SEAB Supply Chain Report

Contents

Foreword

The electricity industry in Scotland has undergone a dramatic transformation over the past fifteen years. It's evolved from one that was reliant on a mix of generation sources dominated by nuclear and coal, supported by gas and hydro power, to one that is dominated by wind generation, supported by some gas and nuclear.

From my experiences with SSE, I have seen the renewables sector in Scotland grow and meet challenges over time I have watched first hand a transformation take place that has created jobs and prosperity for many people in Scotland, particularly in places where economic activity has traditionally been low. This report undertakes new modelling, demonstrating the scale of the economic contribution of renewable energy to the Scotland as a whole between 2010 and 2020, with my company, SSE, itself contributing just under a third of this economic impact. With almost 16,500 average annual gross employment across Scotland, SSE will contribute an average of over 4,600 jobs per year between 2015 and 2020.

I have also watched international Original Equipment Suppliers (OEMs), including Siemens, Vestas, Mitsubishi, GE and ABB innovate and develop new technology including turbines and blades. They have responded to the economic aspirations of developers and political leaders to enhance the local content of their contracts. I have witnessed home grown suppliers develop a competitive offer. – Everything from experienced, high standards civils contractors like RJ McLeod, Balfour Beatty and BAM to new component manufacturers have emerged.

But the future is challenging for the ongoing development of a renewables industry in Scotland. The remuneration mechanisms which contribute to renewable operators earning returns, particularly from onshore wind, are in decline. That means the Scottish onshore wind industry needs to stand on its own two feet. But we mustn't forget that existing wind farms require 25 years of maintenance, so there is a rich opportunity to develop greater Scottish expertise in onshore operations and maintenance.

There is much more to the Scottish renewable electricity industry than just onshore wind. The stronger and more predictable winds offshore provide a great opportunity, as do the development of small scale hydro alongside larger scale pumped storage hydro stations. And further from market, but tantalisingly secure, forms of generation from tides and waves are a matter of time away. And last, but by no means least, there is the development of large scale new transmission infrastructure to transmit the electricity from the places with the most abundant renewable sources to homes and business across the country.

It was against this backdrop that I was asked to chair the Supply Chain Working Group on behalf of the Scottish Energy Advisory Board (SEAB). I am pleased to recommend this report as a contribution to the development of the renewable energy industry in Scotland. There is no doubt that the last few years have been remarkable. But we all – developers, generators, OEMs, suppliers – and government – are going to have to work together if we are to secure the maximum economic benefit for Scotland in the future.

Sandy Biggar, Chair Supply Chain Working Group

1. Executive Summary

7.45 GW

- (Installed capacity of renewables electricity at Q2 2015 in Scotland)

5 GW

- (Potential additional renewables capacity to be developed in Scotland by 2020)

£ 26.2 bn

- (estimated devex, capex and opex related to Onshore wind, Offshore wind, Tidal Energy and Transmission Networks projects in Scotland between 2010 - 2020)

£ 10.5 bn

- (cumulative expenditure estimated to be retained in Scotland for these projects, 2010 - 2020)

16,500

- (average gross annual Scottish employment supported by renewables projects in Scotland, 2015 - 2020)

£ 7.2 bn

- (cumulative gross GVA (present value) generated as a result of project expenditure retained in Scotland, 2010 – 2020)

[1]

RECOMMENDATIONS
1. The ongoing case for a developing Scottish renewable electricity industry, as an affordable solution to the challenge of meeting carbon targets and generating economic benefits should continue to be made and championed by the Scottish Government, its agencies and the industry. The agencies should also continue to support engagement with project developers and potential inward investors, both here and increasingly in overseas markets.
2. In the immediate term, it is recommended that the Scottish Government supports Scotland's key existing fabrication businesses (e.g. Babcock, BiFab, Global Energy Group and Wind Towers Scotland) to enable them to take advantage of the potential positive future by ensuring their sites and resources are 'offshore ready' (e.g. grants, equipment lease, training) and their owners have the necessary financial support (e.g. export credit finance) to win major orders otherwise future opportunities may not materialise. **<u>Key action 1</u>: Scottish Government to investigate all possible support mechanisms to ensure Scotland's key existing fabrication businesses are 'offshore ready'**
3. Also in the immediate term and in addition to the above, it is recommended that Scottish Enterprise and Highlands & Islands Enterprise support existing manufacturers (e.g. Oceaneering, JDR) to pursue wider supply chain opportunities. **<u>Key action 2</u>: Scottish Enterprise to investigate opportunities for subsea array cabling manufacture in Scotland.** **<u>Key action 3</u>: Scottish Enterprise and Highlands & Islands Enterprise to investigate further support for port infrastructure development as potential 'Renewables Hubs'.**
4. Focus should be applied by the Scottish Government, its agencies and the industry on the three further opportunities identified: floating wind; the circular economy and supporting further development of the transmission network, all of which are expected to develop rapidly in the period up to 2020. **<u>Key action 4</u>: Scottish Enterprise and Highlands & Islands Enterprise to investigate the opportunity to develop a strong productive floating wind supply chain.** **<u>Key action 5</u>: Renewable Industry Advisory Group on behalf of Scottish Government to continue to investigate the circular economy opportunities.** **<u>Key action 6</u>: Skills Development Scotland to investigate supporting the training of specialist operatives in transmission networks for jointers, linesman, specialist**

[1] The findings are for offshore wind, onshore wind, tidal energy and transmission networks projects in Scotland and are highly likely to underestimate the economic impact of Scotland's renewables sector. The analysis was limited in that it only covered projects/additional MW of renewable energy expected to be developed in Scotland up to 2020. It is challenging to forecast the level of development beyond 2020 due to continued uncertainty in UK Government policy. The analysis covered impacts associated with Scottish projects only and did not capture the economic impact of supply of Scottish goods and services to renewable energy projects outside Scotland; or, wider renewables test and development activities. The findings are therefore not comparable with some economic impact figures produced for the sector in the past, e.g. those that included wider supply chain export activities.

	protection and commissioning engineers.
5.	**Scotland should continue to seek to influence UK Government policy on renewable energy, to deliver consistent messages and operating environments for companies and investors. Policy and planning horizons must be extended to give certainty to investors (currently 25 year planning consents are granted to onshore wind farms).**
6.	**Macro economic modelling and appraisal of specific supply chain opportunities are separate activities and should be addressed as such in future. The aggregation of impacts from numerous supply chain opportunities at Scotland level provides little additional value and the real value of such work lies in setting priorities and being able to allocate resources to the most important areas.**
7.	**There are potential opportunities for the development of the tidal sector, where Scotland is a world leader. The enterprise agencies should continue to focus on maximising the opportunities from MeyGen and other projects planned in Scotland and overseas markets, and look to support export opportunities for these companies as other markets open up across the world.**

2. Introduction

2.a Background

Energy is one of Scotland's enduring success stories. Decades of North Sea oil and gas production have helped to build a strong Scottish supply chain, extensive skills base, renowned academic sector and an investment environment conducive to growth. Scotland's renewable energy resources, coupled with its ambitious renewable energy targets have positioned Scotland at the forefront of renewable energy development.

This report summarises the findings of a working group established under the auspices of the SEAB, whose aim was to:

- assess the **current status of renewable electricity supply chains** in Scotland (section 3)
- identify the **economic impact of past and future renewable electricity projects** (during this current decade from 2010 to 2020) on the Scottish economy (section 4)
- identify **future opportunities** where the industry and Scottish Government can maximise benefit to the Scottish economy (section 5) and
- conclude and provide **recommended actions to the SEAB** that could strengthen future economic opportunities (section 6)

The remit of the working group was defined as including the following renewable electricity sectors, those sectors deemed by the working group likely to have the most significant additional impact on the Scottish economy:

- Offshore wind
- Onshore wind
- Marine energy
- Transmission networks

The working group's focus centred around understanding the actual impact of these sectors on the Scottish economy from 2010 to the present day and the immediate supply chain impacts that could reasonably be enacted upon up to 2020.

2.b SEAB Supply Chain Working Group

The working group was chaired by Sandy Biggar (Director of Procurement & Logistics, SSE) and consisted of leading industry organisations from across the public and private sector in Scotland. These were; SSE, Scottish Power, EDPR, Global Energy Group, Scottish Renewables, Scottish Government, Scottish Enterprise (SE) and Highlands & Island Enterprise (HIE). Thanks are due to all steering group members, who contributed significant time and expertise to this process over the last 12 months. A full list of members is shown in Appendix 1.

The report's findings take cognisance of policy announcements from the UK Government during November 2015. It is intended as an internal document to inform and guide SEAB, the Scottish Government and its associated agencies regarding future policy developments and supporting actions to maximise the economic opportunities available to Scotland.

2.c Scottish and UK Government Policy

With a wealth of natural resources in Scotland the Scottish Government has always been keen to maximise the use of renewable energy, not only for the economic benefits associated with their development but to also tackle climate change.

In 2011 the Scottish Government published its 2020 Route map for Renewable Energy in Scotland. The most recent energy figures show renewables continue to go from strength to strength, with almost half of Scotland's electricity use coming from renewables last year and wind delivering record amounts of power in the first three months of 2015. Scotland accounts for around a third of total UK renewables generation.

The continuation of this success is challenged by the early closure of the UK Government's subsidy mechanism, the Renewable Obligation to onshore wind and solar PV from 1 April 2016, and is dependent on progress with the implementation of Electricity Market Reform.

The Scottish Government and its enterprise agencies will continue to support the developer and supply chain communities to ensure that Scotland is not disproportionately impacted by recent announcements.

Despite these challenges the Scottish Government remains committed to the renewable sector and to the policy to support a transition from fossil fuel generation to a portfolio comprising renewable and cleaner thermal generation.

Recent policy announcements and decisions from the UK Government are noted as follows:

- Following a shift in wholesale energy prices, higher than anticipated load factors and increased installed capacity, the Levy Control Framework at 2020/21 is anticipated to have been overspent. This has resulted in UK Government seeking to curb support provided under "demand lead schemes" such as the Renewables Obligation and Small Scale Feed in Tariff (SSFiT). This has most notably been effected by:
  - Early closure of the Renewable Obligation for onshore wind at 31 March 2016, with accompanying grace period provisions to allow a 12 month extension for projects meeting the grace period conditions. This has resulted in some projects being ineligible to apply.
  - A review of the SSFiT scheme, particularly with regard to Solar PV, with a reduction in support rates, in line with cost reduction, with a deployment cap of £100m to April 2019.
  - Closure of Renewable Obligation to solar PV <=5MW and additional capacity added to existing accredited stations from 1 April 2016, subject to grace periods.
- Following this cost review exercise, the UK Government has indicated that it intends to hold three further Contract for Difference (CfD) auctions for offshore wind prior to 2020

subject to the industry meeting as yet undefined targets on cost reduction. The first of these auctions is anticipated to take place in Q4 2016. However the UK Government has not yet confirmed the budget to be allocated to this process, with developers therefore limited in their ability to respond/prepare.

- The UK Government has indicated that it will no longer support onshore wind at current subsidy rates and to date has not confirmed onshore wind will be permitted to compete for CfDs despite being the most cost effective, scaleable renewable generation technology. This has resulted in investors/developers of onshore wind considering their position with regard to longer term investment in the sector, causing some projects to stall or be abandoned, thereby curtailing future opportunities for the supply chain.
- The UK Government also announced the removal of Levy Exempt Certificates (LECs) from renewable generation as other support mechanisms have proven to be more effective in stimulating investment in renewable technologies.

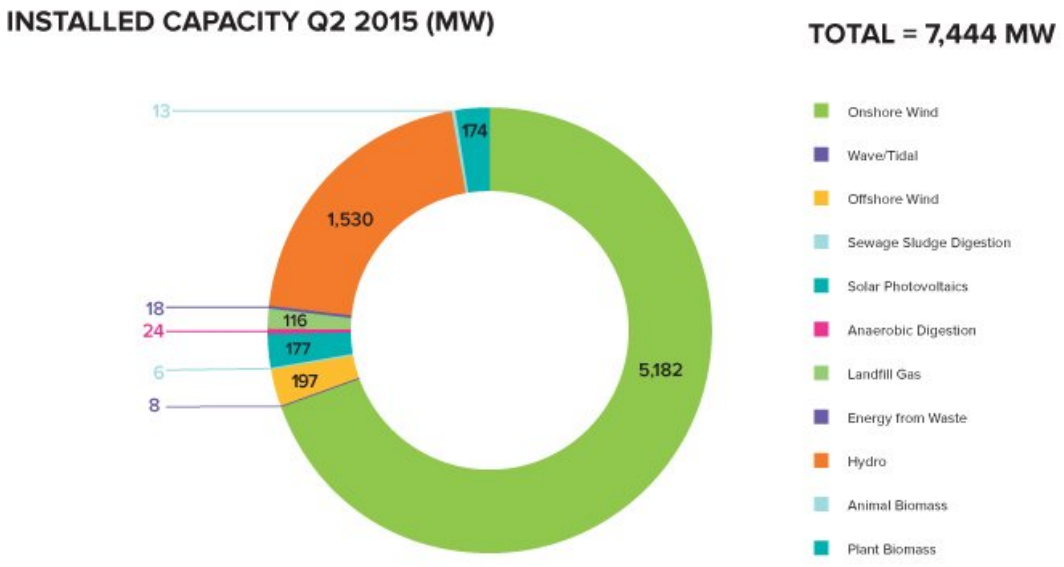
3. Current status of renewable electricity energy supply chains in Scotland

3.a Market Status & Projects

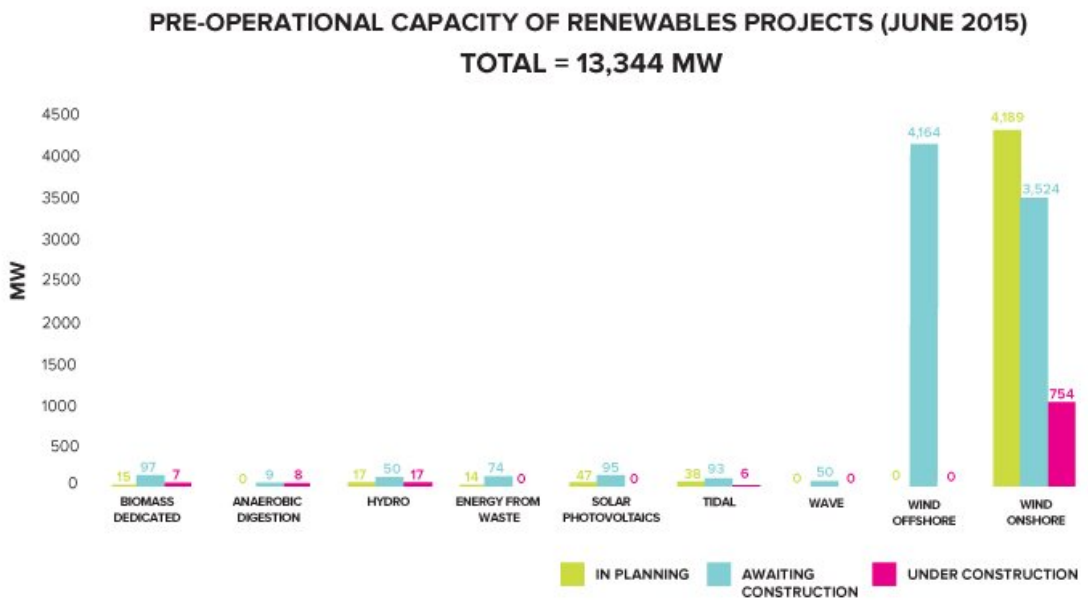
Market

Scottish electricity generation capacity from renewable sources has shown steady growth with an average annual capacity increase of over 660MW since the end of 2007.

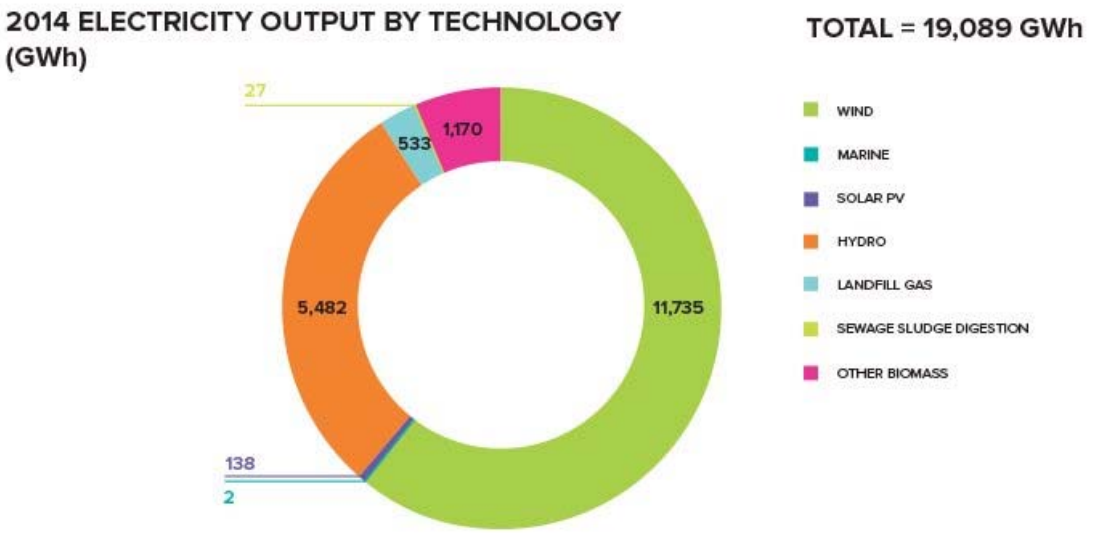
The mix of renewable electricity generation capacity in Scotland at the end of 2014 provides a total of over 7.4GW; the sector is two and a half times bigger than it was at the end of 2007. Onshore wind is the biggest single sector, accounting for over 69 per cent of installed capacity, while hydro, offshore wind and bioenergy are Scotland's other sources of renewable power.



There is significant additional capacity in development across Scotland, with projects either in planning or already consented which now total over 13GW of which 5GW may be delivered by 2020. Again, capacity increases in the short term will come from onshore wind, with over 4.2GW of capacity already consented and a further 4.1GW in planning. In the longer term, over the next decade, we could see major increases in offshore wind, with over 4GW already consented. There is also 244MW of bioenergy projects at various stages of development and 187MW of wave and tidal projects either in planning or already consented.



The chart below shows output from different sources in 2014. Onshore wind generated almost two thirds of all renewable electricity output in Scotland. Hydro power contributed over a quarter of renewable electricity output, and while other sectors such as biomass and marine energy currently make a smaller contribution, they have potential for growth in the future.



Source: DECC Energy Trends

Offshore, onshore, marine and transmission networks activity

The maps shown in Appendix 3 show current:

- UK offshore wind activity
- UK onshore wind activity
- UK marine energy activity
- Scottish transmission networks activity

3.b Supply Chain Activity

The success of any sector within the energy industry requires a strong, efficient and internationally competitive supply chain. A programme of ongoing analysis, engagement and support to build capacity in Scotland's energy supply chains has been in place by the Scottish agencies and the renewables industry for some time.

The public agencies work with leading project developers in Scotland, UK and overseas to foster engagement with the supply chain at all levels. In parallel with this supply chain specialists and account managers support existing and potential suppliers to meet the needs of these global clients. This includes the provision of bespoke assistance to industry, such as the Expert Support Programme[2]. A working group was established in November 2015 by SE and HIE to investigate the international competitiveness of Scottish suppliers, including evaluation of successful tenders and benchmarking against best practice from other sectors.

Furthermore there is an increasing focus on international markets in Northern Europe and beyond. Supporting the global competitiveness of Scottish suppliers will be a key theme for the Scottish Government and its agencies in the coming years, in which Scottish Development International (SDI) will play a vital role in providing market intelligence and assistance to access overseas markets. UK Export Finance will also have a role in ensuring the Scottish supply chain can maximise its value offering outwith Scottish and UK projects.

With that backdrop, the four renewables sectors examined are as follows:

Offshore wind

Given current market conditions, two new large scale offshore wind projects are projected to be built in Scottish waters by 2020, namely Beatrice (588MW) and Neart na Gaoithe (448MW).

The major manufactured components, for example, turbines, nacelles, gearboxes and drivetrains are expected to continue to be designed and built in Europe before being shipped to Scotland for assembly and installation. Further manufactured components for these Scottish projects are likely to be produced in Hull, Germany and Denmark by Siemens Wind. There are, however, opportunities for Scotland in design of offshore foundation structures, fabrication of towers, pile & jacket foundations, subsea array cabling (detailed in

[2] http://www.scottish-enterprise.com/services/develop-your-organisation/offshore-wind-expert-support-programme/overview

Section 5) and offshore substation platforms and topsides together with installation, operation & maintenance and activity at construction ports. The contribution Scotland and the UK can provide to the large scale wind industry was analysed by BVG Associates in 2014[3] [4] and these opportunities are discussed in section 5 below. SDI will continue to pursue further opportunities for attracting inward investment of major components for companies using Scotland as a base for European manufacture.

Onshore wind

In onshore wind, the UK at present has limited facilities for designing and developing components for wind turbines and manufacturing is largely carried out in Denmark and Germany. Whilst Scotland and the wider UK has capacity for developing limited components and small to medium sized turbines, the dominant services provided to the larger utility wind turbine industry are turbine tower manufacture and the mid-stream services such as planning and permitting, construction and maintenance. New opportunities are arising regarding repowering/replanting, remanufacture and reuse, as the first generation of onshore wind farms near the end of their operational life. These opportunities are considered in the circular economy discussion in section 5 below.

Marine energy

Tidal energy is the most advanced marine energy sub-sector and early stage commercial arrays are currently under construction. Scotland is the recognised world leader for tidal energy by market research firm, Frost & Sullivan[5]. However marine energy generation is significantly less mature than onshore and offshore wind and supply chain activity up to 2020 relies on maximising Scottish content in the test and early array demonstration projects planned within that time horizon (e.g. MeyGen, the world's first tidal array). These factors were identified by BVG Associates in 2015[6].

Scotland's leading position in tidal energy has been established with significant support from the Scottish Government to assist the emergence of indigenous device developers and technology companies, including the provision of world leading test facilities at the European Marine Energy Centre on Orkney. Continuing support will be given to ensure that Scottish manufacturers can build up experience, skills and capacity to service the emerging domestic market and subsequently export capabilities to other emerging markets such as France and Canada who are only slightly behind Scotland's roll-out process (first major arrays are due to be installed in France in 2018 although some smaller-scale activity is already under way).

The wave sector has seen a number of setbacks in the last few years however the recent establishment of Wave Energy Scotland (WES) is refocusing the industry to adopt a more

[3] UK supply chain capabilities for offshore wind, BIS, January 2014 - BVG Associates
[4] Scottish Offshore Wind Supply Chain Summary Gap Analysis, 21 October 2014 – BVG Associates for SE
[5] Tidal Energy: Current Status and Future Outlook; Frost & Sullivan (March 2015)
[6] Wave & Tidal Supply Chain Development Plan, RenewableUK and Scottish Renewables, February 2015 - BVG Associates

innovative and collaborative approach to supporting the development of wave technology from the earliest stage of development through to proving and demonstration.

WES is supporting and accelerating the development of wave energy technology in Scotland and was established as part of HIE, at the request of the Scottish Government, during December 2014. WES will provide funding packages for the development of innovative technologies to produce low cost, efficient and reliable components and subsystems which can form the basis of the cost effective generation of wave energy in Scotland. Wave will benefit from developments within the supply chain for tidal with a cross-over of skills particularly in commissioning and maintenance.

A recent success story highlighting this diversification is Green Marine Solutions: Wave and Tidal Energy in the UK: Capitalising on Capability February 2015 – Renewable UK. Details are provided in Appendix 3.

Transmission networks

Development of the transmission network in Scotland will enable the connection of more renewable energy generation and is expected to provide significant future supply chain opportunities.

Major transmission networks projects involve a large capital outlay and have the potential for significant local content due to the advantage of local proximity of suppliers to the developer. A good example of this type of project, to illustrate the scale and nature of such opportunities, is the Beauly to Denny overhead line project which has an overall capital spend exceeding £600m. Details are shown in Appendix 4.

3.c Support Mechanisms

Renewable electricity generation in Scotland and the rest of the UK are remunerated, in part, through a number of financial support mechanisms that are levied from electricity consumers' energy bills. The market mechanisms for supporting renewable energy projects are Renewable Obligation Certificates (ROCs) and CfD incentives, which provide a supportive investment environment for renewable energy developers.

In addition to the market support mechanisms, the Scottish Government, supported by its economic development agencies, SE and HIE provide a number of additional programmes to support innovation and the development of the offshore wind industry in Scotland. Furthermore a number of alliances and cross industry support organisations have been established. Details are provided in Appendix 5.

4. Economic Impact & Analysis Modelling

Economic impact modelling was undertaken on behalf of the working group by Scottish Enterprise.

The summary of economic impacts included in this report relate to existing operational MW and scenarios for development of future Scottish projects/additional MW in the time period to 2020. The analysis covered transmission networks projects, additional onshore and offshore wind energy MW and specific tidal energy projects. The impacts reported in this report are based on the following scenarios for future development[7]:

- **Offshore wind** - the appraisal covered the existing Robin Rigg Offshore Wind Farm and Beatrice Demonstrator projects and was based on the assumption that an additional 1,000MW associated with large scale offshore wind projects and 114MW associated with test and demonstration projects would become operational before the end of 2020.
- **Onshore wind** - the appraisal covered actual onshore wind MW installed to 2015 and thereafter, an assumption was made that committed MW (e.g. MW associated with projects with a planning consent and eligible for ROCs or with a Round 1 CfD award) would become operational over 2016-2018, plus an additional 250MW of onshore wind energy would be delivered per annum in 2019 and 2020.
- **Tidal energy** - due to difficulties accessing robust data for the marine energy sector, the appraisal was limited to analysis of Scottish tidal energy projects, including MeyGen Phases 1a, b and c, part of MeyGen Phase 2 and the Sound of Islay project (150MW in total).
- **Transmission networks** - the appraisal was based on actual and committed spend on transmission projects by Scottish Hydro Electric Transmission and Scottish Power Transmission, estimated at £7.6 billion for the 2010 to 2020 time period.

It is important to note that the findings are highly likely to underestimate the economic impact of Scotland's renewables sector. The analysis is limited in that it only covered projects/additional MW of renewable energy expected to be developed in Scotland up to 2020. The analysis covered impacts associated with Scottish projects only and did not capture the economic impact of supply of Scottish goods and services to renewable energy projects outside Scotland; or, wider renewables test and development activities. The findings are therefore not comparable with some economic impact figures produced for the sector in the past, e.g. those that include wider supply chain export activities. More information on the methodology applied to appraise economic impact for this report is provided in Appendix 6.

[7] More information on the methodology applied and other scenarios analysed are available in Appendix 7.

Table 1: Estimated project expenditure associated with renewable energy projects in Scotland

	Annual Project Expenditure (£M)	Annual project expenditure estimated to be retained in Scotland (£M)
2010	£1,311	£521
2011	£1,054	£459
2012	£2,175	£867
2013	£2,116	£832
2014	£2,059	£845
2015	£2,385	£964
2016	£3,717	£1,355
2017	£3,773	£1,372
2018	£3,244	£1,286
2019	£2,432	£1,033
2020	£1,952	£933
Total	£26,219	£10,469

Source: Scottish Enterprise, 2016

Notes: 1. Expenditure is given in 2014 prices.

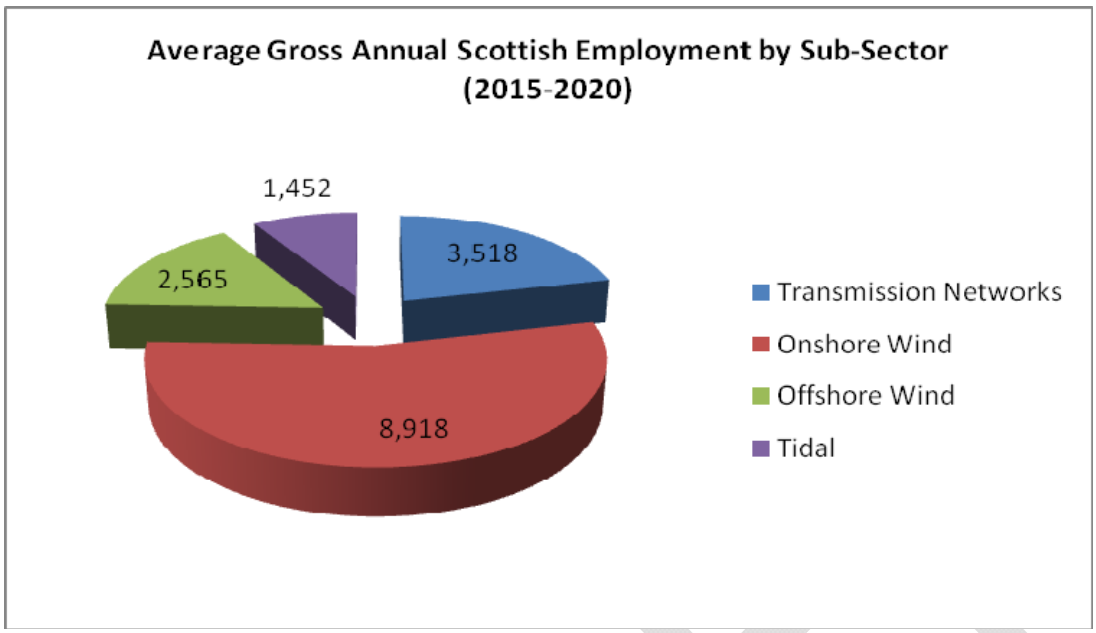
2. Project expenditure includes development expenditure, capital expenditure and operational expenditure estimated for Scottish offshore wind, onshore wind, tidal energy and transmission networks projects.

Figure 1: Estimated gross annual Scottish employment supported by renewable energy projects in Scotland

Source: Scottish Enterprise, 2016

Notes: Includes direct, indirect and induced gross employment estimated to be supported by Scottish offshore wind, onshore wind, tidal energy and transmission networks projects.

Figure 2: Average gross annual Scottish employment, 2015-2020, split by renewable energy sub-sector



Source: Scottish Enterprise, 2016

Notes: Includes direct, indirect and induced gross employment estimated to be supported by Scottish offshore wind, onshore wind, tidal energy and transmission networks projects.

Table 2: Estimated gross Scottish GVA (present value) generated by renewable energy projects in Scotland

	Gross GVA (£M – present value)
2010	**£376**
2011	**£333**
2012	**£623**
2013	**£599**
2014	**£617**
2015	**£693**
2016	**£945**
2017	**£940**
2018	**£845**
2019	**£653**
2020	**£562**
Total	**£7,186**

Source: Scottish Enterprise, 2016

Notes: Includes direct, indirect and induced gross GVA estimated to be generated by Scottish offshore wind, onshore wind, tidal energy and transmission networks projects.

5. Future Opportunities

5.a Immediate Opportunities

Bearing in mind the current status of the respective supply chains, a number of opportunities for development in Scotland become apparent. These are centred round the following:

Fabrication of towers (onshore and offshore wind)

There are logistical benefits of local supply with the sheer scale of offshore towers meaning that quayside access is needed. It has been assumed that the optimum arrangement for the industry in Scotland is for one facility to fabricate all the towers for the Scottish wind farms. Scotland has an opportunity to supply a significant percentage of the UK market in addition to the current onshore wind capacity available through Wind Towers Scotland at Campbeltown which is currently fabricating around 100 onshore towers per annum supporting 150 jobs. Offshore tower manufacture has been identified as an area of opportunity, where there are logistical benefits to local supply and barriers to entry are relatively low. Wind Towers Scotland has ambition to diversify into large scale offshore tower production but requires capital investment (£10-£20m) given the difference in scale of the offshore towers. Such a tower fabrication facility with the capacity to produce 150 onshore and offshore towers per annum is projected to employ in the region of 250 people, an additional 100 direct full-time equivalent (FTE) workers. A key priority must be to ensure that the infrastructure and training is put in place to enable a plant such as this to be 'offshore ready', and their owners have the necessary financial support (e.g. the ability to offer improved securities and bonds) to win major orders otherwise future opportunities may not materialise.

Fabrication of foundations (offshore wind)

The majority of Scottish offshore wind projects are unlikely to use monopiles because of the depth of Scottish waters. Demand for jacket foundations is likely to ramp up during 2016-17. Scotland is most likely to succeed in the supply of transition pieces, secondary steel and piles, since the majority of Scottish projects are likely to use 'jackets', similar to those in the oil and gas industry. Although, there is international competition, this should be a focus for Scotland as capability already exists at BiFab in Methil, Burntisland and Arnish and job creation potential is high. If Scottish projects use concrete 'gravity base' foundations, supply is likely to be local. Scotland has good aggregate and fabrication capabilities and an abundance of wet storage capacity in the longer term.

Recent experience has shown that the Engineering, Procurement, Construction and Installation (EPCI) contractors employed by the developers would prefer to spread their construction risk by sourcing foundations from two yards, therefore it is expected that potentially up to 50% of the jackets for the offshore wind projects could be manufactured in Scotland, unless another yard, such as Global Energy Group's facility at Nigg, is able to supplement BiFab.

Investment in improved quayside, fabrication shed and painting facilities will improve BiFab production capabilities. SE and UK Trade & Industry have been pursuing solutions for a full scale serial jacket fabrication facility. In addition, the ability to offer improved securities and bonds will be of benefit to the wider EPCI market and the UK Government is believed to be studying possible support mechanisms.

Based on estimates in NRIP (National Renewables Infrastructure Plan), one jacket manufacturing facility with the capacity to manufacture 150 units per annum would directly employ an additional circa 260 FTE.

Subsea array cabling (offshore wind and tidal energy)

Market demand may be insufficient at this point in time to justify new investment in export cabling, which requires a strong project pipeline to be in place to justify the scale of investment. There are however, expected to be opportunities for Scottish suppliers outwith supply of main export cables as new projects are developed.

Oceaneering in Rosyth has subsea cabling capability, which is focused on the oil and gas sector but could diversify into offshore wind. JDR Cables in Hartlepool made this transition and now have a base in Aberdeen. JDR Cabling is a pioneer in the development of inter-array cables for offshore wind, wave and tidal energy products. JDR offers a complete package for renewable operators; from design of inter-array cable systems, to manufacture and field service support. There are immediate opportunities for Scotland in cable ancillaries and protection and SE has developed an initiative to advance and support this area of the supply chain.

The £2.4m SE Tidal Array Cabling Solution project was launched in December 2013 with the aim of developing and demonstrating effective methods of locating, securing, protecting and retrieving cables for tidal energy arrays. The R&D phase of the project was completed at the end of 2014 and resulted in the development of five potential solutions to the cabling challenge. Contracts were awarded to Jee and Aquatera to demonstrate two array cabling solutions in Orkney during the autumn of 2015. Jee and Aquatera are working in partnership to deliver this activity and engaging a number of Scottish companies in fabrication, material supply and offshore services. Atlantis has also announced a cooperation agreement with JDR to look at designing efficient cable array solutions for tidal energy.

Cable installation (offshore wind and tidal energy)

Cable installation could support new entrants to the market but developers and financiers place a high priority on track record and specialist vessel capabilities. Scottish companies are well placed to provide sea bed clearance, crew transfer, diving and ROV services, carousels and handling equipment. There is a trend towards EPCI contracting and this has created an opportunity for the oil and gas company, Subsea7, through its Seaway Heavy Lifting JV, to manage the cable installation on the Beatrice offshore wind project.

Substations (offshore wind and tidal energy)

The core components of substations are divided between electrical and structural components. The main UK electrical suppliers are based outside Scotland. No Scottish suppliers have delivered any substation platforms to date but there is a track record at BiFab for substation jacket foundations. There are opportunities for large Scottish fabricators to enter the platform supply market and just recently we have seen an example of this. Babcock International in Rosyth recently won a contract to build an offshore substation for E.ON's 400MW Rampion offshore wind farm; they will deliver design, engineering, procurement and construction of the 2,500 tonne offshore substation platform topside and jacket at Rosyth, using key subcontract partners.

There is evidence that some new wind farms are considering the introduction of modular substations instead of one large substation. These systems could bring a number of additional fabricators into the supply chain, to support the electrical contractor e.g. BiFab or Global Energy Group could build the structures and Babcock assemble. This could also reduce the need for large vessels for sub-station lift/installation, potentially creating an opportunity for smaller, local fleet managers.

Construction and marshalling ports (offshore wind and tidal energy)

A number of Scottish ports are well located to service the offshore wind market with the provision of marshalling harbour facilities for wind turbine generator (WTG) assembly, and possibly temporary storage and marshalling of jacket foundations. The facilities provide storage and laydown areas for nacelles, blades and towers with organisations also capable of providing specialist logistics services for the transfer and movement of these components. For example, Nigg Energy Park is well positioned to become Scotland's first 'Renewables Hub'.

Nacelle assembly makes up a small percentage of lifetime cost but there are known to be several suppliers of composite materials in other sectors in Scotland who could potentially diversify into this area. There is enough land within a number of Scottish ports and engagement with all potential Scottish assembly sites continues.

A Scottish construction port would be most efficient when combined with turbine component manufacturing facilities but it is not a pre-requisite. For example, Global Energy Group has been trying to attract an OEM to assemble components at Nigg, with discussions ongoing. Enterprise agencies can work with ports to help them to be competitive although port expenditure is small in terms of project costs. Nevertheless, it still has the potential to provide valuable revenue streams and contribute significant GVA to local economies.

Operations & maintenance (onshore and offshore wind and tidal energy)

Operation and maintenance can account for up to 20% of project expenditure so the opportunity is substantial and long term. Scotland has already seen the benefits to domestic supply chain in O&M with some companies gaining a significant foothold in the market

place. Therefore, the development of a strong O&M supply chain must be a priority for Scotland.

This sub-element offers a significant opportunity for companies to supply local wind farms/tidal arrays but much depends on the maintenance strategy that is adopted (offshore or onshore based). A number of skilled technicians will be required to provide regular servicing and maintenance of onshore and offshore WTGs over projected 25 year project lifetimes. There is a requirement for the training of skilled technicians for the servicing of On and Offshore Wind Turbines to support long term jobs. An opportunity could be found to utilise towers, blades and nacelles at near ground level to develop a turbine installation and O&M technical course in conjunction with an appropriate Higher or Further Education establishment.

Significant opportunities exist for Scottish ports and for companies supplying labour, goods and services. SE and HIE efforts will be focussed on working with relevant developers and turbine manufacturers to identify local supply chain opportunities. There are wider opportunities for Scottish companies that can offer vessel or access system concepts or provide third party maintenance services.

5.b Further Opportunities

Further to the opportunities discussed above, three core areas for development have been identified as the focus for collaborative action across government, its agencies and the private sector. Floating wind technologies could overcome the particular challenge of placing large turbines in the deep and difficult waters that surround the Scottish coastline. The circular economy refers to the opportunities that arise from an operational and maturing onshore wind sector. Finally, the ongoing development of the transmission network in Scotland will enable the connection of more renewable generation and will provide ongoing supply chain opportunities.

<u>Floating wind</u>

Floating Wind is a core strand to Scotland's offshore renewables potential, providing the opportunity to harness wind power from deep water sites that are currently inaccessible by standard fixed (e.g. monopile and jacket) foundations. Much of the Scottish coast, especially on the West coast, deepens quickly close to shore and floating substructures provide the solution to access. To stimulate the industry, the Scottish Government is offering 3.5 ROCs/MWh under the Renewables Obligation Scotland (ROS) for floating projects installed by October 2018. By comparison, it offers 1.8-2.0 ROCs/MWh for fixed foundations offshore wind.

Floating technology also provides benefits such as:

- Simplified installation and decommissioning
- Extended weather windows for installation & decommissioning
- Access to waters further offshore increasing energy yield
- Opportunities to mass manufacture substructures

- Isleburn (Global Energy Group)
- BiFab
- Babcock International
- Utilisation/expansion of dry dock facilities

- Less seabed dependencies
- Quayside turbine assembly onto substructure (instead of using expensive offshore heavy lift vessels).

Scotland is well suited to the development of this subsector due to the engineering, maritime expertise, natural resources and relevant infrastructure available. Floating substructures, separated into three main classes are well known solutions in the oil and gas industry. These classes are spar buoy, semi-submersible and tension leg platform.

Single devices have been demonstrated at full scale globally in the last six years, including HyWind in Norway, WindFloat in Portugal and the Fukushima Forward project in Japan. Scotland's attributes as well as an enhanced funding mechanism under the ROS, has singled out Scotland as a destination for arrays of floating wind.

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There are currently three pilot projects planned off the Scottish coast including a 30MW demonstration of Statoil's Hywind project; a circa 50MW pilot of semi-submersible turbines by Kincardine Offshore Wind, off the Aberdeenshire coast and a proposed test centre for floating technologies on the north coast of Scotland at Dounreay.

The global potential for floating wind is huge with a collective potential of approximately 7,000GW of deep-water wind resource, and with key involvement from Europe, Japan and the US. Scotland has the potential to be a leader in this field if it can gain first mover advantage with pilot arrays. The opportunity to develop a strong productive supply chain locally as well as export components, knowledge and expertise is there for the taking. Developments such as a test and demonstration centre could have a role in ensuring Scotland's global place in this sector.

<u>Circular economy opportunity</u>

The circular economy has been identified as a major new area of focus for the energy industry to increase its productivity and profitability, which is expected to lead to significant growth opportunities for Scotland's supply chains. The emerging renewable energy industry offers the opportunity to design in 'circularity' when new projects are conceived, leading to both environmental sustainability and higher economic growth.

In September 2014 the Cabinet Secretary for Rural Affairs, Food and the Environment confirmed funding for a pan Scottish Institute for Remanufacture (SIR) to be established at the University of Strathclyde. Funded by the Scottish Funding Council and Zero Waste

Scotland, this will be the first UK Centre of Expertise in Remanufacture. Its central aim of increasing innovation in remanufacturing will be achieved through stimulating and co-funding collaborative projects that address industry challenges. SIR will provide access to specialist academic expertise (in areas such as automation, inspection, cleaning, process optimization, environment audit and reverse logistics). The opportunity to create additional value for companies by enabling them to increase reuse, repair and remanufacture in manufacturing operations, is a key driver in establishing this Centre.

Industry consultations were carried out on behalf of the SEAB Supply Chain Working Group by Optimat Limited, and consultees are shown in Appendix 7. The consultations have identified the following opportunities for developing new supplier clusters. These opportunities will be investigated in conjunction with working groups arising from the recent Circular Economy workshop run by the Renewable Industry Advisory Group (RIAG):

Replacement turbine component manufacture

Cost of replacement parts from overseas wind turbine suppliers after warranty periods expire often carry a premium cost from the original equipment manufacturer, which impacts on the overall cost of energy production. Moving parts such as gearbox[8], rotor and bearing components experience most wear and need for replacement over the lifetime of onshore and offshore wind turbines. Scotland has extensive precision engineering, component and advanced manufacturing capabilities, supplying a wide range of sectors, such as aerospace, automotive, oil & gas, and defence. There is also strong infrastructure supporting innovation e.g. the Advanced Forming Research Centre (AFRC) and Scottish Manufacturing Advisory Service (SMAS) that could form the basis of a replacement turbine component manufacturing cluster initially for onshore wind turbines, but also for offshore wind turbines and marine energy components in the future.

Wind turbine gearbox and drive train overhaul and repair

Wind turbine gearboxes and drive trains usually undergo a major overhaul and refurbishment after ten years, costing tens of thousands of pounds, where the whole drive train is removed and transported to a specialist centre, such as David Brown Gears in England. Over 50% of UK onshore wind turbines are in Scotland, which is estimated will eventually require around 200 turbines each year to be refurbished. This could lead to an opportunity to set up a national independent gearbox overhaul and repair facility in Scotland, which links to local component manufacturers and other specialist service providers. Similar global centres are being established in Europe and the USA for the onshore wind turbines. A Scottish facility could support the UK onshore wind and offshore wind sectors, possibly supporting the European offshore wind sector as the industry develops.

[8] SSE advise however that largely due to better management and maintenance they only changed around 8 gearboxes during 2015, out of 800 in service

Remanufacturing wind turbines and blade refurbishment

End of life issues related to onshore wind farms could provide a major environmental challenge for the whole industry, in terms of disposal of large composite turbine blades. Remanufacturing of turbines including gearboxes, drive trains and refurbishment and the repair of blades, followed by verification of turbine performance offers a potential opportunity to increase the turbine life by five to ten years. This could have significant impacts on reducing costs of energy generation and offsetting future investment to repower existing wind farms. A combination of permanent and mobile on-site refurbishment facilities would provide flexible refurbishment and upgrading of existing wind farms. There are also synergies and linkages with the two other clusters above for replacement components and refurbished blades.

Electric Arc Furnace capabilities for steel re-use

In addition to the suggestions above, the Scottish Government has carried out an evidence building programme to understand how circularity could play a role in Scotland's economy. Modelling calculations suggests that £21m to £71m could be added to end of life asset values if circular economy approaches are implemented. Given the quantity of steel deployed in utility scale renewables projects across Scotland (830,000 tonnes), the study findings support industry recommendations for Scotland to develop an Electric Arc Furnace (EAF) capability[9]. This facility should be co-located with a deep water port to reduce transport and logistics associated with movement of large steel quantities. Together with potential oil & gas decommissioning of steel structures in the next two decades this facility would not be short of feedstock.

<u>Supporting further development of the transmission network</u>

The findings highlighted a shortage of specialist operatives, particularly in transmission networks for jointers, linesman, specialist protection and commissioning engineers. This was highlighted as a problem by both network operators and contractors to large projects. This would have a greater impact on the ability of smaller companies to take on larger projects. The National Grid site at Eakring in Nottinghamshire is best known as the main centre, in the UK, for training electricity transmission engineers to work on electricity pylons and overhead lines. However, a Scottish location providing specialist training could potentially train over 100 specialist engineers per year.

[9] Report prepared for Zero Waste Scotland by AMEC Environment & Infrastructure UK Ltd, November 2014

6. Recommended actions to the SEAB

6.a Conclusions

The Supply Chain Working Group has taken a comprehensive consideration of the current status of Scotland's renewable electricity industry. The Scottish based projects could support average employment of 16,500 workers per annum between 2015 and 2020. The group's particular focus was towards understanding where economic opportunities for Scottish growth lie. The industry is maturing at different rates across the four sectors considered and opportunities are specific to each of these sectors. Opportunities in international markets are not constrained by the scale of the domestic markets that are analysed in this report.

As the sector matures, there will be further short term and immediate challenges for particular developers and their projects. However, the longer term prize is the creation of a more competitive renewable electricity sector that is driving towards its levelised cost of energy targets, on the basis of its low carbon credentials, delivered in a way that is affordable to the end consumer.

The role of the working group was to assess the supply chain and identify attractive opportunities where Scotland is well placed, through focused cross industry and public sector collaboration, and can bear fruits for the Scottish economy as a whole. That is exactly what this report has attempted to assess. The recommendations that follow focus on the immediate imperative to ensure Scottish manufacturing capability for offshore wind towers, foundations and array cabling is 'offshore ready'; that a high quality and technologically sophisticated hub or cluster is established to support the operations and maintenance phase of the onshore wind industry; and finally, that we do not miss the opportunity to continue to position Scotland for future large scale commercial development of marine energy.

There is no doubt this is a particularly challenging time for the renewable industry across Scotland and the UK. But we firmly believe economic opportunities will continue to exist in the months, years and decade to come.

6.b Recommendations

1. The ongoing case for a developing Scottish renewable electricity industry, as an affordable solution to the challenge of meeting carbon targets and generating economic benefits, should continue to be made and championed by the Scottish Government, its agencies and the industry. The agencies should also continue to support engagement with project developers and potential inward investors, both here and increasingly in overseas markets.

2. In the immediate short-term, it is recommended that the Scottish Government supports Scotland's key existing fabrication businesses (e.g. Babcock, BiFab, Global Energy Group and Wind Towers Scotland) to enable them to take advantage of the potential future opportunities by ensuring their sites and resources are 'offshore ready' (e.g. grants, equipment lease, training) and their owners have the necessary financial support (e.g. export credit finance) to win major orders, otherwise future opportunities may not materialise.

   Key action 1: Scottish Government to investigate all possible support mechanisms to **ensure Scotland's key existing fabrication businesses are 'offshore ready'**.

3. Also in the immediate term and in addition to the above, it is recommended that SE and HIE support existing manufacturers (e.g. Oceaneering and JDR) to pursue wider supply chain opportunities.

   Key action 2: SE to **investigate opportunities for subsea array cabling manufacture in Scotland.**

   Key action 3: SE and HIE to **investigate further support for port infrastructure development as potential 'Renewables Hubs'.**

4. Focus should be applied by the Scottish Government, its agencies and the industry on the three further opportunities identified: floating wind; the circular economy and supporting further development of the transmission network, all of which are expected to develop rapidly in the period up to 2020.

   Key action 4: SE and HIE to investigate the opportunity to **develop a strong productive floating wind supply chain**.

   Key action 5: RIAG on behalf of Scottish Government to **continue to investigate the circular economy opportunities**.

   Key action 6: Skills Development Scotland to investigate supporting the **training of specialist operatives in transmission networks** for jointers, linesman, specialist protection and commissioning engineers.

5. Scotland should continue to seek to influence UK policy on renewable energy, to deliver consistent messages and operating environments for companies and investors. Policy and planning horizons must be extended to give certainty to investors (currently 25 year planning consents are granted to onshore wind farms).

6. Macro economic modelling and appraisal of specific supply chain opportunities are separate activities and should be addressed as such in future. The aggregation of impacts from numerous supply chain opportunities at Scotland level provides little additional value. The real value of such work lies in setting priorities and being able to allocate resources to the most important areas.

7. There are potential opportunities for the development of the tidal sector, where Scotland is already a world leader. The enterprise agencies should continue to focus on maximising the opportunities from MeyGen and other projects planned in Scotland and overseas, and look to support export opportunities for these companies as other markets open up across the world.

6.c Economic Impact of Recommendations

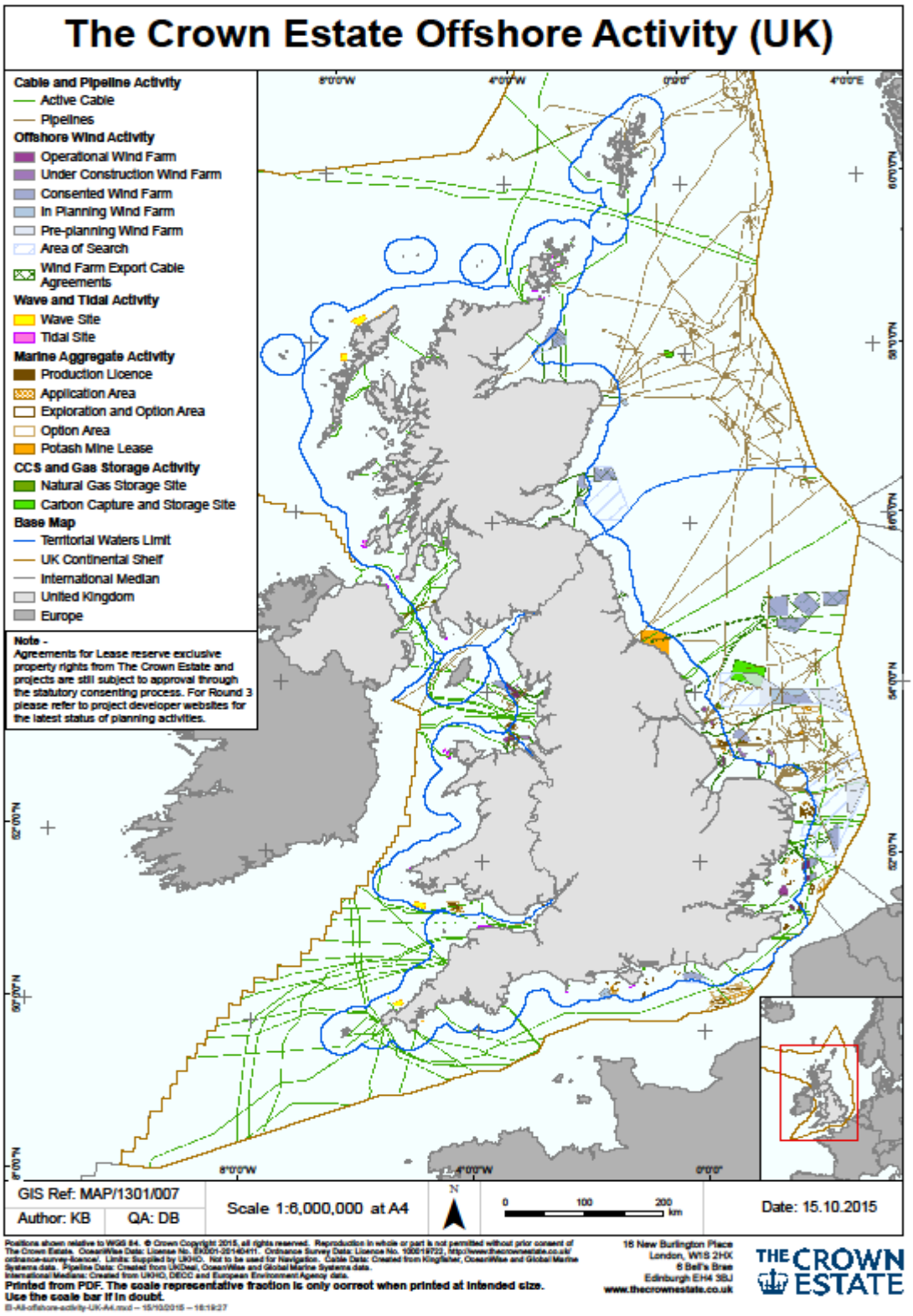
The working group is unable to quantify the additional supply chain employment resulting from each intervention set out above. However, as part of the working group's work, SE has developed an economic appraisal model for each of the four sectors. SE has the capability to run economic appraisals for individual interventions once these are more fully developed.

Appendix 1: Working Group Members

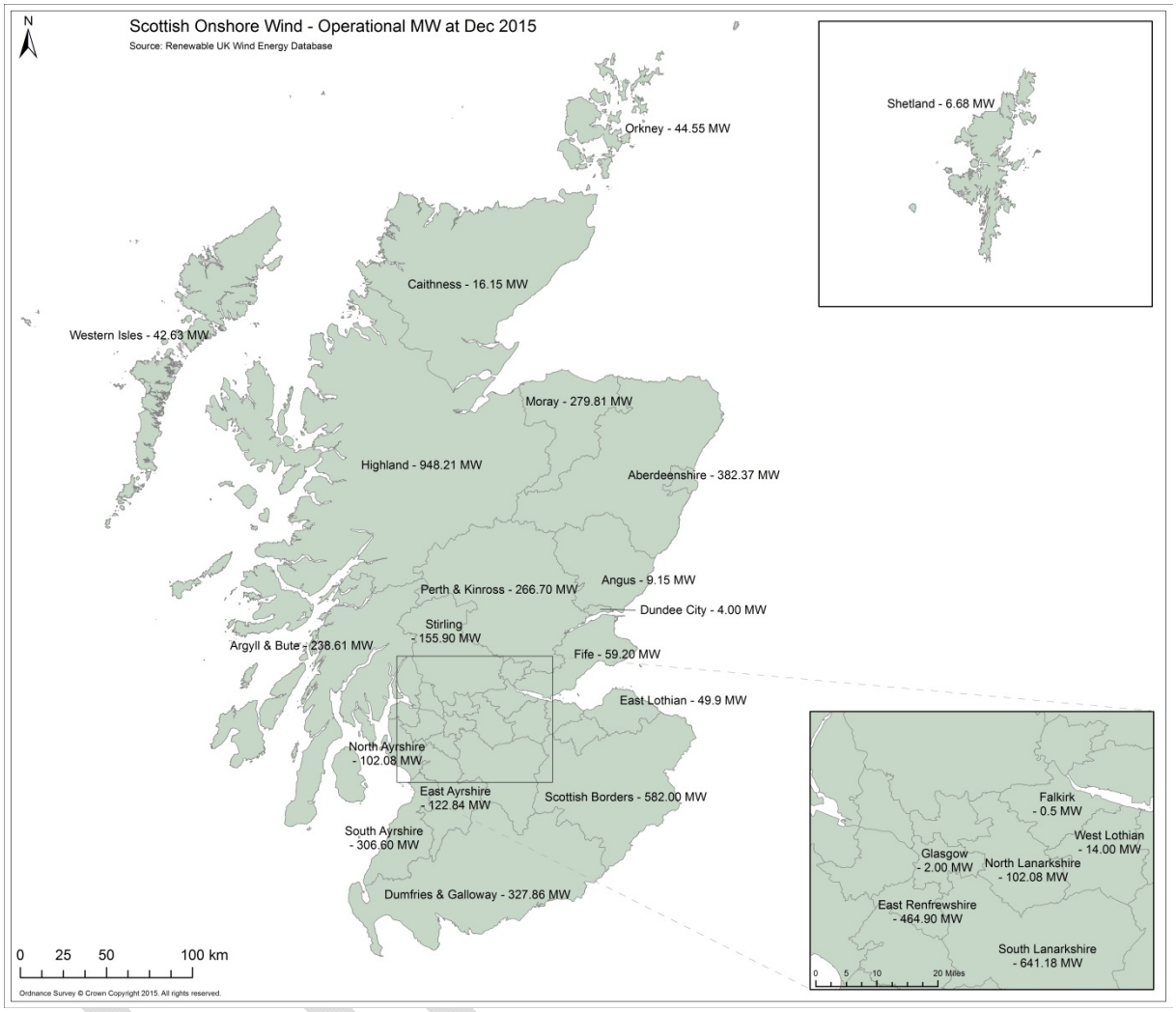
Sandy Biggar, Director of Procurement & Logistics, SSE (Chair)
Stephen Baker, Head of Procurement & Commercial - Offshore Renewables, SSE
Lindsay McQuade, Policy & Innovation Director, ScottishPower Renewables
Dan Finch, EU Country Manager, EDPR
Stephen Thompson, Business Development Director (Renewables), Global Energy Group
Douglas Hyslop, Senior Manager, Scottish Enterprise
Joelle Russell, Appraisal & Evaluation Team, Scottish Enterprise
Calum Davidson, Director of Energy and Low Carbon, Highlands & Islands Enterprise
Audrey McIver, Head of Energy, Highlands & Islands Enterprise
Jenny Hogan, Director of Policy, Scottish Renewables
Lindsay Roberts, Senior Policy Manager – Offshore Wind & Marine, Scottish Renewables
David Stevenson, Head of Offshore Wind Policy, Scottish Government
Stuart Strachan, Business Manager, Scottish Government (Secretary)

Appendix 2: Offshore, Onshore, Marine and Transmission Networks Activity

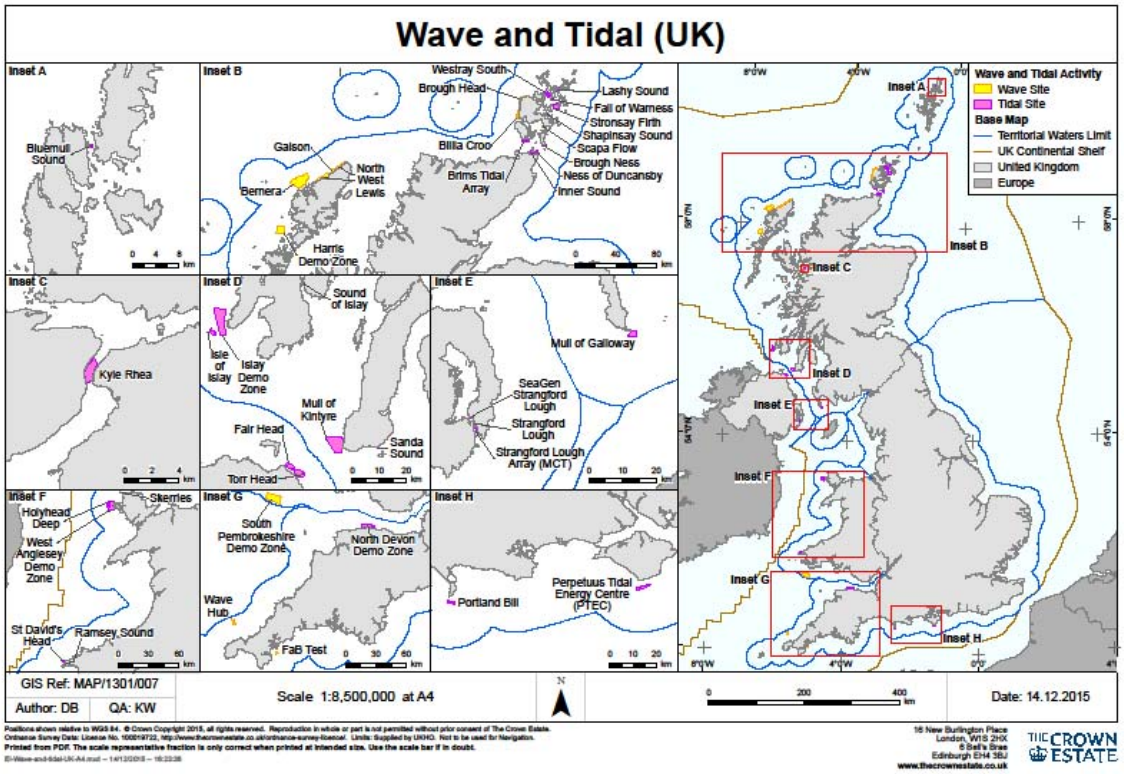
Current UK offshore activity



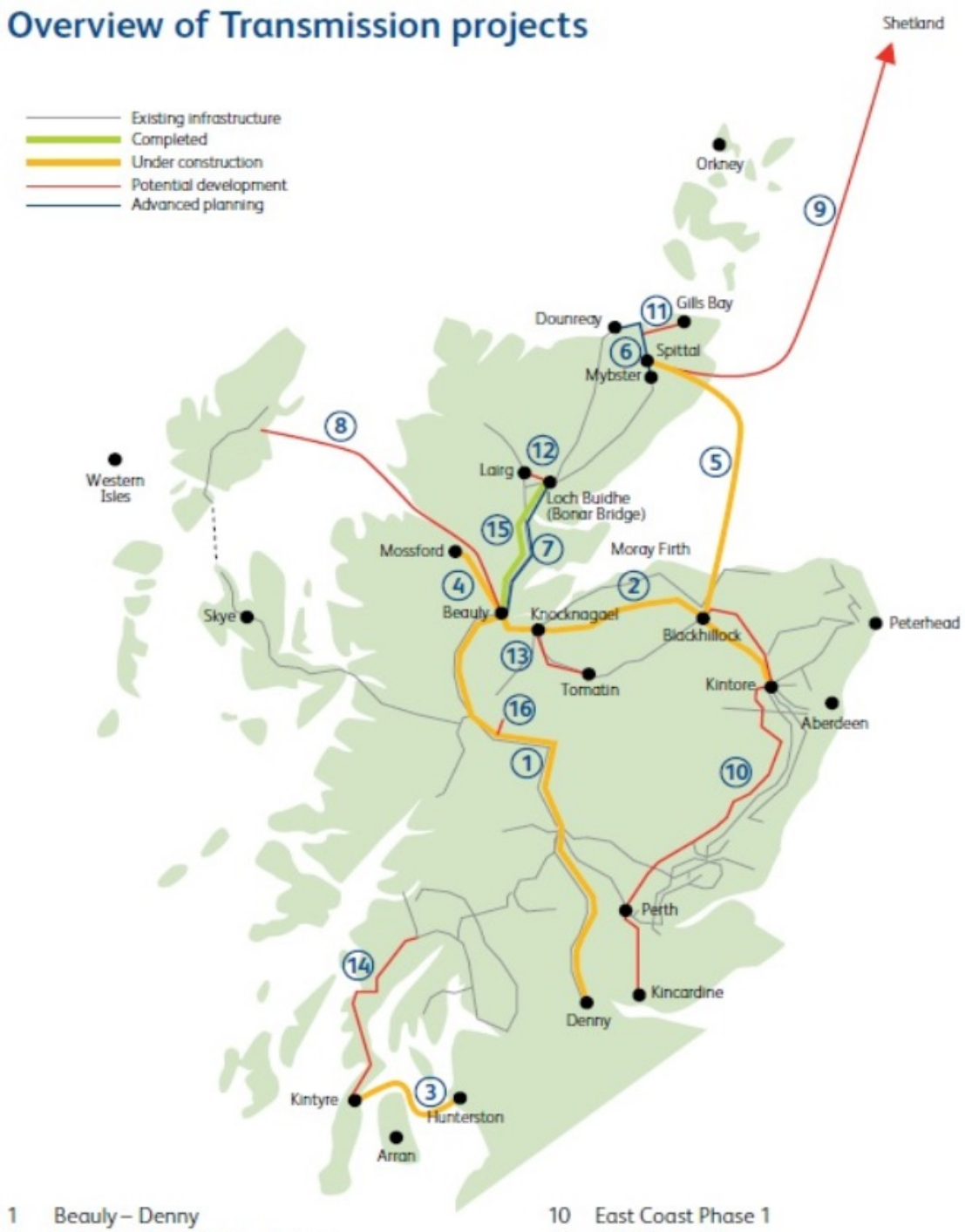
Current Scottish onshore wind MW



Current UK marine activity

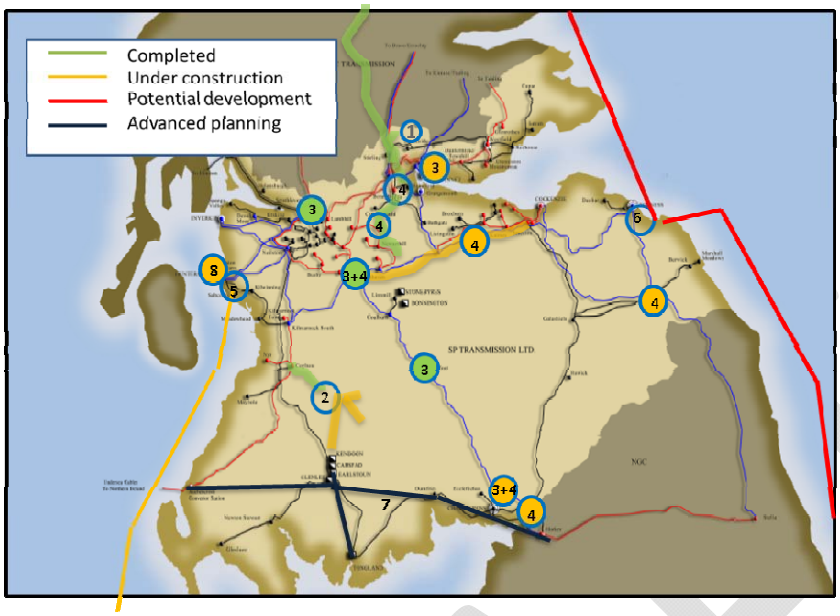


Current Scottish transmission networks activity – Scottish Hydro Electric Transmission territory



1 Beauly – Denny
2 Beauly – Blackhillock – Kintore
3 Kintyre – Hunterston Link
4 Beauly – Mossford
5 Caithness – Moray HVDC
6 Dounreay – Mybster
7 Beauly – Loch Buidhe Reconductoring
8 Western Isles Link
9 Shetland Isles Link
10 East Coast Phase 1
11 Gills Bay Radial
12 Lairg – Loch Buidhe
13 Knocknagael – Tomatin
14 Inveraray – Crossaig Reinforcement
15 Beauly – Loch Buidhe Reinforcement
16 Melgarve Substation (Stronelairg Wind Farm Connection)

Current Scottish transmission networks activity – Scottish Power Transmission territory



Substation works

Overhead Line Works

1. Beauly - Denny
2. SW Scotland
3. 3.3GW interconnector upgrade
4. 4.4GW Interconnector upgrade
5. West Coast HVDC
6. East Coast HVDC
7. D&G Strategic Reinforcement
8. Hunterston-Kintyre

Appendix 3: Case study – Green Marine Solutions

Green Marine provides solutions for the safe installation, removal and maintenance of a wide range of tidal and wave energy devices and gravity bases. The company was set up in 2011 in Orkney in response to the build-up of marine energy activity in the area following the establishment of the European Marine Energy Centre (EMEC). The family company has a history of working in the commercial fishing industry over several generations with ideal expertise to diversify into bespoke vessels and marine operations for wave and tidal energy projects. The number of employees ranges from around 16 to 22 depending on the requirements of the operation, bringing direct employment opportunities to Orkney which now has over 200 people working in the marine energy industry.

Indirect employment is created through the use of the local supply chain, from the local butcher and baker to crane operation and engineering services. This award winning business has opened up opportunities to other local companies involved in the renewables industry by combining their services with those of Green Marine. Having provided services to most of the developers working in Orkney, the team are now exploring opportunities to export their expertise and equipment to projects in other parts of the world such as France and Japan and are regularly involved in talks and visits to these countries to explore upcoming opportunities being generated in this new and exciting industry.

"Before we got involved in some of the projects at EMEC, boats were being called in from the likes of Norway and beyond to do the work. The key thing with Green Marine being readily available to complete the offshore operations is that we can greatly reduce costs for the developer and increase the income for the islands. As one of the few companies with experience providing marine operations to wave and tidal devices we are in an ideal position to win work in the now growing export market."

Jason Schofield, Managing Director, Green Marine

Appendix 4: Case study – Beauly Denny Overhead Line

Major transmission projects involve very large capital outlay and have the potential for significant local content due to the advantage of local proximity of suppliers to the developer. A good example of this type of project, to illustrate the scale and nature of such opportunities, is the Beauly to Denny project, as illustrated below:

The project concerns the upgrade of the line to 400kV to release renewable capacity from the north of Scotland.

Delivery date:
Beauly-Denny assets available from Q4 2015
Project completion: Q1 2018

Status:

- The construction of the outstanding overhead line sections and substations works progressed to programme.
- The Beauly-Denny northern section between Beauly substation and Fort Augustus substation was energised in July 2013.
- The Beauly-Denny central section between Fort Augustus substation and Tummel substation was energised in October 2014.
- The Beauly-Denny southern section between Tummel substation and Braco substation was completed in July 2015. Braco substation 33kV connection was energised in May 2015. The last remaining hurdle on the overhead line was the Glenalmond network overbuild, commenced on 13 June 2015 and completed in July 2015. This allowed energisation of the 275kV circuit between Tummel substation and Braco substation. This milestone marked the completion of the core network infrastructure construction of the SHE Transmission section of the Beauly to Denny line.
- Scottish Power Transmission section Denny 275kV substation energised August 2014.
- Denny North 400kV substation energised November 2015
- 275/400kV line between the Wharry Burn (Sherriffmuir) and Denny substation construction complete and energised November 2015.

The main deliverables have now been achieved. The project team will continue to complete the wirescape rationalisation programme, dismantling of redundant network infrastructure, undergrounding of 132kV circuits, removal of temporary access road infrastructure and landscape enhancements.

The impact of the project in Scotland has been to

- Contribute £151m[10] to GDP over the entire construction period, of which £88m is direct, £40m is indirect and £23m is induced.
- Support the 2,840 person-years of full-time jobs; equivalent to 410 full-time jobs in each year of construction. Of these, 225 are expected to be direct, 120 indirect and 65 induced.

These are based on expenditure with Scottish suppliers only.

[10] 2009/10 prices

Appendix 5: Alliances and Cross Industry Support Organisations

Financial and Innovation Support

- **POWERS** (Prototyping for Offshore Wind Energy Renewables Scotland) - £40 million fund to support the manufacturing of next generation offshore wind turbines and major turbine components;
- **SIFT** (The Scottish Innovative Foundation Technologies Fund) - The Scottish Innovative Foundation Technologies Fund is a £15 million fund to support innovation in offshore wind turbine foundations, in water depths greater than 30 metres;
- **REIF** (Renewable Energy Investment Fund) - The Renewable Energy Investment Fund (REIF) is designed to drive investment into key areas of Scotland's renewable industry;
- **GIB** (The UK Green Investment Bank) - headquartered in Edinburgh, is a key component of the progression towards a green economy. Capitalised with £3 billion, its mission is to provide financial solutions to accelerate private sector investment in the green economy;
- **UK Export Finance** - UK Export Finance complements the private market by providing assistance to exporters and investors, principally in the form of insurance and guarantees to banks.

Support for Infrastructure & test sites

- **ITREZ** (International Technology and Renewable Energy Zone) – Situated in the West of Scotland. ITREZ is an alliance of the public, private and academic sectors that aims to stimulate co-location, investment and job creation by industry. To achieve this, ITREZ will provide the physical infrastructure and specialist expertise to support industrially-relevant research, knowledge exchange and skills provision in offshore renewable and associated enabling technologies;
- **ETP** (Energy Technology Partnership) - An alliance of 12 strong, independent Scottish universities, currently engaged in world-class energy research, development and demonstration. With around 250 academics and 700 researchers, the ETP has a strong track record in the delivery of excellence and is the largest, most broad-based power and energy research partnership in Europe;
- **SEL** (Scottish Energy Laboratory) - A network of Scotland's leading test and demonstration facilities and provides a clear offering of Scotland's capabilities to national and international companies;
- **Wind Energy Systems Research Centre -** The University of Strathclyde has been successful in securing a major funding programme for a new Industrial Doctoral Training Centre aimed at supplying the wind industry with a new generation of specialists in wind energy. Over the next five years, the Centre will produce 50 PhD-level engineers and scientists, bringing together pioneering research and advanced skills training to help the UK meet its ambitious renewable energy targets, as well as addressing the skills shortage in the sector;
- **PNDC** (Power Networks Demonstration Centre) - Based in Cumbernauld and opened in 2013 as a joint venture between the University of Strathclyde, SE, the Scottish Funding Council, Scottish Power and SSE aimed at accelerating the adoption of novel research and technologies into the electrical industry;

- **ORE Catapult** - The UK's flagship technology and innovation research centre, combining world-class research, development, demonstration and testing facilities with leadership, industrial reach and engineering expertise. Catapult accelerates the design, deployment and commercialisation of renewable energy technology innovation.

Direct Supply Chain Support

The Scottish economic development agencies recognise the importance of developing a robust renewable energy supply chain in Scotland and are focusing on ensuring Scotland is a world leader in many of the renewable subsectors. To allow businesses and organisations to reach their potential the agencies have a wide range of support to offer the supply chain domestically and internationally, this includes:

- **Market Intelligence** – A broad range of market information is available to allow business to make a calculated decision about diversifying or starting up in the renewables sector.
- **Expert Support –** Energy Supply Chain Expert Support programme is open to Scottish based supply chain companies looking to diversify into the offshore renewables sector. It currently offers advice in relation to the offshore wind and wave & tidal sectors, but with plans in place to expand the support into additional subsectors. The programme offers free one-to-one industry expert advice and guidance about diversifying into renewable and low carbon energy sectors.
- **Meet the Buyer and Brokerage Events –** This is an identification, brokerage and matchmaking service between developers and prospective suppliers**.** Events are regularly held with project and technology developers to highlight the opportunities and requirements within the supply chain.
- **Supply Chain Mapping –** The agencies have developed processes to map and understand the capability of the Scottish supply chain. This can be a useful tool for developers to understand the capability and reciprocally for the supply chain companies to understand developer requirements. The agencies can then engage with either partner and offer more bespoke products and financial support.

Appendix 6: Economic Impact Analysis Modelling

The full economic impact assessments (EIAs) for offshore wind, onshore wind and transmission networks are attached as separate PDF documents. The EIA for tidal energy has not been included with the Appendix 7 attachments as it is largely based on data from one company and is therefore commercially sensitive. Any enquiries regarding the data analysis or modelling assumptions used should be addressed to Scottish Enterprise, Appraisal & Evaluation Team.

Appendix 7: Supply Chain Study Consultees

The SEAB Supply Chain survey invitees/participants, interviewed by Optimat Limited between January and April 2015, were as follows:

- Alstom
- Andritz Hydro Hammerfest
- Areva Gamesa
- Babcock
- Balfour Beatty
- BAM
- Banks Development
- BiFab
- EDF
- EDPR
- Global Energy Group
- Infinis
- Mainstream Renewable Power
- MeyGen
- MVOW
- Nova Innovation
- Oceaneering
- Ofgem – Energy Networks Strategy Group
- Repsol
- RES
- RJ McLeod
- RWE Innogy
- Scottish Hydro Electric Transmission
- Scottish Power Renewables
- Senvion
- Seaway Heavy Lifting
- Siemens Wind
- Scottish Power Transmission
- SSE Renewables
- SSE Transmission
- Statoil
- Tata Steel
- Wind Towers Scotland