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Public funding for ocean energy: A comparison of the UK and U.S.

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ABSTRACT

This paper presents a detailed analysis of the activities in which ocean energy public funding in the UK and the U.S. has been spent. It conducts a direct comparison of funding from the U.S. Department of Energy (DoE) with that from the UK and Scottish Governments. UK investment in the sector has been relatively sustained and has increased since 2002. Almost $295 million has been spent in total, across multiple funding bodies. U.S. spending began with the establishment of the Marine Hydrokinetic division of the DoE Water Power Programme in 2008, which has administered all non-defence federal public funding for the sector. U.S. funding has steadily increased since 2008, with the total funding approaching $92 million.
Approximately 40% of total U.S. spending has been on underpinning R&D activities, compared to 20% in the UK which has had a larger focus on funding full scale test infrastructure and related deployment activities. Whilst the U.S. has seen steadily increasing funding for all activities to support the sector, UK funding for deployment activities, especially test centre infrastructure and demonstration activities, has not been sustained and has had significant peaks and troughs in recent years as funding programmes and initiatives have started and finished.

1. Introduction

Both the UK and the United States (U.S.) have seen significant public spending on ocean energy in recent years and this paper is focussed on analysing how this funding has been targeted. Analysis is presented which answers a number of research questions, illustrating and discussing a direct comparison between the UK and the U.S. and reflecting on the lessons which can be learnt with regard to the future funding of ocean energy:

- How much public funding have the UK and the U.S. spent on ocean energy?
- How has ocean energy public funding in the two countries evolved over time?
- How has the funding in the two countries been targeted at different activities (such as underpinning research, demonstration of technology or test centre activities)?
- How has the funding been spent by different funding bodies in the two countries?

1.1. Overview of the ocean energy sector

Whilst there is considerable uncertainty over the amount of ocean energy resource which exists globally, the International Energy Agency estimates that ocean energy deployments could reach 337 GW installed capacity by 2050 [1]. The magnitude of these figures, combined with other factors such as the predictability and intermittency characteristics of the technologies, is illustrative of the significant global opportunity which ocean energy presents.

In this analysis, ocean energy is defined to include wave, tidal stream, ocean current, ocean thermal (OTEC) and salinity gradient technologies. These technologies extract energy from the kinetic energy of ocean waves and currents, and from gradients in the temperature or salinity of the oceans. Tidal barrage technologies are not included within the scope of the study, as the technology is relatively more mature and the challenges faced are much more akin to those faced by large civil engineering projects. It is important to highlight that a

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number of other terms – such as marine energy or marine hydrokinetic (MHK) – are used to describe ocean energy technologies.

Due to the relatively nascent status of the different technologies, the primary focus of activity and spending in the ocean energy sector is on wave and tidal stream energy technologies. In both of these sectors, design consensus has not yet been achieved and there are multiple design concepts in development. Despite this lack of consensus, concerns over energy sustainability and security, and commitments such as those set out in the EU Renewable Energy Directive [2] have driven investment in renewable energy generation. There continues to be high interest in the development of ocean energy systems. The benefits presented by ocean energy technologies, including increased energy security, emissions reductions and economic benefits such as job creation, have meant that the ocean energy sector has been the subject of significant political and financial support in a number of countries, and the first generation of commercially viable technologies is now close to market [3]. Growing international interest has seen the establishment of initiatives such as the International Energy Agency Ocean Energy Systems Implementing Agreement, and already a number of countries in Europe have introduced technology push and market pull support mechanisms to encourage energy generated by ocean energy technologies [4].

2. Public funding for ocean energy

2.1. Public money

For the purposes of this study, public money was defined as money distributed by a public body which is ultimately funded by the taxpayer of the country in question. In the case of the UK, public money from a variety of sources – including both the UK and devolved Scottish governments, regional development agencies, government departments and public organisations at arm's length from government – was analysed. To maintain a fair and comprehensive comparison, only federal funding from the Department of Energy (DoE) was considered in the U.S., and this was directly compared to UK and Scottish government funding in the UK. Other sources of public money, such as money from state level initiatives and from the Department of Defence in the U.S. and indirect money from the European Commission in the UK, were not included in the analysis in order to maintain a fair comparison.

It is important to highlight that conducting an analysis of the public money spent in the sector does not take account of the significant amount of private funding which has been directed into the ocean energy sector in the period considered. Initiatives such as the UK based Energy Technologies Institute (ETI), as well as individual companies active in the sector are both responsible for targeting private money into the sector. Also, in a number of cases, the public grants analysed (in both the UK and the U.S.) are conditional on the receiver obtaining match funding of a certain percentage of the amount awarded. In addition to this, a significant number of Original Equipment Manufacturers (OEMs) and large utilities have become involved in recent years, and channelled a significant amount of private funding into the sector. However, a comprehensive analysis of the private funding which has been spent in the sector is not attempted in this study which instead focuses on a like for like comparison of the public funding in the U.S. and the UK.

Whilst the focus of this work is on the public funding that has been targeted at the ocean energy sector, it is important to maintain context that this funding is part of a bigger picture along with private sector funding. Renewable UK conducted a survey of nine of the leading technology developers in the ocean energy sector (Pelamis Wave Power, Marine Current Turbines, Aquamarine Power, Atlantis Resource Corporation, Luna Energy, Voith Hydro Wavgen, Voith Hydro OCT, Pulse Tidal and AWS Ocean), to increase understanding of the total amount of private investment which has been seen in the sector. The survey revealed that to these companies, a total of £230 million of private investment has been made, in addition to £42 million of public funding (leverage of more than 1:5 public to private funding) [5].

2.2. Why public funding is necessary for the ocean energy sector

Ocean energy technologies are not currently cost competitive with conventional power generation in terms of cost of energy alone [3] and, despite growing interest in a number of countries, significant barriers to the development of the technologies still remain. Cost reductions are a high priority to make ocean energy technologies competitive with other forms of generation.

The Carbon Trust [6] has estimated that it is possible to bring the levelised cost of energy for wave and tidal stream technologies down from above £0.30/kWh in 2010 to less than £0.10/kWh in 2050. However, this analysis relies on the assumption that significant deployments of both technologies are seen to ensure cost reductions through learning, as well as targeted programmes to ensure accelerated cost reduction through innovation. Both of these assumptions will only be achieved if sustained support for the sector in both market pull mechanisms (to support deployments and cost reductions through learning) and technology push mechanisms (to support cost reductions through innovation) continues to be provided.

In order to facilitate the investment required for the envisaged cost reductions to take place, and to realise the attractive benefits presented by the sector – such as increasing energy security and stimulating job creation and economic development [7] – a long-term strategic approach is necessary. At present the conditions do not exist for this emerging sector to be privately funded; the timescale for achieving a return on these innovation investments is too long to be borne by the private companies in the sector, the uncertainties surrounding this return on investment are too large, and there are considerable uncertainties over the future market size.

Despite the fact that the private return on investment is not sufficient to stimulate the investment required from the private sector, social benefits such as energy security, emissions reductions and economic benefits will result from any investment made. There is therefore a significant opportunity and justified case for governments to utilise public funding, targeted towards the ocean energy sector, that will support cost reductions until the technologies become cost competitive. Once a technology becomes incumbent, it becomes easier to

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