Ocean Energy as a Sustainable Economic Development Priority

Stephanie Thornton[i], Gareth Davies[ii]

[i] N.A. Sea Energy Alliance Portland, Oregon, USA stephanie@seaenergyalliance.com
[ii] Aquatera Environmental Services Ltd. Scotland, UK gareth.davies@aquatera.co.uk

ABSTRACT

A recent economic assessment of the emerging wave energy industry in Oregon, sponsored by the Oregon Wave Energy Trust, confirmed most expectations that significant economic benefits, such as jobs and tax revenues, will accrue from a thriving wave energy industry. These benefits will most likely accrue from the construction and operations of wave energy facilities at various stages of development, beginning at the initial research and development (R&D) and continuing through to the commercial and industrial stages. The greatest economic benefits are expected at the commercial stage with 500 MW of wave energy capacity installed off the coast of Oregon, and the industrial cluster stage where Oregon is producing wave energy equipment for export.

Oregon represents an important microcosm of the US emerging ocean energy industry. While interest in developing wave energy is strong in Oregon, other coastal regions of the US are looking to develop not only wave, but offshore wind, tidal or current energy resources as well. If the economic benefits projected for Oregon's wave energy industry were expanded to include all ocean renewables throughout the U.S., it is likely that a mature U.S. ocean renewable energy industry could provide substantial economic value as well supply a significant portion of the nation's renewable electricity.

What will it take to capture these potential benefits? In this nascent stage of the ocean renewable industry in the U.S., formulation of a strategic ***ocean energy development plan (OEDP)*** would provide a concrete guide for mobilizing the ocean energy community through a development pathway towards desired production goals. Similar to the role a business plan provides for a start-up business, an ocean energy development plan would provide a "road map" illustrating how the ocean renewable industry will move through the various development stages leading to economic prosperity at maturity.

This paper will explain what a strategic renewable ocean energy development plan is and how it will help achieve economic sustainability. More importantly, the premise of this paper is to establish a compelling case for building upon the planning success and lessons learned in Scotland to implement a similar deployment strategy in the U.S. The detail that an OEDP provides, as well as the process for developing it, could help accelerate development of the renewable ocean energy industry in the U.S.

INTRODUCTION

Around the world there is growing interest in harnessing the power of the ocean to produce renewable, carbon-free electricity. In addition to providing a new source of renewable energy, a renewable ocean energy industry has the potential to provide significant economic benefits, particularly in coastal rural areas.

A recent economic study in Oregon[1] documented the potential economic contribution that construction and operations could provide at three key stages of industry development, which include R&D, commercial and industrial. As expected, the projections indicate that a significant increase in economic benefits would be realized as the industry moves from the R&D stage to commercialization and industrialization levels. The primary benefits would likely include job increases, tax revenues and community output. For example, the study projects the following trends:

- Construction period economic output: an estimated $3 million in economic output and 48 jobs in the R&D stage to a projected $889 million and 6,032 jobs in the industrialized stage.
- One year operation of wave energy projects: an estimated $13 million in economic output and 100 jobs in the R&D stage to a projected $2.4 billion (yes, billion!) in economic output and 13,630 jobs at the industrialized stage.
- Tax revenues: at the industrialized stage, revenues are projected at approximately $56 million for coastal communities and an estimated $90 million for the state.

The key conclusion from the Oregon economic study is that there is significant economic potential for the wave energy industry if the technological and cost barriers can be addressed so the industry can progress to the commercial stage[2].

Looking ahead, if the economic benefits projected for Oregon's wave energy industry were extrapolated to include this emerging industry throughout the U.S., it is likely that a mature sector could provide low carbon, ocean energy production while delivering significant benefits to the economy.

STORMY SEAS

The key word in realizing the potential economic benefits is "mature" renewable ocean energy industry, meaning that associated technologies have reached a level where they are essential contributors to a sustainable energy portfolio. At this point they are positioned at the "commercialization" stage where technologies are growing and entering the commercial marketplace. A large part of the appeal of technologies at this juncture is the perceived sustainable energy supply with minimal environmental risks.

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[1] Grover, Steve, ECONorthwest; *Economic Impacts of Wave Energy to Oregon's Economy*, prepare for the Oregon Wave Energy Trust, September 2009. **Report in Final Review.**

[2] Grover, Steve; Page 33

Currently however, ocean energy devices are identified as immature technologies and are classified under the "research and development stage." While more mature technologies, such as wind and solar, are in or have entered the commercialized marketplace, ocean energy technologies heavily depend on essential research and development commitments to move them along the development pathway. At this level, the public sector can play a significant role as a conduit toward commercialization.

One vital step on the commercialization path for renewable ocean energy is establishing renewable energy production targets or goals. Although many states have established renewable energy standards (RES), they are not broken out by industry contribution. Oregon is an exception. Within their established RES of 25% renewable energy by 2025, the state has identified a specific ocean energy production goal of 500 MW of ocean energy.

While RES and targeted ocean energy goals go a long way toward encouraging ocean energy development by identifying <u>what</u> the desired goals are, they fall short of defining exactly <u>how</u> to achieve that target. In Oregon for example, with their ocean energy production goal 15 years out, what might be a reasonable production target in 3 years or 5 years? How many devices and of what type are needed to deliver 50 MW and/or 500MW? What coastal infrastructure is needed to support ocean energy production at those various levels? Without answers to these questions, states will lack a credible development pathway to building generation capacity and demonstrating that ocean energy can be or is part of their renewable energy portfolio.

While several state agencies and appropriate policy frameworks have statutory authority to conduct ocean renewable industry planning and the desire to do so; the economic malaise of late 2008 and 2009 resulted in public agencies without adequate funding, resources and skilled expertise. Many agencies had to redirect funding initially set aside for planning into other essential program areas. Furthermore, vacant staff positions are not able to be filled, resulting in compounded work load for existing staff and gaps in critical knowledge areas or technical expertise. As a result, comprehensive and integrated planning for ocean energy development is not occurring.

A PATH TO ECONOMIC SUSTAINABILITY

An important mechanism for advancing ocean energy to the commercialization stage is the formulation of a proactive strategic ***ocean energy development plan (OEDP)***. With a specific goal in front, this plan lays out a specific project-development pathway (or "deployment strategy") for mobilizing the ocean energy community toward their target.

Similar to the role a business plan provides for a start-up business, an OEDP would provide a detailed action plan that sets out <u>what</u> needs to happen and <u>by when</u>. This would result in a deployment strategy demonstrating <u>how</u> the ocean renewable industry will move through the various development stages.

A key aspect of an OEDP is how it diverges from a "technology road map". Technology road mapping was pioneered by the University of Edinburgh and today is being applied by the National Renewable Energy Laboratory (NREL) and the Ocean Renewable Energy Group (OREG) in Canada. The intent of this particular type of road map is to lay out a technical development chain for producing ocean energy devices. Technical considerations include topics such as device modeling, mooring & electrical requirements, engineering design, installation, operations and maintenance among many considerations.

Complementing a technology road map is a deployment strategy or an OEDP. This strategy defines a scenario for deployment of the proposed technologies over time and under differing scenarios. An OEDP considers the breadth of issues which must be addressed for putting the technology in the water and delivering electricity to customers. These factors include utility requirements, electrical grid, policies & permitting, supply chain, market assessment, site assessment, community engagement and so forth.

The value of an OEDP is currently being demonstrated in Scotland in support of their very ambitious marine energy goals. Although a number of different "road mapping" approaches are being followed, one specific approach aims to establish a detailed and broad-ranging ocean energy development model which meets the requirements of a strategic OEDP. This particular model is currently being used to investigate what-if scenarios for future planning to achieve their country's goals. And it is this plan that holds the most possibilities for the U.S.

When the plan was developed in Scotland, almost immediately benefits were realized. The following are some that are contributing to Scotland's leadership in this field today:

- Economic blueprint – Their ocean energy development plan has provided a blueprint or "road map" defining a clear pathway for generating economic benefits (green jobs, tax revenues, etc).
- Technology development – Their device production plans, or technology road maps, are integrated into the overall deployment strategy.
- Strategy & planning – Their deployment strategy is helping evaluate and set priorities. Additionally, their plan facilitates coordination of a variety of related programmatic activities leading to improved program efficiency. The plan is helping identify links, dependencies, synergies and conflicts between actions and activities.
- Policy - Their plan is helping inform a clear policy agenda as well as identifying key regulatory processes. Their policy agenda is also providing the building blocks for a future energy system.
- Collaboration - Their plan is helping define roles and responsibilities by key stakeholders, leading to improved collaboration and alignment of people/organizations around a common goal. Through this, buyer/seller (e.g. supply chain) relationships are also identified.
- Financial strategy – Their plan has helped accelerate investment in technology innovation as well as identify potential incentive strategies.

- Decision-making – Their plan helps inform decision-making, especially when the plan is combined with other tools. One of key aspects of the plan is the ability to incorporate lessons learned, leading to increasing quality levels of information upon which decisions are made.

At its simplest, the plan seeks to drive low carbon energy production, in a way which capitalizes on Scotland's unique resources and delivers maximum benefit to its people and their economy. Some of the thinking that has come out of this approach has been introduced into Scotland's national marine energy road map, which was recently published by the Scottish Government.

FOLLOW THE LEADER

The premise of this paper is persuading readers to build upon the success and lessons learned in Scotland to implement a similar deployment strategy in the U.S. The detail that an OEDP provides, as well as the process for developing it, could help accelerate development of the renewable ocean energy industry in the U.S. The plan would help link the general requirements of policy level road mapping to the specific actions, plans and initiatives undertaken by technology and project developers, organizations and communities. Where there are suitable lines of communication, the detailed planning process can feed upwards towards policy levels helping to provide a very effective feedback loop regarding the strategy being followed and indicating any changes that may be required.

Scotland has demonstrated that adoption of significant renewable ocean energy into energy systems requires changes to all stages of the energy supply process. An even more important factor to recognize is that the present structure of energy systems has not and should not be viewed as sacrosanct or anywhere near perfection. Energy systems today have been structured by yesterday's needs and pressures which are very different than those of tomorrow. Changes will need to occur in the future supply and the demand for energy. In short, the Scottish learned that their energy habits today have been formed in a particular era of energy profligacy, but that their future habits will need to be very different.

The approach used by Scotland can help show what the key building blocks of the future energy system may be. In this sense, the approach need not stay focused solely on ocean energy technology but should consider wider integrated energy supply and demand systems.

BUILDING THE YELLOW BRICK ROAD

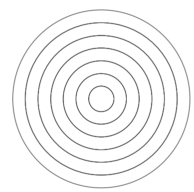
The building blocks for creating an OEDP are quite simple. An ocean energy development plan is essentially a matrix which has future months and years along one axis and different activities along another axis, such as infrastructure needs, manufacturing requirements, permitting requirements, public/community engagement strategies, device support conditions, and much more.

A key aspect of the OEDP is time. The plan identifies future work streams in terms of timing required to achieve the desired energy production goal (such as Oregon's 500 MW by 2025). Built into the plan are indicators or milestones of when a critical point for a particular issue has been reached or needs to be reached, highlighting the key time-critical pathways within the development plan. Additionally, these milestones identify the required actions as well as stakeholder contributions. It does not contain all the answers, for the pace of change demands a constantly-evolving framework of action, undertaken collectively by all involved parties or key stakeholders. Therefore, an OEDP is a living document requiring regular maintenance and oversight to assure its effectiveness as a planning tool.

The following is a high-level conceptual design of an OEDP framework. *NOTE – the framework content is for illustration purposes and is not intended to represent an actual scenario:*

	R&D Experimental 2010 – 2015?	PRE-PRODUCTION Pilot 2016 – 2020?	EARLY PRODUCTION Small Scale 2021 – 2024?	FULL PRODUCTION Commercialization 2025 →
Technology schedule (wave, offshore wind, tide)	1 wind? 4 wave?	4 wind devices 15 wave devices	1 wind arrays 2 wave arrays (200 devices)	
MW Generated (capacity level/targets)	10 MW	50 MW	300 MW	500 MW
Spatial Requirements	2 test areas		Installation at 3 production sites (total = 15 sq. nautical mi.)	
Infrastructure needs & site selection		2 deep-water ports		
Production/Manufacturing Requirements	Design factory complex			Fabricate technologies at 200/year
Licensing & regulatory mechanisms			Combined FERC/MMS license process	
Environmental baseline studies & monitoring plans	Marine mammal, acoustics & bird			
Financial – incentives & support mechanism		National production incentives		
Utility: Grid connect requirements			Substations located adjacent to each port	
OTHER REQUIREMENTS: ▪ Social – public engagement & consultation ▪ Supply chain requirements ▪ Work Force (skills, housing) ▪ Monitoring, maintenance ▪ Transportation ▪ Salvage & decommissioning				

PRODUCTION TARGET



500 MW of ocean energy by 2025

Strong collaborations are needed to build an OEDP. While there may be a single keeper or manager of the plan, effective teamwork with local and state governments, as well as with the ocean energy industry, utilities, academia, key stakeholders and appropriate international interests are essential to populating the matrix. These relationships are also needed to generate buy-in and commitment to plan implementation.

The building process for creating the plan includes the following high-level sequence of events:

- ❑ Location – The specific location is identified and "customer" commitments are secured.
- ❑ Framework – A plan framework is constructed. At this stage, the horizontal and vertical axes of the framework are filled in with appropriate categories for the location the plan intends to serve.
- ❑ Development Plan. The plan 'manager' facilitates direct collaborations with primary OEDP stakeholders for the purpose of gathering, agreeing and populating the matrix with appropriate data. This content begins to define the critical elements as shown in the illustration above. It is also important to note that all renewable energy sectors (e.g. wave, tidal, offshore wind and current) are included in the plan. While each sector has its unique attributes, they are thoroughly interlinked because the end product is the same (e.g. generate & provide electricity) and the operating needs share similarities (e.g. manufacturing facilities, maintenance, transport, engineering, environmental, etc.).
- ❑ Access and Reporting – The first completed iteration of the OEDP is created, vetted and ready for use by its "customers". Concurrently, a variety of reporting mechanisms are designed and ready for implementation.
- ❑ Operation and maintenance - Because the plan is a living document and planning tool, an ongoing system for maintaining data quality and the integrity of the plan is put in place.

IF WE BUILD IT, WILL THEY COME?

As explained in the introduction, ocean energy development heavily depends on long term research and development support. At this level, not only do local and state governments have a major role to play to establish a pathway to commercialization, but they become one of the primary beneficiaries or "customers" of the plan. However, they are not alone. Other potential "customers" or beneficiaries include the utilities, industry trade associations, financial entities, regulators, grant aid bodies and economic development authorities.

An OEDP would also provide important benefits to additional stakeholders, such as the research and academic community, policy forums (e.g. West Coast Governor's Agreement – Renewable Ocean Energy Action Coordination Team), technology developers, project developers, supply chain service providers and more.

The process by which an OEDP is created could lead to important collaborative opportunities such as the following examples:

- OEDP development could facilitate alignment of people and organizations around a common goal.
- Alignment around a common goal could help create a unified industry voice at state and federal levels.

- OEDP development could facilitate 'coopetition'[3], which describes organizations or companies, normally competitive to one another, coming together on initiatives which will lead to overall industry success. In this situation, companies share lessons learned and contribute elements of their individual initiatives to help the renewable ocean energy industry grow.

OCEAN ENERGY AS A SUSTAINABLE ECONOMIC PRIORITY

In closing, prioritizing ocean energy as a sustainable economic opportunity requires evidence. As demonstrated in the economic study of the Oregon wave energy industry, that state has the potential to achieve significant economic benefits if the industry can progress to the commercial stage. Defining a pathway to the commercial and industrial stages is the function of the ocean energy development plan (OEDP).

It is the intent of this paper to persuade its readers to build upon the success and lessons learned in Scotland to implement a similar deployment strategy in the U.S. The detail that an OEDP provides, as well as the process for developing it, could help accelerate development of the renewable ocean energy industry in this country.

[3] Term coined by Chris Campbell, Executive Director, Ocean Renewable Energy Group