Scottish Marine Recreational Resources:
Surfing and the Future of Scotland's Seas

PREPARED 23 Jan 2013

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January 2013

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Forward

The sport of surfing[1] is one of the many Marine Recreational Activities that takes place around Scotland's coastline. Although the sport has been in existence within Scotland for almost half a century recent years have seen an exponential increase in the sport's popularity. It is not only however the sport of surfing that has expanded over Scotland's shores, the demand for the use of the coastal waters around Scotland have never been so great and ambitious plans lay ahead for Scotland's seas to support oil and gas, fishing and the new renewable energy sectors.

It is recognized that as each of the sectors grow and compete for use of Scotland's seas there may be conflicting demands between recreation, wildlife, tourism, heritage and industrial growth.

The plans for Scotland's Seas are developing quickly and changing rapidly as is the legislation which will manage potential conflicting demands. As of January 2013 there are commercial development plans in place which may have a direct impact at some of the following surfing sites:

- Fraserburgh Beach,
- Aberdeen Beach
- Nigg Bay,
- Sandford Bay,
- Spey Bay,
- Carnoustie,
- Burghead,
- Gills Bay,
- Farr Bay.

Broader plans also exist that could affect the sport of surfing along all of Scotland's main surfing coastlines:

- Lothian,
- Fife,
- Aberdeenshire,
- Moray Firth,
- Highland,
- Orkney,
- Shetland,
- Inner and Outer Hebrides,
- Tiree, Islay and the Macrahanish peninsula.

This paper forms part of series relating to the Scottish Surfing Federations Marine Recreational Resource Collection:

1) Assessment of the Sport Of Surfing Within Scottish Waters – capturing in essence the shape and form of Scottish Surfing today to act as a feed for the National and Regional Marine Plans.
2) Scottish Marine Developments, an Awareness from a Surfers Perspective – Dedicated to potential future marine developers giving an awareness of the surf environment and how it may be impacted by new developments.
3) Surfing and the Future of Scotland's Seas – Primarily aimed at Scottish surfers adding perspective on the potential developments that lay ahead and what the future may hold.

The information captured is simply a snapshot in time taken as of January 2013. It is hoped that raising awareness will allow any potential conflicts of demand to be identified and rectified early in

[1] The sport of surfing referred to within this document specifically relates to waveriding in the nearshore environment and excludes kitesurfing and windsurfing.

the planning phase for future developments offering harmony between recreational and commercial development across Scotland's Seas.

1) Understanding Changes in the Marine Environment

Throughout the 1990s huge inroads were made to improve the quality of the water around the UKs coast through UV treatment plants with a lot of help from the work done by 'Surfers Against Sewage'. Whilst there is still ongoing pollution challenges (from radioactive, effluent, industrial waste and household effluent) the seas are now cleaner than they've ever been. The main challenges being faced at present are through conflicting demands within Scottish seas. Scotland already supports an active fishing as well as oil and gas industry and very shortly will be building an offshore renewable industry. Going forward the main challenge from a surfer's perspective will be to ensure that the sport of surfing and other Marine Recreational Resources are considered early on in the planning phases of such projects to mitigate potential conflict.

1.1) What is Renewable Energy?

Renewable Energy describes power that comes from natural resources that can replenish themselves faster than they can be consumed - such as sunlight, wind, rain, tides, waves and geothermal heat. It is generally cleaner than energy from non-renewable sources such as petroleum, natural gas and coal.

Concerns over climate change and peak oil, coupled with high oil prices and technological advancements along with increasing government support have accelerated renewable developments and legislation within the European Union in the last 10 years.

In 2011 overall about 16% of the global final energy consumption came from renewable resources[i]. Assessments carried out identify the natural resource base for renewable energy within Scotland is extraordinary by European and even global standards. However, it's not the solar, biomass or geothermal potential that Scotland is renowned for its the wind, wave (10% of European potential) and tidal (25% of European potential) resources where the untapped potential lies.

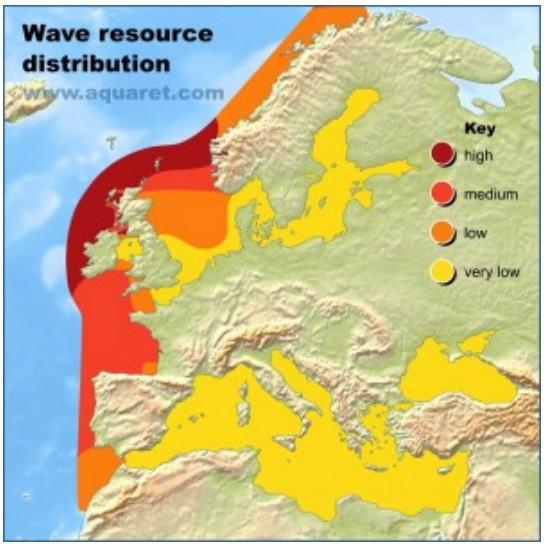

Figure 1 Scotland = 10% of Europe's Wave Resource [ii]

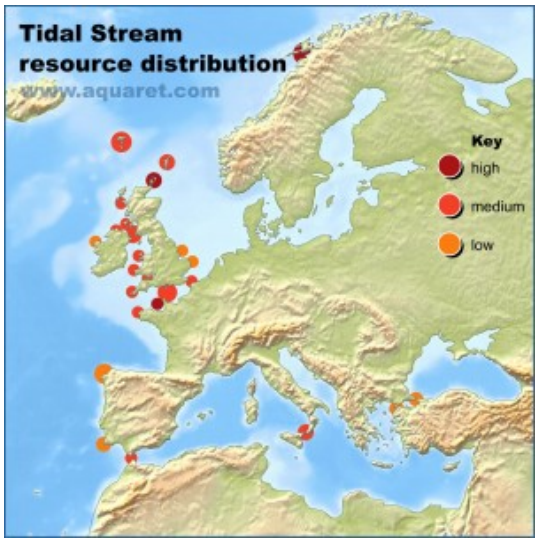

Figure 2 Scotland = 25% of Europe's Tidal Resource[iii]

Europe has been leading the way on a global scale with regards to renewable development and Scotland has by far the most ambitious plans for renewable development within Europe with the following aims:

The Scottish Government Policy is to generate the equivalent of 100% of Scotland's gross annual electricity consumption, the equivalent of 11% of Scotland's heat demand met from renewable sources and 500 MW of community and locally-owned renewable energy, all by 2020.[iv]

1.2) So what is the scale of Scotland's Renewable Industry?

Energy consumption can be broadly split into 3 main areas Heat, Transport and Electricity.

Of the total Energy that was consumed within the UK the breakdown in 2008[v] was approximately as follows:

- Heat (42%),
- Transport (35%)
- Electricity (23%)

To meet the target of 100% electricity generated from renewables by 2020 Scotland needs to have approximately 14,000 MW of installed renewable capacity by such time[vi].

At the end of 2011 there was 4,842 MW of installed renewable electricity capacity within Scotland, this had increased 14% from the year previous but a significant increase in operating efficiency resulted in a 44.5% increase in the amount of electricity generated. Overall in 2011 this meant that around 35% of Scotland's electricity came from renewable sources. By mid 2012 this had increased to 5,453 MW.[vii]

1.3) The Units of Power and Energy in layman's terms

In order to put this level of growth in context it's essential to come to grips with the units used gain a sense of scale.

When comparing Electricity generation power plants/ facilities are normally described by their power capacity which is measured in MW (MegaWatts).

The energy produced by a power plant is measured in MWh (MegaWatt hours).

MWh is a unit of Energy whereas, MW is a unit of Power.

Energy and Power are two words often confusingly interchanged. Energy is the amount of work done, whereas Power is the rate of doing work.

One MW (MegaWatt) is a million watts per second.
One MWh (MegaWatt Hour) is a million watts of power applied over the period of an hour.

MWh = MW x Hours.

The term MegaWatt (MW – 1 Million Watts) describes the amount of electrical power that a plant is capable of generating within 1 hour when operating at full capacity.

So in summary a 10 MW Power Generation system will generate 10 MegaWatts of Power within 1 hour if operating at full capacity.

Power can be described by different scales:

GW	– Gigawatt	=1,000,000,000	Watts
MW	-- Megawatt	=1,000,000	Watts
KW	– Kilowatt	=1,000	Watts

It should however be remembered that plants seldom operate at full capacity and the operating efficiency varies from fuel to fuel. Conventional Electricity plants can have efficiencies as high as 95% however many renewable such as wind farms which rely on the wind speed, direction etc tend to have efficiencies closer to 25-30%.

1.4) Benchmarking Power Capacities of existing Scottish Power Supplies[viii]

To put the growth in context a comparison with some of the other power generation projects may assist.

On the Nuclear front Dounreay had two reactors which provided power to the UK grid which at their peaks produced 14 MW and 250 MW respectively before being taken offline. Torness a further nuclear power station in East Lothian has a capacity of 1,364 MW.

Peterhead Power station, which was designed to burn and produce electricity from waste oil and gas transported nearby onshore has an installed capacity of 2,177 MW making it by far the largest oil and gas fired power station in Scotland with Grangemouth in second place with a capacity of 130 MW.

As far as Coal fired power generation goes Cockenzie in East Lothian, deemed the UKs least carbon efficient power station and an icon of the Lothian coast landscape for the last 50 years has a capacity of 1,200 MW and is due to close as a coal fired power station on 31 March 2013.

The wind turbine site at Boydnie beside Banff has a capacity of 14 MW from 7 turbines (2 MW each).

Within the last 10 miles on the journey to Thurso the 21 wind turbines at Causeymire (2.3 MW each) has a wind farm capacity of 48 MW.

Over a year, 1 MW of installed renewable capacity is estimated to deliver sufficient electrical power to meet the demand of an equivalent 470 average Scottish homes.

1.5) The History of Scotlands Renewables – The Hydro Schemes 1900 - 2000

On the 16th Jaunary 2013 Scotland celebrated 70 years of Hydro Power since the formation of the Hydro-Electric Development (Scotland) Act in 1943. This in essence marked the official start of the Scottish Renewable industry.

Scotland first ventured into renewables capitalizing on the large amount of rainfall over empty Highland glens with the mass development of the Hydro Power schemes between the 1930s and the 1980s. Over half of Scotland's 145 Hydroelectic schemes are based in the Highlands and Islands areas. For the last 50 years the hydro generation has provided the backbone for reliable energy with a steady capacity of approximately 1,200-1,400 MW (1.2-1.4 GW) allowing Scotland to punch well above its weight in the renewable sector when compared with the rest of the UK (Historically average % of electricity generated from renewable resources: Scotland = 20%, Northern Ireland = 10%, Wales = 6% and England = 4%)[ix].

Today Hydro Power still accounts for 10% of Scotland's total current energy generation with over 1,400 MW (1.4 GW) capacity[x]. Although there are still plans for a further major development in the Loch Ness area[xi] the majority of the large scale sites that were optimized for hydropower have already been developed. Surveys indicate that a further 1,200 MW capacity may be achievable mainly from smaller 'run of the river schemes' however it is unlikely these will be fulfilled in earnest due to other land use and commitments.

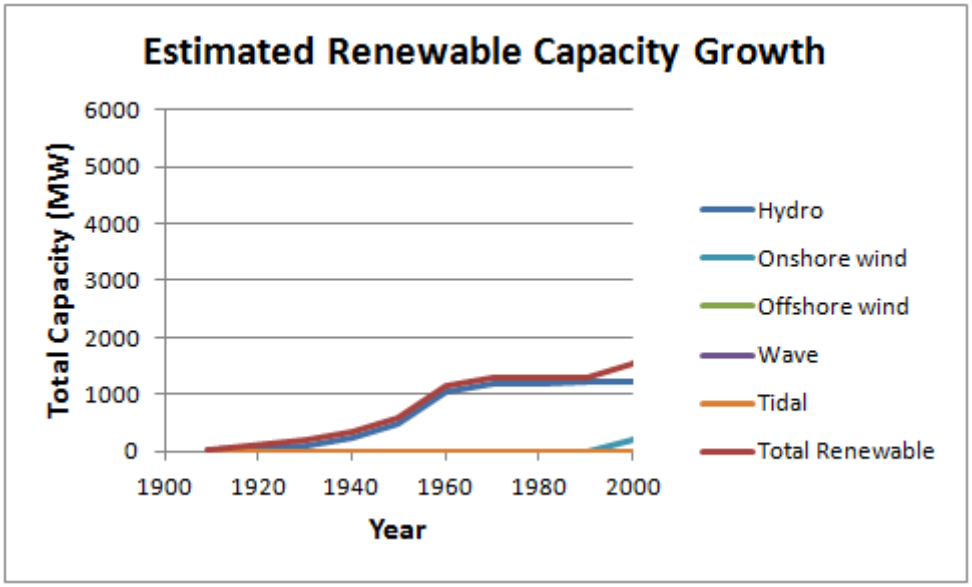

Figure 3 Estimated Growth of Scottish Renewable Capacity 1900 - 2000[xii]

1.6) Onshore Wind 2000 - 2012

Onshore wind farms have been the pivotal catalyst for accelerating the renewable journey within Scotland and without future wind development the technology wouldn't be able to meet the 2020 commitment.

The reason behind its recent accelerated deployment is due to the technological developments. It wasn't until the late 1980s and early 1990s where people started to look seriously at the potential of harnessing wind power to produce mass scale electricity. Across the world people had numerous ideas of different innovations to harness such power. Ideas led to plans which evolved into designs. Models were created to replicate and 'test' the initial design assumptions to ensure that the design would do what it was meant to. Miniature models were scaled up to full size prototypes where continual refinement allowed for further design optimization. Through this design process the wind power industry whittled down the large number of initial innovations to the final three bladed wind turbine by the late 1990s.

Figure 4 Examples of Early Wind Power Designs[xiii]

The recent years between 2000 and 2012 has saw further refinements within rotor design and turbine performance that has further improved such designs and the industry as well as infrastructure is now in place to allow for mass production and rapid deployment of such machines.

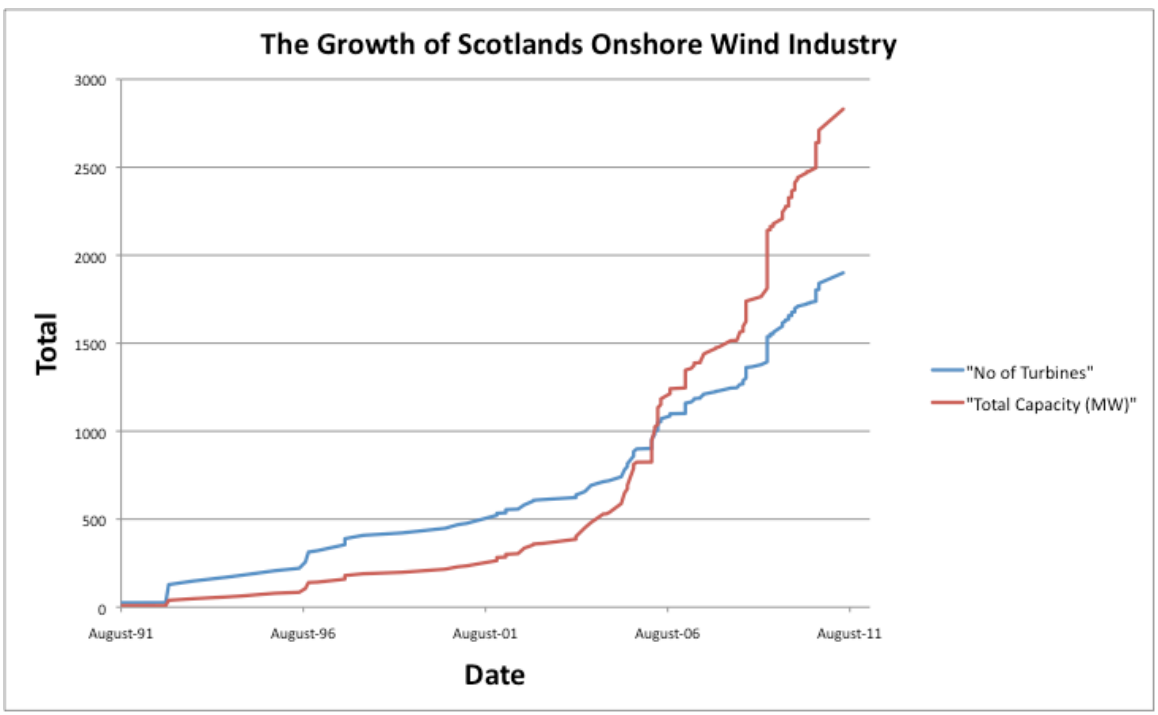

Figure 5 Growth of Onshore Wind Within Scotland[xiv]

As the deployment started to ramp, the installed capacity within a 3 year period between 2005 and 2008 from onshore wind exceeded the equivalent installed capacity from the Hydro Power schemes over its main 30 year development between 1943 and 1973.

Onshore Wind had by far the biggest influence on the growth of 'Total Capacity' generated from renewables in the first decade of the 21st century and by mid 2012 there was 5,453 MW (5.4 GW) total capacity with 3,400 MW (3.4 GW) supplied from Onshore Wind alone[xv].

Given that on average for Onshore Wind the installation cost is approximately £1.4 million/ MW[xvi] this equates to approximately £4,700 million (£4.7 billion) invested in the sector within Scotland to date.

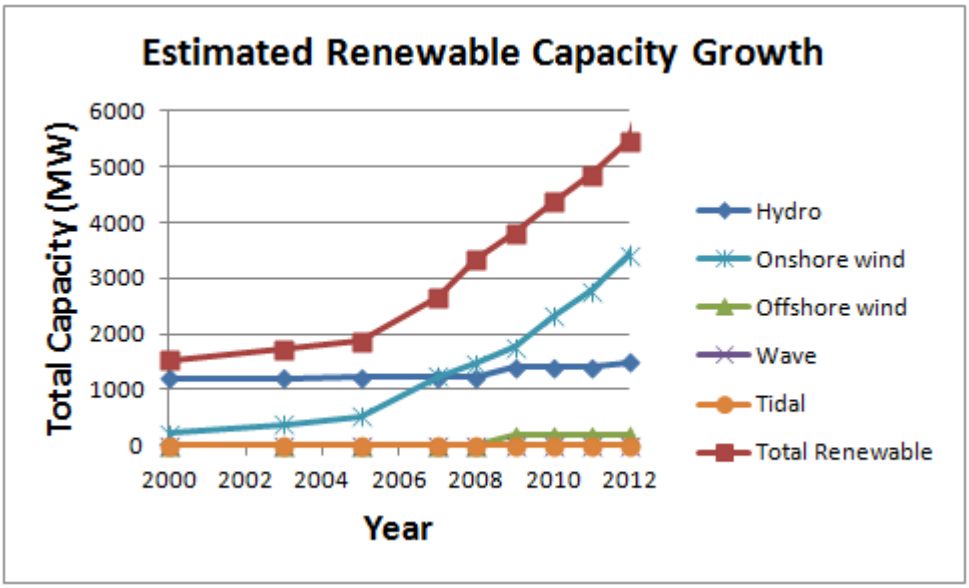

Figure 6 Estimated Renewable Capacity including growth of onshore wind[xvii]

1.7) Offshore Wind - Meeting the 2020 commitment

Despite the renewable sector doubling in the years between 2007 and 2012, at 5453 MW of current installed capacity Scotland is still a fair bit off the 14,000 MW (14 GW) 2020 benchmark.

So what makes this ambitious target seem achievable?

An analysis of the Renewable potential capacity identified there could be up to 36,500 MW of wind (16,500 MW onshore and 25,000 MW offshore), 7,500 MW of tidal power (25% of the total capacity of the EU) as well as 14,000 MW of wave power (10% of EU potential).[xviii]

Including the current Hydro Power schemes this potentially allows for 60,000 MW (60 GW) of potential Total Capacity from renewables.

Of course harnessing such power isn't quite so straight forward, for a start the technology either hasn't been designed or isn't available at present, there may also conflicting demands over land and sea usage preventing areas being utilize to their maximum renewable potential.

With regards to Onshore Wind as of mid 2011, other than what had already been installed or in construction, there was a further 2,000 MW (2 GW) from 755 turbines at 76 sites which have been granted planning permission and a further 7,400 MW (7.4 GW) from 3,073 turbines at 194 sites[xix] going through the planning process, this represents a potential further investment of £13,000 million (£13 billion).

If all were approved then it is feasible Scotland could have over triple the amount of onshore turbines than are currently installed.

Depending on the progress and deployment it may not be possible that Onshore Wind alone will allow for the government to meet the 2020 goal as such the next major renewable 'mass development' in the next ten years will be with Offshore Wind.

The mass expanses of sea surrounding Scotland's coasts and the relatively limited obstacles Offshore Wind offers over 1.5x the potential capacity of its onshore cousin. Capitalizing on the learning's from Onshore Wind development as well as calmer water developments in the Southern North Sea sector the technology has been beefed up for the Harsh environments present around Scotland's coasts.

Whereas the majority of onshore turbines that are being used are 2.3-2.5 MW capacity offshore installations allow for much larger turbines to be used (with 5 MW turbines in current operation and 7-8 MW soon to be available).

Within the UK there has been 3 licensing rounds by the Crown Estate leasing areas of the seabed for commercial development of offshore wind farms in UK waters with Round 1 starting in December 2000. The first round were relatively small in scale with approximately a dozen sites the only one in Scotland was the 'Robin Rigg' site in the Solway Firth south of Dumfries.

During Round 2 in July 2003 there was no Scottish sites present however in 2007 the first offshore turbines were introduced within Scotland which were two giant turbines 25Km offshore at the Beatrice field, the turbines were 88 metres (289 ft) high with the blades 63 metres (207 ft) long and had a joint capacity of 10 MW costing approximately £34 million. The 'Beatrice' windmills acted as a demonstrator project as at the time they were not only the largest offshore wind turbines but they were the deepest, 44 meters (144 ft) water depth, and furthest north offshore wind installation in the world[xx]. In many ways 'Beatrice' has paved the way for future harsh environment wind turbine installation.

Figure 7 Beatrice twin Turbine Demonstrator Project

The 180 MW capacity Robin Rigg wind farm, 60 turbine (3MW each) continued development and came online in April 2010.

During Round 3 in 2009-2010 the Crown Estate went on to release a number of offshore sites as well as sites within 12 Nautical miles of the Scottish shores (Islay, Argyll Array, Beatrice, Inch Cape, Neart na Gaoithe and the Forth Array) which has the potential to produce up to 5,000 MW (5 GW) of capacity. Two further large developments with a combined total of 4,800 MW (4.8 GW) have also been released in the Moray Firth and the Firth of Forth.

If all these projects are to be in operation by the year 2020 then it is likely the 14,000 MW target will be far surpassed.

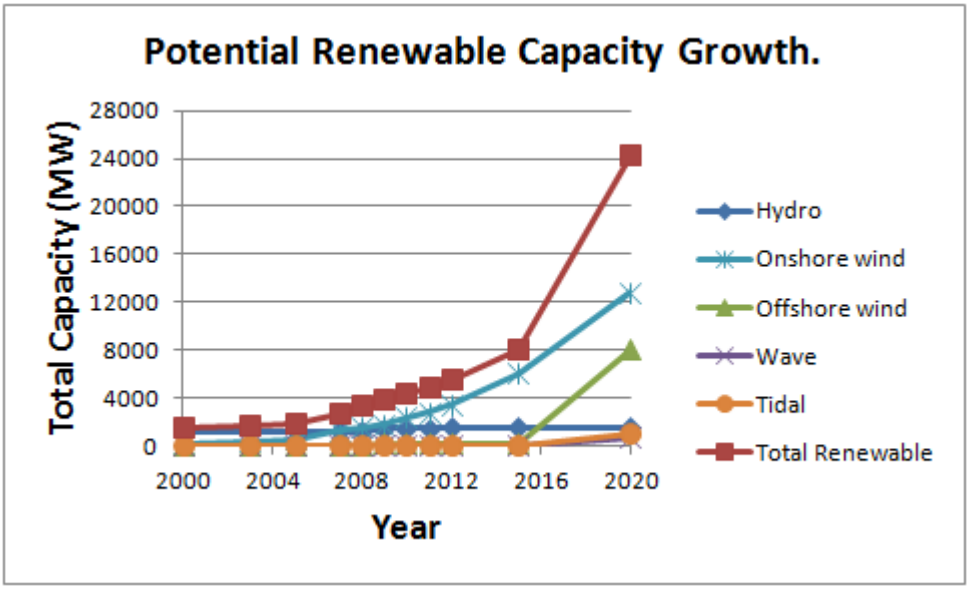

Figure 8 Potential Renewable Capacity with Offshore Wind

The development of turbine technology is progressing quickly, and in future years, larger and higher capacity turbines are expected to be available. The number of turbines required is directly related to their generating capacity, so in order to take advantage of the technological improvements expected in the next few years the consents that are being applied for ought to accommodate such improvements.

- If 3.6 MW turbines are used (which would have a blade tip height of 162m) this would require 2,222 turbines.
- If 8 MW turbines are used (which would have a maximum tip height of 204m) this would require 1,000 turbines.

Development of Offshore Wind does come at an expense however as it s currently over twice the amount of Onshore Wind development per MW. Figures from Scottish Enterprise suggest the cost of building an offshore windfarm in 2009 was £3 million per MW excluding cabling and grid connections. The aim is to reduce this to around £2.5 million per MW.

From the timescales that many of the Offshore Wind companies are working to there is a potential that the majority of these projects could start installation around 2015. The projects that are going through planning could account for 8 GW which could be operational before 2020. At present there is a huge demand to ensure the supply chain for developing such an industry so quickly is in place and will require a significant workforce.

The following diagram outlines areas of further research where the Crown Estate may consider future potential leasing areas for Offshore Wind development.

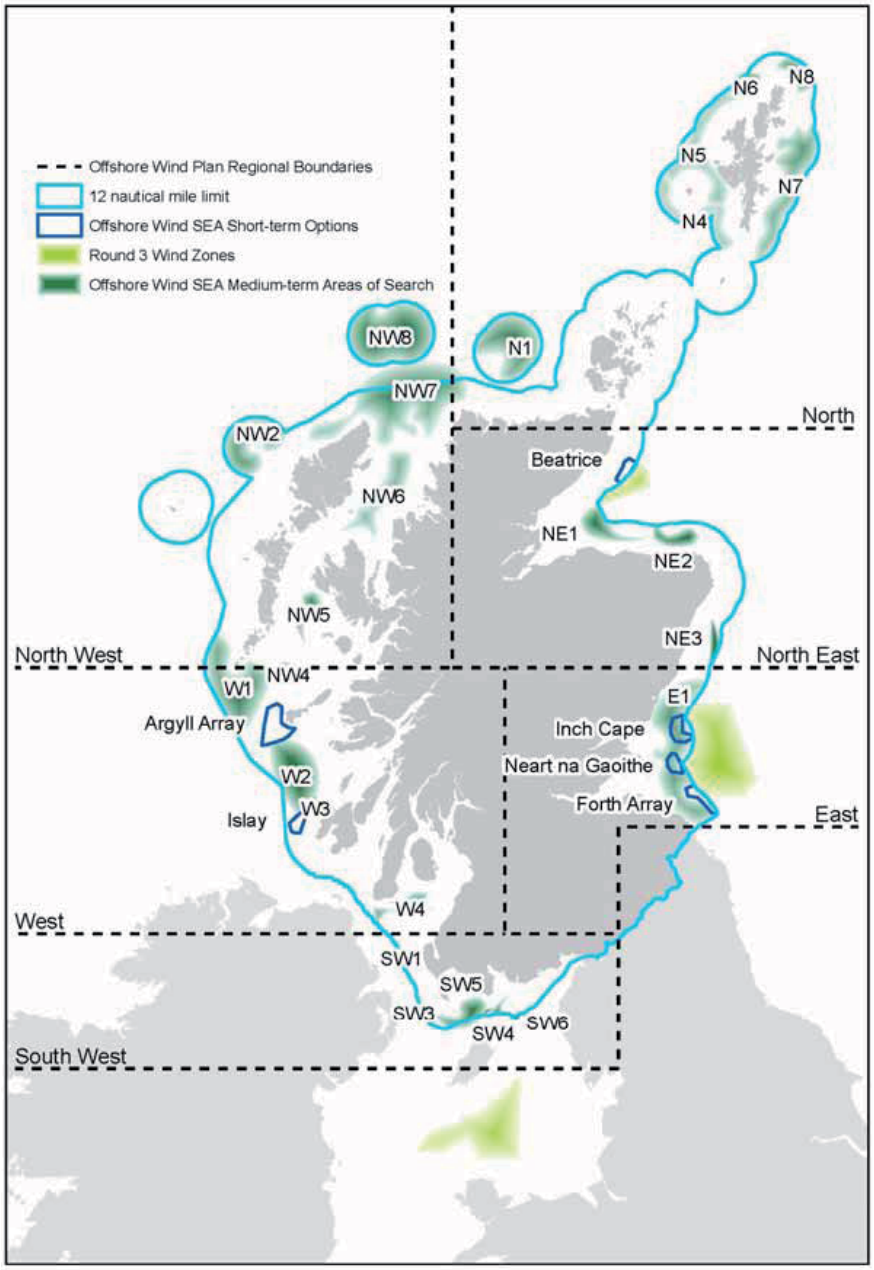

Figure 9 Offshore Wind zones of future interest[xxi]

1.8) Table of Current Offshore Wind Farms (January 2013)

Area	Developer	Location	Capacity	Total Turbines	Size	Commencement	Cable comes ashore	Potential cost[2] GBP
Islay	SSE	Located approximately 13km of the west coast of Islay	690 MW	Up to 138 wind turbines at 5MW each	93 km^2.	Potential start installation 2015.	TBC	2.07 billion
Aberdeen Bay	Vattenfall Wind Power UK, and Aberdeen Renewable Energy Group (AREG)	2.5 km from shore (between Balmedie and Aberdeen)	100 MW	11 turbines			Blackdog	150 million pound
Argyll Array	Iberdrola	5 km off the coast, West of Argyll and the Island of Tiree	1,800 MW	If 6MW turbines were used, 300 would be required for all 1,800MW.	The Argyll Array site covers an area of approx 360km^2	Project currently on hold Earliest construction start 2020.	TBC	5.4 billion
Beatrice	Repsol	Approximately 13.5km from the Caithness coastline.	1,000 MW	The proposed wind farm will have between 142 and 277 turbines.	131.5km^2	Construction starts 2014 - 2015	Port Gordon	3 billion
Inch Cape	EDP Renovaveis, Repsol	The Inch Cape Offshore Wind Farm site lies in the outer Firth of Tay region. The site is located approximately 15 - 22 km to the east of the Angus coastline in Scotland.	905 MW	Planned = 226	150 km2	Construction 2015	Cockenzie East Lothian	2.7 billion
Neart na Gaoithe (Off Fife Coast)	Mainstream	Approximately 15.5 km east of the coast of Fife Ness	450 MW	Planned = 90	105 km2	Pre-construction starts 2014	Thornton Loch (Lothian)	1.4 billion
Moray Firth	Moray Offshore Renewables **Parent Companies:** EDPR and Repsol Nuevas Energias UK **Tenant:** EDPR and Repsol Nuevas Energias UK	Next to Beatrice Development	1,300 MW Two areas (Eastern and Western)	Eastern area being developed only – (3 sites each with 500 MW) 339 turbines at 3.6 MW or 189 turbines at 8 MW	520 km2	Installation commencing 2015, all 3 phases complete 2020.	Fraserburgh	4.5 billion
Firth of Forth	Seagreen	27 km off Fife coast	3,465 MW Phase 1 = 2 x 525 MW, Phase 2 – 3 x WFs Phase 3 – 2 x WFs	Phase 1 2 sites each with 75 turbines (150 Turbines) Phase 2 & 3 = TBC	2,852km^2	Phase 1 installation commence 2015 Phase Two 2016 Phase 3 2018	Carnoustie	10.4 billion

[2] Cost Estimate based on average projection of £3 Million per MW.

1.9) Pioneering Wave and Tidal Power (2013 – 2020 and beyond)

As well as the wind power the Scottish Government have put in place development plans for up to 1,000 MW from tidal power and 600 MW from wave power by 2020. These may seem small in comparison with the developments on the wind front but in many respects may be considered the most ambitious considering the infancy of the current technology as well as the most influential towards the sport of surfing.

Both Wave and Tidal Technology by comparison are approximately 10-15 years behind that of Wind Technology development.

There are limited schemes around the world in operation each with slightly different technologies – the LIMPET device (0.5 MW) installed on Islay off the West Coast of Scotland has been operated by Voith Hydro Wavegen since 2000, there is a 1.2 MW tidal device at Strangford Lough in Northern Ireland and a 240 MW tidal scheme at Rance Estuary in Brittany which has been in operation for over 25 years. In recent years Pelamis installed a three machine wave farm at Aguçadoura in Portugal during 2008 with an installed capacity of 2.25 MW.

The Pentland Firth has been described as the Saudi Arabia of tidal power and recognizing the potential as well as the infancy of the technology the Scottish Government and EU commissioned and opened the European Marine Energy Centre (EMEC) in Orkney as a test and research facility. Wave testing started in Orkney in 2004 and tidal in 2007 with high demand for all test births at present.

This test centre allows for a lot of the 'scaling up' activity for prototypes acting as the prooving ground to see if the tidal and wave designs will do as they 'say on the tin' and are capable of withstanding the potential severe conditions they may see when in operation.

Numerous different design types have been identified some are situated nearshore some offshore to harness the power from such sources.

At present EMEC have identified 8 forms of Wave Energy Converter and 6 forms of Tidal Energy Converter. Although some current designs are similar in class each company's product operates under a different mechanism with different ways of installation and hence require independent assessment.

In a similar way that wind farms compromise of many wind turbines, the basis for deployment involves creating a wave or tidal farm where an array of devices are situated within a given site linking to a common grid supply onshore.

To further incentivize the accelerated development of marine energy technology the Scottish Government have put forward the Saltire Prize (consisting of £10 Million) which is one of the largest ever innovation prizes. The stake has generated 153 registrations of interest from 31 countries across the world and is due to be awarded in 2017.

During 2010 the Crown Estate announced development rights to six wave and five tidal schemes within the Pentland Firth as part of the world's first commercial scale marine energy leasing programme. Developers intentions suggest a total capacity of 1,600 MW could be installed by 2020.

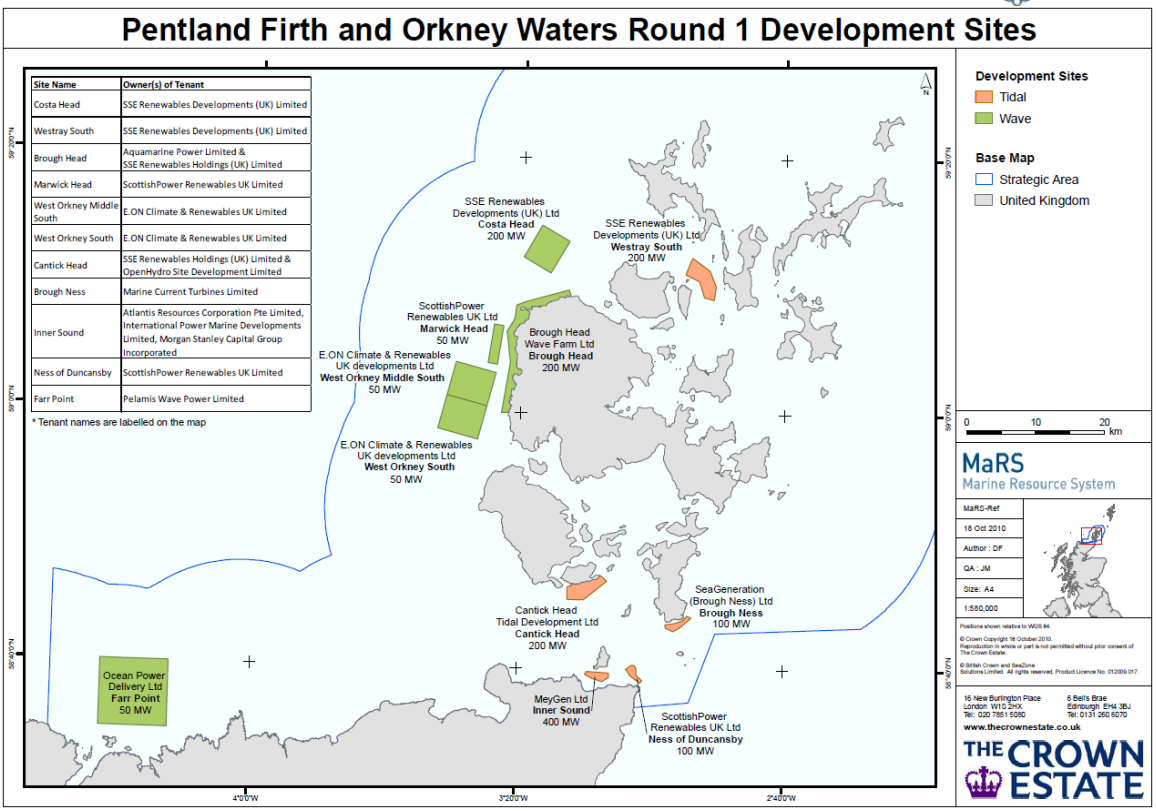

Figure 10 Pentland Firth and Orkney Water Round 1 Development Sites[xxii]

The total capital expenditure to make such projects happen has been estimated in excess of £6,000 million (£6 billion) with a further operation and maintenance expenditure estimated at £100 million per annum.

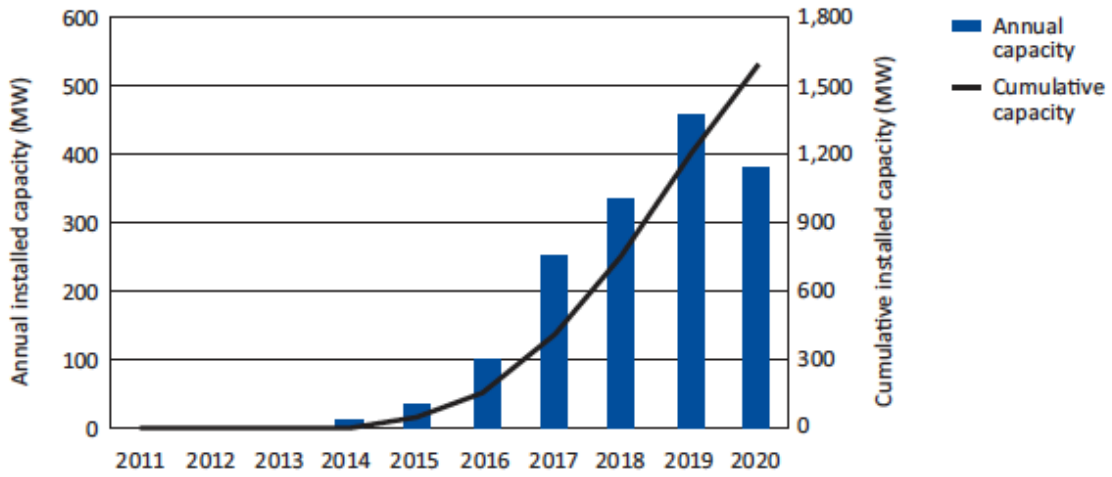

Figure 11 Installed Capacity over plan for the Pentland Firth and Orkney waters projects[xxiii]

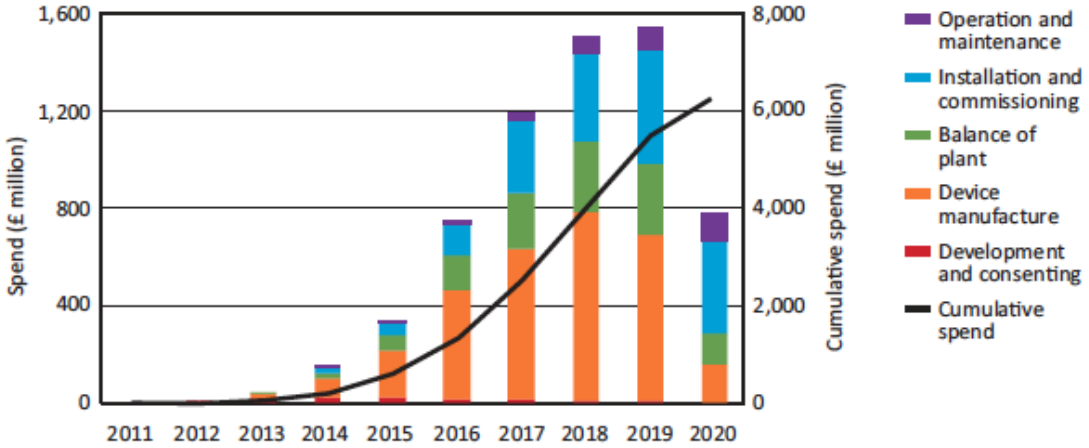

Figure 12 Investment over plan for the Pentland Firth and Orkney waters projects[xxiv]

Outwith the sites planned at the Pentland Firth and Orkney the following sites have been released by the Crown Estate the majority of which came about in 2012:

Project	Region	Capacity	Resource	Company	Stage
Bernera, Isle Of Lewis	Western Isles	10MW	Wave	Pelamis	In Planning
Bluemull Sound	Shetland	0.5MW	Tidal	Nova Innovation Ltd	In Planning
Burghead	Moray	TBC	Wave	AWS Ocean Energy Ltd	In Planning
Esk Estuary, Montrose	Montrose	0.666 MW	Tidal	GlaxoSmithKline Montrose plc	In Planning
Galson	Isle of Lewis	10 MW	Wave	TBC	In Planning
Kyle Rhea, Skye	West Highland	1.6 MW	Tidal	Marine Current Turbines Ltd	In Planning
Mull of Kintyre	Argyll	3 MW	Tidal	Nautricity Ltd	In Planning
Ness of Cullivoe	Shetland	30 KW	Tidal	Nova Innovation Ltd & Nova Yell Development Council	In Planning
North West Lewis	Western Isles	30 MW	Wave	Aquamarine Power Ltd	In Planning
Sandra Sound	Argyll	35 KW	Tidal	Oceanflow Development Ltd	In Planning
Sound of Islay	Argyll	10MW	Tidal	ScottishPower Renewables UK Ltd	In Planning
Southwest Shetland	Shetland	10MW	Wave	Pelamis Wave Power Ltd & Vettenfall AB	In Planning
Isle of Islay	Argyll	30MW	Tidal	DP Marine Energy Ltd	In Planning
Siadar, Isle of Lewis	Western Isles	30MW	Wave	Voith Hydro Wavegen Ltd	In Planning

Figure 13 Planned Marine Projects outwith Pentland Firth[xxv]

1.10) Current wave and tidal technologies

Its difficult at this early stage to forecast how the wave and tidal developments may pan out but based on the technology that has been tried, tested (EEMC) and has successfully stood up to the elements below are a few of the devices currently registered for the Saltire prize and their potential output.

Wave Power
Pelamis Sea snake – 750 KW
Aquamarine Oyster 1 - 315 kW
Aquamarine Oyster 800 – 800 kW

Tidal Power
ScottishPowerRenewables HS1000 =1 MW
MeyGen Limited AR turbines = 1 MW
OpenHydros OpenTurbine = 250 KW

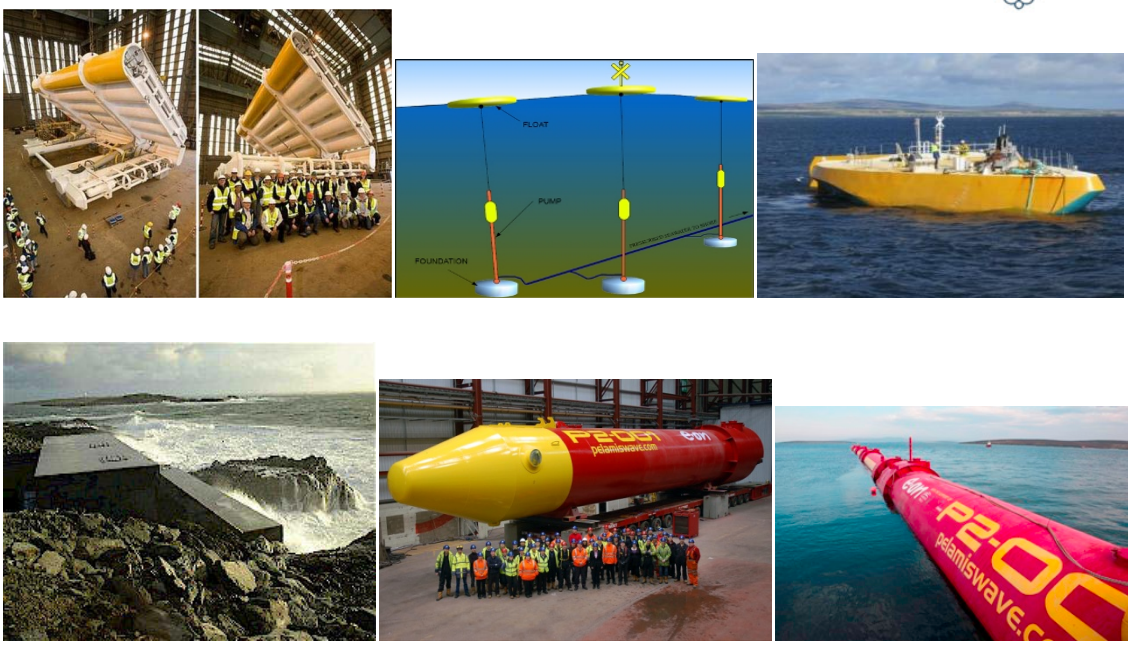

Figure 14 Examples of Wave Energy Technology either in deployment in Scottish Waters or undergoing Testing[xxvi]

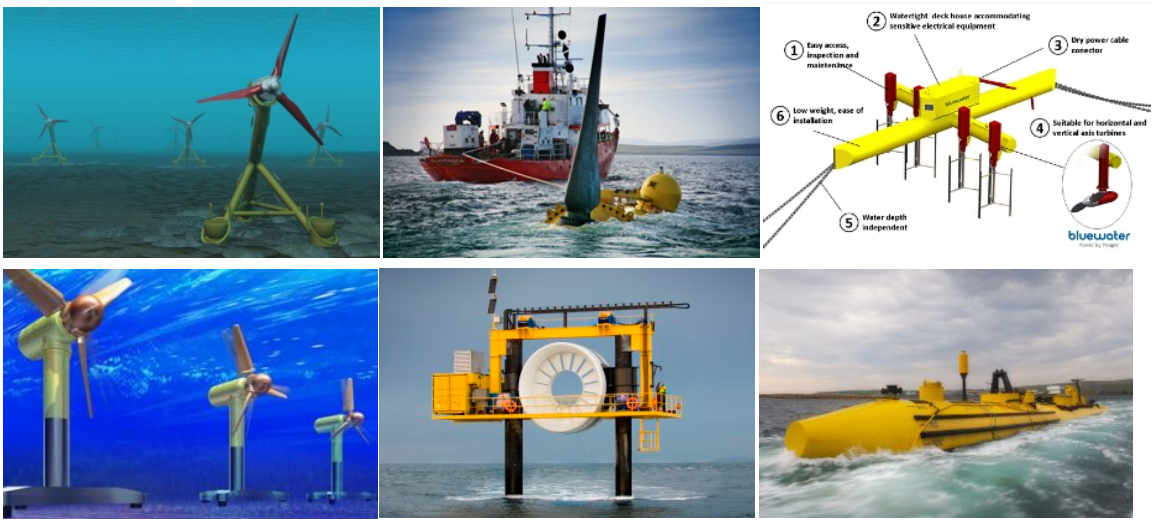

Figure 15 Figure 18 Examples of Tidal Energy Technology either in deployment in Scottish Waters or undergoing Testing[xxvii]

Based on the capacities from existing technology undergoing testing in order to meet the 1,600 MW target outlined for the Pentland Firth by 2020 approximately 1,000 tide turbines and 800 wave power generators will have to be installed before this time.

Assuming by 2020 the technology is wholesale proven then it is anticipated that similar to what has been seen in the accelerated deployment of wind technologies there would be a subsequent acceleration in the deployment of tide turbines and wave power generators.

If Scotland's estimated energy potential was to be realized in full this would result in 7,500 tide turbines (7,500 MW potential) as well as over 18,000 wave power generators (14,000 MW).

1.11) Summary of Marine Renewable Development Potential By 2020

In 2012 the spend on renewables rose from £750 million to over £1,000 million (£1 billion) with the majority of the investment toward Onshore Wind. The combined total of Offshore Wind, Tidal and Wave power technologies only accounted for £3.6 million in 2012[xxviii].

Due to the level of investment that lies ahead will increase several hundred fold for the marine renewable sector within the next few years.

Given the element of uncertainty that still exists within the development rate and cost of the renewable sector the combined investment between Offshore Wind, Wave and Tidal could vary between £10,000 and £30,000 million (£10 and £30 billion) within Scotland by the year 2020.

As the majority of the installation work and financial commitment will likely take place in the second half of the decade this could equate to an average spend between £2,000 and £6,000 million (£2 and £6 billion) per year.

When communicating in such larger figures it can be difficult to get a feel for what this means in real terms: as a broad comparison to give context:

- Donald Trumps golf course North of Aberdeen cost £100 million (£0.1 billion).[xxix]
- The Aberdeen City Western Peripheral Route (ie the city bypass) is expected to cost £654 million (£0.65 billion).[xxx]
- The Edinburgh Tram project is anticipated to cost £774 million (£0.774 billion).[xxxi]

In comparison with other sectors:

- The Total expenditure on the NHS in Scotland in 2009/10 was £11,100 million (£11.1 billion).[xxxii]
- The UK Oil and Gas sector had an estimated investment of £11,500 million (£11.5 billion) in 2012.[xxxiii]

In effect the annual investment in Scottish marine based renewable technology could potentially be more than half that of the UK oil and gas industry in the later part of the decade.

To meet the demands of such a new industry will require a huge workforce influx and skill development along with a multitude of new offshore and nearshore marine developments to service the industry.

In addition to this in recent years there has been proposed developments to service the oil industry at Brimms Ness on the North Coast and Sandford Bay in Aberdeenshire. In more recent months an expansion of Aberdeen Harbour with the development of Nigg Bay has been proposed[xxxiv].

1.12) Sustainable Seas For All

The Scottish Government recognize that there may be conflicting demands for the use of Scotland's sea and as such have put together a set of legislation known as the Marine Bill. On the 10th March 2010 this received Royal Assent making it the Marine (Scotland) Act 2010[xxxv]. In essence it provides a framework which will help balance competing demands on Scotland's seas. It introduces a duty to protect and enhance the marine environment through planning licensing and conservation and includes measures to help boost economic investment and growth.

To fulfill the obligations of the Marine Act both National and Regional plans are being drafted and it's important that surfing is adequately represented throughout these.

The National Marine Plan pre-consultation draft was launched in 2011 and is being revised in response to comments with consultation on the draft plan to follow in June 2013.

As far as a Regional Plan is positioned at present the Scottish Marine Regions are defining their boundaries with 11 marine regions proposed.

The SSF are committed to ensuring that the Marine Recreational Activity of Surfing can be adequately represented in the Marine Act and is considered both within National and Regional Marine Plans.

1.13) The Scottish Surfing Federations stance on Marine Developments

Most Scottish surfers care and have an affinity for the near shore environment - the majority feels strongly about environmental and pollution issues. The SSF supports renewable developments which potentially may improve such conditions and the surfing environment.

The SSF also recognize the potential industry and opportunity that such developments could bring to Scottish surfers and the areas where they reside.

The SSF fully supports renewable developments that can demonstrate they have no detrimental effect to the surfing sites and Marine Recreational Resources of Scotland.

The SSF are proud to be under a government that recognizes potential conflict and are working with the Marine Bill to ensure all sea users are fairly represented.

Where the SSF would normally draw the line between support and opposition is if a potential new development would have a direct detrimental effect to Scotland's existing surf sites or Marine Recreational resources.

Given the handful of precious beaches/ reefs which contribute as a whole to the 'Scottish Surfing Experience' the SSF would be in opposition of any development which has the potential to destroy or block the surfing conditions at one of these surfing sites.

The SSF are committed to working with developers and Marine Scotland by directly involving local surfers at the earliest opportunity within the design phase of new projects, identifying any potential conflicts and working together so a mutual best way forward may be achieved for all sea users.

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