Supply Chain Constraints on the Deployment of Renewable Electricity Technologies

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Final Report

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Douglas-Westwood Limited carries out commercial due diligence work for the financial community and business research, market analysis and strategy work for the international energy industry. The firm has clients in 37 countries and to date over 500 projects have been completed. Clients range from the energy majors and contractors to equipment manufacturers, financial institutions and departments of government in a number of countries. Focused on the energy industries, in the past year we have, for example, completed market due diligence on M&A and financing deals totalling $10 billion.

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1 Executive Summary and Conclusions

1.1 Introduction

In light of the UK's EU-led renewable energy target for 2020, BERR wish to understand the supply chain's capability of meeting the target for renewable electricity generation. To better understand the constraints, energy business analysts, Douglas-Westwood (DWL) were commissioned to quantify likely market growth between 2008 and 2020 and to determine both the present status of the supply chain and how it will grow towards supplying the future demand that the EU target represents.

The study analyses constraints on expansion of the current supply chain, including components, materials, skills and installation capacity. It also goes on to provide an overview of employment and economic benefit from renewable energy and how this could increase by 2020. This study makes reference to other potential barriers to renewables deployment e.g. grid and planning, however, it is not for this study to make recommendations as we understand that Government are already addressing these.

According to existing figures, in terms of renewable energy generating plant capacity, in 2006 this was 5.6 GW and by 2020 this will reach 38.5 GW an increase of nearly 7 times the UK's 2006 capacity with Offshore Wind (47%), Onshore Wind (34%), Biomass & Wastes (10%) providing the majority contribution, and with others such as wave & tidal, hydro and co-firing contributing the remaining 9% (Renewable Advisory Board's (RAB's) central estimate scenario).[1] DWL notes that the UK Government's ambition is to deploy a 25 GW of offshore wind on top of the already planned 8 GW (Press Release 10 December 2007), however, for the purposes of this study we have used the RAB central estimate scenario of 18GW of offshore wind, which puts in context the challenges ahead for the supply chain to support the delivery of the Government's targets.

There are, however, major practical constraints to achieving the Government's ambitions due to problems within, and external to, the supply chain. This document addresses these and suggests recommendations to alleviate them.

1.2 Conclusions

Despite confirming strong future growth, the results from this study have shown an overall gap between what is achievable under existing circumstances (under a 'business as usual' policy scenario) and the RAB central estimate scenario target of 7.6GW. This gap mainly arises from slower than expected progress in offshore wind where major supply chain, infrastructure and market issues must be faced.

The UK is expected to install significant levels of offshore wind by 2020 with 10 GW of new capacity being added. After the leading 'Round 2' projects are built a lull in activity is forecast before the first of the 'Round 3' projects is completed. With 7-9 year development timelines at present, long-term vision is required for the industry to respond sufficiently to allow capacity to be brought online before 2020. The recent launch of Round 3 will deliver greater confidence in the long-term potential of the UK's offshore wind industry.

All sectors must be developed. However, given that grid constraints are set to limit onshore wind, wave/tidal are still embryonic technologies and that biomass faces major feedstock supply and logistics problems, to meet the 2020 target would suggest increased focus on addressing the issues slowing development of offshore wind in particular.

The macro issues being faced by the UK renewable energy sectors, such as skills shortages and inflated materials costs, are common to many other industries, but in addition, other countries can offer more attractive markets for the manufacturer. Large-scale grid-connected renewable energy generation is different in that many of its sectors are relatively new and require long-term investments.

The expected new capacity that will be installed will have significant economic impact and offers considerable supply chain development opportunities for the UK. In key sectors such as onshore and offshore wind, supply chain constraints at an international level present opportnities for new market entry and diversification.

[1] RAB (2008) 0226 2020 VISION – How the UK Can Meet its Target of 15% Renewable Energy, June 2008

If RAB's 2020 capacity target is met, this is forecast to require 122-133,000 jobs to manufacture, construct and operate. The UK must adopt multiple new approaches and intitatives to ensure maximum domestic economic benefit is gained from this new capacity deployment.

Notwithstanding the issues around grid and planning, which DWL understands are to be addressed in the Government's Renewable Energy Strategy, if the UK takes positive action as recommended in this report to address supply chain constraints, then the RAB central estimate scenario target, although challenging, can be achieved.

1.3 Market Forecasts

1.3.1 Comparative Forecasts

UK Renewable Electricity Generation: 2020 Comparison

The charts below plot DWL's in-house forecasts for the renewable electricity sectors against RAB's 2020 scenarios. The aim is to establish if any shortfall or addition to the 2020 scenario is expected.

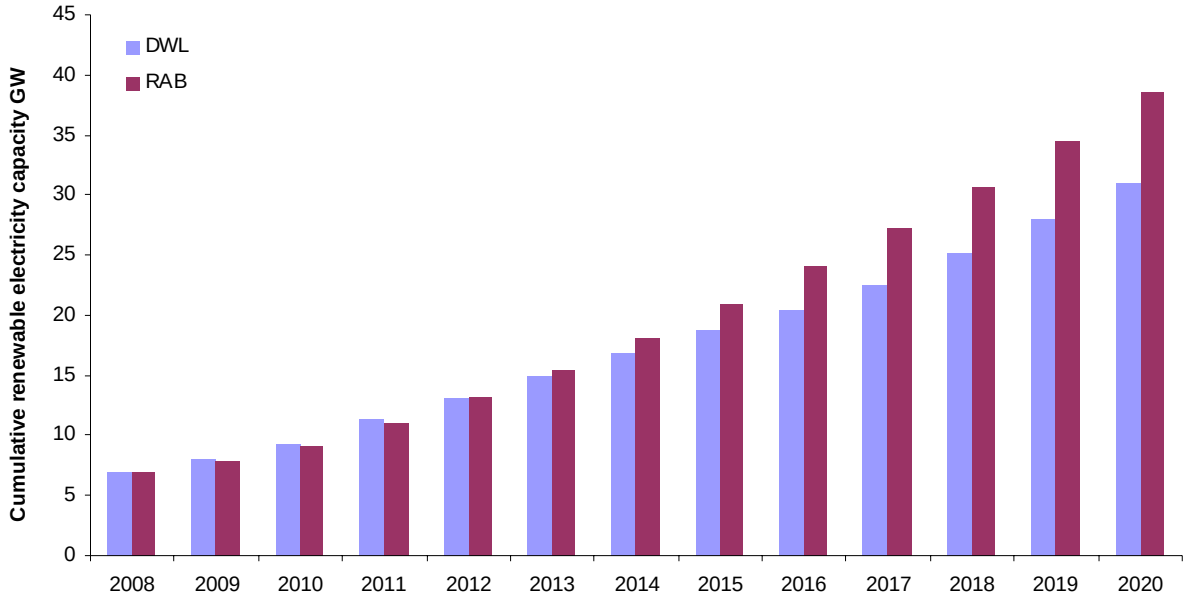

Figure 1-1: Comparative Forecast: Cumulative UK Renewable Energy Capacity

Table 1-1: Comparative Forecast: Cumulative UK Renewable Energy Capacity

GW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
DWL	7.0	8.0	9.3	11.3	13.0	14.9	16.8	18.7	20.4	22.6	25.2	28.0	30.9
RAB	6.9	7.8	9.1	11.1	13.2	15.5	18.1	21.0	24.0	27.2	30.6	34.5	38.5
Difference	0.1	0.2	0.2	0.2	-0.3	-0.6	-1.3	-2.2	-3.6	-4.6	-5.5	-6.5	-7.6

The chart above shows the cumulatively installed renewable electricity capacity in the UK to 2020. Comparison between Douglas-Westwood and RAB figures shows a 7.6 GW gap between the 2020 target and that which DWL have independently forecast.

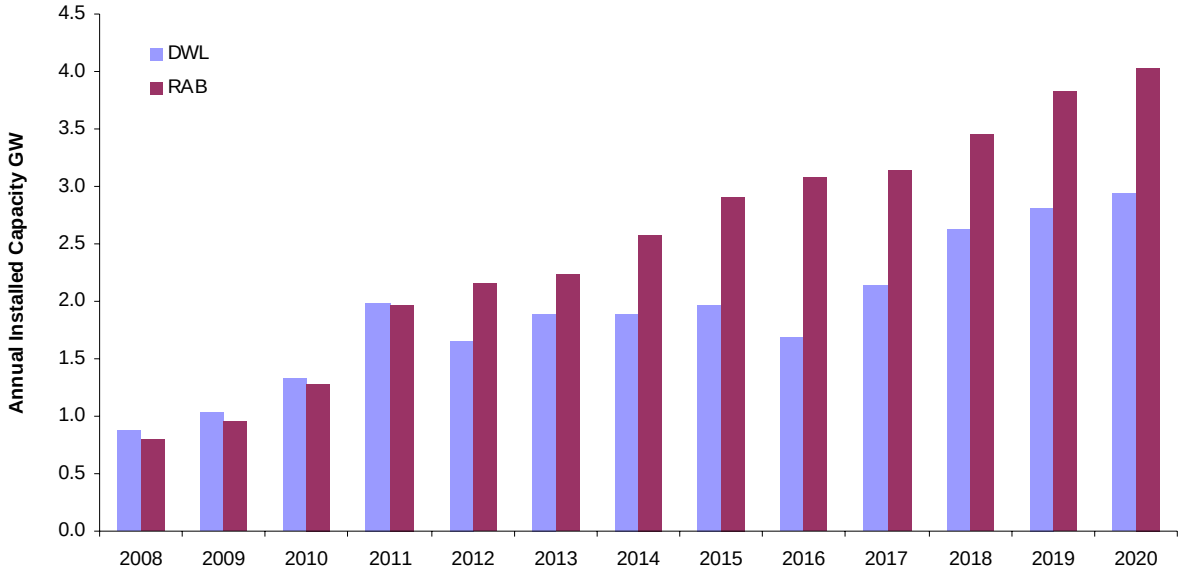

Figure 1-2: Comparative Forecast: Annual Installed UK Renewable Energy Capacity

Table 1-2: Comparative Forecast: Annual Installed UK Renewable Energy Capacity

GW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	08-'20
DWL	0.88	1.03	1.33	1.99	1.65	1.89	1.89	1.97	1.69	2.13	2.62	2.80	2.94	24.83
RAB	0.79	0.95	1.28	1.96	2.16	2.24	2.58	2.90	3.08	3.15	3.45	3.83	4.03	32.40
Difference	0.09	0.08	0.05	0.03	-0.51	-0.35	-0.69	-0.93	-1.39	-1.01	-0.83	-1.02	-1.08	-7.57

The chart above shows a comparison between rates of annual installation as forecast by DWL against those expected by RAB.

It should be noted that RAB's annual figures displayed have been estimated based on the stated 2020 targets for each sector. Annual activity towards these targets is estimated but the total is the same.

1.3.2 RAB Forecasts

UK Renewable Energy Capacity

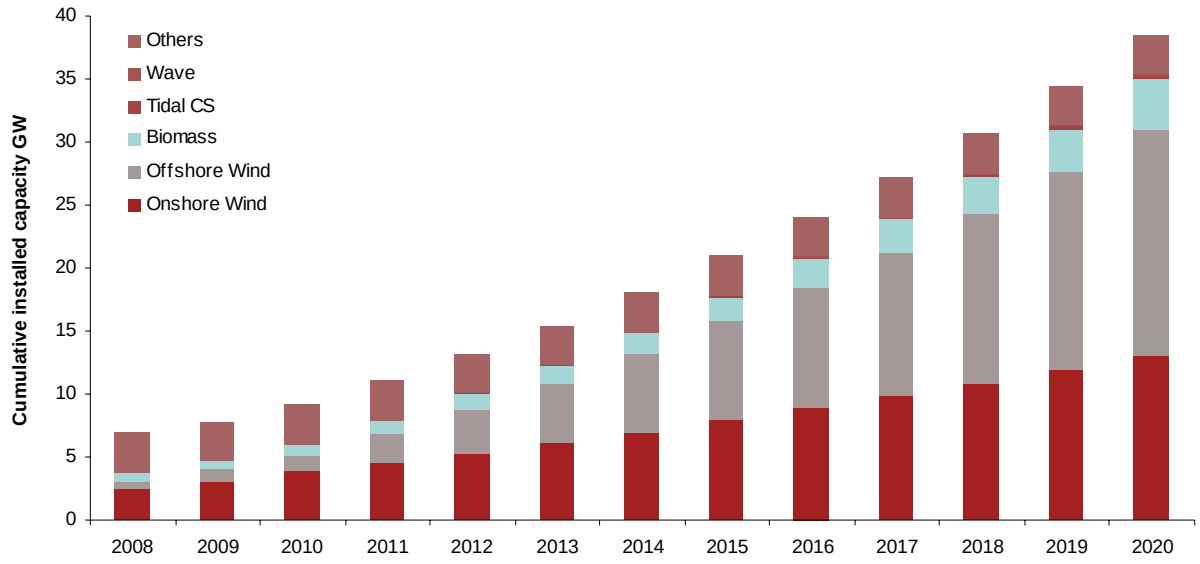

Figure 1-3: RAB Forecast: Cumulative UK Renewable Energy Capacity by Sector

Table 1-3: RAB Forecast: Cumulative UK Renewable Energy Capacity by Sector

MW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Offshore Wind	598	868	1,340	2,240	3,490	4,740	6,240	7,940	9,690	11,440	13,440	15,690	18,000
Onshore Wind	2,525	3,125	3,825	4,525	5,275	6,075	6,925	7,850	8,850	9,850	10,850	11,900	13,000
Wave	1	4	9	16	26	38	53	68	83	98	113	130	150
Tidal CS	2	5	9	14	21	30	42	57	76	99	127	161	200
Biomass	625	700	800	1,150	1,290	1,460	1,660	1,905	2,205	2,565	2,975	3,450	4,000
Others	3,142	3,142	3,142	3,142	3,142	3,142	3,142	3,142	3,142	3,142	3,142	3,142	3,150
Total	6,894	7,845	9,126	11,088	13,245	15,486	18,063	20,963	24,047	27,195	30,648	34,474	38,500

RAB's 2020 target for 38.5 GW of installed renewable electricity capacity by 2020 is broken down by sector above, showing the importance of the major sectors of wind and biomass to the targets. Offshore wind has the highest target at 18 GW installed, followed by onshore wind with 13 GW and biomass with 4 GW. The annual additions are estimated below by DWL based upon the 2020 target and likely growth rates.

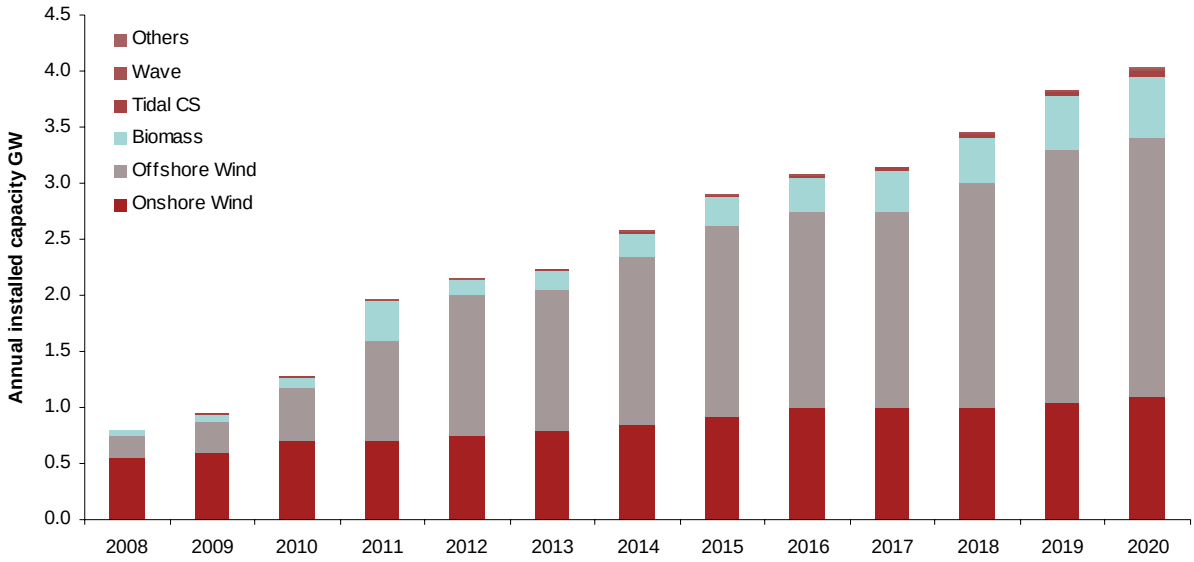

Figure 1-4: RAB Forecast: Annual Installed UK Renewable Energy Capacity by Sector

Table 1-4: RAB Forecast: Annual Installed UK Renewable Energy Capacity by Sector

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	08-'20
Offshore Wind	194	270	472	900	1,250	1,250	1,500	1,700	1,750	1,750	2,000	2,250	2,310	17,596
Onshore Wind	548	600	700	700	750	800	850	925	1,000	1,000	1,000	1,050	1,100	11,023
Wave	1	3	5	7	10	12	15	15	15	15	15	17	20	150
Tidal CS	1	3	4	5	7	9	12	15	19	23	28	34	39	199
Biomass	47	75	100	350	140	170	200	245	300	360	410	475	550	3,422
Others	0	0	0	0	0	0	0	0	0	0	0	0	8	8
Total	791	951	1,281	1,962	2,157	2,241	2,577	2,900	3,084	3,148	3,453	3,826	4,027	32,398

Above, RAB's 2020 targets have been split annually for each sector by DWL. The 2008-2020 figure shows how much additional capacity is required to meet the 2020 targets based on what is currently installed.

17.6 GW of offshore wind installations are therefore needed by 2020 to make the 18 GW sector target. For the other major sectors 11 GW of onshore wind is required and 3.4 GW of new biomass capacity. The onshore target set by RAB may seem low considering the potential growth rate of the sector, but it is this low due to grid capacity constraints which limit how much can be brought online by 2020.

1.3.3 DWL Forecasts

UK Renewable Energy Capacity

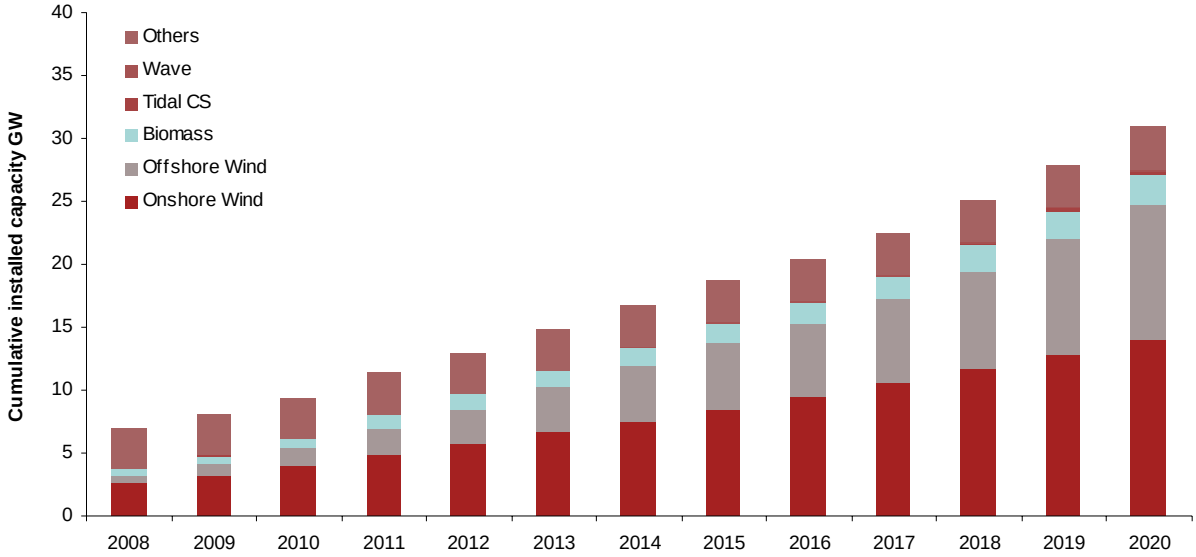

Figure 1-5: DWL Forecast: Cumulative UK Renewable Energy Capacity by Sector

Table 1-5: DWL Forecast: Cumulative UK Renewable Energy Capacity by Sector

MW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Offshore Wind	598	868	1,340	2,094	2,779	3,579	4,454	5,349	5,899	6,749	7,799	9,224	10,724
Onshore Wind	2,572	3,263	4,051	4,906	5,714	6,629	7,518	8,425	9,421	10,506	11,708	12,828	14,003
Wave	1	1	4	11	20	31	46	59	78	101	129	154	186
Tidal CS	3	8	9	15	25	31	41	56	74	98	132	171	220
Biomass	622	660	696	1,046	1,162	1,294	1,371	1,492	1,578	1,714	2,003	2,177	2,346
Others	3,183	3,209	3,243	3,261	3,285	3,313	3,337	3,352	3,375	3,390	3,410	3,432	3,452
Total	6,980	8,010	9,343	11,333	12,985	14,877	16,767	18,733	20,426	22,559	25,181	27,986	30,931

Douglas-Westwood's forecasts give a total UK installed renewable electricity capacity of 30.9 GW by 2020. A total installed capacity of 14 GW is expected for onshore wind. The total of offshore wind installations by 2020 is forecast at 10.7 GW. The total capacity from biomass by this time will be 2.3 GW.

The forecast annual installed capacity by sector is broken down below.

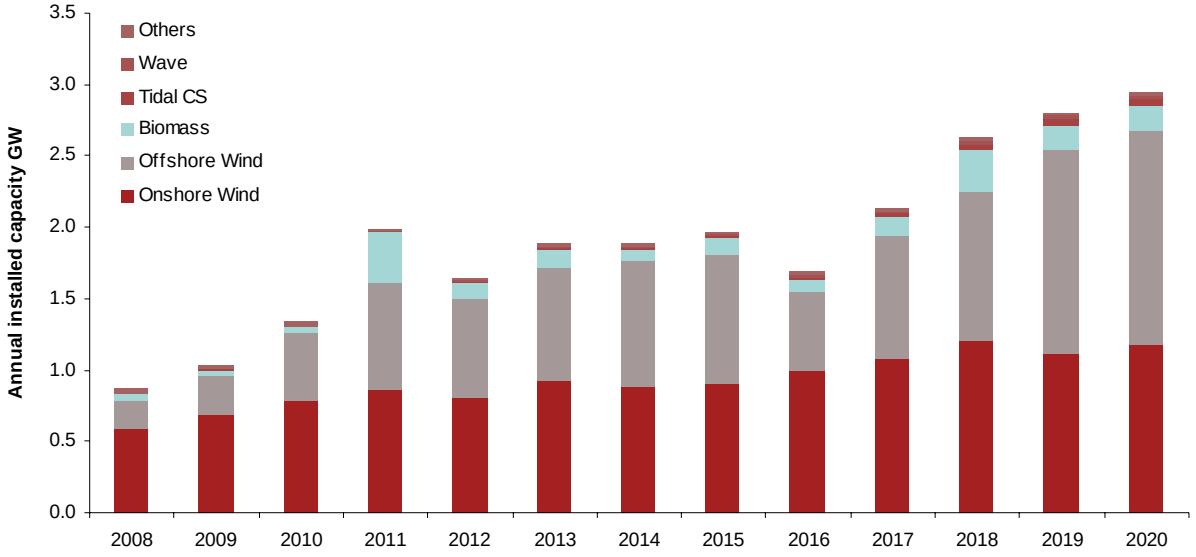

Figure 1-6: DWL Forecast: Annual Installed UK Renewable Energy Capacity by Sector

Table 1-6: DWL Forecast: Annual Installed UK Renewable Energy Capacity by Sector

MW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	08-'20
Onshore Wind	595	691	788	855	808	915	889	907	996	1,085	1,202	1,120	1,175	12,026
Offshore Wind	194	270	472	754	685	800	875	895	550	850	1,050	1,425	1,500	10,320
Biomass	44	38	36	350	116	132	77	121	86	136	289	174	169	1,768
Tidal CS	2	4.5	0.75	6	10	6	10	15	18	24	34	39	49	218
Wave	1	0.4	3	7	9	11	15	13	19	23	28	25	32	186
Others	41	26	34	18	24	28	24	14	24	15	20	22	20	310
Total	878	1,029	1,334	1,990	1,652	1,892	1,890	1,965	1,693	2,133	2,623	2,805	2,945	24,829

DWL forecast the installation of 24.8 GW of new renewable energy capacity by 2020.

The onshore wind sector is expected to be the largest over the period to 2020 and 12 GW of new capacity is expected. The main constraint preventing further growth is the limited grid transmission available, particularly for Scottish projects. New transmission capacity could be matched by further onshore wind capacity. The 12 GW forecast is very similar to RAB's target of 11.3 GW which was set following studies on grid capacity.

10.3 GW of new offshore wind capacity is forecast to 2020, 7.6 GW less than RAB's target of 17.9 GW. The reasons for the more conservative forecasting is explainable through many factors including growing costs, increasing development timeframes and several key pinch points within the supply chain. These are examined more fully in the offshore wind section of this report. Efforts can be made to shorten developmental timeframes by creating a more efficient and transparent planning and application process for future Round 3 projects.

New biomass capacity is forecast at 1.8 GW, 1.7 GW below RAB's 3.5 GW target. The sector is struggling with feedstock supplies, with lack of UK availability forcing increased imports. A shortage of large projects coming through planning limits the potential of new capacity on the required scale. Concerns surround the operations and maintenance costs of plants and the industry is watching the Port Talbot plant (the world's largest) for signals of true running costs and profitability margins when it comes online in 2011.

Wave and tidal current stream are still in their infancy and RAB's modest targets are seen as achievable by 2020.

Europe

UK Proportion of European Renewable Energy

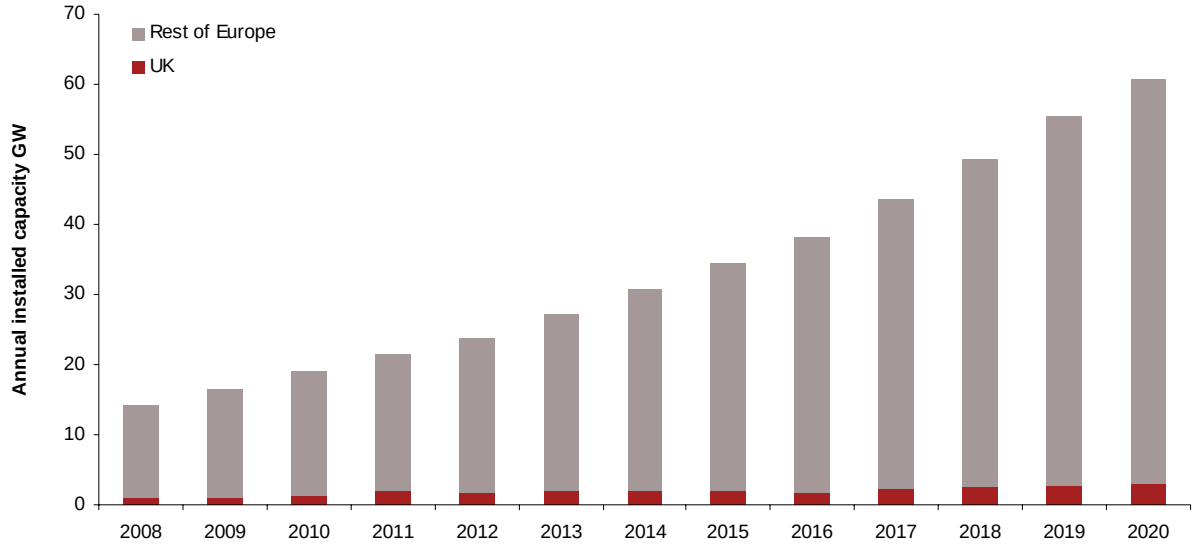

Figure 1-7: DWL Forecast: Annual Installed European Renewable Energy Capacity

Table 1-7: DWL Forecast: Annual Installed European Renewable Energy Capacity

GW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	08-'20
UK	0.9	1.0	1.3	2.0	1.7	1.9	1.9	2.0	1.7	2.1	2.6	2.8	2.9	25
Rest of Europe	13	16	18	20	22	25	29	32	37	41	47	53	58	410
Total	14	17	19	22	24	27	31	34	38	43	49	55	61	435

435 GW of new renewable energy capacity is expected within Europe by 2020. The size of the wider European market should be considered in terms of supply chain. For key supply chain components, the UK faces considerable competition from elsewhere in Europe, particularly for wind turbines, offshore installation vessels and biomass feedstock.

European Renewable Energy Capacity by Sector

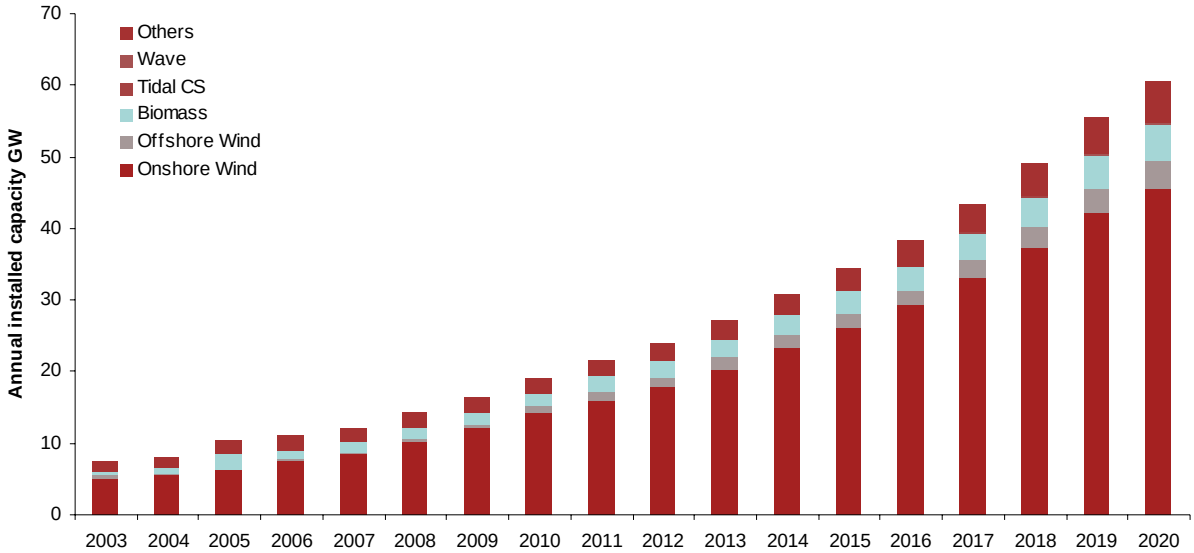

Figure 1-8: DWL Forecast: Annual Installed European Renewable Energy Capacity

Table 1-8: DWL Forecast: Annual Installed European Renewable Energy Capacity

MW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	08-'20
Onshore Wind	10,288	12,129	14,314	16,004	17,926	20,430	23,331	26,266	29,398	33,180	37,308	42,101	45,434	328,109
Offshore Wind	374	564	932	1,147	1,297	1,520	1,739	1,932	1,894	2,443	2,842	3,475	3,980	24,138
Biomass	1,436	1,584	1,754	2,259	2,237	2,488	2,695	3,031	3,318	3,728	4,280	4,608	5,096	38,514
Biogas	292	304	258	196	168	160	175	160	170	170	180	160	180	2,573
Tidal CS	2	5	2	8	12	9	14	20	23	31	40	48	61	274
Wave	3	3	9	11	16	23	23	30	42	49	47	44	57	356
Solar PV	1,294	1,306	1,307	1,543	1,820	2,088	2,383	2,707	3,058	3,547	4,115	4,773	5,536	35,477
Geothermal	35	36	31	35	35	35	35	35	35	35	35	35	35	452
Large Scale Hydro	333	474	311	157	186	285	227	67	196	53	148	40	64	2,541
Small Scale Hydro	155	156	158	168	172	171	182	183	189	188	199	204	203	2,329
Total	14,213	16,560	19,076	21,528	23,868	27,209	30,803	34,430	38,323	43,424	49,194	55,488	60,647	434,763

Within Europe, onshore wind will be the major component of new renewable energy capacity added in the period to 2020 with 328 GW forecast. Installation rates in emerging markets such as France and Poland are growing rapidly and at a rate current leaders Spain, Germany and Denmark were installing only a few years ago. Technology development in turbine capacity, improving reliability and most importantly, attractive rates of return for investors are propelling the market.

The UK will have installed almost half of all offshore wind capacity between 2008 and 2020. The remaining 14 GW will be installed by Germany, Denmark, The Netherlands and later Spain and Norway. High competition for resources is expected.

The UK is by far the most prominent tidal current stream market having Europe's best natural resources. In wave energy, Portugal and Spain are the other major players throughout the period.

Large-hydro projects are diminishing throughout Europe and relatively low new capacity will be added when compared with previous decades. By the end of the period more new capacity will come from small-scale hydro.

Whilst solar PV is a small UK contributor, Europe-wide potential is high and growth is fast spurred by improving technology and reducing costs.

Global

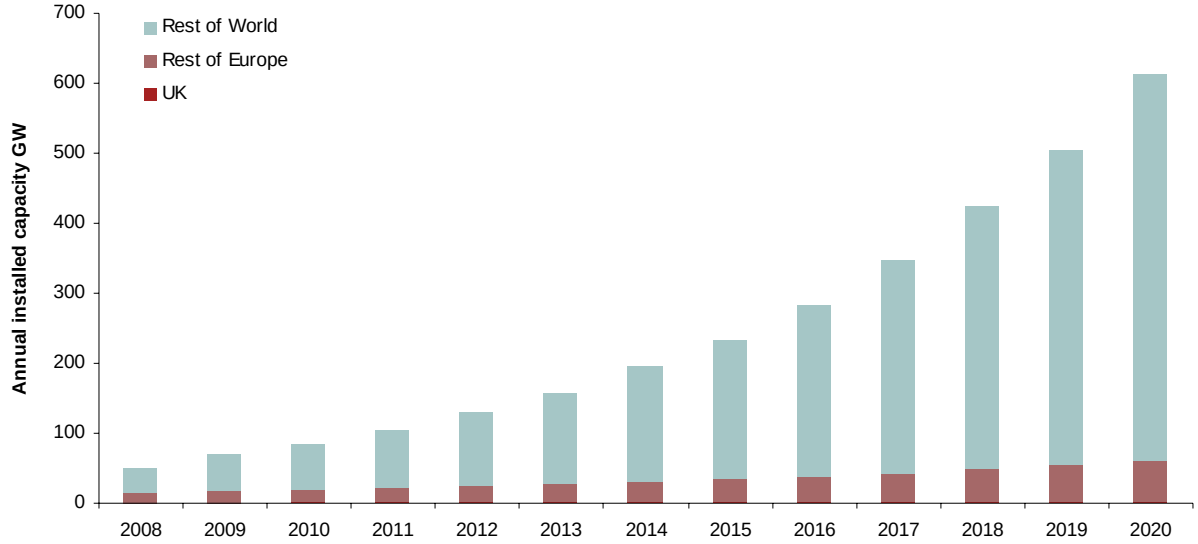

Figure 1-9: DWL Forecast: Annual Installed Global Renewable Energy Capacity

Table 1-9: DWL Forecast: Annual Installed Global Renewable Energy Capacity

GW	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	08-'20
UK	0.9	1.0	1.3	2.0	1.7	1.9	1.9	2.0	1.7	2.1	2.6	2.8	2.9	25
Rest of Europe	13	16	18	20	22	25	29	32	37	41	47	53	58	410
Rest of World	36	53	67	84	106	131	164	199	245	304	375	450	552	2,767
Total	51	70	86	105	130	159	194	234	284	348	424	506	613	3,202

Total global annual capacity will grow from an expected 51 GW in 2008 to 613 GW by 2020. Individual sectors are forecast to grow at between 15-35% annually with overall annual growth rates for renewable energy increasing at 22-32% per year.

1.3.4 Overall Potential Employment

Employment Assumptions

All employment figures are based on 2008-2020 UK installed capacity only. They are shown based on DWL's forecast capacity and on RAB's central estimate scenario. The employment figures are, therefore, jobs that occur from the UK's expected increase in renewable energy capacity and are not necessarily located within the UK.

The overall employment estimates below have been calculated in two separate ways: firstly using a multiple-based approach and then by using a revenue-based approach.

The multiple-based approach took the example of key top-tier manufacturing companies in different renewable energy sectors to establish the number of employees per MW. This was supplemented by estimating the number of additional jobs per MW elsewhere in the supply chain, from development through to operation.

The revenue-based approach looks at turnover of leading companies and their employment records. A turnover of £75,000 per job was assumed. Using capital expenditure forecasts generated for each sector this enables a revenue-based estimation of employment to be created.

The second part of this section looks at specific UK wind energy jobs under a number of different scenarios.

RAB – Employment from Central Estimate Scenario

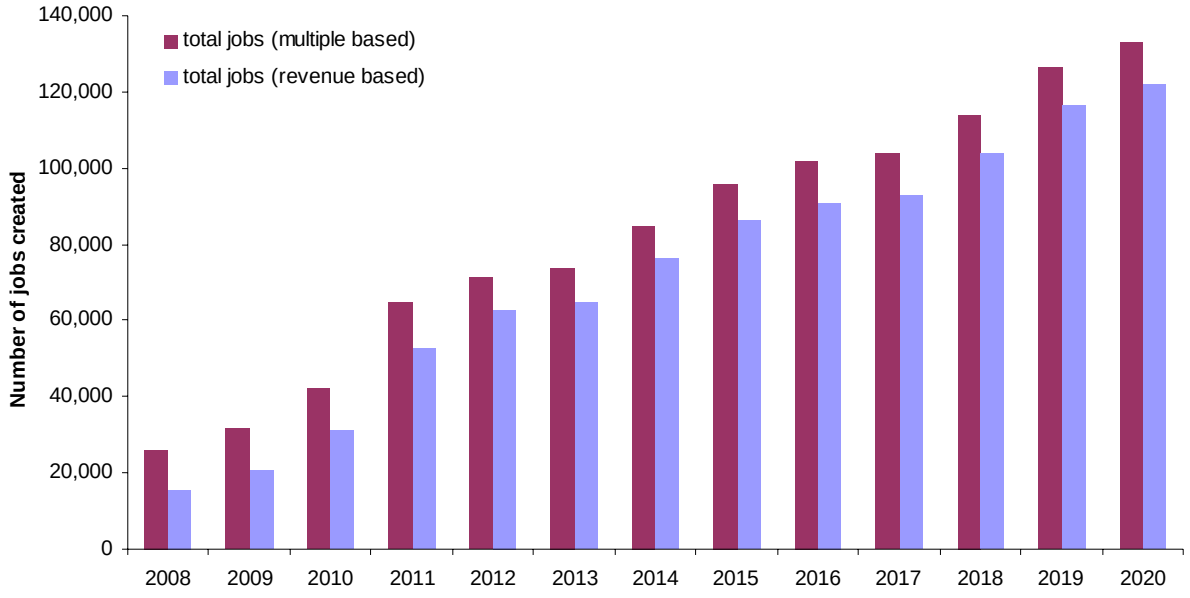

Figure 1-10: Employment Required to Meet RAB Target Capacity

Table 1-10: Employment Required to Meet RAB Target Capacity

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total jobs (multiple based)	26,116	31,383	42,273	64,746	71,181	73,953	85,041	95,700	101,772	103,884	113,949	126,258	132,883
Total jobs (revenue based)	15,722	20,525	30,984	52,492	62,670	64,622	76,080	86,134	90,854	92,818	103,775	116,177	121,865

If RAB's 2020 target is met, this is expected to require 122-133,000 jobs from current levels of 16-26,000.

DWL – Employment from Forecast Capacity

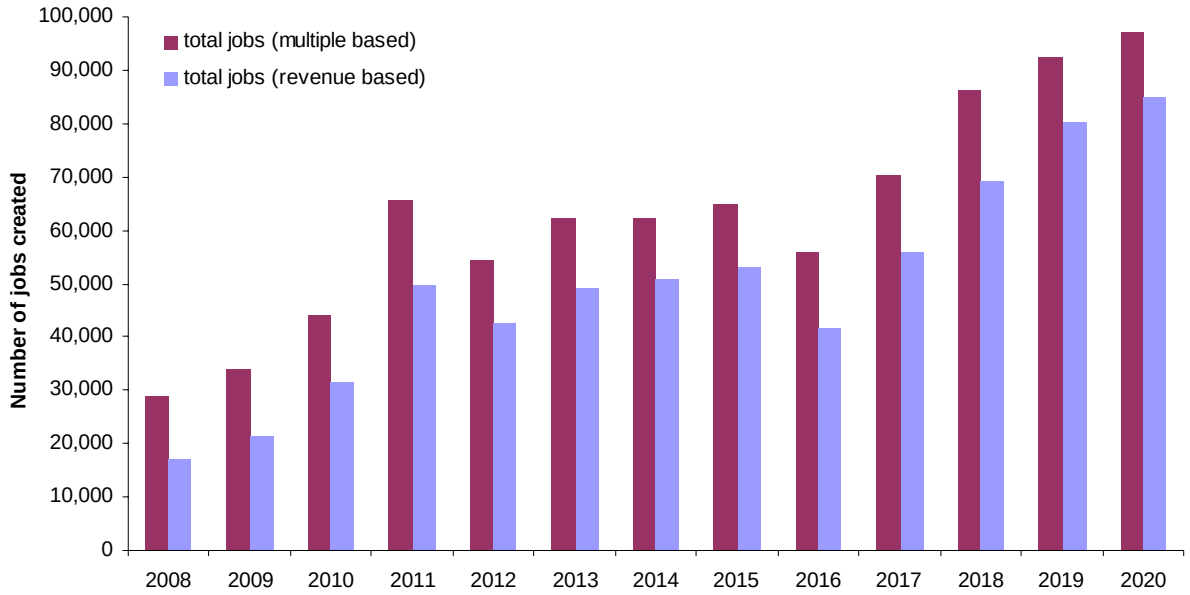

Figure 1-11: Employment Required to Meet DWL Forecast Capacity

Table 1-11: Employment Required to Meet DWL Forecast Capacity

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total jobs (multiple based)	28,968	33,973	44,020	65,664	54,500	62,448	62,380	64,858	55,858	70,393	86,552	92,555	97,182
Total jobs (revenue based)	17,261	21,604	31,379	49,781	42,499	48,976	50,998	53,141	41,688	55,902	69,125	80,257	85,008

Based on Douglas-Westwood's market forecasts for 2020 capacity, the estimates of employment range from 85,000 to 97,000 jobs by 2020 from current employment levels of 16-26,000.

1.3.5 Potential UK Employment from Forecast UK Wind Development

Employment Assumptions

Wind

A low, mid, and high case has been created for the combined wind energy sectors. The basis for the cases is the number of wind turbine manufacturers establishing in the UK. The size of the UK supply chain is expected to grow dependent on the number of turbine manufacturers present and their output. O&M jobs are calculated differently for onshore and offshore wind due to the specific requirements of offshore wind.

These low, mid and high cases have been applied to RAB's and DWL's expected new capacity and therefore aim at assessing the UK job potential for UK wind industry growth.

- **Turbine manufacturers**

1 turbine manufacturer = 10% of UK installed capacity manufactured in UK
2 turbine manufacturers = 25% of UK installed capacity manufactured in UK
3 turbine manufacturers = 50% of UK installed capacity manufactured in UK

- **Turbine manufacturing jobs**

3 jobs per MW (based on Vestas/Siemens figures)

- **Supply chain jobs**

With 1 UK turbine manufacturer = further 3 jobs per MW in rest of supply chain
With 2 UK turbine manufacturers = further 5 jobs per MW in rest of supply chain
With 3 UK turbine manufacturers = further 8 jobs per MW in rest of supply chain

- **O&M jobs**

Offshore = 1 job per 8 MW
Onshore = 1 job per 20 MW

RAB – UK Jobs from UK Wind Power

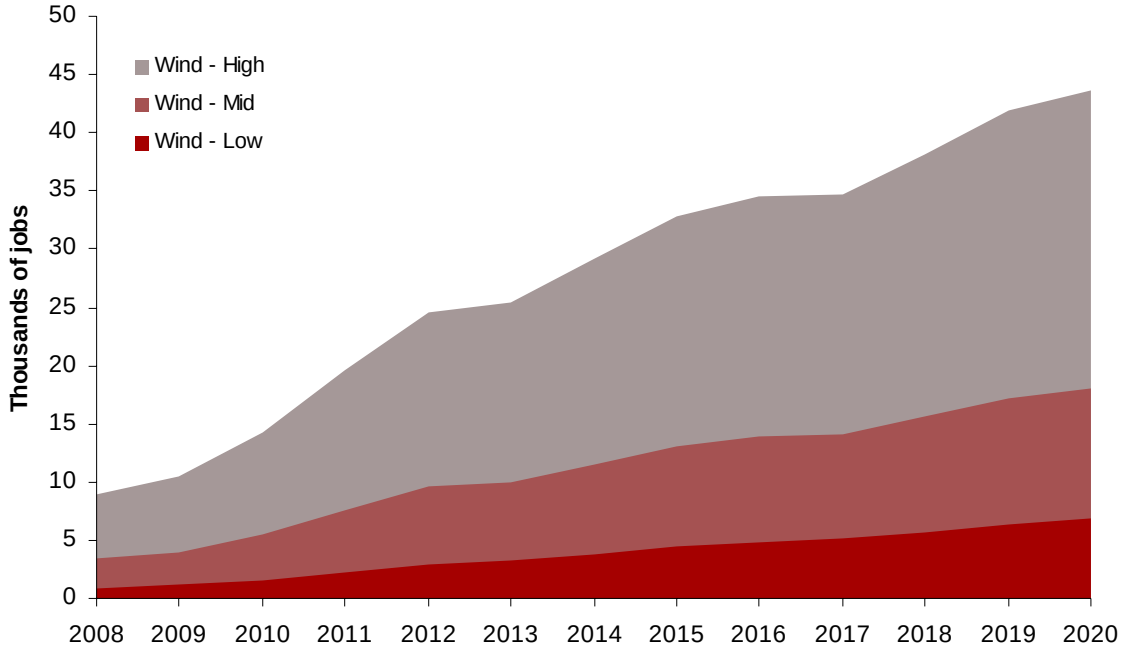

Figure 1-12: UK Wind Power Jobs – RAB Capacity Forecast

Table 1-12: UK Wind Power Jobs – RAB Capacity Forecast

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LOW	944	1,162	1,618	2,279	2,953	3,209	3,799	4,388	4,807	5,076	5,676	6,369	6,845
MID	3,393	4,033	5,486	7,559	9,553	9,974	11,554	13,051	13,882	14,151	15,576	17,259	18,098
HIGH	8,958	10,558	14,276	19,559	24,553	25,349	29,179	32,738	34,507	34,776	38,076	42,009	43,673

DWL – UK Jobs from UK Wind Power

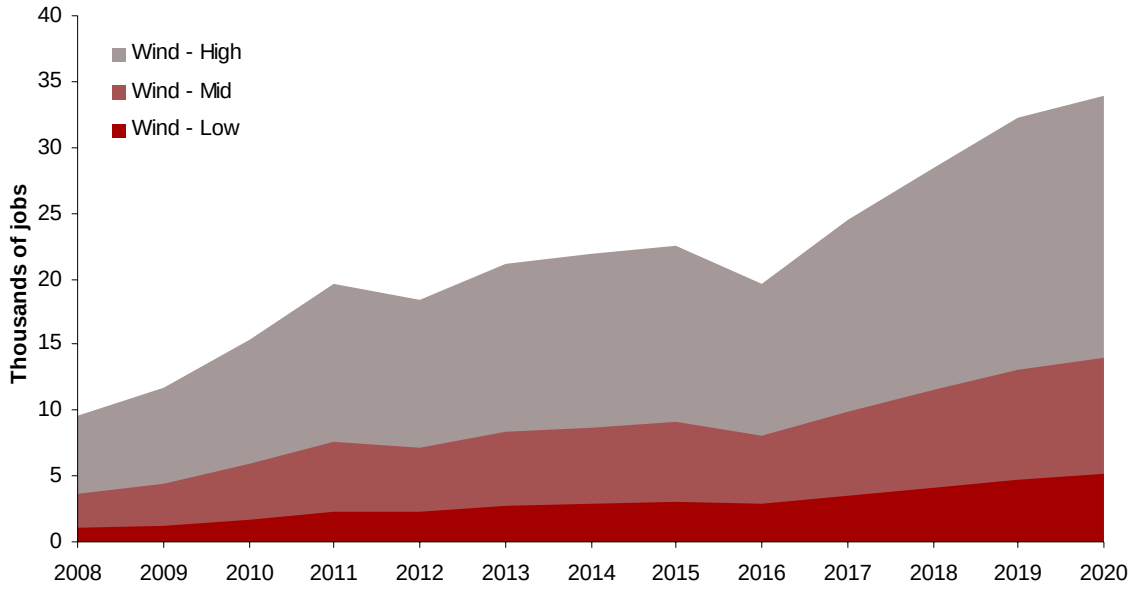

Figure 1-13: UK Wind Power Jobs – DWL Capacity Forecast

Table 1-13: UK Wind Power Jobs – DWL Capacity Forecast

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LOW	1,001	1,276	1,733	2,289	2,275	2,687	2,900	3,103	2,914	3,542	4,113	4,699	5,101
MID	3,605	4,447	5,891	7,598	7,202	8,347	8,721	9,050	8,016	9,927	11,545	13,098	13,929
HIGH	9,522	11,654	15,341	19,666	18,400	21,209	21,951	22,565	19,611	24,440	28,435	32,185	33,991

1.4 Key Sector Analysis

The onshore wind, offshore wind, biomass, wave and tidal current stream are the sectors expected (by RAB and DWL) to have most potential to meet the UK's 2020 targets and this report gives predominance to these sectors for this reason.

A summary of the sectors and the key issues in each is given below.

1.4.1 Onshore Wind

The wind industry has demonstrated excellent growth rates over the past five years and the future forecast is extremely encouraging. Worldwide, in 2007 annual installations showed a 26% growth over 2006 with the total cumulative installed capacity growing almost 22%. New markets such as France are growing quickly to join leaders Spain, Germany, Denmark and the US. Technology is increasing turbine size to allow larger projects to be built. UK installations have increased with Scottish projects in particular driving market growth.

There are, however, practical constraints with growing lead-times across the industry. The longest are found in supply of blades, bearings and generators. Some blade manufacturers, including market leader LM are reporting very long lead-times of 2-3 years. Bearing manufacturers are quoting lead-times of up to 32 months. The strong market and constrained turbine supply situation has driven turbine prices upwards by up to 30% over the last two years. None of the manufacturers we spoke with anticipated an improvement to their lead-times before 2010. However, of the major turbine manufacturers, most claim to have already secured supply chain capacity through to 2010.

DWL believe that some underlying issues are progressively being addressed by both the industry and government with the overall result that by 2020 RAB's 'central estimate scenario' for onshore wind installations should be achievable subject to the UK remaining a competitive location for investment in windfarm developments. This is largely due to RAB's target being realistic in terms of grid availability. Supply chain constraints are an important factor given the massive international growth forecast.

Without doubt, the UK grid remains the major constraint, with at present a lack of necessary transmission capacity available to allow the onshore wind sector to develop at a faster pace.

1.4.2 Offshore Wind

Delays to projects are still occurring. The first Round 2 projects are, in most cases, still several years from completion and contracting on them is difficult due to competition from other UK and European projects. With a huge future project portfolio, in future years Germany will increasingly be competing for limited resources.

Constraints within the supply chain, most notably turbines and installation vessels, are already having an impact and will continue to do so. The availability of new installation capacity for larger turbines in greater water depths is paramount, but newbuilds have significant delays due to the massive demand for vessels whose capabilities span multiple industries such as offshore wind and oil & gas.

Costs have risen to the point where major utilities, now the biggest owners/developers are re-assessing rates-of-return on their development portfolios. Supply chain constraints and risk allocation are behind cost increases and the cost-ceiling has not yet been reached. In the UK, multiple ROCs will help but are insufficient on their own to deliver the Government's expected contribution from offshore wind by 2020.

It can be seen from the above forecasts that in the view of Douglas-Westwood, RAB's central estimate scenario is not achievable in the present circumstances. In addition to the issues discussed earlier for onshore wind, the factors slowing progress on offshore wind are:

- Project cost increases – over 100% in five years. £2.4m/MW is now seen as common, with projects progressing at £2.8m/MW
- Offshore turbine supply – with only three main players, strong demand may further increase the existing 3-year lead-times
- Turbine installation vessels – lack of capacity (the market leader is booked to 2013). Vessel build costs have doubled in past 5 years and new build time is up to 4 years.
- Ports – UK ports viewed as under-developed and over-expensive in comparison to continental ones. Limited interest is also associated with the lack of UK offshore turbine manufacturers

- Cable supply – two suppliers dominate the sector and new specialist players are finding some difficulty in accessing the market
- Cable installation – more capacity will be required as lead-times are expected to rise significantly in the next decade
- Cable burial – the UK 3-metre burial depth requirement significantly increases time and costs as seabed ploughing is required
- Weather risks – top level players are not accepting installation weather risk increasing risks borne by the supply chain
- Overall risk – developers are pushing this down onto contractors
- Skills – experience and desire to work offshore are becoming increasingly scarce
- Visibility – one of the greatest benefits to the supply chain and investment is project visibility. Confidence in a long-term project pipeline is essential for the development of the industry (the recent announcement of Round 3 should help to deliver this).

1.4.3 Biomass

Biomass has been an under-used resource in the UK where DEFRA calculates that 18 million dried tones of solid biomass are available; however, the UK's biomass industry and logistics is not as well developed as in the rest of Europe. Currently a wide range of fuels are used including wood pellets, fuel crops, solid recovered fuel (SRF) and poultry litter. These resources will have to be managed properly if biomass power generation is to be sustainable.

RAB's central estimate scenario of 3.8 GW electricity from biomass by 2020 is an ambitious target that will require an increase in large-scale dedicated biomass plants and in feedstock fuel produced both in the UK and through import.

There has been a growth in dedicated power biomass plants in the UK, for example at Wilton (30 MW), Ely (38 MW) and Lockerbie (44 MW). The biggest biomass plant in the world will be operational in 2011 at Port Talbot. It is expected to produce 350 MW – 9.2% of the 2020 central case. This facility also demonstrates a new trend of importing biomass material from other countries such as Canada and Estonia. The Port Talbot plant is situated with easy access to the sea in order to receive shipment of wood fuel and this is likely to be the pattern for other future large biomass plants being considered for the UK due to insufficient domestic output.

Certain issues must be addressed:

- Fuel supply – there is concern about the UK's ability to supply fuel in the quantities that will be needed to produce the electricity output forecast for 2020. Energy crop production, such as short rotation coppice will have to be stimulated further if demand is to met form UK sources and DEFRA grants examined
- Transportation – the transport of fuel is costly and this will have to be tackled by situating plants close to areas of biomass production or at ports
- Plant construction – growing lead-times due to levels of power plant construction both inside and outside the UK
- Equipment supply – global competition from other types of power plant
- Maintenance costs – both plant upkeep and skills shortages.

1.4.4 Wave and Tidal Current Stream

The UK benefits from an excellent wave and tidal current stream resource. This is coupled with the emergence of leading home-grown technology development. With prototype devices successfully undergoing and completing trials the step to commerciality is now the next challenge.

Issues to be addressed include:

- Grants – financial incentives are currently focused on technology developers. There is a case for making them available to project developers to aid site selection, testing and project development
- Environmental impact – insufficient knowledge of the environmental impact of different devices exists. Work done here could help the pace of site development

- Reliability – investors are nervous over the commercial viability of wave and tidal current-stream due to a lack of information
- Competition – Spain and Portugal are two examples of countries that offer competition for UK technology developers looking at commercial projects. The UK must be a leader in the commercial development of wave and tidal current stream, to take advantage of home-grown technologies and the natural resource available to the UK.

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2 Common Supply Chain Issues

A series of issues cross the different renewable electricity sectors and are discussed below. The individual sector issues are discussed separately in the specific sector chapters of this report.

2.1 Skills

How the skills shortage could affect the Renewables sector

The 2007 Energy White Paper: 'Meeting the Energy Challenge', has given the renewables sector a welcome boost with the ambitious target of generating 20% of the UK's electricity by 2020. However, surging demand for energy, an aging workforce and a lack of new entrants to the energy industry in general is combining to threaten the UK's energy strategies and specifically the delivery of this 20% renewables target.

The skills shortages are not specific to the renewables sector, or the energy sector as a whole, but symptomatic of an historic lack of national investment in all levels of skills development in engineering and the trades.

Competition with Traditional Energy Sectors

The demand for energy is now being driven up by the developing countries, in particular China and India, whilst at the same time production of oil & gas is reducing in non-OPEC areas such as the UK North Sea. The result is oil prices at record levels and a surge in exploration & production activity, particularly in the Middle East and offshore in West Africa, Latin America and North America. This is fuelling major worldwide competition for human resources at all levels, but the key need is for experienced staff.

Although there seem to be plenty of graduates and post-graduates willing to enter the renewables sector, the general opinion from companies within the renewables supply chain is that there is a lack of experienced staff, especially engineers and project managers in the UK, willing to enter the sector. Cross-sector competition for experienced staff was also highlighted by many of those interviewed as an issue that affects a company's ability to hold onto staff and build good teams. With all energy sectors struggling with the same issue, developing renewable sectors are trying to compete with the more traditional sectors of Oil & Gas and Marine who have plenty of work and much bigger cheque books.

The end result is that the developing renewables sectors in the UK such as wave & tidal will experience bottlenecks in the project development process as they struggle to attract and/or retain experienced staff.

> *"Difficulty in attracting resources – graduates can be attracted, however, offshore / marine with 5 + years' experience and project management skills in such environments are very difficult to attract"*
> - Major offshore engineering firm

Engineering skills shortage

The 'baby boomers' that entered the energy industry in the late 1970s and the early '80s are now retiring and there appears to be a lack of experienced staff across the entire energy industry to fulfil current demand.

The energy companies themselves are able to offer good salaries and excellent training programmes, so the real problem is amongst the huge number of companies that constitute the supply chain and in particular those in the developing energy sector of renewables.

By 2016 it is likely that some 15 to 20 GW (about a quarter of the UK's existing generating capacity) will need to be replaced, and further substantial investment on a similar scale may be required in the following decade. Conventional and nuclear power generation and the oil & gas industry are all, together with other engineering sectors, competing for the same people as the renewable energy sector.

Education unfit for purpose

The core of the problem is that, in the view of many, the UK's education system has been unfit for purpose. It has failed to provide young people with the necessary skills to enter the workforce at all levels, from the 'black trades', through technicians to graduates. The recent UK Employers Survey noted that the main skills lacking were technical and practical ones. Another noted a 'lack of specific engineering skills with the right levels of experience'. And this is happening a time when (in 2007) over 518,000 18-24 year olds were out of work.

The House of Lords Select Committee on Economic Affairs noted in its July 2007 report that 'many young people leave school without the basic functional literacy and numeracy required for apprenticeships and that schools also fail to inform many students about apprenticeship'.

Even the OECD has criticised UK government urging it to 'devote more effort to getting better value for money' and to 'take care that a greater quantity of education is not sought at the expense of quality'.

Again, in the view of many companies, the current major problem is the production of graduates with economically valueless degrees. The respected Petroleum Review notes that 'in the past few years the UK has produced more media studies graduates than physics and chemistry graduates combined.'

In addition, the present system responsible for delivering skills is dominated by skills providers' rather than end-users. The 2006 Leitch skills review has called for a 'simplified structure, focus & control'. In short, the system is over-complicated and is difficult for individuals to access.

The future

On November 1 2007, the Prime Minister pledged to overhaul the apprenticeships system and to introduce a legal entitlement to an apprentiship for every young person by 2013. And on November 16th 2007 the government promised a massive skills push including 3.5 million literacy and numeracy courses.

Over the period to 2020 DWL forecasts further growth of energy demand and that the basic skills situation could slowly improve but the experience deficit grow. The UK's offshore oil & gas and nuclear decommissioning programmes plus power station replacement will increase competition for human resources in future years and the UK renewable energy programme is likely to be hit by skills shortages.

Energy skills development comprises four key needs: to educate, attract, train and retain. The main issues identified by industry are:

- The need to change perceptions of the energy industry to improve its appeal as a career
- The requirement for more employer involvement in skills development
- The need to re-focus the skills providers / training organisations on employers needs
- The considerable differences in needs of the various energy sectors.

Recent work we have carried out for the East of England suggests that the way ahead is to:

- Effectively interface with both students and staff in schools and further education
- Change perceptions of the energy industry across all age groups and with government at local, regional and national levels
- Apprentiships are key to addressing many of the problems faced by the energy sector. A new approach is needed that includes the SMEs
- Assure employers fully buy-in to future initiatives.

With regard to getting 'experience' into the industry, cross-training from other industry sectors outside of the energy sector will have to be considered. Such sectors are identified in our consultations with industry.

> *"Getting experienced people is a problem. There are plenty of new and enthusiastic young people coming into the sector but few experienced people. The UK hasn't been developing a good base of engineers."*
>
> - Energy consultancy

2.2 Grid

Introduction
The UK's electricity industry is relatively well deregulated and unbundled compared to most of the EU, according to a recent report commissioned by Highlands and Islands Enterprise (HIE).[2] There are three transmission owners: National Grid Electricity Transmission (NGET) for England, Scottish Power Transmission Limited (SPTL) for Southern Scotland, and Scottish Hydro-Electric Transmission Limited (SHETL) for Northern Scotland. There is only one GB transmission systems operator (TSO), NGET. Generation and supply are separate functions, with the industry overseen by a single regulator, Ofgem.

Distribution is split over a number of operators. At present there is no special treatment of renewable energy projects within the current regulatory frameworks. Rules and regulations that apply to RE generation projects apply to all other generation project types.

Renewable Energy Targets
The Government is aiming towards two ambitious targets for the renewable sector – to generate 10% and then 20% of Britain's electricity from renewable sources by 2010 and 2020 respectively. A large part of this electricity is intended to come from offshore and onshore wind farms, with wave and tidal (around 400 MW) in the future helping to create 33 GW by 2020.

The National Grid – Transmission & Distribution
The National Grid is made up of the *transmission grid* and the *distribution grid*, with renewable energy projects that generate electricity usually connecting up to either of these.

The difference between these grids is normally the voltage: transmission grid voltages are normally 220 kilovolts and above (132 kilovolts and above for offshore wind and Scotland); distribution voltage levels are normally 11 kilovolts, 33 kilovolts, 66 kilovolts and 132 kilovolts (except offshore wind and Scotland).

The National Grid
The introduction of UK-wide electricity trading and transmission arrangements in 2005, coupled with the strong financial incentives to build new renewable generation created under the Renewables Obligation, have left the national grid facing significant new challenges. A substantial proportion of the new generating capacity is, and will be, renewable and not only from large-scale conventional generation.

Renewable generators are often located in geographically remote locations further away from both the existing transmission system and places where energy demand is high. In many cases, they also have intermittent output. Therefore, the key questions for the government and industry to address in this current period of consultation are:

- How can the present system be improved so that it is 'fit for purpose' to accommodate a fuel mix of considerably more than 20% of intermittent generation, and
- What are the fastest, most efficient ways of removing any barriers to connecting this level of generation by 2020?

According to BERR, the National Grid currently has around 120 GW of generation capacity that is either connected (c80 GW), or is seeking connection by 2017 (c40 GW), excluding any potential new nuclear generation. For example, there are currently 12 GW of new, mainly renewable, generation seeking connection to the transmission system in Scotland, over 9 GW of new connections in Wales including a significant amount of renewables, plus, for offshore wind generation, current plans to develop 8 GW in UK territorial waters and an objective of achieving up to an additional 25 -33 GW by 2020. [3]

State of the Scottish Grid
The Highlands and Islands of Scotland represent the greatest density of renewable energy resources in the UK and this has resulted in an increase in generation connection applications. However, the existing transmission network in Scotland and Northern England was not originally designed for the level of generation that is projected in the future. Therefore, upgrade of the electricity grid is needed if Scotland is to realise fully its renewable energy

[2] Highlands and Islands Enterprise, Assessment of National Grid Connection Options for the Scottish Islands - March 2007
[3] P2 Ofgem & BERR Transmission Access Review – Interim Report, January 2008

potential. Decisions on investment in new infrastructure are a matter for the relevant transmission owners, Scottish Hydro-Electric Transmission Ltd (SHETL) and SPTL, in tandem with the system operator NGET and the industry regulator Ofgem.

To put this in context, currently the Scotland/England inter-connector only has a firm capacity of 2.2 GW. With the additional 12 GW of connection agreements in Scotland, there will be significant constraints on the lines. The reinforcement that has been identified by SPTL and NGET as the most effective way of increasing the networks capacity will only increase it to 3.3 GW. To date, no further reinforcements to increase this capacity have been detailed or approved by Ofgem. To increase capacity an additional inter-connector will need to be built either onshore or offshore.

Ofgem has initiated a workstream to look at the issues associated with potential connections to the Scottish islands. Recent developments with the Renewable Obligation mean that there is a greater likelihood that infrastructure investment will become viable. Although when the transmission price control for the period 2007 to 2012 was reviewed, there was insufficient financial commitment from generators to justify an allowance for building connections to the Scottish islands at that stage.

National Grid GB Seven Year Statement 2007

In its report, 'GB Seven Year Statement 2007 – Embedded and Renewable Generation', the National Grid offered two transmission impact scenarios in general terms against meeting the government's target of 10% of renewables, which equates to around 8 GW of renewables, by 2010.

- If there were to be 6 GW of (embedded and/or non-embedded) onshore wind farms in Scotland, where wind conditions and the prospects for obtaining consents are favourable, and 2 GW of (embedded and/or non-embedded) onshore wind farms in England and Wales, the broad transmission implications would be as follows. There would be a need for reinforcement of the GB transmission system within Scotland to transmit the power from the wind farms to the Scottish load centres but primarily to facilitate the transfers south into England. The capacity of the interconnections between Scotland and England would need to be enhanced and parts of the system in the North West and North East of England would require reinforcement to accept the additional imports from Scotland.[4]

- Alternatively, if there were to be 2 GW of (embedded and/or non-embedded) onshore wind in Scotland and 6 GW of offshore wind in England and Wales, the broad transmission implications would be as follows. The offshore wind may be embedded or non-embedded but is more likely to be directly connected to the GB transmission system than onshore wind farms. Offshore developments are likely to be located in clusters beyond the 13km exclusion zone but near connection points to the GB transmission system close to the Thames Estuary, the Wash and the North West of England. Given these broad locations, the system effect would be less than in the previous case since flows from Scotland to England would be backed-off. Nevertheless, some transmission development in the Cumbria area could be required and also some reinforcement in the North West to accommodate the 2 GW of onshore wind in Scotland. While the need for transmission reinforcement, and consequently the cost, would be less, the cost of establishing and connecting the actual offshore wind farms is likely to be more.[5]

In the longer term, NGET do not think it likely that there will be a technical limit on the amount of wind that may be accommodated as a result of short-term balancing issues but economic and market factors will become increasingly important.

Political and regulatory consultation

Ofgem and BERR have been working together to develop a regulatory regime for offshore electricity transmission activities that will allow generators in offshore waters to transport their electricity to onshore networks and then on to consumers. The Energy Act 2004 provided the Secretary of State with broad powers to introduce a new regulatory regime for offshore electricity networks. We are currently witnessing a period of consultation as the government and industry work on the offshore transmission project. These current consultations are briefly reviewed below:

[4] P10 National Grid, GB Seven Year Statement 2007 – Embedded and Renewable Generation
[5] P10 National Grid, GB Seven Year Statement 2007 – Embedded and Renewable Generation

- The Government published a response to the consultation: Offshore Transmission – A Joint Ofgem/BERR Policy Statement July 2007', held last summer on the initial proposals for the licensing and regulatory framework that will apply to offshore electricity transmission networks. The document, published in January 2008, sets out decisions in a number of key areas concerning the competitive tender process and transitional arrangements and addresses the key concerns raised in the consultation responses.

- Ofgem have published a further consultation document: 'Offshore Electricity Transmission –Regulatory Policy Update', which sets out further thoughts and clarifications on the design of the offshore transmission regime.

- On 14 February 2008 BERR and Ofgem published 'Modification of Electricity Transmission Standard Licence Conditions – The Way Forward'. This document forms part of the consultation process jointly undertaken by the Government and Ofgem to establish a regulatory regime for offshore electricity transmission. It sets out a way forward for modifying electricity transmission licence conditions. It provides an overview of the proposed structure of the standard conditions in electricity transmission licences in order to accommodate new offshore electricity transmission licensees and sets out proposed modifications to standard conditions for offshore transmission licensees and the Great Britain System Operator.

- On 18 February 2008, BERR held an Offshore Wind and Transmission Investor Conference to highlight and explain in detail the proposals and significant investment opportunities relating to further competitive rounds for offshore windfarm sites ('Round 3') and the regulatory regime for offshore transmission. The conference was aimed at existing and potential investors in both offshore wind generation and related grid infrastructure.

- Finally, Ofgem has recently approved unprecedented levels of investment (with flexibility for even more investment if demand for capacity increases further). Ofgem approved £560 million of investment through the Transmission Investment in Renewable Generation (TIRG) mechanism and a further £4 billion in the transmission price control review 2007-12.

Reasons for connection delays

The existing transmission system is still causing delays for renewable and conventional generators wishing to connect. These delays have arisen for several reasons and were highlighted in a recent government report, 'Transmission Access Review'.[6]

- The National Grid's current first-come-first-served approach to connecting generation does not assess the status of generating projects in the queue. Therefore it does not reflect the likely order that projects will be ready to connect with new generators often unable to get connection dates that match their project development timescales.

- Although construction times for new generation and transmission capacity are similar it can take years for planning permission to be granted to allow construction to begin on major transmission infrastructure. If enacted by Parliament, the Planning Reform Bill will help improve the planning process in England and Wales and reduce the time it takes to deliver new transmission capacity.

- Existing generators have limited incentives to release or sell transmission capacity in the short term, given uncertainty over whether they will be able to acquire it again in the future. Generators are required to give only very limited notice of their intention to close and/or disconnect from the system making it harder for the system operator to reallocate capacity quickly to other generators.

- In addition to the practical problems of the existing system in delivering new capacity there are some process difficulties that need addressing. Recent efforts by National Grid and the industry to amend the access arrangements through changes to the industry codes have been relatively slow. National Grid and industry need to make sure that any further proposals for reform are assessed and brought forward for decisions as quickly as possible without compromising proper assessment and consultation.

[6] P2-3 Ofgem & BERR Transmission Access Review – Interim Report, January 2008

- A further problem we have identified is that the quality of information regarding infrastructure plans made available between transmission licensees and generators is limited, and may result in poor or costly decisions to locate plant on the system given limited knowledge of cost and timing implications resulting from transmission factors.

Summary

The final recommendations from the Transmission Access Review will set out proposals for changes to the framework which will better support the connection of renewable generation to the grid in the medium and long term.

The term ‘fit for purpose’ is what BERR/Ofgem are aiming to achieve with the National Grid’s infrastructure and management as they look to achieve the targets set out in the 2007 Energy White Paper.

3 Supply Chain Stimulation

This section considers actions that may enable BERR to stimulate the supply chain. Potential actions listed were developed in conclusion to the supply chain interview programme and Phase 1 work and further explored during a workshop session held with BERR in London on 23rd April 2008.

3.1 Macro-factors

3.1.1 Grid connection

We understand this most important subject is already being addressed. However, BERR efforts in this area must be made more visible. Timelines of 2014-2016 for connection are currently being quoted to developers. As this may have financial implications for developers before sites are even permitted, financial assistance could be considered.

3.1.2 Costs

Continually reviewed tax breaks and incentives are required for manufacturers and developers to keep the UK competitive with other world markets. A detailed costing exercise should be completed looking at current and future project costs. This should include a rate-of-return component to understand the cost issue from an investor point-of-view.

3.1.3 Skills/HR

Offshore renewable energy sectors in particular are suffering from skills shortages, as the smaller companies in the sector cannot compete with the wage levels in the oil and gas sector. The viability for cross-industry knowledge transfer partnership (KTP) type schemes between existing offshore oil & gas players and offshore renewable companies could be considered for engineers with 10+ year's experience. Trade bodies and Engineering Institutions should be encouraged to bring forward initiatives for funding skills transfer and education and training – establish working groups. Specific industries from where experienced engineers and project managers may be encouraged to participate include aerospace, automotive, defence and offshore oil & gas.

3.1.4 New entrants

Efforts should be put into encouraging high capability UK technology companies into the renewables sector. For components such as turbines, the UK aerospace sector may be a source of additional skills and capacity (aerodynamics, turbine design, reliability, composites and advanced materials, etc). This is discussed in more detail below.

3.1.5 R&D

A well-funded, industry-managed ongoing R&D programme is required to improve the efficiency of renewable energy power generation, storage and distribution. For example, increased capacity turbines would allow upgrading of existing and planned windfarms – R&D areas could include HTS (high temperature superconductor) generators.

Future work should review in more depth any gaps in the current expected outputs from programmes being run by Supergen, ETI and The Carbon Trust.

3.2 Planning Approval/Availability of Sites

A major driver towards the industry and investors engaging with more confidence is the surety of enough new sites being approved through the planning process in the next 2-3 years to allow developments to meet generating capacity targets. This presents several areas across a number of renewable sectors where Government may consider action to assist, although we understand that this is being addressed.

3.2.1 Onshore wind

Local planning needs to fully recognise national strategic objectives in renewables. A vehicle available may be through PPS1. The Government has recently introduced the Planning Bill which has a number of initiatives relevant to onshore windfarm proposals. The concept of 'nationally significant infrastructure projects', including

the construction or extension of electricity generating stations is proposed. These cover English and Welsh projects over 50 MW.

The Bill provides for a single consent regime, removing the requirements for other consent such as the Electricity Act and planning permission. Government proposals include the establishment of the Infrastructure Planning Commission (IPC), a new independent body to consider applications and take decisions on individual projects. The IPC will be made up of leading experts from key sectors including, planners, lawyers and environmentalists and includes debates where local residents can have a say.

The system raises interesting questions and the differing approaches taken on new projects will depend on the size of the project. Consistency in the decision making progress will be crucial.

Communication with local authorities and communities about the benefit of renewable development must be increased. This should not just be in terms of 'green benefit' but the actual economic development potential that renewables can bring to local communities and the wider area in terms of job potential and economic benefit.

Government may wish to examine any potential for local authorities to establish the identity of potential sites based on resource and local conflicts of interest for incorporating into regional plans (similar to areas designated for housing, industry, etc). This would allow for earlier voicing of public approval or complaints thereby putting in place a map of areas where developers know they can come forward with confidence that site has been through some degree of public consultation process, thereby reducing some of the risk associated with one of the major risks in the planning approval process, that of public opinion.

3.2.2 Offshore wind

Round 3 was launched on 4th June 2008. The Crown Estate will in due course be inviting potential partners to bid for development zones; identified through both spatial planning by The Crown Estate and the Strategic Environmental Assessment (SEA) being undertaken by BERR. Successful bidders will have exclusive rights to develop windfarms in specified zones.

The Crown Estate is planning to co-invest up to 50% of the cost of obtaining planning consents for windfarm sites, including the funding of enabling works intended to speed up windfarm delivery. This may include action to address generic, zone-wide environmental concerns, consenting bottlenecks, supply chain constraints and options for connecting new windfarms to the national grid.

3.2.3 Wave and tidal current stream

This is an embryonic sector, where the developers want to move forward; however, having to choose relatively unproven technology/development concepts at the initial planning application stage is not realistic. Therefore we suggest revision of Crown Estate procedures. Consideration to be given to staged approval process with initially outline permission granted and the specific structure type/technology then forms the final approval stage. (Similar to the Annex A and Annex B type procedure used for oil & gas field development).

The application requirement of specifying the device to be used could be changed so that more general specifications of the likely technology can be stated, for example, how the device will be anchored to the seabed.

Because of the current lack of understanding of the environmental impact of wave and tidal CS technologies a testing programme is suggested. A study of the impact of different devices should be undertaken, potentially in association with a test centre such as EMEC. The aim is to help smooth planning applications for commercial sites.

At present funding is going to technology developers. Although some of the device developers are progressing with site development for initial installations, in the future this is unlikely to be the case, with the devices simply being supplied to an independent development company. Allocation of funding could be routed in part to site developers, to help them assess device viability and site selection.

3.3 Component Supply

3.3.1 Wind

Longer-term visibility will highlight the scale of the turbine market needed to meet UK demand, which may encourage both domestic and inward investment. However, in light of foreign markets (particularly onshore wind) incentives may also be required to attract companies to the UK market.

Consideration and attention should be given to targeting new entrants from other indigenous UK industries (aerospace, automotive, marine) based on manufacturing and servicing capability. Skills transfer should be initiated using industry supply chain workshops, 'Meet the Buyer' and an 'approved supplier' process (e.g. similar to the Achilles-FPA system used in the oil & gas industry). The home market opportunities should be promoted in both onshore and offshore wind together with the export potential.

Several prominent UK companies are seeking to diversify into renewable energy. They have capability and capacity to enter the market with particular opportunities noted for bearings and gearboxes. Generators and transformers also hold UK manufacturing potential. With quality assurance and previous track record being important, a list of quality-assured suppliers could be developed from, for example, the automotive and aerospace sectors. Developers could initially be given incentives for using new quality-assured suppliers, not already in the wind energy supply chain, where by the use of such a supplier, significant gain on project timescales can be realised. Gearbox and bearing manufacturers face massive demand. Diversification and company start-ups require significant help to become established as costs are extremely high.

Understanding of the renewable energy sectors is of key importance and information on the forecast levels of activity and their value must be communicated to companies from other sectors, where knowledge on the size and scale of the market opportunity in wind energy is often limited.

Potential UK players face the difficulty of entering a market where experience is counted as paramount. Bearings and gearboxes are highly critical components and exacting standards are required. Efforts to market suitable companies based on quality control and reliability are the best methodology to push UK companies. An example would be experience of supplying the aviation industry where quality control and tolerances are crucial.

It should be noted that this is also applicable to the wave & tidal market.

New entrants should be encouraged to meet demand of the onshore and offshore sectors through grants towards capital for new facilities – significant export potential exists for manufacturers.

Turbine manufacturing

The importance of a UK turbine manufacturer is widely accepted and the achievement of attracting Clipper Windpower should be recognised (One-North East, BERR and UK Trade and Investment worked collaboratively to give Clipper Windpower the confidence to invest in the UK). The UK must attract other manufacturers for maximum supply chain development benefit and we note that efforts are ongoing from BERR in this respect.

Given the nature of the offshore sector, it is smaller manufacturers with next-generation turbines that we feel will offer the maximum benefit to the UK and it is here that BERR are pushing strongly. New manufacturers with high-capacity offshore-specific turbines could be introduced to the UK. With these companies, more opportunities exist for UK companies to enter their supply chains as opposed to majors such as Vestas where opportunities are constrained due to long-standing supply agreements and the inflexibility of such a large production line.

Bring in 'best practice' in communicating the needs from turbine manufacturers to component suppliers.

Blades
Increased manufacturing capacity for onshore and offshore wind sectors is required. Investigation should be carried out into the possibility of attracting new entrants into blade manufacturing from existing composite materials manufacturers and aerospace sector players within the UK.

Cable supply
Smaller UK players are finding it difficult to break into the market as the industry preference is for the two or three larger cable supply companies with experience of working in the offshore renewables sector. Incentives are required for the industry to engage with smaller UK players for offshore wind (and the wave & tidal sectors). These smaller UK companies are experienced in subsea cable supply and need assistance from Government to open up the offshore and marine renewable sector markets. The potential for UK manufacturing could be strong.

3.4 Marine Installation & Infrastructure

3.4.1 Ports
There is a need for investment in key UK ports to meet the needs of the new offshore renewables industries. Government could identify a subset of UK ports which have the potential to meet future industry requirements.

Enhance communication is neded with ports on future offshore industries project plans and associated facilities requirements. Having visibility of the future pipeline of projects greatly enhances prospect of port investments occurring as previous experience shows that there is a lack of understanding by port operators of the prospects and nature of the offshore wind and marine renewables markets.

RDAs should be informed of the supply chain development potential and regional benefit that is associated with port use in offshore wind and marine renewables.

3.4.2 Cable installation
Efforts are ongoing to re-address the requirements of subsea cable burial. New cable burial depth/methods guidelines need developing for offshore wind and wave/tidal installations. These should consider seabed make-up in specifying the type of cable burial methods necessary. Consideration needs to be given to altering the standard three metre burial depth. This will have a direct benefit in reducing offshore wind capital costs. It will also create more opportunities for UK players to enter the installation market.

3.4.3 Installation vessels
It is essential to facilitate development of additional capacity for offshore wind projects and attract vessels to be available for the UK market – having a visible pipeline of projects greatly enhances prospect of this occurring. A continuity of visible demand is needed to stimulate investment as a vessel build may take 4 years

Vessel conversion for offshore wind may be a UK opportunity, but it is unlikely that new build would occur in the UK. The cost of conversion/refit as opposed to new build would need to be examined in greater depth, and set in the context of potential for UK jobs and resulting GDP impact at a regional level.

Further investigation is required into the economic benefit of vessel conversions for offshore installation.

3.5 Risk Management

There is a need to better understand the risk profile associated with offshore renewable projects (e.g. weather risk/delays during installation) and then encourage industry and trade bodies in the sector to apportion risk appropriately.

The definition of risks carried by each party should be standardised. Lessons can be learned here from the offshore oil & gas industry.

3.6 Biomass Specific Issues

3.6.1 Feedstock and fuel supply

The main issue to be addressed is that of feedstock. Consideration should be given to introducing subsidies for short rotation coppice growing to provide feedstock for biomass plants. Based on the predicted output from biomass by 2020, the UK Government should be assisting large-scale plant developers ensure security of feedstock supply from a mix of home market supply and imports. In the home market, consideration needs to be given to the removal or extension of the 50 mile radius limit on distance between grower/producer and end-user (biomass plant location) for provision of DEFRA grants.

Tax breaks or subsidies on imported feedstock supplies could be used, to ensure large-scale plants can be economically viable and sustainable.

Further R&D should be encouraged into feedstock efficiency, and alternative feedstocks, in the fuelling process.

There is a need for greatly improved communication with agricultural sector and DEFRA

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4 Key Inward Investment Targets

From our discussions in Sections 2 and 3, there is evidence of the opportunity for supply chain gaps to be met from indigenous UK companies. The diagram below highlights where the need for inward investment to stimulate the supply chain gaps should focus.

Recommendations on how BERR may encourage companies from other indigenous industries to consider entering the renewables sector have previously been made, and companies already expressing an interest should be supported through developing appropriate linkages within the European and International supply chain.

	Developers	Main contractors	System integrators	Product suppliers	Service companies	R&D and demonstration
Offshore Wind	Existing strong UK capability	Need to attract additional manufacturers (in addition to Clipper) through inward investment to stimulate the supply chain and meet future demand.	e.g. Local assembly in designated UK ports. Requires inward investment of major player to support development of supply chain. Requires indigenous investment in designated ports to make attractive for inward investors.	For those components identified as being in short supply – gearboxes, bearings, turbines – an indigenous base exists in other UK industries with necessary skill sets and quality assured equipment provision. Education and encouragement is required for them to enter the sector. These and other components such as cables, generators and transformers are potential UK growth areas.	Indigenous UK company base will grow up around servicing and maintenance, once initial equipment providers' guarantees lapse and local provision is sought to keep O&M costs down.	Nearshore test-site required for testing new offshore wind turbines, other components and installation methods, and for O&M training. Several sites in Europe are recognised by turbine developers for testing but none in the UK.
Onshore Wind	Existing strong UK capability	Lack of large-scale UK turbine manufacturing. Efforts are ongoing to attract manufacturers but a difficult task.	Existing UK capability.	As for offshore wind, need to encourage and assist indigenous UK companies from other sectors to become integrated into turbine manufacturers' supply chains.	Indigenous UK company base emerging around servicing and maintenance.	Improvements to efficiency, reliability and availability.
Biomass	2-3 developers of large-scale plants in UK	Contracting for turbines, boilers and turnkey plant construction primarily involves non-indigenous companies, often from Europe and North America e.g. Alstrom, Siemens, Abengoa and Foster Wheeler.	Typically the developer will employ a turnkey contractor who will be responsible for building and commissioning the plant. UK companies can fulfil demand.	Number of producers of feedstock in the UK limited by availability of resources and land for this purpose. Foreign feedstock imports will increase.	In most cases the developer itself takes responsibility for O&M but relies upon the equipment supplier to service turbine, fluidised bed and boiler systems. No significant gap.	Lack of fundamental research in the UK into improving fuel efficiency of existing and potential new feedstock sources. Crucial R&D work is required with high potential benefits.
Wave & Tidal Current Stream	Several small indigenous UK developers emerging, who are also the device developers. Such companies seeking partnerships with larger utilities/developers	Small number of UK main contractors becoming involved – e.g. fabrication of devices. Same contractors focused on oil and gas sector. Issues of confidence around sub-contracting with a small/micro-sized device development company	To date, the business model of most device developers, is also to do the system integration work	Availability of key components will be an issue as these devices become commercial. Need to encourage indigenous companies, with complementary equipment experience and track record from other UK sectors to enter the market.	Indigenous UK device developers are currently proposing to provide service and maintenance as part of their business model.	Several devices moving forward from both sectors. These have been supported by a mix of public and private investment. Further investment required to advance the development and demonstration of these devices to begin increasing confidence with investors on standardisation of designs for first generation commercial devices. Testing is crucial. Joint research/testing initiatives could benefit the rate of commercialisation.

Figure 4-1: Supply Chain Gap Analysis – Inward Investments

5 Maximising Potential Benefits to the UK Economy

Over the period to 2020, we estimate Government investment in stimulating and growing the renewable sector could reach £1.5 bn, if the maximum benefit to the UK economy can be gained through jobs created or secured. This is based on an average government spend of £17,000 per job created or secured in the sector and RAB's 2020 targets being realised.

Key Interventions and Investment Required

Sector(s)	Issue	Potential Intervention Mechanism
Offshore Wind, Onshore Wind	Lack of major players. Need to attract another 'Clipper'.	Inward investment programme to target next-generation turbine manufacturer to UK.
Offshore Wind	UK port suitability for assembly and construction.	Grant for port refurbishment (remaining made up from regional and private investment).
Offshore Wind, Onshore Wind, Wave & Tidal Current Stream	Availability of key components.	Cross-industry communication initiative with aerospace, marine and automotive sector on scale of opportunities for component manufacture and supply to the renewable sectors, including potential for export. Supply chain programme to provide 'one-stop shop' between wind turbine manufacturers and UK industry and facilitate key component manufacturing in the UK.
Offshore Wind, Onshore Wind, Wave & Tidal Current Stream	Availability of key components capital support	To provide capital support to business to put in place the facilities and/or equipment required.
Offshore Wind, Wave & Tidal Current Stream	Attraction of experienced offshore engineering and project management staff.	Knowledge/skills transfer programme to ensure small offshore renewable companies can be competitive in job market to attract experience into company. (Grant based – similar to KTP schemes).
Wave & Tidal Current Stream	MRDF monies flowing through small companies developing devices with long timescales. Progress is slow.	To get decisions on feasibility faster, monies could be channelled through larger developers or utilities who could test and assess feasibility faster, because of commercial drivers.
Biomass	UK feedstock supply	DEFRA grant conditions to be re-evaluated and scheme to continue

Figure 5-1: Key Actions