Regulatory Interventions in Support of Marine Energy Deployments in New Zealand

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Abstract

The immense potential marine energy resources of New Zealand have been recognized for many years but development of marine energy projects has lagged behind European and North American developments. Happily the gap is beginning to close for a number of reasons:

1. Increasing energy supply/demand imbalances
2. Increased costs for imported, internationally traded energy products
3. Need to meet greenhouse gas emissions reductions targets
4. Potential incentives for new renewable generation

Nonetheless, it will be some time before marine energy will be commercially competitive with other renewable and fossil fuel forms of generation. It is therefore appropriate and necessary for the New Zealand Government to offer legislative and regulatory support for marine energy projects, not only R&D but also for establishment of demonstration and commercial projects.

In December 2006 the New Zealand Government published a number of draft energy and climate change strategy documents for consultation, a process that closed on 30 March 2007. Implementation of legislation or regulations to give effect to the Government's strategic objectives is anticipated in the second half of 2007.

Proposed initiatives to promote marine energy include a '*marine energy deployment fund*', potential for a revenue support mechanisms, such as a '*feed-in tariff*' and a "*Renewables Obligation*" and priorities for R&D funding. New Zealand will provide an interesting case study for other countries, contemplating how to accelerate and promote uptake of marine energy.

Keywords: New Zealand, Marine Energy, Regulatory Interventions

Introduction

This paper reviews recent New Zealand Government initiatives to address both climate change and energy supply with a particular focus on Government initiatives to promote and accelerate the uptake of marine energy. Until the end of 2006 the Government did not have a coherent energy strategy and showed no particular interest in marine energy, despite its potential to contribute to the future energy supply portfolio and reduce greenhouse gas emissions from electricity generation.

That situation changed with the publication of a number of Government strategy documents and discussion papers on the energy supply system and New Zealand's climate change obligations. The Government has now clearly recognized the potential for marine energy and proposed a number of initiatives to promote and accelerate marine energy uptake.

The paper begins with a review of the current energy environment in New Zealand, focusing on the electricity sector. The recent strategy and discussion papers are then described before a more detailed review of the marine energy-related initiatives. The paper presents the author's views on the initiatives that have been proposed and identifies some weaknesses and gaps, which, hopefully, will be addressed in the final strategy documents and the supporting implementation.

2 New Zealand Energy Environment

Most people's image of New Zealand is the calendar view of fluffy white sheep, roaming emerald green pastures below snow-capped mountains. The truth is somewhat different. If New Zealand's territorial claim succeeds at the United Nations' Commission on the Limits of the Continental Shelf later in 2007, the expansion of New Zealand's Exclusive Economic Zone (EEZ) will make it the fourth largest nation in the world (Figure 1). Further only 6% of this area will be land, 94% will be sea [1] with world-class waves and some tidal-stream potential [2]. Despite its apparently small land area, New Zealand also has a very long coastline – 15,134 km.

New Zealand's marine economy already contributes about 3% (NZ$ 3.3 billion; Euro 1.88 billion) to New Zealand's Gross Domestic Product (year to March 2002 [3]). The sector's growth matches the overall economic growth but it is likely to increase as marine energy projects start to contribute to these figures.

Since 2000 the New Zealand Government has been working on an Oceans Policy, which is a comprehensive policy covering all marine activity. The introduction of the Policy was delayed in 2003 due to territorial claims to offshore and coastal areas by some of New Zealand's indigenous Maori groups. These claims were over-ruled by Government legislation, the Foreshore and Seabed Act 2004, which declared that effectively all of New Zealand's foreshore and seabed was Crown-owned.

All but two of New Zealand's major cities are located on at least one coast and there are a large number of isolated coastal and island communities.

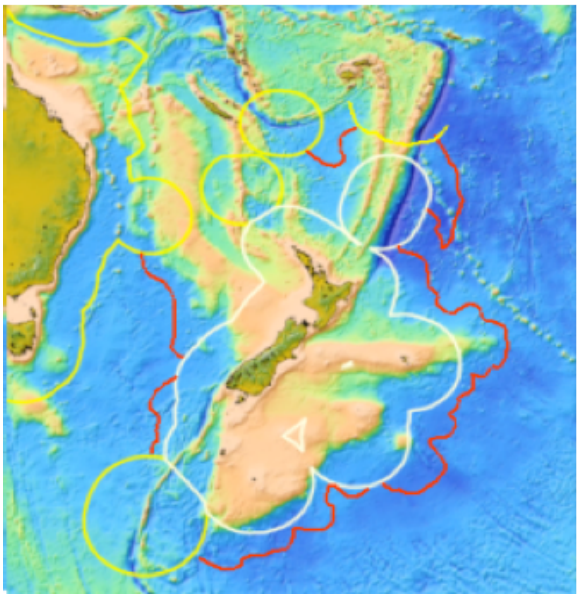

Figure 1: EEZ boundaries; white are current 200 nm boundaries; yellow and red are additional boundaries defined for UNCLCS submission (Source: www.unclosnz.org.nz)

The potential for marine energy to provide power, through the National Grid, local distribution networks or in stand-alone distributed applications, is large, at a time when the nation is suffering the effects of growing dependence on increasingly expensive imported fossil fuels, declining domestic gas reserves and a slow rate of new renewable generation construction. Compounding the uncertainty is the need to reduce greenhouse gas emissions (GHGs) so that New Zealand can make its contribution to addressing global warming and honour its commitments under the Kyoto Protocol.

It is against this threatening background that the New Zealand Government has published a draft Energy Strategy and related climate change documents. The nation has not had a national energy strategy for over 20 years; the present draft is the first to consider the potential for marine energy.

Before describing the proposed regulatory interventions for marine energy in the draft Energy Strategy and related documents, it is appropriate to give some background to the electricity industry into which marine energy project developers will be competing to supply, and a brief review of the marine energy potential of New Zealand.

3 Electricity Industry: Structure

The electricity generation industry was until the late 1990s a wholly Government-owned monopoly. In 1997, the Electricity Corporation was split into four separate companies. Three of these remain State-owned Enterprises, wholly owned by the Crown, whilst the fourth, Contact Energy, was partially and then fully sold to public shareholders. There are also a number of smaller generators but their contribution to electricity supply is small. One or two of the major generators have been early investigators of the marine energy potential of New Zealand.

The National Grid is owned and operated by Transpower, another State-owned Enterprise. There are currently 24 electricity distribution businesses, which are regional monopolies. There are various ownership structures amongst the distribution business, from major traded companies to small trust organizations. Under the Electricity Industry Reform Act of 1998 (EIRA), the electricity distribution businesses were required to separate their lines and retail energy supply businesses. Most elected to retain their lines businesses and sold off their retail businesses, usually to the major generators, now called "*gentailers*". However, amendments to the EIRA have progressively enabled lines businesses to get back into electricity generation, although remaining restrictions have prevented much investment in new generation to date. Nonetheless, lines businesses with coastal distribution networks have shown significant interest in the potential for marine energy.

The Electricity Commission has a national planning role and also regulates the operations of the electricity industry. Commercial aspects of the industry's operation are subject to the rules and regulations of the Commerce Commission.

4 Electricity Industry: Supply

New Zealand's electricity supply has been dominated by renewable generation since the 1950s, particularly hydro generation in the South Island. However, the proportion of hydro generation has been in steady decline because of the absence and difficulty of consenting new major hydro schemes, since the 1980s. In the meantime a sharp rise in gas-fired generation, principally supplied by the Maui gas field, which came on stream in 1979, raised the proportion of electricity generated from gas to 28.3% in 2001 [4]. The decline in reserves and production from the Maui Field has led to a resurgence of the use of coal since 1996: over 1.1 million tonnes was imported in 2005 primarily for use at Huntly Power Station. New Zealand's annual imported fuel bill currently exceeds NZ$ 3 billion (Euro 1.7 billion).

Although there are vast coal reserves and significant potential gas and oil reserves in lightly or unexplored basins around New Zealand, the urgent need to manage and reduce greenhouse gas emissions to meet New Zealand's Kyoto obligations, mean that renewable energy forms are increasingly attractive.

Wind energy has been growing since the first wind farm was established in 1996. There are currently seven wind farms (170 MW), three of which have been under recent expansion (www.windenergy.org.nz). The majority of these wind farms are co-located on the same ridgeline, in the south-central part of the North Island, raising concerns about security of supply and environmental effects. There are also substantial numbers of proposed wind farm projects (~1,670 MW), although there is increasing local public concern about wind farm developments and a number of proposed projects are delayed by resource consent application hearings.

5 New Zealand and Climate Change

New Zealand produces only 0.025% of the world's greenhouse gas emissions but recognized the need to meet its international obligations by ratifying the Kyoto Protocol on 19 December 2002. In 2005 New Zealand's greenhouse gas emissions were 77.16 Mt CO_2eq., 24.7% higher than 1990 levels with 91.9% of these emissions coming from agriculture (48.5%) and energy (43.4%). The energy sector had the largest increase (42%) to 33.48 Mt CO_2eq. with emissions from electricity generation up 134% [5].

The New Zealand Government has therefore set the country on a short-term course to reduce emissions significantly on BAU forecasts and to set total gross emissions on a permanent downward path by 2012. Longer-term targets are yet to be set.

On 8 May 2007 the Government announced that a carbon emissions trading scheme will be operational by mid-2008. The '*cap and trade*' scheme will cover all emissions and apply to all sectors of the economy, including the agricultural sector. The New Zealand Stock Exchange and a number of major companies plan to start a new Asia-Pacific carbon trading platform, called TimeZoneOne (www.tz1market.com), which is likely to begin operating in early 2008. New Zealand's most active trading website, TradeMe (www.trademe.co.nz), also announced that it may establish a carbon trading platform, after a farmer tried to sell carbon credits on the site.

6 Government Funding and Tax Credits for Research and Development

To date New Zealand Government funding for marine energy has been limited to relatively small capital grants (<NZ 0.8 million *per annum;* Euro 0.457 million) to three R&D projects but this figure is expected to rise. The Government published draft investment guidelines in April 2007, which indicate that it will devote NZ$ 9 million (Euro 5.14 million) *per annum* over the next 6 years to Optimizing Physical Resource Use, including projects to develop marine energy devices and improve resource understanding [6]. The majority of Government funding on R&D is distributed to Crown Research Institutes. Government also fund some technology commercialization.

In its May 2007 Budget the current Government announced a new tax credit scheme for expenditure on research and development (R&D). Qualifying expenditure will include R&D conducted in New Zealand to acquire new knowledge or create new or improved materials, products, devices, processes and services. Some overseas expenditure may be recoverable. The regime is a '*cash back*' scheme, which means that loss-making and exempt taxpayers will receive cash in hand.

The scheme is due to start in the 2009 income year and will be included in the annual tax return. Thus R&D expenditure incurred from 1 January 2008 may be qualify, depending on a company's balance date.

This new scheme is welcome, as it brings the NZ tax regime into competitive alignment with other jurisdictions, notably Australia, the United Kingdom and Canada. New Zealand-based projects, and their overseas investors, will benefit, although primarily for expenditure in New Zealand. The scheme is thus likely to stimulate investment in R&D here, including for marine energy projects.

7 Marine Energy Potential

Since New Zealand's electricity system is isolated, the management of intermittent renewables is problematic. A recent study by the Electricity Commission suggested that the maximum capacity of the National Grid to accept wind energy projects was approximately 2,000 MW. No attempt has been made to integrate the less variable but still intermittent supply that could be expected from marine energy generation projects. Nor has there been any formal assessment of the national potential for marine energy to contribute to electricity supply. The National Institute of Water and Atmospheric Research (NIWA; www.niwa.cri.nz) has undertaken hindcast studies of the wave and tidal resources but these have not extended to a calculation of the potential contribution to electricity generation from wave and tidal energy. Indeed, physical measurements of the waves and tides are very limited and usually short-term. Further the national work does not easily translate to site-specific scales and so realistic estimates of the resource, let alone the technically recoverable or economically recoverable reserves of marine energy, are lacking. The Aotearoa Wave and Tidal Energy Association (AWATEA; www.awatea.org.nz) has suggested that marine energy might eventually contribute as much as wind energy, *i.e.,* 2,000 MW, although this figure is based on supposition, until site-specific physical measurements are undertaken nationally.

The Energy Efficiency and Conservation Authority (EECA; www.eeca.govt.nz) commissioned nine regional studies of renewable energy resource assessments, including wave and tidal energy resources, in 2006. NIWA and other Crown Research Institutes have recently received NZ$ 1.3 million (Euro 0.74 million) to undertake a stock-take of the potential renewable energy resources around New Zealand. A study of marine energy potential will be included in this study.

The Government's official assessments of future energy requirements were published in August 2006 in the "*Energy Outlook to 2030*" [7]. This presented a number of future energy scenarios. Not all contained forecasts of marine energy contributions but one that did indicates that marine energy might contribute 1% of primary energy by 2030, *i.e.,* 1,850 GWh *per annum*, as compared to 5% for wind energy (9,200 GWh *per annum*).

The potential for marine energy projects has been recognized and the author is aware of at least 21 active projects, though this is almost certainly an under-estimate. The projects are split evenly between wave and tidal-stream projects and again split evenly between device developments or importations. Of the 6 projects that have been made public, only one, a tidal-stream proposal by CREST Energy, has advanced as far as applications for resource consents. Public hearings on those applications are likely to be held towards the end of 2007. However, it is difficult to forecast the outcome of these hearings and development timetable.

8 Recent Energy and Climate Change Strategy and Related Documents

Although New Zealand has a Minister of Energy, there is no Ministry of Energy; the Ministry of Economic Development manages the energy sector on behalf of the Government. As noted above there have been significant changes in the energy supply portfolio since 2000 and serious concerns have emerged about future energy supply and, in particular, the increasing dependence on fossil fuel-fired electricity generation. Although the Government had published "*Framework for Sustainable Energy*" in 2004 [8], it was not until 2006 that the Government announced its intention to establish an Energy Strategy.

Concurrently, New Zealand has, like most nations, been considering its response to climate change and the need to reduce greenhouse gas emissions. New Zealand ratified the Kyoto Protocol in December 2002, having calculated that the country's emissions profile confirmed that the country was in surplus. However, more recent calculations have demonstrated that New Zealand is actually in deficit by roughly the same amount (NZ$ 656 million; Euro 374 million). New Zealand's active response to climate change is thus critically important. Although approximately 50% of New Zealand's emissions come from agricultural ruminant emissions, the energy and transport sectors contribute 9.6% and 19.2%, respectively. There is thus pressure on the energy industry to respond.

The private sector responded to the increased Government interest in the energy sector and climate change. Various groups published discussion documents, notably the New Zealand Business Council for Sustainable Development and the Royal Society of New Zealand, to which the present author contributed [9-10]. These documents offered a range of scenarios for future energy supply in New Zealand, in the context of managing and limiting national greenhouse gas emissions. Perhaps the only consensus amongst them was the need and urgency to address both issues.

In December 2006 various Government departments published a series of draft strategies, discussion documents and related papers on both energy and climate change. These papers include:

1. Draft New Zealand Energy Strategy [11]
2. Draft New Zealand Energy Efficiency and Conservation Strategy [12]
3. Transitional Measures Discussion Paper [13]
4. Measures to Reduce Greenhouse Gas Emissions in New Zealand post-2012 [14]
5. Energy Research Roadmap [15]

These documents represent a comprehensive, if not completely coherent, view of the future for the energy sector to 2050 and of New Zealand's efforts to reduce its greenhouse gas emissions. The principal features of each are described with a focus on marine energy.

All of these documents were published concurrently as drafts for consultation. The consultation period was brief and closed on 30 March 2007. Nonetheless over 300 submissions were received on each of the documents.

9 Draft New Zealand Energy Strategy

The draft New Zealand Energy Strategy (NZES) was published on 11 December 2006. It comprises two sections: the first covers the Government's vision for the energy sector to 2050, whilst the second covers the actions that the Government proposes to achieve its vision. The strategy notes that electricity generation and transport fuels dominate energy use, whilst energy prices are low by international comparison. These low prices have been a source of international competitive advantage but they have also been a brake on investment in energy infrastructure, particularly new technologies. The strategy recognizes that with sustained increases in oil price and decline in domestic gas reserves, energy prices are rising inexorably. The security and stasis of the last 25 years has come to an end.

The proposed actions in the NZES relate to six principal areas: resilient, low carbon transport, security of electricity supply, low emissions power and heat, energy efficiency, sustainable technologies and innovation and affordability and well-being. The NZES models the contributions to emissions reductions from the energy and electricity sectors and recognizes the potential contribution of new hydro, geothermal, wind and marine energy generation, although it does not identify the potential proportionate contribution from marine energy. One of the scenarios described in the Strategy indicates that marine energy might contribute 1% of primary energy by 2030, *i.e.,* 1,850 GWh *per annum*, as compared to 5% for wind energy (9,200 GWh *per annum*) by that time.

The NZES recognizes that New Zealand's R&D and innovation capabilities have a significant role in development new energy-efficient, low emissions technologies, which may enhance energy security of supply and reduce GHG emissions. Four actions are proposed:

1. Establishing public/private sector working groups to provide leadership in priority innovation areas, including marine energy.
2. Strengthen capabilities, collaboration and networks around key sustainable energy themes, including renewable Energy
3. Enhance energy innovation through R&D tax credits and other measures
4. Establish a contestable fund to support the deployment of marine-based electricity generation.

Clearly all four of these actions have the potential to enhance and accelerate the uptake of marine energy in New Zealand. The contestable fund, here called the Marine Energy Deployment Fund (MEDF), is the most direct, but the Government needs to ensure a cross-sectoral approach to ensure that marine energy is taken up successfully. Lack of investment in R&D, lack of alignment between the public and private sectors could lead to New Zealand effectively becoming a '*technology-taker*', rather than an innovator in marine energy. The potential of marine energy to contribute to the '*decarbonization*' of the energy supply sector is clearly recognized.

The NZES was published on 11 December 2006 and drew 332 submissions to the Ministry of Economic Development (www.med.govt.nz).

10 Draft New Zealand Energy Efficiency and Conservation Strategy

New Zealand has had a National Energy Efficiency and Conservation Strategy (NEECS) since September 2001. The same Act that established the NEECS also established the Energy Efficiency and Conservation Authority (EECA), a Crown Entity, which has a promotional and partly regulatory role in energy efficiency and conservation. The NEECS was statutorily reviewed in 2006, as required under the establishing Act, but the implementation of the review was deferred to enable the revised draft strategy, now called the draft New Zealand Energy Efficiency and Conservation Strategy (NZEECS) to be aligned with the draft NZES.

The draft NZEECS supports and complements the draft NZES and embodies five principles for the future:

1. Maintaining security of energy services
2. Investment in energy efficiency that is cheaper than the long-term cost of extra supply capacity
3. New electricity generation should be renewable, except as necessary to maintain security of supply
4. Where fossil fuels are utilized, lowest carbon fuels will be given priority
5. New forms of renewables that can become competitive with fossil fuels in the next ten years will be supported

The draft NZEECS recognizes New Zealand's competitive advantage as a small country with an existing focus on renewable generation: "*As a small place, we can quickly exploit new technologies, such as marine energy technologies, and move much faster than those countries that rely heavily on coal and nuclear power*". The draft NZEECS proposed actions in eight areas, including increasing the contributions of electricity and heat from renewable energy sources. This includes a specific action to fast track marine energy technology in 2007 and 2008, which involves "facilitating early deployment of wave and tidal technologies to achieve the first large-scale commercial deployment by 2015". This explicit objective is not described in the draft NZES but the document goes on to suggest that this objective will be achieved by "*developing a marine energy 'atlas' and/or supporting marine energy demonstration projects through a contestable fund*". The draft NZEECS does not clarify whether this contestable fund for demonstration projects is the Marine Energy Deployment Fund. Hopefully, the final documents will confirm that separate contestable funds for demonstration projects and deployments will be available. These objectives are then carried through into the post-2012 period.

The draft NZEECS was published on 11 December 2006 at the same time as the NZES and related climate change documents. The NZEECS drew about three hundred submissions from industry and the public, which are available on the EECA website (www.eeca.govt.nz). The final version of the NZEECS is due to be published and implemented in the second half of 2007.

11 Energy Research Roadmap

The Ministry of Research, Science and Technology (MoRST; www.morst.govt.nz) published the Energy Research Roadmap in November 2006, nearly a month before the other draft documents. Unlike them, the Energy Research Roadmap is not a draft, although many of the initiatives it contains clearly carry through to the draft documents. The Roadmap focuses on the New Zealand's requirements for core energy research, science and technology capabilities. These include:

1. Increasing renewable resource assessments, including marine energy
2. Oil and gas information processes and geological aspects of carbon capture and storage
3. Smart integrated grids for distributed and variable (intermittent) energy sources
4. Economics and system modelling
5. Accelerating the uptake of energy efficient technology and behavioural change in energy use.

The Roadmap records that Government currently supports three marine energy R&D projects but the total financial contribution is only NZ$ 727,000 *per annum* (Euro 415,000) whilst noting that marine energy R&D in New Zealand has "*almost no critical mass, a problem that seems unrelated to the maturity*" of the marine energy sector. The Roadmap then gives details of the project, which Government funding has principally supported, the Wave Energy Technology – New Zealand (WET-NZ) R&D programme. This consortium research project, of which Power Projects Limited is a member, has developed and is testing an experimental point-absorber wave device (www.wavenergy.co.nz).

The Roadmap identifies indigenous energy resources and capabilities to research these resources as critical to New Zealand's future. The Roadmap proposes that marine energy technologies will be largely adapted from overseas, although there is no justification for this conclusion. It proposes that R&D for marine energy technologies should be based upon a '*fast adapter*' strategy, adopting a similar strategy for smart integrated grids for distributed, intermittent energy sources, such as marine energy. This '*fast adapter*' is controversial and not supported by all, including the author, on the premise that New Zealand needs a lively domestic marine energy industry (from R&D to operations), regardless of the provenance of the technologies. Since technologies are immature both internationally and domestically, New Zealand can afford a broader approach. The '*fast adapter*' strategy risks disadvantaging domestic device developments, not least the WET-NZ programme, which is the current recipient of Government funding.

In summary the Energy Research Roadmap appears slightly out of step with the later documents, although officials at MoRST have confirmed that the intention is that Roadmap will reflect the outcomes of the overarching NZES and NZEECS.

12 Climate Change documents

The Government also published two discussion documents to accompany the draft energy strategy documents, which addressed proposals for measures to reduce GHG emissions. The first document, entitled "*Transitional Measures*" addresses measures to address emissions reductions in the energy sector in the short-term (*i.e.,* from 2007 – 2012). These measures will lead a transition to a longer-term (post-2012) series of measures to continue these reductions. The long-term measures are described in the second document, entitled "*Discussion Paper on Measures to Reduce Greenhouse Gas Emissions in New Zealand post-2012*".

The first document describes seven policy measures to reduce emissions:

1. Emissions trading
2. CO_2 charge
3. Renewables obligations
4. Incentives/subsidies
5. Project-based measures
6. Direct regulatory options
7. Voluntary measures

It is likely that the Government will adopt some of these measures but which remains unclear at present. A limited carbon tax has been proposed. Emissions' trading is likely to begin in 2008 without intervention by Government, since a number of carbon trading platforms have been proposed (Section 6). The Government has previously used a projects-based measure, called the "Projects to Reduce Emissions" (PRE) mechanism to distribute tradable emissions reductions units (ERUs) for marginally economic energy projects, which would reduce emissions. A number of wind farms, small hydro and landfill gas projects were commissioned as a results of receiving ERUs, although few have yet traded the ERUs they were awarded. A third round of awards under the PRE mechanism was expected in 2006 but was halted when New Zealand's emissions deficit was realized. Renewables obligations have not been utilized in New Zealand before but they are under active consideration (see Section 11).

The longer-term discussion document considers similar measures for the future, including emissions trading, GHG charges, emissions reductions agreements and other regulatory approaches. Whilst the long-term future of marine energy in New Zealand will be affected by the selection of long-term measures, there are no specific initiatives for marine energy.

The Government has already announced one specific short-term incentive/subsidy measure, called the Marine Energy Deployment Fund. A Renewables Obligation, if implemented, will also promote marine energy as well as other renewables. A specific recognition of the need for Government support for the full range of activities from R&D, through demonstration and deployment projects, will also be important to build a viable marine energy industry, not only supplying a significant proportion of New Zealand's future energy needs but also exporting technologies and capabilities internationally. The remainder of this paper discusses these themes.

13 Marine Energy Deployment Fund

The single most important initiative in the NZES for marine energy is the Marine Energy Deployment Fund (MEDF). The contestable fund will "*bring forward the deployment of marine power in New Zealand*". Further priority will be given to "*small-scale deployment near islands and coastal communities, which currently rely on expensive, diesel-fuelled electricity generation*". Although not mentioned in the draft NZES, supporting documents indicate that the fund will be worth NZ$ 8 million (Euro 4.57 million) over four years to "*support early deployment of marine-based electricity generation such as wave and tidal*". The criteria and arrangements for the contestable fund were still under development at the time of writing. Indeed, until the final version of the NZES is published in the second half of 2007, it is not clear when the MEDF will operate. The Government has sought submissions on the draft NZES and the high profile of the MEDF has not escaped the notice of enthusiasts of other alternatives. A brief review of some of the submissions on the draft NZES, NZEECS and related climate change documents, indicates that some parties think that the funding for the MEDF is ill directed. However, it seems likely that the MEDF will survive and be implemented in the final version of the Strategy.

14 Marine Energy Feed-in Tariffs

Feed-in tariffs are widely used internationally to promote uptake a number of energy technologies. Feed-in tariffs are attractive measures from governments' point of view as they are performance-based measures, *i.e.,* project developers are rewarded for electricity production. A recent study conduced for the International Energy Agency's Ocean Energy Systems Implementing Agreement (IEA:OES-IA) shows that the United Kingdom, Portugal and Germany have introduced feed-in tariffs for marine energy [16]. The best example is in Portugal, where project developers will receive Euro 230/MWh for the first 100 MW of marine energy generation capacity. The tariff has been very successful in attracting deployment projects to Portuguese waters. Scottish, Dutch and United States-developed devices will have their first deployments in Portugal, rather than their home countries, which is attributable to the existence of the feed-in tariff. Spain has a similar feed-in tariff and has been successful in attracting deployment projects to its waters too.

A similar feed-in tariff may be both a necessary and appropriate form of incentive mechanism for New Zealand, as a complement to the MEDF and as a way of attracting overseas device developers and foreign investment. The "*Transitional Measures"* document recognises the potential and need for a feed-in tariff: "*a similar approach could be taken in New Zealand with, for example, marine energy*". Any consideration of a feed-in tariff will need to weigh up the benefits of bringing forward marine energy projects against the additional cost to taxpayers or electricity consumers to make up the difference.

AWATEA advocates a feed-in tariff for marine generation projects. However, it is not advocating an open-

ended feed-in tariff, but one that is sensibly bounded by size, duration and quantum, *e.g.,* NZ$150/MWh for 10 MW or 40 GWh *per annum* for ten years [17].

15 ME Renewables Obligations

Renewables Obligations (ROs) are revenue support mechanisms, which require electricity generators to acquire their production from a certain percentage of renewable energy sources or, alternatively, pay a penalty. Generators are awarded Renewable Obligation Certificates (ROCs), which are tradable. ROs are specified either as generation output (in Mwh) or as capacity obligations (in MW).

The "*Transitional Measures*" discussion paper notes that the UK Renewables Obligation (an output-based scheme) was unbanded, *i.e.,* there is only one price for a ROC. As a result of which energy suppliers had an incentive to buy the cheapest renewable energy, such as wind or landfill gas generation. Less mature, more expensive technologies, such as marine energy have not been developed.

However, it is notable that, since the documents here were published, the British Government has reviewed the Renewables Obligation. The recent Energy Review indicates that it may introduce a banded RO, from 2009, to provide incentives for specific technologies, including marine energy.

Separately, the Scottish Executive published proposals in September 2006 to amend the Renewables Obligation (Scotland), so as to provide greater support for wave and tidal-stream technologies. A separate Marine Supplier Obligation was introduced in April 2007. Rather than banding the Obligation, the MSO requires generators to acquire a certain proportion of their generation from marine renewables.

The New Zealand Government has not announced its intentions with respect to ROs but their development in England and Scotland provide useful test cases and experience, on which to base New Zealand's future legislation. It would be fair to record that the major generators in New Zealand do not welcome the imposition of any obligation.

16 Discussion

This paper has presented the key energy strategy and climate change documents published by the New Zealand Government. The strategies and programmes of action are likely to be enacted and implemented before the end of 2007. The documents recognize the huge potential for marine energy in New Zealand and propose some specific measures to encourage the uptake of marine energy projects. Whether these measures are implemented will be revealed in the second half of 2007. How their implementation will be affected by the outcome of the next General Election (by July 2008) is an open question.

A '*whole-of-industry*' approach is required to promote the development of a marine energy industry in New Zealand. In other words the Government should implement measures and incentives for the whole range of activities from R&D, demonstration, pre-commercial deployments and supported and fully commercial operations. To date, Government support for marine energy has been in R&D capital grants but the size of these grants is now too small to promote an active and growing R&D sector. Increases in funding and the introduction of an R&D tax credit scheme will promote marine energy R&D. The announcement of the MEDF and the possible introduction of a feed-in tariff and/or a Renewables Obligation are very welcome and will effectively promote commercial deployments. However, there is currently a lack of funding and support in the published documents for demonstration and pre-commercial projects (Figure 2). This funding gap has been described as the "*valley of death*" and identified as problematic in other countries [18]. A related problem is that domestic R&D projects will find it difficult to move through these phases to commercial development, where they will have to compete with overseas technologies. A lack of funding and support will limit New Zealand to becoming a '*technology taker*', unable to develop the major export opportunity that marine energy technologies currently offer.

Other initiatives have potential to promote an export marine energy industry in New Zealand. Three initiatives, which have been proposed, are:

1. Establishment of an Aotearoa Marine Energy Centre (AMEC) in New Zealand waters, similar to the European marine energy centres. Such centres are proving successful in stimulating deployments and testing of marine energy devices through to commercial development and are contributing to the development of testing and certification protocols for marine energy devices. The author is working, with others, on a project to develop AMEC.
2. Development of a dedicated marine energy strategy for New Zealand. Such strategies have been developed for the United Kingdom, Scotland, Portugal [19] and, most recently, Canada [20], though usually by marine energy industry associations rather than Governments. AWATEA is seeking Government support to develop a dedicated marine energy strategy, once the NZES and related initiatives are operational.
3. A space and resource allocation regime, similar to that established for oil and gas exploration and production to replace the '*first-come, first-served*' Resource Management Act process.

There are oceans of opportunities for marine energy in New Zealand. The Government need an array of initiatives, including both capital and revenue grants and supportive regulations, to promote both '*technology push*' and '*market pull*', using a '*whole-of-industry*' approach, to encourage private investment. The development of a marine energy industry in New Zealand will contribute to diversification of the country's energy supply portfolio, bolster its security of supply and enhance the balance of payment by reducing reliance on fossil fuels, as well as potentially creating an active export industry.

In the 1880s New Zealand's early wealth was established on the "*back of the sheep*" and its 20th Century was underpinned by agriculture and hydro-electricity. In the 21st Century its future wealth lies in harnessing its enormous marine resources and capabilities.

Acknowledgements

The author would like to thank colleagues on the Executive of the Aotearoa Wave and Tidal Energy Association (AWATEA) and those in various Government departments and agencies for their enthusiasm and commitment to the promotion of marine energy in New Zealand. The improvements in the present paper to the original manuscript are due to the anonymous reviewer; the errors remain those of the author.

Note on Units

New Zealand dollars are converted to Euros at the rate of NZ$ 1.00: 0.5708 Euro.

Greenhouse gas emissions are expressed in units of Mt CO_2eq., which is 1 megatonne of Carbon dioxide equivalent

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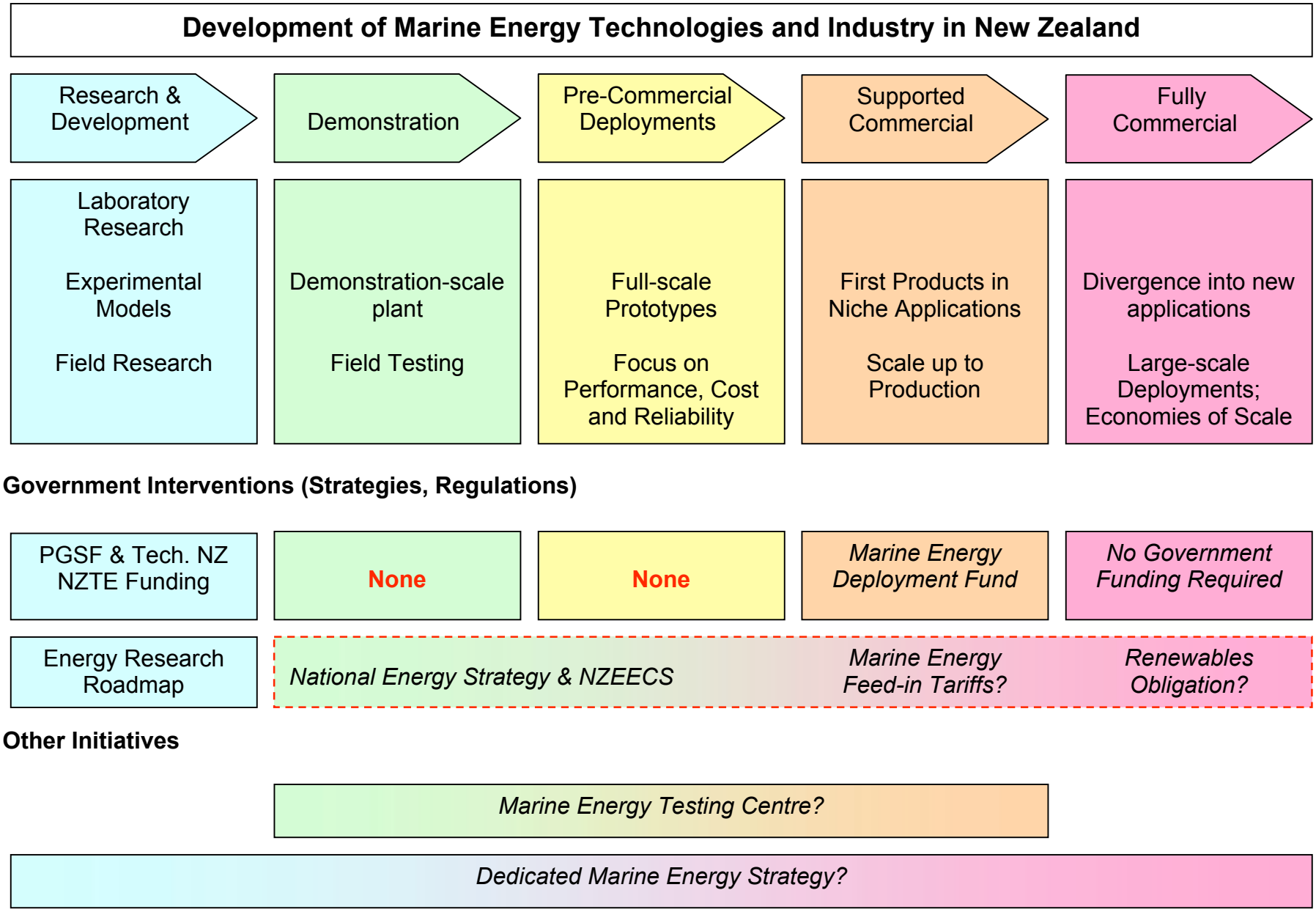

Figure 2: Development of Marine Energy Technologies and Industry in New Zealand (modified after [16] and [18])