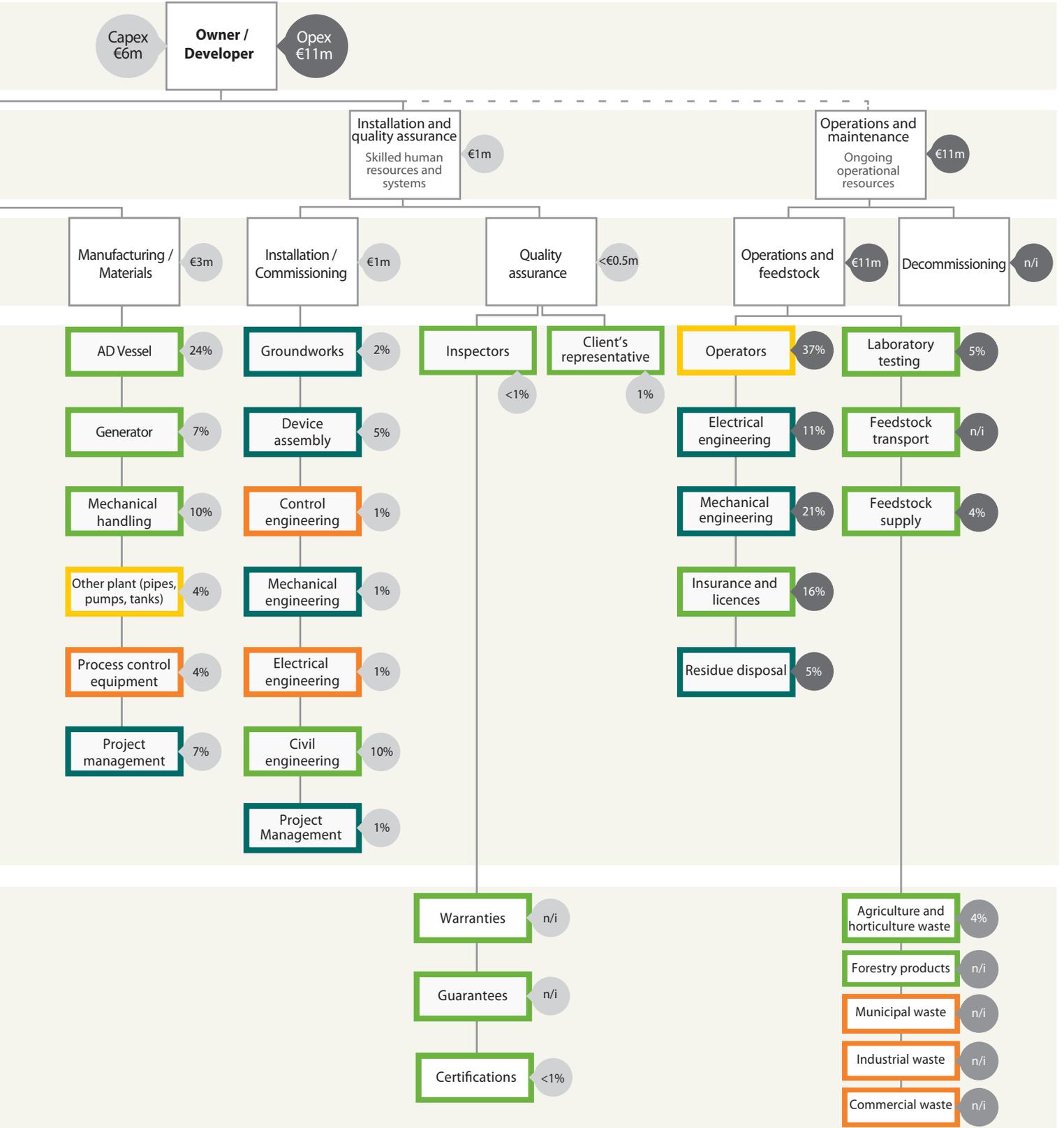
AD systems are less standardised than biomass combustion plant. AD systems can work with a variety of feed stocks, whose solids content and biogas generation potential can vary considerably. These aspects impact on a number of design aspects, which can lead to variations in costs.

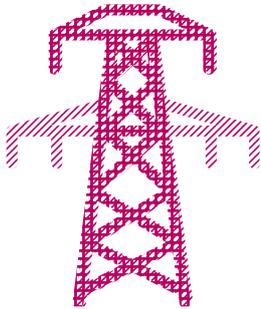
Apart from specialty manufactured control equipment and engineering, most of the anaerobic digestion supply chain is already either somewhat developed or well established in Ireland. If the AD market experiences further growth post 2020 there is potential for Ireland to develop niche markets in AD manufacturing. At present the technology is considered too expensive for widespread deployment – so innovations to cut costs will be important. Manufacturers could be challenged to develop new lower cost packaged solutions that make use of Ireland’s indigenous biomass resource.



<sup>1</sup>The published estimates did not include all supply chain divisions. These have been displayed as not included (n/i), and will be updated when data becomes available.

**'Very well positioned'** - no significant barriers to address  
**'Well positioned'** - some barriers affecting capacity to scale to be addressed  
**'Average'** - action is needed to develop capacity and exploit local factors  
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# Electricity transmission grid

All key national entities, including the energy regulator, the distribution and transmission system operators and the renewable energy sector, are working with the Government to deliver the 2020 NREAP targets through grid connection and grid development strategies.

As Ireland moves towards obtaining 40% of electricity from renewable sources by 2020, the Irish grid increasingly has to cope with the challenges posed by large amounts of intermittent power. The Irish Transmission System Operator, EirGrid, is examining the issues in detail and undertaking several renewables facilitation studies to enable effective management of the grid and stability of the electricity system during this transition. The All-Island Single Electricity Market, overseen by the regulatory authorities north and south, is progressively evolving to take account of the growth in renewable energy.

The Grid 25 programme sets out the framework to build a more cost-effective and efficient electricity system to support development in the regions, ensure continued reliability and security of supply (an essential condition for all businesses), enable use of Ireland's natural renewable energy resources, reduce emissions, and enable increased connectivity to the European grid. A total investment of €3.2 billion is planned over the period to 2025 to achieve the multiple aims of grid development.

**Table 15: Estimated annual investment – the Irish electricity transmission grid**

| Technology                    | Average capital investment by 2020 (€m/year) | Average Operations & Management expenditure (€m/year) |
|-------------------------------|--|---|
| Electricity transmission grid | 290 – 350                                    | 45 – 70   |

# Case Study

## Kirby Group – From Irish roots to international success

Kirby Group is one of Ireland's largest engineering firms, founded in 1964, with operations in Dublin, Galway, Limerick, the UK and Europe. From only 10 employees in the late 1980s, the company initially expanded its operations from Limerick to Dublin and secured contracts with multinational technology and pharmaceutical companies in Ireland including Intel, IBM, Analog Devices and Janssen Pharmaceutical, part of Johnson & Johnson. With core strengths in electrical and mechanical engineering, controls, power and energy, data technology and engineering design, Kirby Group focussed on servicing a range of existing cutting edge clusters already based in Ireland.

After establishing itself in the domestic market, Kirby Group won several contracts to work on gas-fired power station projects in the UK, eventually leading to the establishment of offices in London and Manchester. Over the years the company has developed a first class mechanical engineering division, which now accounts for 30 per cent of its turnover, and electrical division which has won significant power generation and transmission contracts in Britain and Ireland for companies such as ESB, Eirgrid, Siemens and Alstom.

The company has just opened its third British office in Glasgow arising out of a framework agreement with Scottish Power. Kirby Group's UK operations account for about 25 per cent of its revenue and include contracts such as the design and construction of a major new energy centre in Burton-on-Trent for Brewer Molson Coors, won in 2013.

While expansion into the UK has been the primary driver of growth, business in Ireland has also improved significantly. Turnover is expected to rise to €100 million in 2014 and the company employs over 600 staff across Ireland and Britain. The group is now looking to expand into the Benelux region, where it sees opportunities for further growth.

Mark Flanagan, Kirby Group's Operation Director notes that: *"The IDA is doing a great job at attracting foreign direct investment into Ireland. There has been some understandable concern in recent years over the patent cliff in the pharmaceutical industry, but we are seeing new medical device companies coming in, as well as some generic manufacturers, which is very promising for Ireland. A lot of our clients are busy at the moment, which means we're also busy. But we understand it can be cyclical, and we are not complacent. We are looking at every opportunity to expand, and to safeguard the business for the future."*



A breakdown of the anticipated Irish market according to how well positioned Irish organisations are to capture the investment is shown in the table. Further detail is provided in the supply chain map (Figure 14).

**Table 16: Current position of Irish supply chain for electricity transmission grid**

| Rating | Position to capture investment   | Anticipated average market size - 2013-2020 (€m/year) |
|--------|----------------------------------|---|
| 0      | No local supply chain at present | 45  |
| 1      | Less well positioned             | -   |
| 2      | Averagely positioned             | 40  |
| 3      | Well positioned                  | 132   |
| 4      | Very well positioned             | 135   |
|        | <b>Total</b>                     | <b>352</b>  |

### EU market size for electricity transmission grid investment

The estimated EU market size for electricity grid investment up to 2050 is based on the European Commission's 2050 Energy Roadmap – Impact Assessment & Scenario Analysis.

**Table 17: Estimated EU market size for electricity transmission grid investments**

|                                     | 2020   | 2030   | 2050   |
|-------------------------------------|--------|--------|--------|
| Annual capital investment (€m/year) | 33,700 | 41,600 | 47,950 |

### *Securing jobs with enterprising policy in Italy*

The Lombardy region of Italy used enterprise policy to overcome barriers and encourage the development of an indigenous sustainable energy supply chain. In 2008, to prevent the number of firms in the region decreasing due to the financial crisis, the Lombardy Energy Cluster was established with a focus on power generation, transmission and distribution. This includes 100 small to medium enterprises employing 7,228 people with €8.5bn annual turnover, 10 universities and five research centres with 480 lines of research. Most members of the cluster have developed new products or improved products.

The Lombardy Energy Cluster is financed by three sources: 20% to 30% from members' fees, 65% to 75% by Lombardy Region and other local institutions such as the Chamber of Commerce of Varese, and around 5% from the Ministry of Economic Development. The Italian national and regional governments also created the Driade programme (2008-13) to support new and different forms of consortium, local production systems and supply chains. This was co-financed by the region of Lombardy and the Ministry of Economic Development at a total cost of €14.7m.

The estimated average expenditure in the electricity transmission grid between 2013 and 2020, overlaid on the supply chain map, is shown in Figure 14. A considerable amount of high-level cost breakdown data has been published by EirGrid and the Commission for Energy Regulation (CER) in respect of proposed transmission-grid improvement projects. However, the published breakdown of capital investment by category was more limited, so estimated cost breakdowns for UK grid upgrade projects were used to develop a more detailed breakdown.

The areas of the Irish supply chain for the transmission grid that face the greatest barriers to domestically capturing investment are: manufactured cables, underground pipes, insulators and conductors.



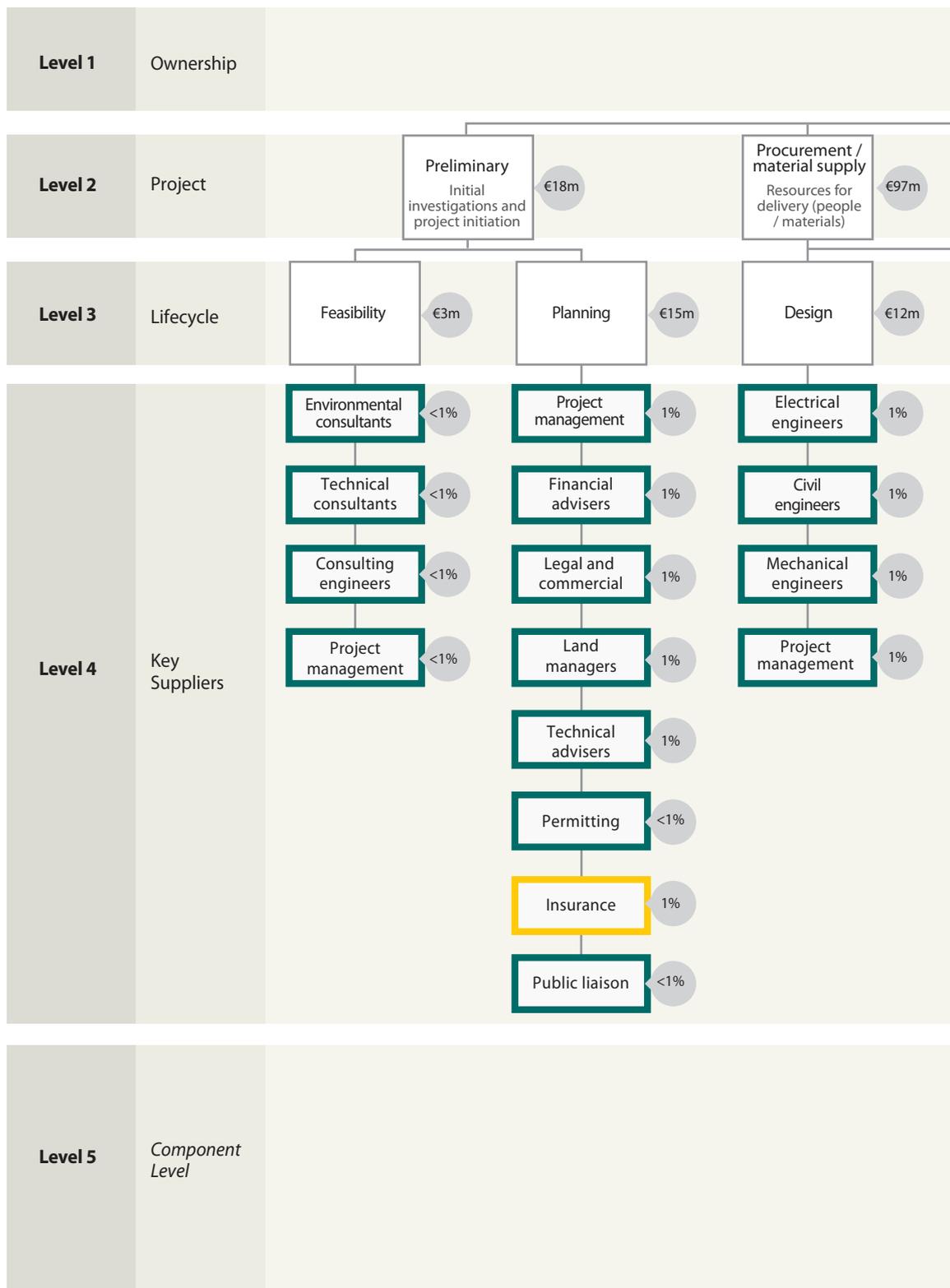
### Figure 14: Electricity Grid - Capacity to capture investment

Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.<sup>1</sup>

All €m figures are per year averaged (2013-2020).

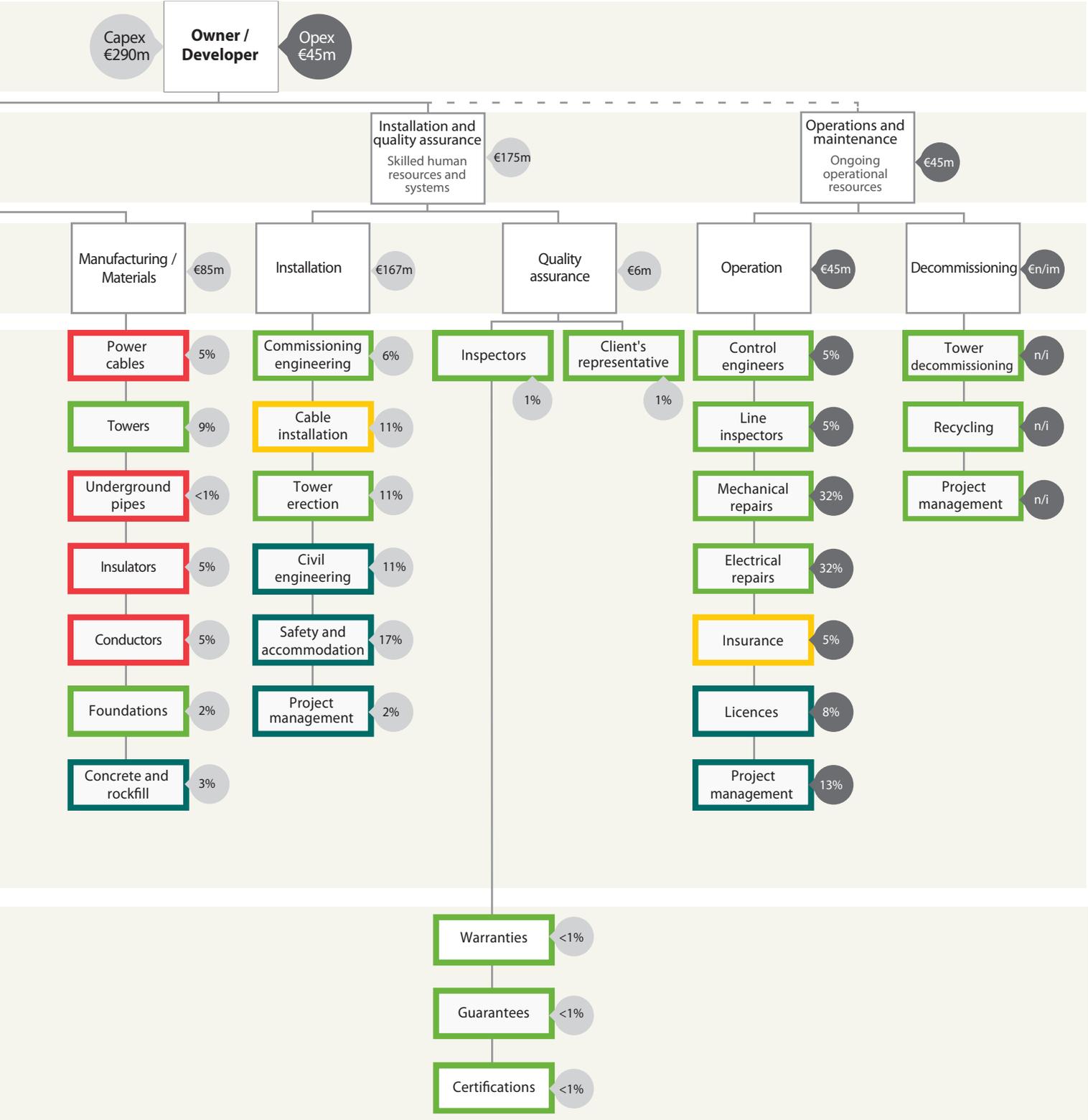
The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them. Percentage breakdown of CAPEX (light grey) and OPEX (dark grey) totals are provided for Level 4 and below. Some rounding has occurred.

The Irish supply chain is very well positioned in all of the preliminary and design aspects of the development of the electricity grid. Installation and operations may require some scale incentives for supply chain expansion. The areas of the Irish supply chain that face the greatest barriers to domestically capturing investment are manufactured cables, underground pipes, insulators and conductors.



<sup>1</sup>The published estimates did not include all supply chain divisions. These have been displayed as not included (n/i), and will be updated when data becomes available.

**'Very well positioned'**- no significant barriers to address  
**'Well positioned'**- some barriers affecting capacity to scale to be addressed  
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# Small-scale generation technologies

Three technologies are included under the heading of small-scale generation for the purpose of this report: small-scale wind, solar photovoltaics (PV) and small hydroelectric (hydro) power.

Definitions of what qualifies as small-scale generation vary considerably from country to country. For the purposes of this work, we have adopted the definition used by the Electricity Supply Board (ESB) of Ireland<sup>21</sup> which is based on the European standard EN 50483. This sets an upper boundary for small-scale generation of 11 kW for a three-phase grid connection (at 400V) and 6kW for a single-phase grid (230V).

The relative split in investment levels between the three small-scale generation technologies considered is indicated in Table 18.

**Table 18: Range of installed costs for small-scale electricity generation**

|           | Installed cost range (€/kW) |
|-----------|-----------------------------|
| Solar PV* | €1,200 - €2000              |
| Wind**    | €4,000 - €5,000             |
| Hydro***  | €3000 - €5,000              |

\* The solar PV figure is based on installations between 4.5 and 10kW

\*\* The wind figure is based on installations between 2.5 and 6kW

\*\*\* The Hydropower figure is based on installations of the less than 15kW.

Annual operating costs for small-scale wind-turbines, solar PV and small-scale hydroelectric plant are typically around 3%,<sup>22</sup> 0.4% and 2% of capital costs, respectively.

<sup>21</sup> [http://www.seai.ie/Renewables/Microgeneration/Microgeneration\\_FAQ/#whatis](http://www.seai.ie/Renewables/Microgeneration/Microgeneration_FAQ/#whatis)

<sup>22</sup> [http://www.seai.ie/Publications/Energy\\_Modelling\\_Group/SEAI\\_2050\\_Energy\\_Roadmaps/Wind\\_Energy\\_Roadmap.pdf](http://www.seai.ie/Publications/Energy_Modelling_Group/SEAI_2050_Energy_Roadmaps/Wind_Energy_Roadmap.pdf)

# Case Study

## C&F Green Energy designed and manufactured in Ireland

C&F Green Energy is part of the Irish-owned C&F Group. C&F, established in 1989 in Galway employs over 2,200 people in seven sites worldwide. With manufacturing locations in Ireland, Germany, Czech Republic, USA, Philippines and China, and offices in the UK, Italy and Japan, C&F is a global company with a local face.

C&F's engineering capabilities are reflected in its customer list, which includes IBM, EMC, BMW, Mercedes, Ford, VW, Thermo King, which have all awarded C&F multiple global contracts. C&F Green Energy was officially established by the C&F Group in 2008. The group CEO recognised the need to provide a more powerful and safer wind-energy solution for home, farm and business owners.

With its experience in the manufacturing area, C&F set about designing an innovative wind-turbine that would combine high performance and power with clean aesthetics and reliability. It assembled a world-class team of industrial design experts in this field to deliver solutions based on innovation and engineering excellence. The group's success is attributed to its workmanship quality, streamlined manufacturing processes and customer care and retention. This team developed an innovative range of small to medium-sized turbines that incorporate the same advanced technologies that are used in megawatt-sized turbines. Leveraging the company's expertise in manufacturing and design and its global reach enabled C&F Green Energy to offer this advanced technology at competitive prices.

All the wind-turbines are designed and manufactured in Ireland. The main markets are the UK, Italy and Japan, due to the feed-in tariffs set by these countries to reduce dependence on fossil fuel. C&F currently has contract offers in the €30m range and, in the renewable part of its business, employs around 400 people. Since it is to start manufacturing towers and blades in Ireland, employee numbers are to increase in the near future.



The estimated breakdown of the anticipated Irish market according to how well positioned Irish organisations are to capture the investment is shown in Table 19.

**Table 19: Current position of Irish supply chain for small-scale generation**

| Rating | Likelihood of growth in Irish share of market                | Anticipated average market size - 2013-2020 (€m/year) |
|--------|--|---|
| 0      | Very unlikely  | 1.2   |
| 1      | Possible but unlikely  | 1.1   |
| 2      | Potential for the future                                     | 4.6   |
| 3      | Short-term growth expected                                   | 2.9   |
| 4      | Limited scope for further growth (in established businesses) | 3.8   |
|        | <b>Total</b>   | <b>13.6</b>   |

In general, the areas of the supply chain considered to be poorly positioned to capture investment are those where there is no significant manufacturing base (e.g. solar panels). However, Irish organisations are well positioned to capture investment related to the manufacture of micro-turbines as there are well-established Irish manufacturers in this area.

### EU market size for small-scale generation

The estimated EU market size for small-scale generation up to 2020 was estimated using member states' NREAPs and publications by the European Photovoltaic Industry Association. No EU market estimates were available for 2030 or 2050.

**Table 20: Estimated EU market size for small-scale generation**

|                                     | 2020  |
|-------------------------------------|-------|
| Annual capital investment (€m/year) | 9,146 |

The estimated average expenditure of the small-scale generation market between 2013 and 2020 is overlaid on the supply chain map shown in Figure 15.

There is a considerable amount of variability in the estimated breakdowns of capital costs, particularly for micro-hydro where there are many determinants of total capital costs, including the vertical distance the water cascades down, the width of the river, the distance to the nearest electrical power supply and whether there is a need for a fish ladder. Because of the variability in hydro estimates, a larger number of relevant studies were reviewed.

The capital and O&M cost breakdowns are mainly based on SEAI's analysis of Small- and Micro-scale Generation Pilot Field Trials.



### Figure 15: Small-Scale electricity generation - Capacity to capture investment

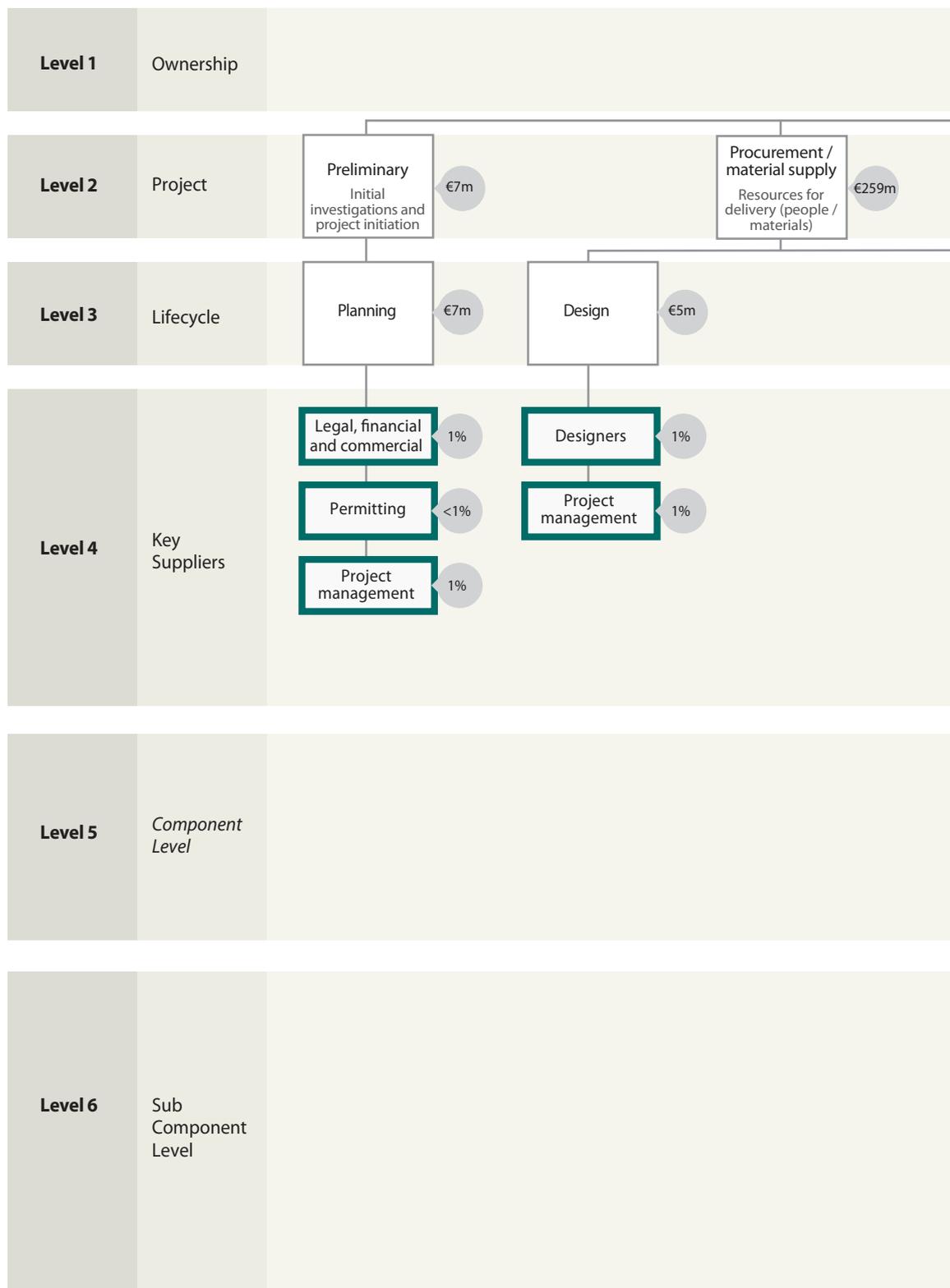
Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.

All €m figures are per 100MW installed capacity.

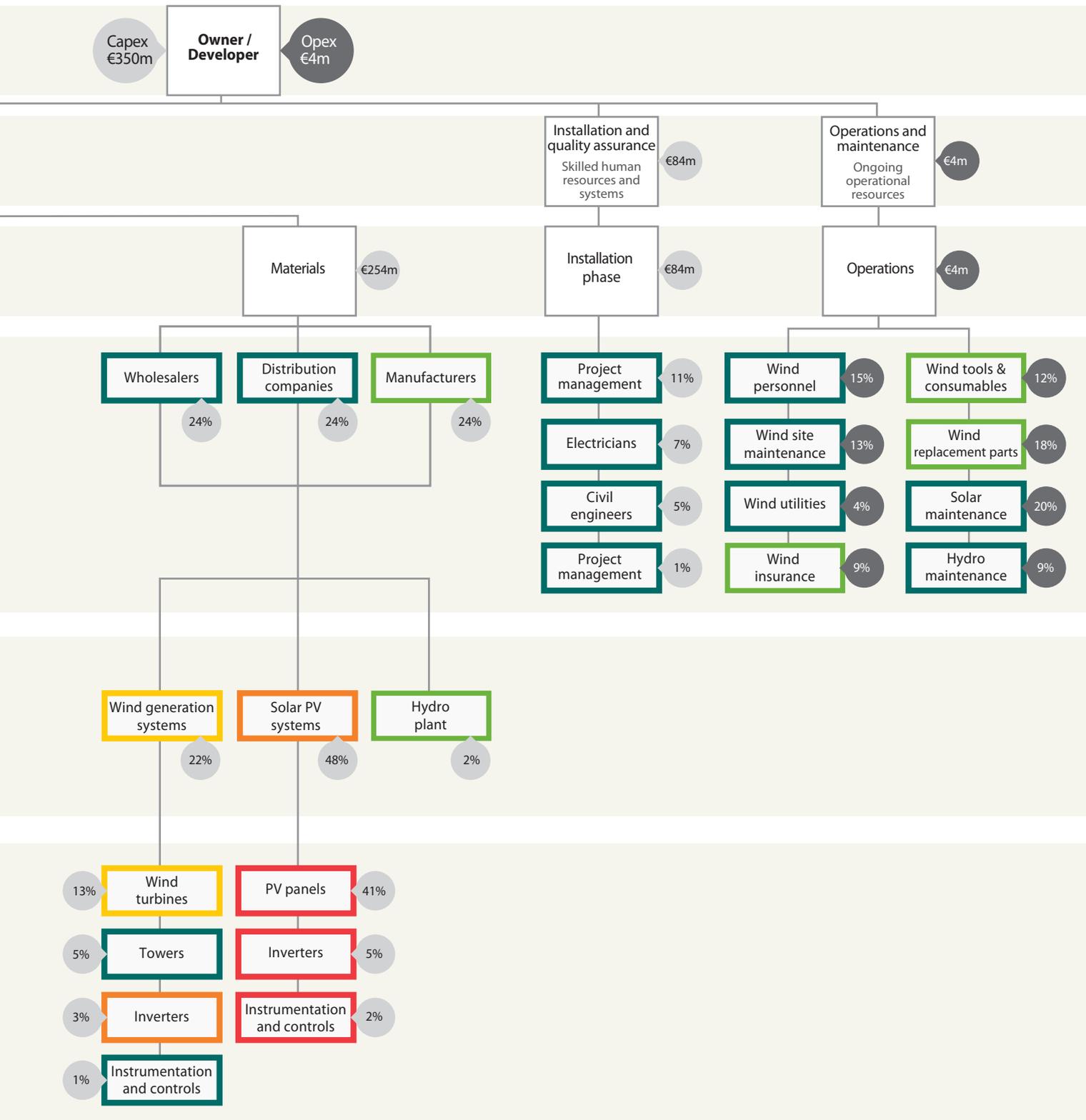
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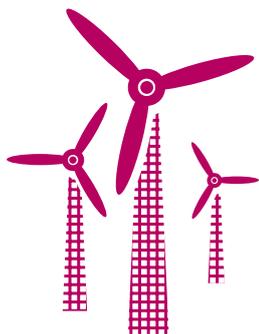
The planning, design, installation and maintenance of the micro-generation market is well served by existing Irish industry.

The manufacturing of micro-gen technology such as solar PVs and inverters is already captured elsewhere rendering Irish infiltration of the market unlikely.



**'Very well positioned'**- no significant barriers to address  
**'Well positioned'**- some barriers affecting capacity to scale to be addressed  
**'Average'**- action is needed to develop capacity and exploit local factors  
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# Offshore wind energy

Ireland has vast offshore wind resource potential due to the extensive area of the Irish Exclusive Economic Zone (EEZ) in the Atlantic and Irish Sea. SEAI's Wind Energy Roadmap outlines the potential to install up to 30 GW of offshore wind capacity by 2050, which could allow Ireland to export considerable amounts of renewable electricity to the UK and beyond, when combined with the necessary electricity transmission upgrades.<sup>25</sup>

A study which considered the maximum capacity of the entire Irish EEZ estimated it at almost 2,000 GW.<sup>26</sup> At present, offshore wind energy development worldwide is concentrated in European waters. A dynamic European supply chain industry supporting offshore wind is expected to have a strong effect on future cost and deployment in Ireland. In the recent Gate 3 round of grid connection offers, approximately 800 MW was included for offshore wind. Most of the proposed offshore wind-farms are located in the Irish Sea, close to the east coast where the grid is currently more developed.

There are currently no specific government schemes in place to support offshore wind projects, but as this is an important area for future development it has been included in the analysis.

The typical capital investment costs for offshore wind are estimated at €3m per MW.<sup>27</sup> Operating & maintenance costs are estimated at between 2% and 4% of capital costs.<sup>28</sup>

A breakdown of the anticipated Irish market (per 100 MW of installed offshore wind capacity) according to how well positioned Irish organisations are to capture the investment is shown in Table 21. Further detail is provided in the supply chain map (Figure 16).

**Table 21: Current position of Irish supply chain for offshore wind sector**

| Rating | Position to capture investment   | Anticipated average market size – 2013-2020 (€m/year) per 100 MW installed |
|--------|----------------------------------|--|
| 0      | No local supply chain at present | 5.5  |
| 1      | Less well positioned             | 45   |
| 2      | Averagely positioned             | 145  |
| 3      | Well positioned                  | 140  |
| 4      | Very well positioned             | 5.5  |
|        | <b>Total</b>                     | <b>341</b>   |

<sup>25</sup> [http://www.seai.ie/Publications/Energy\\_Modelling\\_Group/SEAI\\_2050\\_Energy\\_Roadmaps/Wind\\_Energy\\_Roadmap.pdf](http://www.seai.ie/Publications/Energy_Modelling_Group/SEAI_2050_Energy_Roadmaps/Wind_Energy_Roadmap.pdf)

<sup>26</sup> [http://www.seai.ie/Renewables/Ocean\\_Energy/Ocean\\_Energy\\_Information\\_Research/Ocean\\_Energy\\_Publications/Offshore\\_Wind\\_Study.pdf](http://www.seai.ie/Renewables/Ocean_Energy/Ocean_Energy_Information_Research/Ocean_Energy_Publications/Offshore_Wind_Study.pdf)

<sup>27</sup> Export Policy: A renewables development policy framework for Ireland, Irish Wind Energy Association, 2012.

<sup>28</sup> Offshore wind: The cost challenge, Presentation by PVilliers, Carbon Trust, 2012.



## EU market size for offshore wind generation

An estimate of the EU market size for offshore wind generation up to 2050 is shown in Table 22. Data is sourced from the NREAPs of European member states, the European Wind Energy Association and the International Energy Agency.

**Table 22: Estimated EU market size for offshore wind power generation**

|                                  | 2020   | 2030   | 2050   |
|----------------------------------|--------|--------|--------|
| Annual increase in capacity (MW) | 7,000  | 14,000 | 15,240 |
| Annual capital investment (€m)   | 10,570 | 18,760 | 20,664 |

### *UK grant experience*

The UK has designed a coordinated set of policies to secure its place at the forefront of the global offshore wind industry. The UK government supports development of offshore wind supply chains in six regions of England and Wales; 19 programmes provide grant support for RD&D, and assistance for inward investment, innovation, training and loans. Since 2006, £255m has been invested in developing the offshore wind industry in Scotland through state aid programmes, with another £54m invested in the UK since 2013, and £3.2 billion of project loan finance has been made available for offshore wind from the new Green Investment Bank.

As a result, 3,000 training places have been supported and over 4,000 new jobs announced, with potential total jobs in offshore wind expected to reach 30,000. New UK procurement rules and long-term support contracts ensure 70% local content in offshore wind projects. Centres of excellence have been established in Aberdeen, Edinburgh and Glasgow. In total, £7.1bn of investment is expected to be captured to meet a target of 10 GW of offshore wind capacity by 2020.

A similar approach in Ireland would require sizable investment to gain a foothold in the international offshore wind technology market.

The supply chain map for offshore wind (Figure 16) shows the estimated breakdown of total expenditure on technology and service components in offshore wind generation per 100 MW. Early estimates by SEAI and EU sources have been updated with data from the UK Department of Energy & Climate Change (DECC) and Scottish Enterprise analyses to estimate the cost breakdowns presented in the map. The variability in estimates is addressed using weighted averages favouring more recent analyses.

There is reasonable consensus across data sources that the major mechanical parts will account for around 45% of capital expenditure, but other costs depend on the following factors:

- *Where the offshore wind-farm is located, i.e. how deep the water is, how far away from the nearest port, how severe the weather is at the site*
- *The size and type of wind-turbine used – floating wind-turbines are being developed to access deeper waters & in future vertical-axis turbines could be developed*
- *How advanced or mature the technology is at date of installation*

In general, Irish companies are less well positioned to capture investment than for onshore wind. This reflects the likelihood that more professional and engineering services will tend to be sourced mainly in neighbouring countries (at least initially).

### Figure 16: Offshore Wind - Capacity to capture investment

Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.<sup>1</sup>

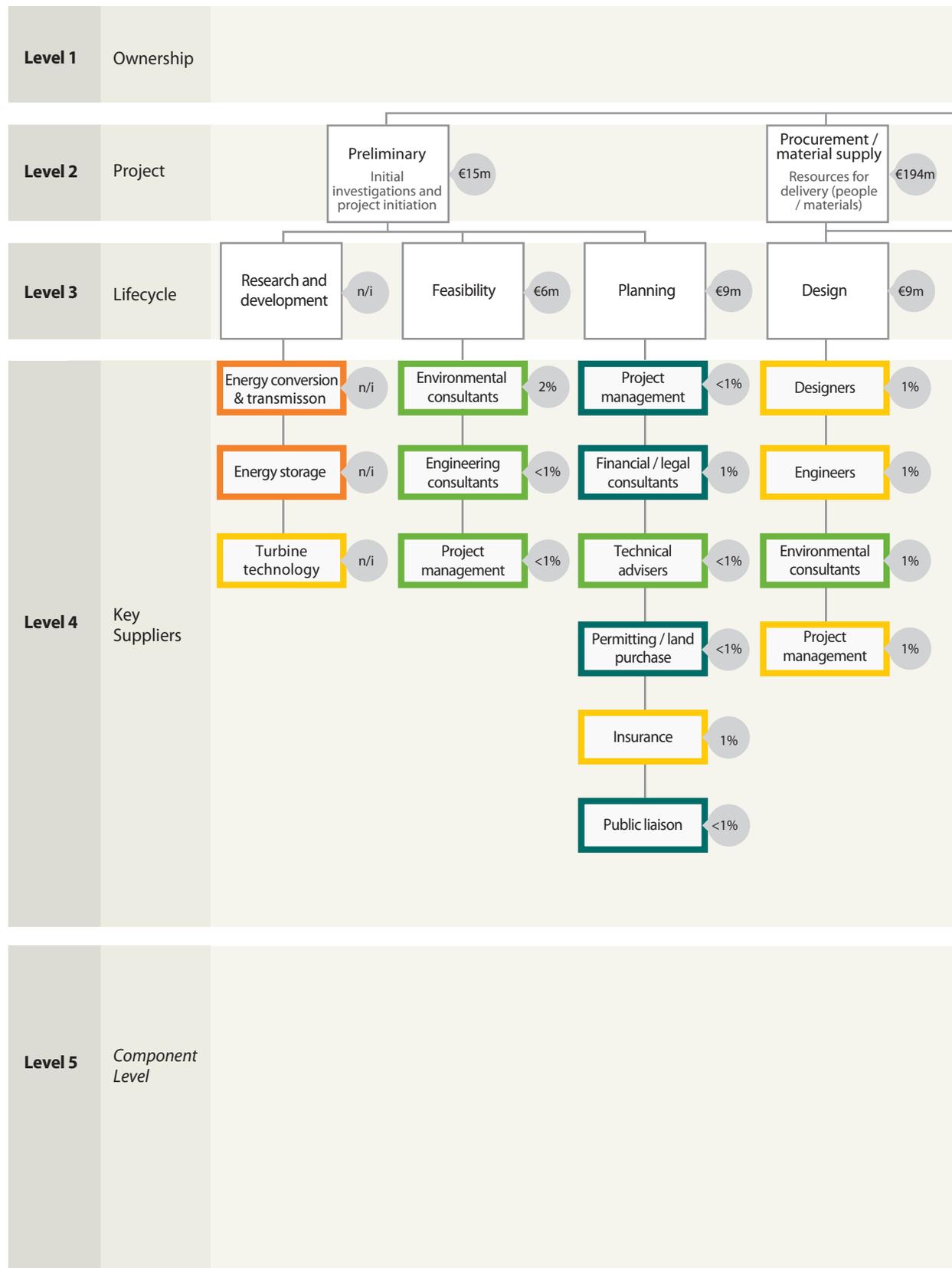
All €m figures are per 100MW installed capacity.

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them. Percentage breakdown of CAPEX (light grey) and OPEX (dark grey) totals are provided for Level 4 and below. Some rounding has occurred.

Ireland is well placed to provide services in feasibility, planning and the installation of offshore wind plants.

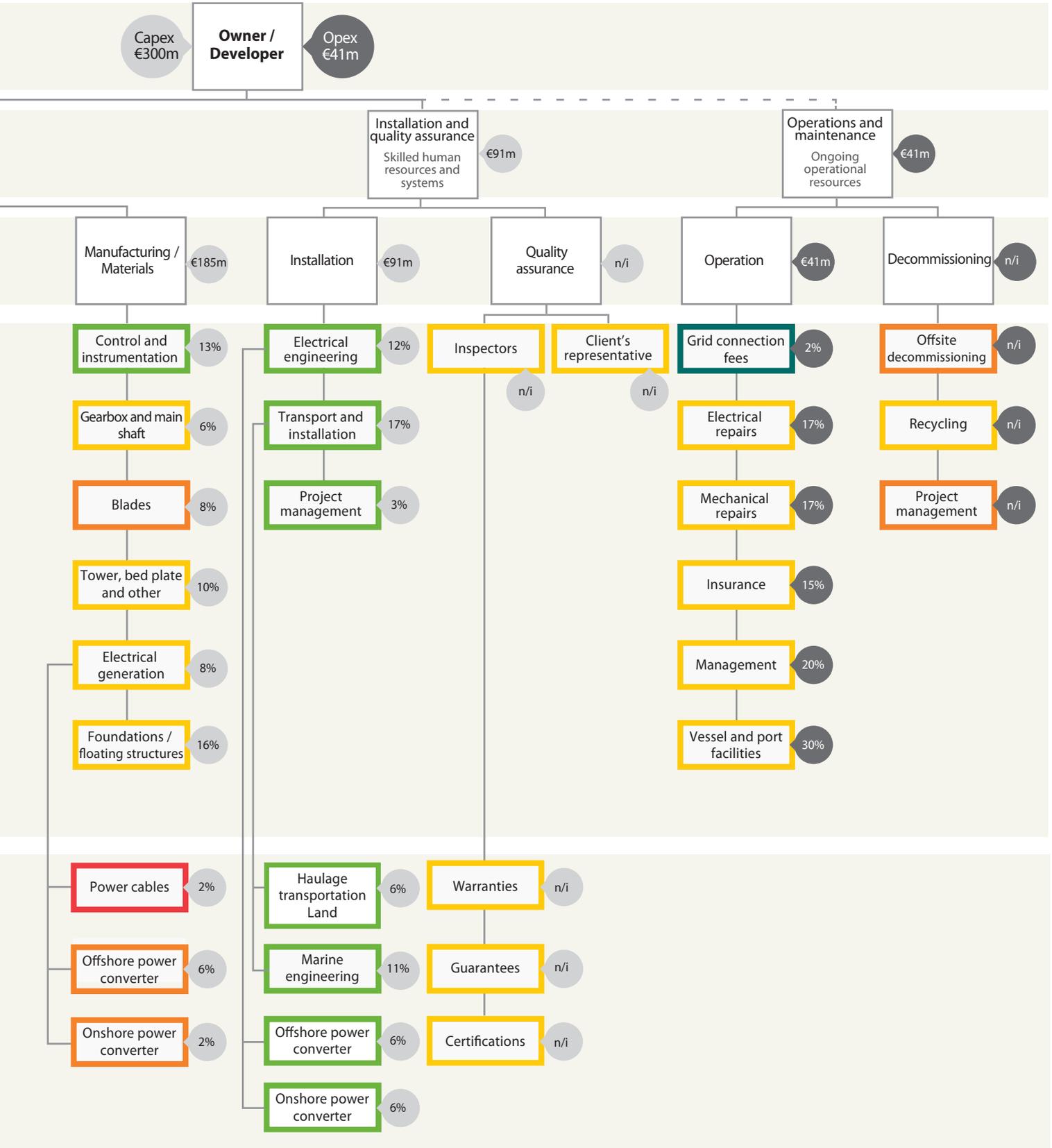
Like onshore wind, controls and instrumentation is a substantial manufacturing area that Ireland could capture given the country's indigenous expertise in electrical and control engineering.

Component design, manufacturing, repairs and project financing are further areas which could be developed given the appropriate critical mass and growth of supporting Environmental industry.



<sup>1</sup>The published estimates did not include all supply chain divisions. These have been displayed as not included (n/i), and will be updated when data becomes available.

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# Wave energy

The accessible wave energy resource in Irish waters is estimated to be 21 TWh per year<sup>29</sup> (i.e. two-thirds of Irish energy demand).

The Government intends Ireland to be a world leader in the development of wave energy, with as much as 1.5 GW of wave and tidal energy devices installed by 2030.<sup>30</sup>

Schemes currently in place supporting wave energy are:

- *The Ocean Energy Prototype Development Fund, which is supporting the development and deployment of prototype wave energy devices (e.g. Jospa Chuter, WestWave and subsystems)*
- *A wave energy test facility – the Atlantic Marine Energy Test Site (AMETS) located off Annagh Head, west of Belmullet in County Mayo*

The published estimates of typical capital investment costs for wave energy range between €1.2m and €11m per MW, with estimated O&M costs between 3% and 6% of capital costs.<sup>31</sup> This wide range of costs reflects the early stage of development of the devices and the limited commercial development and deployment.

Table 23 shows the estimated annual expenditure (capital expenditure and operation & maintenance expenditure) in Ireland's wave energy generation sector by 2020.

**Table 23: Estimated annual investment in wave energy in Ireland**

| Total installed capacity in 2020 (MW) | Average capital investment 2013-2020: (€m/year) | Average O&M expenditure 2013-2020 (€m/year) |
|---------------------------------------|---|---|
| 60-120                                | 32 -64  | 6 - 13                                      |

Based on capital expenditure of €4m / MW and O&M expenditure of 3%-6% of capital expenditure

<sup>29</sup> [http://www.seai.ie/Renewables/Ocean\\_Energy/Ocean\\_Energy\\_Information\\_Research/Irelands\\_Wave\\_and\\_Tidal\\_Energy\\_Resources/](http://www.seai.ie/Renewables/Ocean_Energy/Ocean_Energy_Information_Research/Irelands_Wave_and_Tidal_Energy_Resources/) (accessed 21st June 2013)

<sup>30</sup> Offshore Renewable Energy Development Plan, (DCENR, 2014).

<sup>31</sup> Economic Study for Ocean Energy Development in Ireland, SQW Energy for SEAI and Invest NI, 2010.

A breakdown of the anticipated Irish market according to how well positioned Irish organisations are to capture the investment is shown in Table 24. Further detail is provided in the supply chain map (Figure 17).

**Table 24: Current position of Irish supply chain for wave energy sector**

| Rating | Position to capture investment   | Anticipated average market size – 2013-2020 (€m/year) per 100 MW installed |
|--------|----------------------------------|--|
| 0      | No local supply chain at present | 2.0  |
| 1      | Less well positioned             | 4.0  |
| 2      | Averagely positioned             | 10.5   |
| 3      | Well positioned                  | 20   |
| 4      | Very well positioned             | 1.5  |
|        | <b>Total</b>                     | <b>38</b>  |

The areas of the wave energy supply chain highlighted as being well positioned to capture investment are similar to those for offshore wind, with slightly more professional and engineering services potentially being sourced from neighbouring countries, including Scotland, which are also making a substantial investment in wave energy development and deployment.

### *SEAI supporting ocean energy*

SEAI is coordinating the relevant activities of state agencies and initiating other measures to promote and develop the wave energy sector:

- *Ocean Energy Prototype Development Fund – this provides support for tank testing, sea trials and site investigations*
- *Galway Bay 1:4 Scale Test Site – this test site is managed by the Marine Institute through funding provided by SEAI. It is intended to allow up to 1:4 scale models to be tested in realistic scale ocean conditions. This greatly reduces the cost of development while allowing availability and performance of machines to be tested ahead of a full-scale grid-connected test*
- *Atlantic Marine Energy Test Site – this is intended to be a full-scale grid-connected facility offering the most robust wave energy conditions of any test site in the world. It has a shallow and deep water offshore test area, with a grid connection point onshore*

## EU market size for wave energy generation

Data for the estimated EU market size for wave and tidal energy generation up to 2050 was sourced from the NREAPs of European member states, the European Ocean Energy Association (Industry Vision Paper) and the 13th EurObserv'ER report, 'The State of Renewable Energies in Europe'.

**Table 25: Estimated EU market size for wave and tidal energy power generation**

|                                  | 2020 | 2030   | 2050   |
|----------------------------------|------|--------|--------|
| Annual increase in capacity (MW) | 178  | 3,286  | 3,286  |
| Annual capital investment (€m)   | 799  | 13,307 | 10,779 |

### *The Lombardy example*

A pertinent case study for the future development of the ocean energy cluster in Ireland is the approach taken in Lombardy. One of the key elements of the Lombardy Energy Cluster (described above) is the use of synergies between different companies through supporting knowledge exchange and learning via a web-based platform. This platform also functions as a hub for international promotion.

The marine energy research portal for Ireland (<http://www.imerc.ie>) and the current initiatives to develop ocean-energy RD&D in Cork (<http://www.energycork.ie/>) could expand the international promotion side of Irish cluster websites. Like the Lombardy Energy Cluster, Ireland could also raise its profile in European and international cluster networks. A more proactive approach using the learning and promotion opportunities offered by international networks could help the Irish sustainable energy industry internationally, leading to increased investment by overseas organisations and more transnational collaborations.



The wave energy supply chain profile is similar to that for offshore wind, with professional and engineering services mainly supplied by neighbouring countries, in particular Scotland. Nonetheless, Ireland is home to a world-class academic and commercial base which is developing its own indigenous ocean energy expertise.

*The Offshore Renewable Energy Development Plan for Ireland (2014)* sets out Exchequer support for marine energy test sites off the Irish coast, prototype developments and REFIT provisions from 2016. Funding is being provided for the Irish Maritime and Energy Resource Cluster (IMERC) and the Beaufort Research Lab in University

College Cork, which aim to integrate research and industry expertise through the development of an innovation cluster in the ocean energy sector. Launched in March 2010, specific targets for IMERC are for 70 new research jobs by 2014, five companies incorporated by 2015, and two foreign direct-investment clients secured by 2016. In addition, the new Centre for Marine Renewable Energy Ireland (MaREI) will receive funding of €19 million from Science Foundation Ireland, with a further €10.5 million contributed by industry partners to bring together research teams from NUIG, NUI Maynooth, UCC, UCD, UL and Cork Institute of Technology. Up to 77 jobs will be supported at the centre.

### *Ocean Energy Innovation*

An example of innovation in the ocean energy sector is the Marine Institute's National Marine Technology Programme which facilitates research and development activities in the area of sensor development, data management and information systems. National and international relationships between industry and academic centres are being developed for application-driven technology development in marine ICT.

A key initiative of the Marine Institute's Advanced Technology Programme is the SmartOcean (ICT for the Sea) Strategy. Launched in 2010, it seeks to harness Ireland's natural marine resources and specialist expertise in marine science and ICT to establish Ireland as a leader in the development of high-value products and services such as aquaculture, environmental monitoring, shipping and security, and marine renewable energy. Currently over 50 indigenous and multinational companies based in Ireland are engaged in the development and provision of high-tech marine products and services to the global marine sector.

WestWave, the first wave energy project in Ireland, aims to generate 5 MW of renewable electricity off the coast of Co. Clare. It is a collaborative project led by the ESB, in conjunction with technological partners from Ireland and abroad and associate partners from the supply chain who are providing project support and services, such as Alstom, MRIA, Siemens, the Marine Institute, the Irish Maritime and Energy Resource Cluster (IMERC), TechWorks Marine and the Ryan Institute, among others.



A number of estimated cost breakdowns have been published in respect of wave energy devices and systems. However, there is considerable variation between them as:

- *Wave energy generation is at an early stage of development*
- *There are currently no large-scale commercial-scale installations in place, and it has not been possible to realise economies of scale in the manufacturing process*
- *Considerable research and development work on reducing capital costs is ongoing, but much uncertainty remains over the rate and level of cost reduction possible*
- *A number of different types of wave energy device are under development and each device will have different capital and operating costs*
- *Some wave energy sites are more expensive to develop than others; for example, nearshore sites will have lower installation costs and lower subsea grid connection costs*

The supply chain map for wave energy (Figure 17) shows the estimated average expenditure in wave energy generation up to 2020. Data sources used to estimate the cost breakdown across the supply chain include estimates from the Carbon Trust (UK) and UK Committee on Climate Change (Mott MacDonald report, 2011).

### Figure 17: Wave - Capacity to capture investment

**Breakdown of capital expenditure, and operations & maintenance costs by supply chain area.**

**All €m figures are per year averaged (2013-2020).**

The figures at higher parts of the tree are the sum of the figures shown in the parts of the tree linked by lines to them.

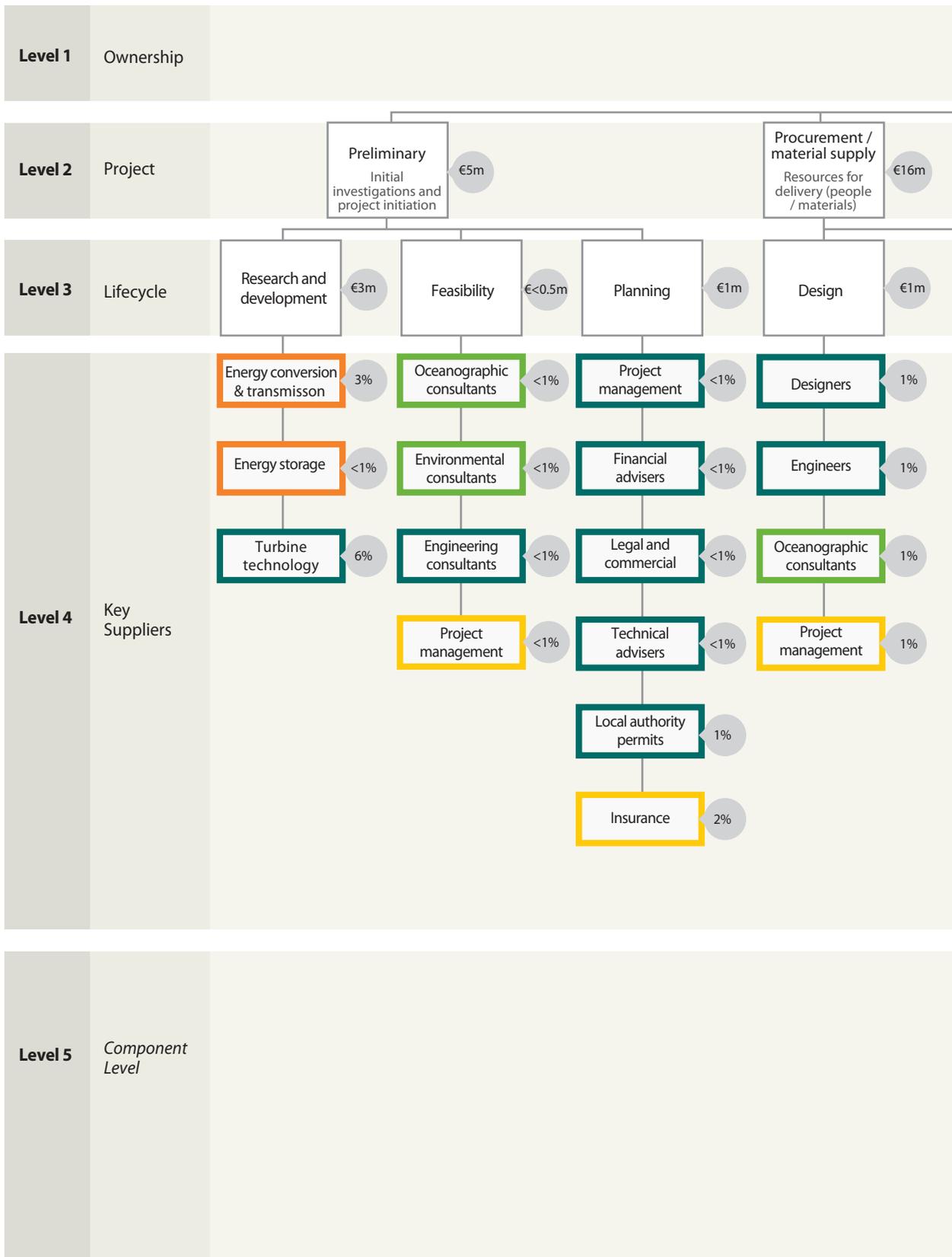
Percentage breakdown of CAPEX (light grey) and OPEX (dark grey) totals are provided for Level 4 and below.

Some rounding has occurred.

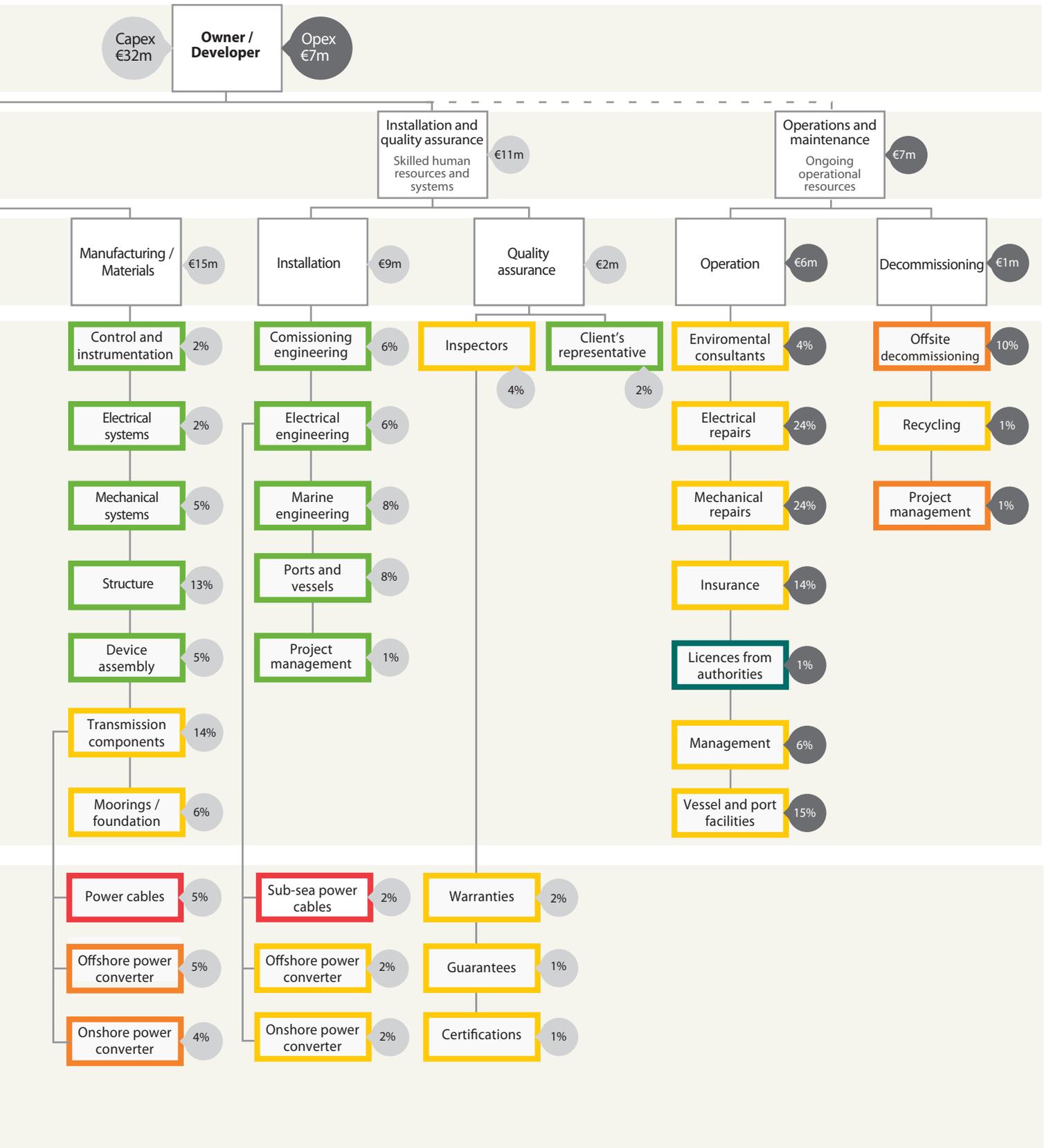
With the right policy initiatives the Irish supply chain is well placed to capture the majority of domestic investment in wave energy.

With the exception of power cables, the technology, design, manufacturing, and installation of wave devices relies on a knowledge base which is growing in Ireland.

This will be assisted by continued synergy between marine research institutions, growing intellectual property rights and the expansion of the transmission grid



**'Very well positioned'** - no significant barriers to address  
**'Well positioned'** - some barriers affecting capacity to scale to be addressed  
**'Average'** - action is needed to develop capacity and exploit local factors  
**'Less well positioned'** - concerted action required to reinforce supply chain  
**'No local supply chain at present'** - longer term action needed to establish Irish presence



# Conclusions and next steps



Irish companies have already taken significant strides into sustainable energy markets

## The potential

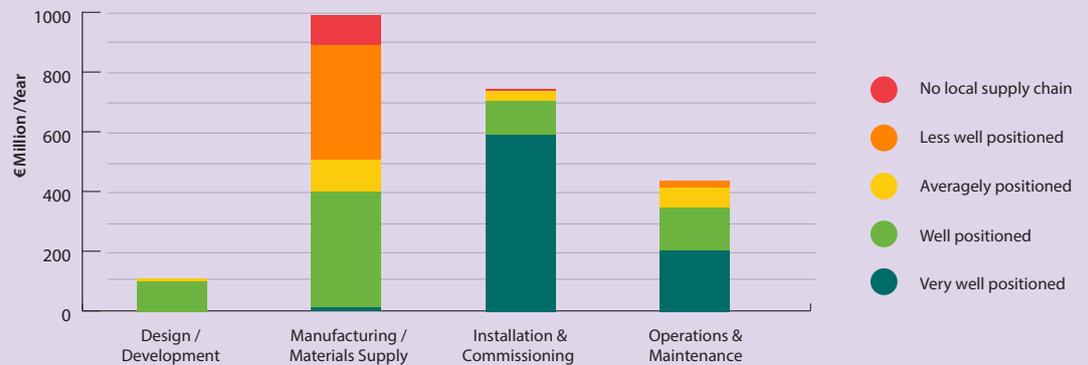
This report highlights the huge potential available to Irish companies if a focused approach is taken to develop the sustainable energy supply chains in Ireland. A substantial pipeline of business in energy efficiency and renewable energy technology and service delivery is anticipated in the period to 2020. The Irish market for the technologies considered in this report is estimated at between €2.2 billion and €2.9 billion per annum. Beyond direct cash-flow, this provides Irish companies with a market to build the required scale, skills and expertise to avail of the massive opportunities in the much larger European, US and other international markets.

Published estimates for the European market indicate that the expected total average annual investment required for Europe to reach its 20:20:20 ambitions will be in the order of €155 billion per annum to 2020. That puts the EU market at between 60 and 70 times the size of the Irish market. With continuing high levels of investment (averaging €133 billion per annum) to 2050 across the EU, the opportunity for export of renewable energy and energy efficiency technologies and services is likely to be sustained over the long term. The North American market for sustainable goods and services is considered to be of a similar size to that in the EU.

Irish companies have already taken significant strides into sustainable energy markets. Many have been exporting into the EU and US markets for years. Export estimates for renewable energy and energy efficiency technologies and services from companies supported by Enterprise Ireland more than doubled over the period 2010–2012, to almost €300 million.

Access to the EU, US and other markets from Ireland is a draw-card for global companies. Ireland has a number of strengths and competitive advantages that make doing business here attractive, including leading pools of talent and centres of excellence in core disciplines such as engineering, IT, sales & marketing, design, and research, development & demonstration (RD&D), as well as an attractive tax regime. The sustainable energy opportunity presented in this report is yet another attraction to foreign investors. This stems not only from proximity to major markets, but also the possibility of doing business in a country that recognises the necessity to provide a secure, low-carbon source of electricity.

This report indicates that Ireland is very well placed in many supply chains to capitalise on these growing national and international markets. The breakdown of how well positioned Irish organisations involved in the different stages of sustainable energy project lifecycles are to capture investment in Ireland indicates that over 80% of the anticipated investment is in areas where such organisations already have a good (21%) or very good (50%) share of the market.

**Figure 18: Position of Irish organisations to capture investment, by lifecycle phase**

In order to further develop sustainable energy supply chains, gear more companies for export and enhance our attractiveness as a place for international companies to do business, we must focus on addressing (or continuing to address) a number of key issues. These include:

- *Need for adequate skills*
- *Protection of intellectual property (IP)*
- *Requisite sales volume to sustain supply chain*
- *Efficient procurement practices*
- *Critical mass for supply chain establishment*
- *Condition of key infrastructure*

### The benefits of concerted action

A number of actions are already underway to address some of the identified needs for supply chain development by various stakeholders, including SEAI, Enterprise Ireland, IDA Ireland and Forfás. International experience suggests that cooperation at both the industry and policy levels leads to greater success.

Support for research, innovation, development, demonstration and deployment clusters, for example, can lead to increased innovation and competitiveness by shared learning and by complementary businesses providing a boost to supply chain development.

At the policy level, a concerted effort to address the barriers and to support priority supply chain opportunities in Ireland will lead to the biggest returns. This has been proven with international examples including, for example, the Energy Vaasa supply chain initiative in west Finland, the Lombardy Energy Cluster in Italy and the combination of energy and enterprise policy deployed in Upper Austria to develop biomass supply chains. Similar approaches are under development in Ireland – some of which have been highlighted in this report.

With a combination of appropriately designed and complementary energy and enterprise policies and measures, Ireland will be well placed to gain major rewards from the transition to a sustainable energy future.

## The next steps ...

This report is the first to examine in some detail how well the Irish supply chain is positioned to capture new business arising from the anticipated investment in sustainable energy-related products and services over the period to 2020.

SEAI encourages anyone interested in contributing to the development of the ideas and analysis in this report to send comments, including on the detail presented in the supply-chain maps, via email to [emg@seai.ie](mailto:emg@seai.ie). The maps will be refined over time to produce a more accurate picture of Ireland's strengths and weaknesses across the sustainable energy supply chains.

Further results from the analysis undertaken as part of this study will be made available on the SEAI website in the coming months (see [www.seai.ie](http://www.seai.ie) for updates).



## Selected references

A broad range of sources have been used in the development of this report, including those listed below. A more detailed list is provided in the technical document which will be available at [www.seai.ie](http://www.seai.ie).

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Sustainable Energy Authority of Ireland  
Wilton Park House, Wilton Place, Dublin 2, Ireland

T. +353 1 8082100  
F. +353 1 8082002

info@seai.ie  
www.seai.ie



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