

# **A Report on Possible Government Interventions to Promote the Sustainable Development of New Zealand's Ocean Resources**

Report to Ministry for the Environment, PO Box 10362, WELLINGTON

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This report presents the views of CAE and selected representatives of marine industries. The recommendations have been generated independent of government to stimulate future discussion around marine economic opportunities. Some recommendations in the report relate specifically to identified barriers and opportunities facing certain marine industries.

CAE acknowledges that other recommendations in the report involving direct financial support, such as subsidies or tax reduction, would be welcomed by any industry. We comment that a strong case, such as demonstrated market failure, would need to be made before the government would consider their application to particular marine industries.

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## EXECUTIVE SUMMARY

Development of Oceans Policy to date has established that a substantial number of opportunities exist for possible commercial development. This includes expansion of existing industries and the development of whole new sectors of the New Zealand economy. The Centre for Advanced Engineering (CAE) has contributed to that recognition, in particular through its 'Our Oceans' Conference in 1999<sup>1</sup> and subsequent programmes of work directed at gaining better recognition of the economic importance to New Zealand of its Exclusive Economic Zone (EEZ) and continental shelf extensions.

In advancing the development of an Oceans Policy, the Ministry for the Environment has identified a desire to better understand the factors that lead to or impede commercial development, especially of new sectors. The Ministry commissioned this investigation of the subject, with a view to inform the design of suitable interventions that could catalyse such sustainable development. Our basis is that Oceans Policy is intended to promote the sustainable economic development of marine resources, whilst preserving the integrity of oceans ecosystems and social and cultural values of the oceans.

To gain a practical understanding of the issues, barriers and opportunities facing development of economic activities in the ocean this investigation considered only a selection of cases. All case studies pertain to the energy sector; they represent a temporal spectrum from historic (the discovery and development of the Maui gas and oil field) through contemporary (current oil and gas exploration and development) and near-term (wave and tidal electricity generation) to far-term (gas hydrate mining and conversion). These case studies, in turn, spanned the full range of anticipated activities from fully commercial to future-focussed potential activity.

At various times in our history, the shape of the New Zealand economy has been impacted by bold government interventions at key junctures, for better or worse. One such instance was part of an aggressive response to the energy crises of the 1970s, which happened to coincide broadly with the discovery in 1969, and subsequent appraisal of, the giant Maui gas and oil field ('Maui') off the Taranaki coast by the Shell-BP-Todd consortium. The exploration campaign that resulted in Maui was itself a response to two precursor conditions: the progressive international development and deployment of marine exploration and development technologies; and the passage of the Continental Shelf Act 1964 that provided for the application of the Petroleum Act 1937 beyond the narrow territorial sea and out to 200 nautical miles from shore (the Exclusive Economic Zone).

While these 'settings' were sufficient to enable development of the resource that has done much to fuel New Zealand's economic activity over the past quarter century, during the early 1970 the business case for the field's development was marginal at best without the bold, direct involvement of the New Zealand government. The intervention took the form of a direct (50%) equity interest in the joint venture, in consideration for guaranteed project revenues through a take-or-pay contract. This commitment by government, in turn provided the impetus for development of the vast majority of the infrastructure needed for consumption: power stations, the pipeline grid and associated networks, and a petrochemical industry. Initially much of this was in public hands but eventually these enterprises were all corporatised and mainly privatised. Collectively they have accounted, both directly and indirectly, for a substantial proportion of national economic product over the intervening period; with particular regional importance in Taranaki.

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<sup>1</sup> Centre for Advanced Engineering (2001). *Our oceans: A journey of understanding*. CAE Comments Series 1.

As a consequence, offshore oil and gas exploration since Maui was brought on-stream in 1979 has not required government involvement; the former state oil company (Petrocorp) was privatised in 1987. A number of commercial discoveries have been made offshore Taranaki, and some sub-commercial discoveries in offshore South Island basins. In recent years it has become evident that the rate of discovery and delineation of gas reserves in New Zealand has not kept pace with production. With the pending depletion of the Maui field squeezing the reliability of future thermal fuel requirements for the national power system, government has decided to make some relatively modest interventions to stimulate exploration.

The exploration sector remains at a critical juncture as rapid escalation in global oil and gas prices have impacted on activity levels and put pressure on the availability of core capability such as seismic vessels and drilling rigs. Policy settings are under constant review to ensure as far as possible that New Zealand's undiscovered conventional petroleum resources yield the desired discoveries to sustain, and if possible extend fuel stocks and their contribution to our energy system.

Global oil and gas prices have reset the economics of energy technologies, and climate change policies have tended to promote renewable electricity generation in particular. Hence, marine renewable energy sources have begun to move closer to commercial viability. New Zealand has substantial potential opportunities for both wave and tidal power generation; currently up to 12 projects are under investigation. These all draw on the implementation of technology that has been developed overseas and adapted for specific New Zealand sites. In some respects this is analogous to most of the considerable wind power development New Zealand has seen in the past few years.

Setting aside the considerable technical risk factors that dominate investment in this industry, our investigation has found that proponents of wave and tidal projects enjoy a high level of 'moral support' from government policy including access to research and development (R&D) funding. Yet they see themselves as being quite seriously impeded by issues generally lumped together as related to the Resource Management Act. Perhaps, more accurately, this reflects insufficient clarity as to property rights and market dynamics. However, under current settings it is near impossible for a project sponsor to constrain the expense and delays that may be attendant on an initiative, to secure the right to install a marine power station and offer its production into the electricity market.

The wave and tidal energy case illustrates the very best and the very worst of entrepreneurial or pioneer development. Technical risks are generally high and the often nebulous policy support for renewable energy (for example) is not sufficient to facilitate consequent development. Support to these types of activities must be supplemented by detailed attention to uncertainties in the business cases, which are related to completion and to revenue risk during early-stage development.

Another potential energy source is gas hydrate. Yet to be proven viable, research has shown it to be an important aspect of New Zealand's marine realm. The most optimistic timeline for commercial exploitation of gas hydrate is: at least one decade away. Current research, at a modest but material level, is improving the inventory and characterisation of the resources offshore New Zealand. But there appears to be a complete gap in research addressing the technology for sustainable exploitation of the resource, for which New Zealand is generally considered likely to be dependent on overseas innovation. There is no sign of commercial interest in gas hydrate commercialisation, and while such development would appear to be governed by the Crown Minerals Act 1991, it is not certain that this statute will indeed provide the optimal development regime. Also, investment will be discouraged by the very high risk levels in the absence of any fiscal incentives.

In summary, these three cases demonstrate that to be effective, interventions will have to be carefully tailored to meet the particular impediments or circumstance that face the various

opportunities for commercial development in the ocean. Extending this finding to ocean development as a whole suggests two key points:

***Technological innovation*** is essential, but a small economy can only expect to maintain a cutting-edge position in very few fields. Otherwise, the contribution of resources such as gas hydrate will have to await the availability of technology from overseas sources, just like the discovery of the Maui Field followed international technological advances in the 1960s.

**An effective statutory and regulatory framework** is essential for new sectors to develop in a desirable and orderly fashion. While resources such as petroleum and fish are governed by specific regimes, it is not apparent that these regimes can be extended universally into other marine-based industries. In the absence of such a framework, history tells us that the Resource Management Act proved an insufficient and unsatisfactory de facto regulatory framework for aquaculture, resulting in a moratorium that curtailed the realisation of the industry's growth potential. With the emergent marine energy sector, reliance on current planning and consenting frameworks appears to be similarly compromising renewable energy initiatives.

Finally, where opportunities and technology exist, investment may still not be forthcoming when major risk factors cannot be offset. In such cases government may consider specific interventions even though these may distort market functionality. The interventions in the energy sector during the 1970s, while imperfect, have nevertheless delivered a key point of competitiveness to the New Zealand economy that would be desirable to sustain. Recent modest initiatives to facilitate gas exploration go some way, and other instruments should be considered: both to extend existing marine industries, and to catalyse the development of others such as wave and tidal power and eventually gas hydrate, if proven technologically viable.

## DEFINITIONS

**Commercial Development**

Establishment of a new economic activity as a consequence of a viable business case.

**Economic Development**

Aggregate of commercial developments in a sector, region or the nation.

**Frontier Territories**

Oceans are Frontier Territories, where sovereignty has been established but only limited commercial and economic development has occurred and substantial untapped opportunities are perceived.



# 1 INTRODUCTION

## 1.1 Background

The Ministry for the Environment (MFE) is leading the whole-of-government development of an Oceans Policy that will enable the integrated and consistent management of the Ocean Territory within New Zealand's jurisdiction.

New Zealand's Ocean Territory encompasses close to 6 million square kilometres (or 15 times its terrestrial landmass), representing approximately 1% of the Earth's surface. However, only a very small part of it has been surveyed to date. Early indications suggest vast and potentially valuable resource opportunities, including:

- hydrocarbon deposits worth approximately NZ\$100 billion and Manganese deposits worth approximately NZ\$200 billion<sup>1</sup>
- phosphoric deposits (for use in agriculture) on the Chatham Rise worth approximately NZ\$10 billion<sup>2</sup>
- the largest methane hydrate deposits in the South Pacific.<sup>3</sup>

However, New Zealand's ability to realise the economic potential of these resources is limited by a number of factors. These include:

- the 'frontier' nature of the proposed activities and consequently high investment requirements
- access to and availability of cost effective 'enabling' technology
- appropriate legislative, regulatory and policy frameworks
- access to markets and margins that would justify commercial development.

MFE has sought to gain a better understanding of these factors by commissioning an investigation into barriers to the commercial development of three new economic opportunity cases. The aim is to ensure that the new national Oceans Policy framework will have the ability to support the sustainable development of such opportunities.

## 1.2 Purpose and Scope of Consultancy

The purpose of the project was for Centre for Advanced Engineering (CAE), by consulting with a range of marine sector representatives, to bring a business-focussed perspective of the

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<sup>1</sup> Dominion Post newspaper, Wellington 13 October 1999, p 11.

<sup>2</sup> Centre for Advanced Engineering (1996). *New & Emerging Renewable Energy Opportunities in New Zealand* and (2003). *Economic Opportunities in New Zealand's Oceans*. Report to the Oceans Policy Secretariat, Ministry for the Environment, p 6.

<sup>3</sup> CAE (2003) *Economic Opportunities in New Zealand's Oceans*, p 5.

potential barriers to the commercial development of maritime opportunities; and to provide practical examples of corresponding strategies or interventions to overcome them.

The scope of the project was limited to consultation interviews with approximately 15 respondents to highlight and illustrate through case studies, the key ingredients for development of commercial activities. It addresses three new specific maritime opportunity cases at different stages of commercial maturity. Consequently, this report is not intended as an exhaustive solution to the challenges of formulating appropriate policies for each of the resource opportunities highlighted, nor does it provide conclusions that are applicable across the entire marine sector. Instead it attempts to offer an assessment of the range of interventions that can assist with development of commercial activities.

# 2 APPROACH

## 2.1 Case Studies

The Centre for Advanced Engineering’s previous work on Oceans Policy (2003) has identified a substantial number of areas with potential for commercial development. These are in addition to sectors that already contribute economic activity and have varying degrees of growth potential. The scope of the present project is limited to three case studies and one existing sector as a basis for comparison. The Maui gas and oil field (‘Maui’ for short) provides the established case; three further cases are concerned with energy resources that lie on a spectrum from active, through advanced pre-commercial, to long-term commercial but research-dependent.

## 2.2 Consultation

Consultation with industry was undertaken in three phases:

- a. phase 1 consisted of wide-ranging unstructured interviews with five general sector representatives who have policy, regulation, scientific and commercial roles in the maritime space
- b. phase 2 consisted of in-depth structured interviews with a minimum of three respondents for each specific resource opportunity (9 respondents total)
- c. phase 3 consisted of a 2-day Workshop, involving MFE, the Ministry of Economic Development (MED), the CAE project team and the earlier respondents, to review and validate the issues raised in the consultation process.

Table 1: Case Studies

| CASE STUDY                         | RESOURCE OPPORTUNITY  | RELEVANCE   |
|------------------------------------|---|---|
| Success Story                      | The Discovery, Development and Production of the Maui Gas and Oil Field | When enabling technology became available, a governance framework already existed for a major discovery to be made. However, considerable intervention was necessary for its development. |
| Current Opportunity                | Oil and Gas Exploration   | Considerable private sector investment in response to perceived opportunities, are governance arrangements optimal to give best chance of restoring inventory and sustaining supply?      |
| Emergent / Undeveloped Opportunity | Wave & Tidal Energy   | Emerging technology being tested but as yet no viable business case identified; governance and/or economic interventions may catalyse development.  |
| Future Opportunity                 | Methane Hydrates  | Very large resource opportunity awaits technology development in first instance; governance deserves detailed consideration.  |

## 2.3 Analytical Framework

Each of the new three case studies were examined in terms of the impact of a range of critical ingredients (eg, infrastructure, investment, technology, policy) that would support the evolution of a particular sector: from an ‘embryonic’ or emergent stage towards ‘critical mass’, at which point they would be expected to sustain material contributions to the national economy.

For each case study, we attempted to identify and benchmark the gaps that exist between ‘embryonic’ or ‘pre-embryonic’ stages of a sector’s development and the attainment of ‘critical mass’, against an established case: the successful discovery, development and production of the Maui gas and oil field.

This analysis was intended to assist in the identification of optimal government interventions to address the gaps, so as to support the development of the resource opportunity and stimulate a growth sector that can ultimately enable the sector to achieve critical mass and contribute to the growth of the national economy on a sustained basis.

## 2.4 Case Study Structure

Each case study is intended to illustrate the following issues:

- current activity in New Zealand and internationally, including proposed or actual commercial activity
- reported barriers and issues impacting on commercial development activities, specifically in terms of ‘know-how’, ‘capital’ and ‘property rights’
- analysis of the reported barriers and issues
- recommendations on potential strategies and/or interventions to overcome or mitigate the reported barriers, constraints and issues.

# 3 KEY FINDINGS

## 3.1 Summary of Case Studies

### Discovery, Development and Production of Maui *Success Story*

Maui was discovered by the Shell-BP-Todd (SBPT) consortium in 1969 and started production in 1979. With an estimated 3830 billion cubic feet of gas reserves, it was one of the largest offshore gas fields ever discovered at that time.

Key factors underlying Maui's successful development include:

- Exploration Technology – Acquisition of New Zealand's first seismic data by SBPT reduced their exploration risk and led to the discovery of the Kapuni and then Maui fields; also, the discovery was made during the first deployment of an offshore drilling rig to New Zealand
- Policy – The Continental Shelf Act 1964 vested offshore resources with the New Zealand government and allowed the issuing of permits; the government's role as the major purchaser of Maui gas (through the Take-or-Pay agreement) enabled the economic production of the field; the oil crisis in the 1970s led to the development of supportive policies eg, energy self-sufficiency and efficiency
- Energy Demand – The international oil crisis and associated high prices and short supplies in the Pacific created a substitution opportunity for fuelling the thermal power stations then being built and meeting the country's needs for transport fuels
- Maui Joint Venture – This provided for government the sharing of production risk, infrastructure development, cost overruns in platform construction and redesign, as well as the 'upside'.



### Oil and Gas Exploration *Established industry*

New Zealand has an active exploration industry focused on the Taranaki Basin where it has been successful in the past. Expansion of the industry is primarily dependent on the capital and know-how of international exploration companies, as well as their business decisions based on global market factors and their appreciation of prospectivity.

New Zealand currently ranks 14th internationally in terms of attractiveness to exploration investment.<sup>4</sup>

Reported barriers to expanding exploration activity includes:

- highly competitive international exploration ‘marketplace’, including higher prospectivity in other parts of the world, closer proximity to markets, better access to equipment, availability of and access to high-quality exploration data
- relatively small New Zealand gas market, historically low prices for gas in New Zealand due to oversupply from Maui, and associated transportation and logistics issues related to New Zealand’s distance to other markets
- infrequency in recent times of economically significant discoveries like Maui (2000 discovery of the 700 petajoules (PJ) Pohokura field being an exception) that would stimulate exploration activity
- no discoveries to date of a scale to justify development of new infrastructure and production outside the Taranaki Basin
- predominance of gas rather than the more desirable oil in the New Zealand Basin structures.

## Wave and Tidal Energy *Emergent opportunity*

This is an emergent industry reliant on technology developed overseas. An industry grouping, Aotearoa Wave and Tidal Energy Association (AWATEA), has just been formed and there are approximately 12 projects at various stages presently underway. However, none are expected to be capable of deployment within at least a 24-month timeframe.



Reported barriers to the development of the wave and tidal energy industry in New Zealand are mainly related to their uncertainty in respect of the operation of the Resource Management Act (1991). The RMA is a de facto ‘portal’ for development but is seen as inefficient in dealing with novel projects for which plans are almost always silent. Specific issues identified by respondents include the:

- ‘not in my back yard’ (NIMBY) issue, the ease with which objections can be lodged under the RMA and the potential for perceived vexatious objectors

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<sup>4</sup> United Kingdom Trade & Investment (n.d.). *The Oil And Gas Market in New Zealand, a Sector Summary*. p7.

- high perceived costs and complexities of consent applications relative to the small scale of the proof-of-concept or technology demonstration projects currently being planned
- absence of a specific protocol for offshore wave and tidal projects that would streamline and standardise the application process for both the industry and consenting regional authorities, thereby minimising inconsistent processing of applications across regions
- perceived sovereign risk as a result of the ongoing Foreshore and Seabed debate, the Moratorium on Aquaculture, and the Minister of Conservation's veto powers over restricted coastal activities;
- perceived business risk in the allocation regime posed by the 'first in, first served' policy and the potential for both 'free riders' and speculators to secure occupancy and use rights ahead of industry trailblazers
- reliance on predominantly overseas-developed technology that is largely still pre-commercial and unproven, and which is expected to be relatively expensive to import to New Zealand
- uncertainty over the cost of, and responsibility for, infrastructure development and access to the national grid as a result of the low priority given to wave and tidal energy by the big power companies
- investment difficulties due to negative media reporting of deficiencies and failures of the RMA process.

Such uncertainties, compounded, impose a risk premium that severely dampens any business case already burdened with significant technology risk. In effect, the required capital investment will not be forthcoming until greater clarity is achieved, or unless the risks are offset through tax concessions, revenue guarantees, or similar instruments.

## **Gas Hydrates**

### ***Future opportunity***

Gas hydrates (or methane hydrates) present a future opportunity. It is not immediately commercialisable due to the technical complexities of extraction, transportation, environmental implications; and a fundamental lack of scientific and engineering knowledge of the resource.

New Zealand gas hydrate deposits have been discovered offshore in the Hikurangi (East Coast) and Fiordland margins. There are additional indications of deposits in Canterbury, Great South and Taranaki Basins.

Japan (USD\$50m pa funding), Canada and the United States lead gas hydrate research worldwide. Scientists from the Institute of Geological and Nuclear Sciences (GNS), Canterbury and Otago Universities are currently leading New Zealand research efforts.



## 3.2 Reported Cross-Sectoral Issues and Barriers

The case studies highlighted uniformly the following issues (as categorised under subheadings) – the need to:

### Policy

- address inconsistent application of environmental policy across different regional councils and government departments, particularly in respect of project planning processes - inconsistencies leading to delays and increased opportunity costs
- develop consent processes scaled to meet the scope of typical projects in frontier industries eg, exploration, proof-of-concept, technology demonstration, site assessment
- acknowledge and secure property rights of trailblazers / pioneers in frontier industries – the present allocation regime with its ‘first in, first served’ policy undermines investment in the industries: it permits ‘free riders’ and speculators to secure property and use rights to resources without contributing to the development of the industry
- develop mechanisms to sanction speculators who secure use rights over resources but do not maximise the value of those resources to the New Zealand economy in a timely manner – note that the previous two points are important and interwoven: one person’s pioneer / trailblazer is another’s speculator
- design property rights and systems for their allocation and administration: these should balance incentives to pioneers and trailblazers with constraints on pure speculators and monopolists, to foster the emergence of effective market dynamics in emerging commercial sectors

### Technology and Specialist Equipment

- develop mechanisms that would provide timely access to new technologies and specialist equipment given New Zealand’s reliance on overseas technologies and expertise. This results from the limited capacity New Zealand has, to meet the high research and development (R&D) costs for new frontier activities
- consider ways of attracting specialist operators and expertise to New Zealand in the face of worldwide demand and competition for equipment (eg, oil and gas drilling rigs) and expertise: the tight supply is reportedly leading to significantly increased costs and delays in deployment. Such delays in turn threaten tenure to prospective areas

### Investment

- address the impact of policy-related sovereign risk issues (eg, Foreshore and Seabed, Aquaculture Moratorium) and business risk issues (eg, allocation regime) on inwards investment: inconsistent and ad hoc policy is leading to uncertainty and perceptions of unreasonable risk
- encourage pioneering investments that have the potential to seed developments from which new sectors can emerge. These may need to be favoured with taxation or other

provisions (such as flow-through of losses to shareholders) to overcome risks that cannot be minimised

## Infrastructure

- facilitate development at the ‘frontier’ stage with some level of government commitment, by supporting the development of new infrastructure, expertise and investment because of the high infrastructure costs for new industries;
- develop scientific, engineering and technical skills to enable rapid response to new frontier opportunities: despite the significant economic potential, none of the universities in New Zealand have programmes dedicated to addressing new opportunities like wave and tidal energy or gas hydrates

## Resource Data

- have better access to accurate and up-to-date resource and site data as the key driver to increasing industry activity
- more intensive mapping of available site, resource and reserve data: this should be considered a national priority due to the strategic and economic value of the data to New Zealand
- more closely align science and engineering research: the focus should be on developing potential solutions to specific opportunities rather than on undertaking scientific research with limited or isolated application

## 3.3 Context for Policy Development

### A. ‘Frontier Territories’ and ‘Frontier Activities’

The concept of the ocean as a ‘frontier territory’ is the fundamental theme emerging from the investigation and should be considered a central tenet in the development of the new Oceans Policy framework.

The case studies in this report are classic ‘frontier activities’, characterised by:

- significant technical risk
- high start-up costs
- gaps in policy, governance and management regimes (at least at frontier level)
- a long / convoluted / complex / uncertain path to market in the early stages of the industry.

While these points may seem obvious, they provide an important contextual consideration that is often overlooked as policy development tends to lag economic development requirements.

Production from the Maui oil and gas field took 10 years from its initial discovery. It required the pioneering of an offshore gas production system in New Zealand (an activity that was then novel elsewhere in the world), new structural designs, new onshore infrastructure, new ‘enabling’ policies (energy self-sufficiency, empowering legislation, Take-or-Pay Agreement etc) and new utilisation opportunities for the gas (synthetic fuels, methanol, other chemical

derivatives, thermal fuels for power generation, liquefied petroleum gas (LPG), compressed natural gas (CNG) etc) to facilitate its economic development. While this process was consistent with international practice at the time, its application in New Zealand was ‘unique’.

Oil and gas exploration is the definitive frontier activity in New Zealand. Exploration activity occurs despite:

- often limited geophysical information available for the permit area (which increases risk and costs)
- high prospecting costs (up to \$100m to effect all of the work required to identify an offshore prospect and test it by drilling)
- low success rates (9 out of 10 prospecting wells drilled may be ‘dry’ holes despite promising seismic data).

The future development of a gas hydrates industry is likely to share most if not all of the features of both current oil and gas exploration, and the economic development of Maui. Current investment is limited to publicly funded research. Although not a newly discovered resource, its potential as a significant energy source and economic opportunity is yet to be firmly established. The technical complexities involved in mining, processing and transportation of the hydrates in a useable form to market will mimic the conditions faced by New Zealand’s embryonic exploration industry in Taranaki up to the Kapuni discovery in 1959, and in the development of Maui in the 1970s – but on a significantly larger scale. The enabling legislative steps were taken well in advance (Petroleum Act 1937; Continental Shelf Act 1964) of first commercial exploitation. Consideration should now be given to the adequacy of the enabling framework for future sectors such as wave and tidal energy. At present this is simply subjected to the blunt instrument of the RMA and faced with a turbulent electricity sector regulatory regime. For the gas hydrate potential, the Crown Minerals Act may prove similarly sub-optimal.

The embryonic wave and tidal energy industry in New Zealand also shares many of the characteristics of a ‘frontier’ activity: generation technology is still at an early stage of development and largely unproven. The novelty of the proposed activity in New Zealand is expected to result in delays in the consent application process, and niche markets will need to be identified and developed for an energy source that is projected to cost 3-4 times more per kWh than wind power.

### **The commercial development of frontier opportunities will require a high return to match the high risk**

At its most fundamental level, the development of economic opportunities in New Zealand’s ocean territory will require a strong business case, in particular, a return commensurate with the perceived level of risk involved.

The economic production of Maui required a high degree of certainty over the sale of a large quantity of gas for a sustained period of time. This certainty was provided by the Take-or-Pay Agreement entered into by the government of the time, which obliged the Crown to purchase the agreed volume of gas over a 30-year period, irrespective of whether the gas could be utilised at the time it had to be paid for. In consideration of this, the government gained a 50% share in the field. This intervention supported the economic development of Maui by offsetting the sovereign risk against a property right.

The gas hydrates case supports the greatest potential economic return to the country. It also carries the highest risk due to the technical complexities of extraction, transportation and production, along with environmental concerns that are still to be researched and are some

considerable way from being resolved. While Japan has an annual gas hydrates R&D budget of US\$50m per annum, New Zealand's effort is limited to the activities of one small scientific team led by Dr Ingo Pecher at GNS in Wellington.

Given New Zealand's current vulnerabilities in respect of future thermal fuels supply (consideration of CNG importation is currently underway) and substantial indigenous sources of gas hydrate, a strong case could be made for a quantum increase in research effort towards expanding the excellent geoscience base in this country and complementing it with technological and environmental lines of enquiry. A dedicated agency, similar to the Liquid Fuels Trust Board (LFTB) of the Maui era, may well be justified.

In the exploration sector, the risk-return hurdle is also extremely high as an offshore prospecting programme may cost between NZ\$7m and \$10m over the term of the permit. Oil and gas exploration has in recent years expanded with specific instruments such as frontier basin seismic surveys, and the enhancement of systems to provide existing exploration data at low or no cost. Substantial arrangements in place for this, are intended to reduce risk and increase exploration activity. With the progressive depletion of Maui and other developed fields in Taranaki, New Zealand's exploration sector needs to be increasingly focussed on frontier areas. Success in such areas will raise infrastructural and potentially environmental issues that have been successfully addressed in Taranaki over the course of several decades. The Taranaki experience should be able to be adapted effectively to those regions where the industry proves successful in the future, so that the value of discoveries can be maximised.

The risk-return hurdle in wave and tidal energy is much lower than for hydrocarbons, but is no less significant. The development of the wave and tidal energy industry is likely to struggle to become established until generation costs are reduced (currently estimated at 3-4 times the cost of wind per kWh due to technology costs) and next-generation technology becomes available.

Besides the project sponsor, the costs and benefits of an operational wave or tidal power scheme will be borne locally and regionally. Pioneering development might best be catalysed by facilitation by local or regional interests. These include local government but also potentially economic development agencies, lines companies and/or iwi entities. This route to commercialisation could well facilitate or promote project development through providing access to designated (non-consent) sites and guaranteed production revenue.

The 'high risk, high return' argument has also been used to explain the lack of current activity in the offshore mining of manganese nodules. Despite innovative 'enabling' technology currently being available (which was demonstrated at the 1999 CAE Conference at Te Papa, Wellington), the world price for manganese at present or for the foreseeable future does not justify commercial production.

## **An internationally competitive risk and return scenario**

New Zealand is both reliant on the capital and expertise of multinational companies in the commercial development of ocean opportunities (eg, gas and oil). It is exposed to the global market for these vital components of the commercialisation process. In this respect, the global market may be both a threat and an opportunity for emergent industries in New Zealand.

On a negative note, New Zealand is ranked only 14th in the world in attractiveness to exploration investment<sup>5</sup>. This ranking is due to the predominance of gas rather than oil in the Basins, the low price for gas in New Zealand due to the historic surplus from Maui and a small

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<sup>5</sup> United Kingdom Trade & Investment (no date). *The Oil And Gas Market in New Zealand, a Sector Summary*. p 7.

domestic market, distance to other markets and related logistics costs, and lower prospectivity than other regions in the world. A number of government initiatives have been launched to increase exploration activity, including a \$15m programme to acquire seismic data with a database development project to provide data access to exploration companies.

On a positive note, there are indications that New Zealand's low population density and vigorous wave and tidal environment are attracting overseas technology developers. Two respondents to this study indicated approaches by European technology companies who were unable to secure access to suitable sites in their home countries; they were interested in partnering up with New Zealand companies to demonstrate and prove their technology here. This is perhaps an opportunity for government intervention to assist in overcoming the risk hurdle the incumbents face, develop the local industry by expediting access to new technology, and also capitalise on a potential international scientific and economic opportunity.

It has been suggested that New Zealand could capitalise on the opportunity through the development of a 'marine energy technology incubation park', with research and pilot facilities that would facilitate the plugging-in of new technologies for testing or demonstration purposes.

### **The first frontier projects are never fully commercial**

As demonstrated by Maui and other projects internationally such as Wave Hub UK, and the European Marine Energy Centre (EMEC – wave and tidal energy), some level of government assistance at an early stage is central to the development of new frontier industries. At its optimal level, government interventions will assist in the development of these frontier industries by providing certainty and confidence to pioneers by minimising completion risk. This can avoid a project failing due to the incapacity of the sponsor to complete the development stage or other factors outside the immediate control of the pioneer. Such factors include sovereign risk or more broadly, retrospective application of new legislation or shifts in government policies.

### **The level of intervention should be commensurate with the risk-return profile of the opportunity**

The successful development and production of the Maui gas and oil field required a 30-year commitment by the government to purchase an agreed volume of gas at an agreed price irrespective of utilisation. The government was the only possible purchaser due to factors underlying the economic development of the field.

The economic development of the gas hydrates opportunity may require a similar level of commitment, perhaps even on a larger scale. This is because of the complexities of discovery, development and production demonstrated by the high levels of gas hydrate R&D being undertaken by Japan, the US and Canada; New Zealand is in no position to emulate these. Japan in particular is striving to achieve a target of commercial production of gas hydrates by 2013.

Despite the huge economic potential of gas hydrates to the country, New Zealand is not in a position to match the level of funding by Japan, the US and Canada. However, the case study has indicated that New Zealand researchers are implementing, and are continuing to develop, 'smart' ways of leveraging their available contribution to these international efforts. In doing so, we share the results of the international R&D activities.

Anecdotal evidence from respondents suggests that increasing New Zealand researchers' visibility and participation at international conferences is an extremely cost-effective mechanism for increasing scientific collaboration. Participation at one international conference cost the host organisation less than NZ\$5,000; it has since led to an exchange programme and

invitations to the host organisation to participate in a fully funded survey of one of the gas hydrate zones in New Zealand approximately 12 months later. The opportunity cost of otherwise purchasing participation would be in the hundreds of thousands of dollars.

The study team applauds the approaches being taken by the respondents and other members of the New Zealand scientific community. Yet we wish to caution that such activities should be driven by strategic game plans rather than short-term science objectives.

Unlike gas hydrates, the exploration and the wave and tidal sectors are nearer-term opportunities. Interventions are, or should be, scaled accordingly to achieve a primary objective of minimising ‘opportunity costs’ to both the pioneers and the New Zealand economy from delays to the development of the industry.

A wide range of interventions is currently available to the exploration sector, including tax incentives and adjustments to the royalty regime and free access to seismic data. Yet wave and tidal proponents have limited support. Although not unexpected given the emergent nature of the industry and the lack of capital formation within the current industry grouping, it does suggest a need for some facilitative action from government.

Interventions suggested by the respondents included:

- MFE facilitation of the development of a Code of Practice for the industry
- sponsorship of a test case of this Code of Practice through the Environment Court to identify the issues involved in securing resource consent for this new and novel activity
- funding for more site and resource data research
- further research to gauge the feasibility of developing a ‘marine energy technology incubation park’ in New Zealand. The two marine parks in Europe (Wave Hub in the United Kingdom and EMEC in Portugal) have allowed the wave and tidal energy industry there to develop at a faster rate.

It has been suggested that a New Zealand marine energy technologies incubation park, should it be viable, would have benefits, such as:

- providing New Zealand with advance access to new technologies
- opportunities to test and demonstrate new technologies under New Zealand conditions
- capacity building opportunities across the sector.

## **B. Development of Frontier Opportunities Will Require New Zealand to Compete Internationally for Investment and Expertise**

The case studies are characterised as ‘frontier’ activities by a dependence on the capital, resources and know-how of multinational companies. This dependence is the result, among other things, of New Zealand’s small economy being unable to provide the high levels of R&D funding and investment required to develop these frontier opportunities, or to support a permanent pool of indigenous expertise.

Multinational companies make their business decisions within a global context; and in many cases it is inevitable that opportunities in other parts of the world will prove more attractive for investment than particular opportunities in New Zealand. Three key factors play a part: acceptable returns on investment, acceptable levels of risk, and certainty of completion.

All three factors are within the scope of government intervention. The appropriate mechanism to do so will be a policy framework that balances the risk return equation to provide pioneers with an acceptable rate of return which does not compromise competition in the frontier activity. At the same time, it will also explicitly support and incentivise the identification and commercial development of new and novel economic opportunities.

Suitable generic policy instruments could include ‘flow-through’ tax concessions that allow tax losses from frontier activities to be offset against the tax liabilities of investors in such projects. Alternatively, ‘bounties’ could reward the first successful fully commercial projects in specific frontier industries, and the development and testing of Codes of Practice for new frontier activities at an early stage of the industry (ie, before they become commercially necessary).

### **C. Commercial Development of Frontier Opportunities Will Inevitably Challenge Conventional Resource Law and Governance**

The identification of new and unique opportunities in frontier territories, and the drivers for their commercialisation, often emerge well in advance of relevant governing policy. This is because conventional policy development is concerned with managing risk, and is therefore generally more reactive than proactive; and tends to focus on known or existing (quantifiable) activities.

Frontier activities are, by their very nature, pioneering endeavours undertaken in the unknown. They have longer-term commercial time horizons and higher risk tolerances than ‘business-as-usual’ projects in established industries (eg, Japan’s US\$50m/pa gas hydrates R&D budget to achieve commercial production by 2016).

Consequently, the study team has formed a view that in order for New Zealand Oceans Policy to be supportive of frontier activities, it must give effect to the principle that there should be tolerance of risk commensurate with the uncertainty prevalent in frontier activities posed by the lack of information. Frontier opportunities are activities for which considerable allowances are made to the conventional business case evaluation process. These are needed because there is insufficient data about the specific opportunity and even more critically, a lack of knowledge regarding potential consequences. Yet the potential returns from successful development can justify this latitude. Our argument is that without greater tolerance for risk, pioneers may be unwilling to develop these opportunities. This is ultimately to the detriment of the New Zealand economy.

We accept that this is at odds with the dominant paradigm, but believe that it is consistent with international best practice and the science of risk management.

## **3.4 Recommended Interventions**

The successful governance of frontier territory opportunities will require a policy framework that:

- is based on clear principles to provide continuity and consistency to pioneers and developers
- manages with risk, rather than attempts to manage risk
- maximises the opportunity value to New Zealand of the resource opportunities

- actively provides for and supports the emergence of entrepreneurial and pioneering activity.

The Ministry's key contribution to the development of the case study (and other appropriate) industries may well be the leadership and facilitation role it can play in:

- facilitating the advance development of consent protocols / codes of practice for specific new and novel activities; and in taking test cases through to the Environment Court in order to identify and resolve issues before the protocols are needed commercially
- facilitating consistent and standardised application of policy across the country. One opportunity would be to develop a training programme for regional councils around the Taranaki Regional Council's extensive expertise and experience in processing offshore consent applications
- facilitating better communication and understanding of the RMA and success stories, both to reduce uncertainty and to prevent the small number of negative stories to evolve into urban myth. In the wave and tidal energy industry, in particular, we note that participants reported RMA hurdles impacting on their business without having verified them or seeking external advice
- facilitating the development of a wide skills base that would support the commercialisation of new, novel and undiscovered opportunities by:
  - encouraging universities to expand their existing academic programmes to include relevant learning modules for near-term opportunities in the oceans
  - encouraging linkages with best-of-breed programmes and researchers at other academic institutions
  - encouraging a closer alignment between science and engineering research, as both fields complement each other and are central to the development of potential solutions.

At a broad policy level, we add the following suggestions:

- ellocate regimes to both incentivise commercial development of opportunities and also sanction applicants who act as speculators or squatters on resource opportunities (as seen in the aquaculture sector)
- include more flexibility in management and consent regimes to reflect the embryonic state of the case study industries (with their focus on R&D, proof-of-concept, technology demonstration and site evaluation, rather than commercial deployment) and allow for better scaling of consent requirements to the scope of projects
- greater consideration of the impact of jurisdictional boundaries (particularly between regional councils) on nearshore activities compared to frontier activities undertaken beyond the territorial limits.

## 3.5 Summary and Conclusions

The principal theme emerging from this investigation is that the New Zealand's Exclusive Economic Zone and its continental shelf extensions should be considered as 'Frontier Territory' as these areas are basically 'un-charted'. As a country we are only just beginning to understand the marine environment, the ocean process that operates within these boundaries, and the

resource potential that lies within. As this understanding grows and knowledge increases, it is inevitable that new resource opportunities present themselves. We argue that to capitalise on these emergent opportunities, it is appropriate to accept a higher risk tolerance in respect of commercial development activity and that focus should be given to policies and practices that are adaptive to the risk circumstances in this context.

This is reflected in the case studies, seemingly characterised by, among others:

- gaps in resource information
- high upstream investment requirements (exploration and prospecting, site evaluation, resource mapping, new pre-commercial technology)
- a ‘first-in, first-served’ allocation regime if one is available
- the absence of a specific management regime for commercialisation of the resources
- the need for new infrastructure.

The respondents to this investigation are aware that as ‘trailblazers’ or pioneers, they will be exposed to the high costs of:

- creating precedents with the relevant regional and Crown authorities
- pioneering consent and other regulatory protocols and processes
- developing infrastructure
- quantifying and qualifying economic opportunities, at the risk of ‘free riders’ and speculators obtaining occupancy and use rights to resources that they have sought to secure for themselves. They are also aware that as new or novel activities, governmental policies impacting on their businesses could be applied retrospectively at anytime.

CAE suggest that the following policy considerations be deliberated on, in the development of Oceans Policy, to encourage the development of new and novel opportunities in New Zealand’s oceans; and to support the transformation of their embryonic industries into mature industries contributing significantly to the national economy:

1. **‘New Zealand’s Economic Future lies in its Oceans’** – the diminishing of terrestrial resources will focus attention on developing new economic opportunities in the oceans. Oceans Policy must be flexible enough to allow new opportunities to be developed in a cost-effective manner with all due regard to applicable allocation, governance and management regimes.
2. **‘The Ocean is Frontier Territory’** – Oceans Policy should reflect the fact that ‘frontier activities’ are unique because they will involve significant technical risk, high costs and a long uncertain complex pathway to market in the early stages of the development of the industries. Ocean Policy should also recognise that pioneers are operating in a dearth of information, in hazardous conditions and have to react quickly to both hazards and opportunities.
3. **‘Frontier Opportunities are Business Development Opportunities’** – without an appropriate business case, and a return commensurate with the risk involved, there is no viable opportunity for policy to support.
4. **‘Risk and Return, Opportunity Costs and the Time Value of Money are the Key Drivers to the Development of Frontier Opportunities’** – frontier opportunities are by necessity speculative. Long-term opportunities are likely to be driven by risk-return

considerations, while immediate and near-term opportunities will be driven by the opportunity costs and time value of money. The provision of ‘certainty’ through policy is thus especially crucial for near term opportunities where the commercial viability of a pioneering project is particularly sensitive to delays and impediments to the business plan.

5. **‘New Zealand Opportunities Must be Both Nationally and Internationally Competitive’** – the commercial development of opportunities in New Zealand will require competitive business cases firstly, because New Zealand is dependent on multinational companies, who operate in a global market for their capital, expertise and resources; and secondly, because local markets need to be established to support the development of infrastructure, supply chains etc for economic production.
6. **‘Early Projects in Frontier Industries are Rarely Fully Commercial’** – the first few projects in ‘frontier industries’ have historically benefited from a level of government intervention to clarify policy principles, formalise property rights, establish certainty and reduce completion risk.
7. **‘Frontier Projects require Flexible and Discretionary Policy Frameworks’** – policy elements that control established industries may not be appropriate for embryonic or emergent industries. Under the current RMA regime it is apparent that the scope of required reporting, investigation costs and timeframes required for planning approvals are disproportionate to the scale of early-stage projects; being predominantly technology demonstration and evaluation projects.
8. **‘Policy Frameworks for Frontier Activities Must be Based on Clear Principles’** – clear principles will provide certainty to pioneers; and the clearer the principle, the sooner an opportunity is likely to be commercialised.
9. **‘Policy Frameworks for Frontier Activities Must Maximise the Opportunity Value to New Zealand’** – this includes ensuring sufficiently robust policy mechanisms are in place to balance, among other things, the natural desire by pioneers for monopolies versus the government’s role to promote and support competition.
10. **‘Conventional Policy Frameworks Must and Should Apply Once an Industry is Established’** – the availability of infrastructure and supply chains to support the commercialisation of a frontier opportunity generally indicate the difference between a mature and an emergent industry.

## 3.6 Issues for Further Investigation

The study team has the view that encouraging the sustainable development of new economic opportunities in New Zealand’s Ocean Territory will require their treatment as ‘frontier opportunities’; and a policy framework that will ‘manage with risk’ rather than attempt to manage all risks inherent in frontier activities.

The development of a policy framework that ‘manages with risk’ requires further investigation into the following issues:

1. What are the underlying issues to the adoption of a risk-based approach?
2. What are the optimal levels of ‘risk tolerance’ for new economic opportunities in New Zealand’s Oceans, which would actively support, encourage and incentivise the development for new marine opportunities, without imposing undue risk or fiscal burdens on the New Zealand economy – as the development of Maui has been found to have done?

3. What are the optimal balance points between providing pioneers with sufficient incentives to investigate and develop frontier opportunities, while ensuring sufficient competition to maximise the opportunity value to the New Zealand economy?
4. Should work programmes be a standard requirement for all new frontier activities? Work programmes could address the issues faced in the aquaculture allocation model, in which speculators were able to lock up optimal aquaculture sites through the consent process without any intention of utilising the resource directly themselves.
5. The results of these investigations could then provide the basis for a focused Risk Management Framework for Offshore Frontier Activities.



Agreement that committed it to purchase gas from the field for a 30-year period. In consideration of this, the New Zealand government gained 50% ownership of the field.

Production on Maui is from three reservoirs within separate formations of the Kapuni Group. The Maui-A platform wells commenced production in 1979, while Maui-B came on stream in 1993. Thirty-four wells have since been drilled in the field as of 2003, consisting of 14 production wells within Maui-A and 12 development wells within Maui-B, along with a further eight exploration / appraisal wells.

Maui accounts for between 75%<sup>2</sup> and 80%<sup>3</sup> of New Zealand's hydrocarbon production. Annual production from the year to June 2002 was:

- 168 billion cubic feet of gas
- 6 million barrels of oil and condensate
- 168,000 metric tonnes of LPG<sup>2</sup>.

Since commencing production in 1979, Maui has made a massive contribution to the New Zealand economy. In addition to providing approximately 50% of the (relatively cheap) fuel used for electricity generation, it has also contributed an estimated \$472 m directly<sup>2</sup>, excluding revenue to the government from other downstream activities, such as Methanex.

Production from field reduced in 2003, following a downwards revision of the size of the reserve; it is expected that the specified economic reserves will be depleted sometime after 2008. Projections are that additional reserves will be delineated to enable further production that could well extend this timeframe<sup>4</sup>.

The decline of the Maui field may prove to be a double-edged sword for the New Zealand economy. While the low price of gas from Maui has contributed significantly to New Zealand's international competitiveness by allowing the government to attract large multinational companies like Methanex and Comalco, providing them with low-cost electricity contracts over a long term. On the downside, it has also suppressed the commercialisation of new gas field discoveries (particularly Kupe, discovered in 1986 and with first production now scheduled for 2008) and disincentivised exploration, because the Maui gas prices made concurrent production from other fields uneconomic.

## **b. Factors Supporting the Development of the Maui Gas and Oil Field**

### **Know-How**

- Shell-BP-Todd (SBPT) as well as Mobil, Gulf Oil, Hunt and Exxon undertook marine seismic surveys during the 1960s and early 1970s as the technology became widely available.
- The first offshore drilling campaign based on seismic data led to the Maui discovery.

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<sup>2</sup> Centre for Advanced Engineering (2003). Economic Opportunities in New Zealand's Oceans. Report to the Oceans Policy Secretariat, Ministry for the Environment, p 3.

<sup>3</sup> Ministry for Economic Development (no date). Taranaki Basin Producing Fields, p 22.

<sup>4</sup> Hooper, RJ (2006). *Medium Term Vulnerabilities Within The New Zealand Gas Market*, Paper to New Zealand Petroleum Conference, p 8.

## Capital

- Cooperation between Shell, BP and the New Zealand company Todd enabled them to leverage off each individual company's strengths to discover and develop the field – the previous onshore discovery at Kapuni was the culmination of a joint venture to systematically explore the most prospective parts of New Zealand, with Shell operating the western side of the country and BP the eastern.
- Government stepped in to promote and facilitate the development of Maui during a period when energy security and affordability was (as again today) very high on the political agenda globally. However, even with governments of both parties persuaded of the desirability of facilitation and commercial involvement on an unprecedented scale, the path from discovery to development took 10 years.

## Clear Title

- The Continental Shelf Act 1964 vested ownership of resources of the Continental Shelf with the New Zealand Government; and extended the reach of the Petroleum Act 1937 over the newly gazetted territory.

## c. Barriers

- The main barrier to the development of the field was the lack of a ready market for the production of gas on the scale required for commercial development
- There were also a number of technical and technological hurdles that had to be addressed, as offshore gas production was unknown in New Zealand and relatively novel elsewhere in the world at the time.

## d. Interventions

- The Take-Or-Pay Agreement entered into by the government enabled the commercial development of the field by securing the sale of a fixed volume of gas to the government irrespective of whether it was, or could be, utilised.
- The development of a market for Maui gas in New Zealand was facilitated by massive predominantly government investment into the development of infrastructure for processing, transportation and consumption (power generation, synthetic petrol etc).
- Government also took an active lead, through the Liquid Fuels Trust Board, Power Planning Committee and the Department of Trade and Industry among others, to develop utilisation options for the gas.

## Summary and Conclusions

Think Big gave government intervention a bad name.

However its failures largely arose from the collapse of oil price negating the underpinning case for self-sufficiency. While much attention has been given to the negative outcomes associated with this fundamental impact on specific business cases, nevertheless the development of Maui has had a large and widely distributed positive effect on the competitiveness of the New

Zealand economy due to its sustaining of competitive energy prices, enjoyed by manufacturing and other industries. For example, Taranaki was until 2003 one of the most efficient sites for methanol production in the world.

More importantly however, the establishment of a viable gas industry in New Zealand was only made possible by the infrastructure that was established and the gas market that subsequently ensued. The Gas industry remains an important contributor to national gross domestic product.

# CASE STUDY 2: ISSUES AND BARRIERS FACING THE OIL AND GAS EXPLORATION SECTOR

## a. Introduction

The modern era of exploration in New Zealand began in 1955 when Shell and BP established New Zealand's first major consortium with the Todd Brothers of Wellington. Their acquisition and analysis of the first seismic data shot in New Zealand led eventually to the discovery of the Kapuni Field (264bcf of gas reserves) in 1959 and Maui in 1969 (3830bcf of gas reserves); together these produce approximately 83% of New Zealand's oil and 87% of its gas.

The start of production from Kapuni in 1970 marked the beginning of the natural gas industry in New Zealand, and Taranaki as the hub of New Zealand's oil and gas industry.

Although Taranaki is the most explored and commercially successful of the New Zealand Basins (with 350 exploration wells drilled to date), it is still relatively under-explored by world standards. Increasing levels of exploration over recent years have led to an enviable success rate for wildcat drilling and a commercial discovery success rate of one in three in the Taranaki Basin based on recent exploration activity.<sup>5</sup> Offshore discoveries have also been very successful with Pohokura in 2000, and Tui and Karewa in 2003.



Figure C2.1: Hydrocarbon Basins in New Zealand's EEZ (source: Crown Minerals, MED).

<sup>5</sup> Crown Minerals (1991). *Petroleum Systems of New Zealand*. [www.crownminerals.govt.nz/petroleum](http://www.crownminerals.govt.nz/petroleum)

New Zealand is currently rated 14th in the world in terms of attractiveness to oil and gas investment.<sup>6</sup> As the business process for investment is driven entirely by oil company investment and know-how, exploration investment and activity in New Zealand is limited primarily by the risk perceptions established by oil companies in a highly competitive global market, rather than resource potential.<sup>7</sup>

However, New Zealand's ranking may change as exploration activity in New Zealand is expected to increase dramatically in the near future due to:

- the impending depletion of Maui, that will drive the need for new discoveries as a result of New Zealand's heavy dependence on gas including for electricity generation (around 50% of total national gas production is used to generate 23% of the national energy supply)
- incentives for new discoveries, due to rising gas prices (200% in the past three years) inline with the run-down of production at Maui and global sector profitability due to high oil prices, peak oil concerns and Middle East instability
- Shell's withdrawal from 2004 from all prospecting in Australasia, which is expected to make New Zealand more attractive to smaller exploration companies by reducing competition for prospecting permits
- the potential for significant commercial hydrocarbon discoveries in the seven additional Sedimentary Basins besides Taranaki that have been severely under-explored. Many untested structural closures could be potentially larger than Maui
- a lack of alternatives to gas-fuelled electricity generation due to the New Zealand public's resistance to coal-fired power plants, new hydro-electric dams and nuclear-power stations. This will create unique opportunities for exploration companies to create value when gas demand, with its associated pricing, is at its maximum and energy alternatives are at a minimum.

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<sup>6</sup> United Kingdom Trade & Investment (no date). *The Oil And Gas Market in New Zealand, a Sector Summary*. p 7.

<sup>7</sup> Centre for Advanced Engineering (2003). *Economic Opportunities in New Zealand's Oceans*. Report to the Oceans Policy Secretariat, Ministry for the Environment, p 4.

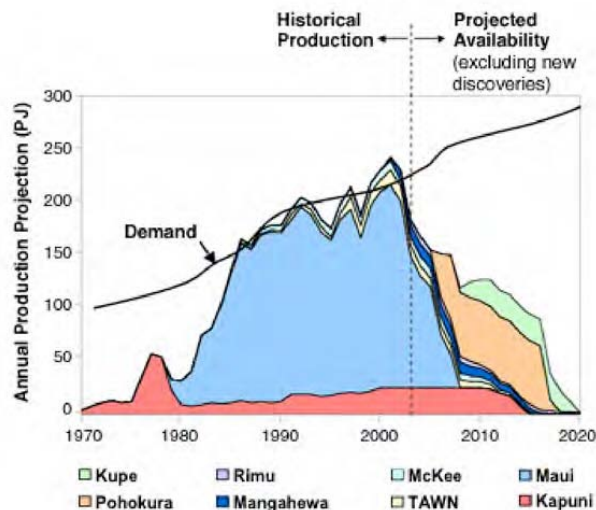


Figure C2.2: New Zealand Natural Gas Supply and Demand (source: TAG Oil (NZ) Ltd)

## b. Reported Barriers

The business case process for oil and gas exploration is mature; key sensitivities include field (prospect) size, flow rate, costs, timing and prices. Despite the positive factors supporting the development and expansion of the exploration sector in New Zealand, a number of issues were raised by respondents as potential barriers, or causes of curtailment, to their activities.

### 1. TECHNOLOGY AND EQUIPMENT

- Global scarcity and heavy bookings for specialist equipment was reported as one of the main barriers to the respondents expanding their future exploration activities in New Zealand. Supply of rigs worldwide is tightening as international exploration increases in response to high oil prices.
- Already only 14th in the world in terms of attractiveness to oil and gas investment,<sup>8</sup> New Zealand is becoming even less attractive as a prospecting destination than some other parts of the world, due to a predominance of gas rather than oil in the New Zealand sedimentary structures.
- The scarcity of specialist equipment is contributing to difficulties experienced by the respondents in aligning the completion of work programme commitments with equipment availability within the permit time frames.
- Cost of equipment was cited as a limiting factor for future exploration, especially in areas of lower prospectivity. Rig costs have increased from \$70,000/day in 2003-04, to \$128,000/day in 2005-06, to a projected \$378,000/day for 2007-08.

<sup>8</sup> United Kingdom Trade & Investment (no date). *The Oil And Gas Market in New Zealand, a Sector Summary*. p 7.

- Demands for work programmes of 12 months or longer from rig operators may contribute to the ongoing scarcity of specialist equipment for New Zealand exploration activities. The small New Zealand exploration industry would struggle to support such a commitment in the absence of a ‘primary contractor’ willing to underwrite a 12-month rig programme.

## **2. POLICY: Permit Regime and Work Programmes**

- Respondents raised concerns about the ‘aggressiveness’ of the current permit regime, in particular the difficulties they faced in aligning the requirements of their respective work programmes with the availability of rigs and other equipment, within in their permit timeframes.
- Respondents suggested more flexibility in or extensions to permit terms may be required as the worldwide demand for specialist equipment is increasing the time horizon to relocate rigs to New Zealand beyond two years. Exploration permits currently run on a two-year rolling system.
- In conjunction with their inability to meet their work programme requirements due to non-availability of equipment, respondents also cited difficulties in securing deferments to their Work Programmes from Crown Minerals as an additional barrier to an expansion of their exploration activity.
- Lack of access to exploration acreage was raised as an issue, despite the previous bid round being significantly under-subscribed.

## **3. POLICY: Resource Management Act**

- Inconsistencies in the treatment and processing of resource consents by different councils was reported as being of concern, especially when it impacted on the respondents’ abilities to either plan for or meet their Work Programme commitments. Most regional councils are generally focused on consent protocols for onshore / land-based projects, and only Taranaki was reported to have high-quality in-house RMA expertise for offshore projects.
- Exploration permits and activities that crossed territorial boundaries increased the scope and scale of the consent application process, which compounded the inconsistent treatment reported above.

## **4. FISCAL REGIME AND INCENTIVES**

- Currently, tax incentives are only available for new gas discoveries. However, respondents suggested that the incentives should be applied for both types of hydrocarbons, as oil and gas are generally found together and New Zealand has greater dependence on oil.
- Respondents suggested that the incentive regime be applied to the development of previous discoveries, which may now be more economic to produce with the demise of Maui.
- Respondents questioned the implications of the recent initiative by the Inland Revenue Department to remove the tax obligations on survey ships and rigs operating in New Zealand beyond the 186-day exemption period while maintaining the obligation on rig support vessels. Respondents pointed out that rigs operate symbiotically with support

vessels and this initiative could increase both the cost of drilling programmes and lead to potential delays due to non-availability of the rigs.

## 5. RESOURCE INFORMATION

- Some respondents cited ‘prospectivity’ as the greater driver for exploration activity than the availability of infrastructure in proximity to new discoveries, and shared their experiences of difficulties in accessing seismic data purchased by the Crown for this purpose. *These experiences have not been reported here because it was the consensus of participants at the Workshop that the opinions expressed were not valid.*
- Recent government initiatives to increase prospectivity and provide access to the seismic data include:
  - the NZ\$15m Ministry of Economic Development programme (from 2005) to acquire data in frontier basins, in conjunction with a database project that will provide free online access to both old and new exploration data<sup>9</sup>
  - a NZ\$23m multidisciplinary programme funded by the Foundation of Research, Science and Technology (FRST) in conjunction with GNS. It will undertake mapping, geological analysis and modelling of yet-to-be discovered petroleum accumulations to reduce exploration risk and increase exploration success for both established companies and new entrants.<sup>10</sup>

## 6. INVESTMENT

- Respondents suggested that New Zealand’s attractiveness to international investment in exploration was limited by low prospectivity, a predominance of gas rather than oil in recent discoveries, its relatively small market size and distance to larger markets, and the historically low gas prices due to the oversupply of gas from Maui.
- The lack of a domestic exploration sector capable of completing frontier-type activities unless in conjunction with international investment. Above the relatively small scale of Austral Pacific, and New Zealand Oil & Gas Ltd, only Todd (as a domestic company) has created a linkage with overseas companies to drive offshore exploration in New Zealand. These multinational companies operate globally and tend to come and go as more competitive opportunities emerge elsewhere.

## 7. INFRASTRUCTURE

- Some respondents reported that although their exploration activities outside the Taranaki Basin had yielded discoveries, they were unable to commercialise their discoveries due to lack of infrastructure. *However, it is worth noting that the size of the discoveries did not justify government intervention to lead the development of new infrastructure as the discovery of Maui did.*

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<sup>9</sup> Hart Energy Publishing (2006). *Kiwis Help Exploration*. News item on website of Hart’s E&P net, January. [www.eandpnet.com/articles/newsAndComments/4187](http://www.eandpnet.com/articles/newsAndComments/4187)

<sup>10</sup> Anonymous (no date). *Success Story: In Pursuit of Petroleum*. News item on website of Foundation for Research Science & Technology [www.frst.govt.nz/research/Success\\_Stories/Oil\\_and\\_Gas\\_Exploration.cfm](http://www.frst.govt.nz/research/Success_Stories/Oil_and_Gas_Exploration.cfm)

- One respondent cited lack of access to existing pipeline infrastructure as the reason for his company’s inability to commercialise discoveries within Taranaki. The lack of access was reportedly for commercial reasons but the respondent chose not to discuss this further. *It may be useful to investigate to what extent this is an issue for other exploration companies operating in the Taranaki Basin as it could conceivably be an uncompetitive practice.*
- Respondents all supported government intervention to kick-start the development of infrastructure outside the Taranaki Basin as a means of encouraging and supporting exploration activity in the other Basins. *However, we comment that this would first require the existence of a proven petroleum system sufficient to support such an investment, which is yet to be achieved. Internationally, government investments in infrastructure are typically linked to the development stage, not exploration.*

### **c. Suggested Interventions**

1. Adjustments to the tax regime – exemptions for support ships, incentives for new oil and gas discoveries, incentives to developed existing discoveries.
2. Strategies to attract small to medium-sized international exploration companies – respondents suggested that exploration in New Zealand Basins is more suited to such companies, who are likely to be hungrier and more responsive to current government initiatives to boost exploration activity.
3. Strategies to assist New Zealand companies to develop into world-class operators – respondents highlighted the opportunity for government to assist local companies to become internationally competitive as a result of anticipated local demand and high world prices.
4. Strategies to increase the availability of specialist exploration equipment in New Zealand – respondents suggested that the government might have a role as a ‘primary contractor’ or underwriter for an extended drilling programme.
5. Adjustments to permit regime – consideration of exit points: respondents suggested that a more flexible approach be implemented for the work programmes, in particular more flexibility in reasons for deferral other than rig non-availability.

*The study acknowledges that government has already moved in part in the above areas by adjustments to taxation regimes and the provision of seismic data sets without condition to interested parties at no or limited cost. Our investigation suggests that more could be done to better match initiatives to the business interests of targeted mid-sized exploration companies. In respect of specialist exploration equipment, we suggest that there may well be a role for government in underwriting rig programmes for extended periods and then tendering spare capacity to the industry. Such an initiative or similar scaled interventions will require further investigation.*

## **Summary and Conclusions**

The oil and gas industry in New Zealand is currently at a crossroad due to the depletion of Maui. In particular:

- it is an established industry with a tight geographical focus (the Taranaki Basin) facing a contracting gas market, competition from imported oil and gas and a high incidence of dry holes

- despite the drilling of almost 600 exploratory wells, it is still considered a ‘frontier territory’, with a well density of 1:14 km<sup>2</sup> in the Taranaki Basin that is considerably lower than other geologically similar regions around the world<sup>11</sup>
- successful discoveries (eg, Pohokura) have been counter-cyclical and ‘lumpy’, causing strains to infrastructure and support services.

The depletion of Maui is creating an energy shortfall for New Zealand and new opportunities for the industry: exploration activity needs a significant increase in order to produce sufficient successful discoveries for appraisal and development to secure New Zealand’s energy system. Exploration intensity will need to increase by a minimum of 300% to come up with the discoveries to meet anticipated petroleum demand, as stated in a recent article on the Foundation for Research Science & Technology’s website.<sup>12</sup>

The study team suggests that the following issues, which were outside the current scope, require further investigation:

1. How should the sector cope with sub-optimal known discoveries (ie, proven reserves that are either too small, too expensive or of uncertain quality to warrant extraction at current prices) through existing infrastructure and support services?
2. Assuming the stimulation of exploration activity through the current incentive programme, how should the sector cope with any resulting new discoveries that do not conform to the Maui ‘profile’ on which the existing infrastructure is optimised for, ie, discoveries in new basins, discoveries with different mixes of oil and gas, discoveries of different sizes?
3. Which government agency should take the lead in facilitating capacity development in the sector that would address the above?

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<sup>11</sup> United Kingdom Trade & Investment website, Oil & Gas Exploration page:  
[www.uktradeinvest.co.nz/services/trade/sectors/oilandgas.htm](http://www.uktradeinvest.co.nz/services/trade/sectors/oilandgas.htm)

<sup>12</sup> Anonymous (no date). *Success Story: In Pursuit of Petroleum*. News item on website of Foundation for Research Science & Technology [www.frst.govt.nz/research/Success\\_Stories/Oil\\_and\\_Gas\\_Exploration.cfm](http://www.frst.govt.nz/research/Success_Stories/Oil_and_Gas_Exploration.cfm)

# CASE STUDY 3: ISSUES AND BARRIERS IN THE DEVELOPMENT OF A WAVE AND TIDAL ENERGY INDUSTRY

## a. Introduction

Marine energy, often referred to as ‘blue energy’, is a renewable and sustainable energy resource with relatively limited impacts on the environment and marine life. Although the ‘Marine Energy’ definition can encompass energy derived from offshore winds, ocean currents, heat and salinity exchange, and marine biomass conversion, the focus of this project is on devices to generate energy from wave action and tidal currents.

New Zealand is particularly suited to wave and tidal energy production as it:

- is surrounded by ocean
- has a large wave energy resource in the western and southern coasts from waves generated in the Southern Ocean and Tasman Sea
- has significant tidal currents in Cook Strait, French Pass and Foveaux Strait
- has a number of harbours (eg, the Kaipara and Hokianga) with tidal movements.

The concentration of the New Zealand population along the coastline also provides many potential opportunities for the deployment of wave and tidal devices as options for localised or distributed generation, supplanting the need for high-cost transmission network upgrades.

A recent EECA fact sheet on Marine Energy<sup>13</sup> highlighted some additional commercial arguments for the deployment of wave and tidal energy devices, including the shorter transmission distances from localised utilisation; modular and incremental deployment options that minimise installation costs and capital requirement; and the more rapid installation timeframes compared to hydro or thermal fuel plants (although this is not always the case).

Table C3.1: Types of Wave and Tidal Devices

|       |                                  |   |
|-------|----------------------------------|---|
| WAVE  | Wave power system devices        | Generate energy by translating wave displacement into hydraulic force to rotate onshore turbines                    |
|       | Oscillating water column devices | Generate energy when rising and falling waves move air in a fixed volume chamber, which rotates a turbine           |
| TIDAL | Barrage devices                  | Generate energy by forcing water through turbines along a dam   |
|       | Tidal fences                     | Generate energy when tidal currents rotate turnstiles along a fence stretching across a strait                      |
|       | Tidal turbines                   | Generate energy when tidal currents rotate turbines more to the seafloor – similar to the generation of wind energy |

<sup>13</sup> Energy Efficiency and Conservation Agency (no date). *Fact Sheet No 5: Marine Energy*.

## b. Wave and Tidal Devices

At 2 March 2006, there were seven wave energy and six tidal energy devices nearing, or being at, commercialisation stage worldwide (Table 2).

Table C3.2: Current Market Readiness of Wave And Tidal Devices<sup>14</sup>.

|       | System                | Company  | Country     | Size*    | Status   |
|-------|-----------------------|--|-------------|----------|--|
| WAVE  | PowerBuoy             | Ocean Power Technologies                               | USA         | 20 kW    | Commercial   |
|       | Pelamis               | Ocean Power Delivery Ltd.                              | UK          | 750 kW   | Commercial   |
|       | Limpet                | Wavegen  | UK          | 500 kW   | Commercial   |
|       | 'Buldra'              | Fred Olsen Ltd   | Norway      | 500 kW   | Prototype testing complete – set for commercialisation |
|       | 'Parabolic Wall'      | Energetech   | Australia   | 300 kW   | Prototype testing complete – set for commercialisation |
|       | 'Manchester Bobber'   | The University of Manchester Intellectual Property Ltd | UK          | Variable | Prototype testing                                      |
|       | Archimedes Wave Swing | Teamwork Technology BV                                 | Netherlands | 2 MW     | Prototype testing                                      |
| TIDAL | Turbine               | Verdant Power  | USA         | 36 kW    | Commercial   |
|       | Turbine               | Hammerfest Strom                                       | Norway      | 300 kW   | Commercial   |
|       | Seaflow               | Marine Current Technologies                            | UK          | 1 MW     | Prototype testing complete – set for commercialisation |
|       | Tidal lagoons         | Tidal Electric   | UK          | Variable | Planning developments                                  |
|       | Vertical axis turbine | Blue Energy  | Canada      | 250 kW   | Planning full-scale prototype                          |
|       | TidEl                 | SMD Hydrovision  | UK          | 1 MW     | Planning full-scale prototype                          |

\* The size of the device given here is the rating for one device though many are designed to be built as an array utilizing multiple units.

<sup>14</sup> Sherman, M & Fisher, GW (no date). *The Current Status of Wave & Tidal Energy*, Pacific Clean Energy, p 2.

Literature references suggest that wave power is likely to be best suited to small to medium-sized generation extending to 20 MW capacity at any single site. Tidal current systems are likely to be a magnitude greater.<sup>15</sup>

### c. The International Wave and Tidal Energy Industry

Tidal barrages have been generating energy in Europe since 1966 (the 240 MW La Rance plant in France) and in the US since 1984 (the 20 MW Annapolis plant).<sup>16</sup> Despite falling out of favour due to its adverse environmental effects, a new 254 MW tidal dam is currently being built in South Korea. Their contributions have, however, been small and development has been slow.

This is despite tremendous support internationally (and from European governments in particular) for the development of commercial devices within 3–5 years,<sup>17</sup> including:

- the opening of the European Marine Energy Centre (EMEC) in 2004
- a £50m UK Marine Energy Development Fund
- a pledge of £42m (NZ\$111m) in 2005 by the UK Minister of Energy to facilitate wave and tidal energy feeding into the UK national grid by 2008.<sup>18</sup>

The WaveGen and the Pelamis devices are already producing energy for local grids in a number of locations; other devices are expected to come on stream shortly. The availability of these devices commercially is leading to the emergence of a New Zealand wave and tidal industry.

### d. The New Zealand Wave and Tidal Energy Industry

There are currently 12 wave and tidal projects underway in New Zealand at various stages of development.<sup>19</sup> Most of the projects appear to be relatively small, privately funded, led by entrepreneurs and enthusiasts, and focused on testing or proving devices developed overseas in New Zealand conditions.

One government-funded project was identified: the FRST-funded NIWA-IRL-Power Projects Ltd joint venture (FRST Contract C08X0401). This project commenced in 2004 with the objective of deploying a nominal commercial device in New Zealand waters by July 2008.<sup>20</sup> The joint venture is currently evaluating a range of potential devices while one of the partners, Industrial Research Ltd, is understood to be developing a device of its own.

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<sup>15</sup> Centre for Advanced Engineering (1996). *New & Emerging Renewable Energy Opportunities in New Zealand*: pp 169–188.

<sup>16</sup> Sherman, M & Fisher, GW (no date). *The Current Status of Wave & Tidal Energy*, Pacific Clean Energy.

<sup>17</sup> Energy Efficiency and Conservation Agency (no date). *Fact Sheet No 5: Marine Energy*.

<sup>18</sup> Huckerby, J (2006a). Maritime 21 Presentation, February.

<sup>19</sup> Huckerby, J (2006b). Presentation at inaugural AWATEA Meeting, 10 February. Aotearoa Wave and Tidal Energy Association.

<sup>20</sup> Huckerby, J (2005). *Wave & Energy Conversion*. Presentation to the Maritime 21 Oceans of Opportunities Workshop, Lincoln University, February.

Power companies, who would be expected to be involved in evaluating both devices and potential installation sites as part of a balanced generation portfolio, reported low levels of interest and activity in wave and tidal energy, merely maintaining of 'watching briefs'. They cited the more established and predictable resource consent outcomes for wind projects, lower comparative generation costs, proven technology and existing policy support as factors for their focus on wind (rather than wave and tidal energy).

None of the New Zealand projects reported deployment horizons of less than 24 months. Reasons include capital; availability of suitable devices; and timeframes for consent applications, for construction of on-site and site-to-shore transmission infrastructure, and for negotiating grid access.

However, the Aotearoa Wave and Tidal Energy Association (AWATEA) noted at its inaugural meeting in Wellington on 10 March 2006 that the association was expecting the deployment of a pre-commercial or demonstration technology in New Zealand within 3–5 years. This seems optimistic.

A more realistic scenario, however, may be a deployment horizon as far out as 10 years from 2006. This was the consensus that emerged at a Renewable Energy Technology Scanning Workshop run by CAE for MED and New Zealand Trade and Enterprise (NZTE) in Christchurch in February 2006.

Deployment and installation timeframes for wave and tidal devices will be shorter than for large-scale hydro or thermal energy, due to their modular design and scalability and also their relatively low environmental impact. Nevertheless, timeframes are dependent on the availability of installation equipment (eg, 'jack up' rigs to drill mooring points into the sea bed), specialist staff, access to transmission infrastructure, and securing both use rights and resource consent approval.

*Whilst a promising technology, international experience suggests that without some form of government assistance wave and tidal projects, in the near term, will be unlikely to achieve the price point at which they are competitive with wind or other conventional forms of renewable energy.*

## **e. Reported Barriers**

The following issues were raised by the respondents as potential barriers to the development of a wave and tidal energy industry in New Zealand.

### **1. POLICY**

The policy issues reported by respondents were centred on the scope and resulting cost of the RMA process, the perceived inconsistent processing of applications and the need for a specific protocol for wave and tidal energy applications to potentially address the former. *The RMA difficulties reported are largely anecdotal and have not been validated.*

### **Resource Management Act**

It was argued that the RMA was too blunt an instrument to support the development of the emerging wave and tidal industry because:

- the extensive data and consultation requirements were disproportionate to the small scale of the predominantly proof-of-concept or demonstration projects proposed

- the respondents would bear a disproportionate share of the costs of developing a standardised protocol for assessing wave and tidal applications
- the costs to meet the above were consequently disproportionate to the scale of the projects and were diverting capital away from expenditure items on engineering and other project activities
- as a relatively new activity, a standard protocol to specifically assess wave and tidal applications is not available. Respondents were anticipating high direct and opportunity costs while such a protocol was developed and refined. This is anticipated to lead to relatively high application and opportunity costs for the respondents as the data requirements for the consent application (eg, effects, hazards and resources) are still undefined, baseline data to measure potential effects is not available and may need to be developed from scratch
- the ‘not in my back yard’ syndrome and the relatively easy process for objections were cited as major concerns, along with concerns related to so-called ‘vexatious’ objectors within the RMA legislation
- uncertainty was also deemed to be compounded by the varying levels of expertise among regional councils in processing applications for offshore projects; this in turn was expected to create delays in the approval process as consent officers sought external advice to process new and unfamiliar scenarios. *It is worth noting that none of the respondents had actually applied for consent although an application was likely from one respondent within 6 months.*
- provisions of the Marine Reserves Act, the Aquaculture Moratorium and the Foreshore and Seabed issues were cited as having a significant impact on risk management plans and capital raising activities due to the resulting uncertainty surrounding their ability to secure use, occupancy and/or property rights
- related issues of ‘first in, first served’ and ‘the free rider problem’ were cited as barriers to development of the industry in general. Better-resourced respondents expressed a reluctance to expend capital to ‘blaze a trail’ and develop a new industry, when doing so would lower entry barriers to ‘cowboys’. *It is worth noting that one respondent was thinking tactically about this issue and planned to exploit perceived loopholes in the RMA legislation to secure occupancy rights and block potential competitors. No detail on these loopholes was provided on the grounds of commercial sensitivity.*

### **Allocation Regime**

- The issue of consent ‘squatters’ was raised, with parallels to the aquaculture industry where speculators sought to lock up, through the consent process, and then sell access to significant areas of coastline to aquaculturists.
- Respondents operating as entrepreneurs or enthusiasts generally seemed to fixate on the bad news surrounding the RMA process, particularly with respect to cases from parallel industries like aquaculture and coastal development.

### **Restricted Activities**

- Respondents cited fragmentation in policy, implementation (by regional councils) and regulation (by government departments and agencies) as significant issues. Funding issues were perceived as being the reasons for lack of interest among specific government

departments to address issues impacting on their industry – unless specifically tasked to do so and only for the areas in which they have been tasked.

- The extent and the complexity of consultation were raised as an issue. Large-scale consent applications for wave and tidal are likely to be treated as a restricted coastal activity. As such, consent applications would require to be approved by the Minister of Conservation as the final decision maker under the RMA. The likelihood of additional information being sought by regional councils and other stakeholders all contribute to higher costs disproportionate to the scale of the anticipated projects.
- The establishment of a responsible allocation regime was raised as a priority activity for government due to potential competition for the relatively few optimal tidal sites and more extensive wave sites.
- The effect of possible retrospective policy changes as the new Oceans Policy regime is implemented was raised as another issue that respondents felt could impact on their projects. *We suggest however, that this is simply a project risk management issue.*

## 2. INFORMATION

Respondents suggested that resolution of the following issues would greatly assist them in their projects:

- resource data needs to be centralised, as it is currently fragmented and not easily accessible
- resource data needs to be updated as the currently available information dates back to the late 1980s to work undertaken by ECNZ as part of its limited evaluation of wave and tidal energy technology. *It could be argued that this is a private good and ultimately the responsibility of a developer. A comparison with current wind projects indicates that in the case of wind, project sponsors have gathered the site information at their own volition*
- reasonably priced access to resource data needs to be facilitated. Respondents have reported issues accessing the ECNZ resource information from Shell, who purchased the information from ECNZ in the mid 1990s
- at a national level, more extensive resource mapping and collation of site-specific data would allow better matching of sites to projects of a particular scale or utilising specific technologies. The availability of site-specific information could have a positive impact on the allocation regime by moderating competition for sites. *See comment above. However, there is a public-good element in data gathering and collection but it is a matter of achieving the right balance*
- more extensive and accurate site-specific baseline data would enhance the impact assessment requirements of the RMA process. *We suggest that this is a sponsor's responsibility*
- more information is required on the environmental effects of subsurface structures. While structures would increase biodiversity, they could also attract more intelligent organisms eg, dolphins wanting to play
- more resource information will be required for ocean tidal vs. harbour tidal, in situ production opportunities (eg, hydrogen), materials design and development. *These comments reflect the realities faced by the current wave and tidal project sponsors in that the requirements being placed on them for detailed baseline data is inappropriate given the lack of information in the public domain. As a result, a potentially unfair burden is*

*placed on such frontier activities. We refer to our comments in the main body of the report that in these situations, a greater risk tolerance is an appropriate response.*

### **3. TECHNOLOGY AND SPECIALIST EQUIPMENT**

The issues reported centred on the availability and cost of the devices and the availability of equipment for their installation and deployment:

- technology licensing costs are high despite lack of investment-grade information (eg, licence for Pelamis device estimated at NZ\$400k despite no info on power curve or whole-of-life costs)
- respondents believe that they will face delays in accessing specialist technologies (eg, rigs) for installation of their devices due to the tight supply internationally.

### **4. INVESTMENT**

As discussed previously, most of the projects are small in scale, run by enthusiasts (rather than power companies) and appear undercapitalised.

The following factors were cited as impacting on investment into their projects:

- uncertainty caused by policy issues such as the Foreshore and Seabed debate and the Aquaculture Moratorium (around the perceived ability or otherwise to secure resource approvals, suitable sites and long-term operating approvals)
- legislation restricts certain potential investors/strategic partners from entering the market. For example, the Electricity Industry Reform Act requires separation of 'generation' from 'networks' or distribution and restricts, for example, lines companies' ownership of power plants.

### **5. INFRASTRUCTURE**

The following infrastructure-related issues were reported:

- some level of government assistance will be required to kick-start the development of offshore, on-site infrastructure
- access to the national grid will need to be facilitated;
- responsibility for back-up storage or co-generation facilities to smooth generation peaks needs to be determined.

### **6. OTHER**

- The lack of a wave or tidal energy focused courses within existing Renewable Energy programmes courses at New Zealand universities will limit the development of the necessary skill base to service the industry. This is already being seen in the inability of the respondents to secure qualified people for small-scale proof-of-concept or demonstration projects. *The study team considers this irrelevant as core skills in mechanical engineering, power engineering, control systems and related skills areas are well covered by conventional tertiary engineering programmes. The issue is that these skills are in high demand and there are excellent other opportunities in the marketplace.*

- The single tank testing facility at Auckland University is not designed for testing and development of wave and tidal devices. Respondents suggested that inadequate facilities will limit activity in the industry and force proponents to test technology offshore. *We note on the other hand, that overseas technology developers do not see this as a major issue as presumably they have access to their own in-house facilities or similar.*

## **f. Suggested Interventions**

### **POLICY issues**

Government should consider:

1. taking the lead on facilitating the development of a specific assessment protocol for wave and tidal energy projects which reflects the risk profile of these types of activities. The protocol should take into account the scope of proposed projects (ie, demonstration or proof-of-concept vs. commercial projects) and scale the data and consultation requirements accordingly, which should expedite the consent process to the advantage of the project sponsor
2. better communication on resource consent applications, outcomes and corresponding rationales could address the respondents' general fixation on failures in the RMA process
3. establishing a web directory for directing wave and tidal practitioners to appropriate experts and advisers would ensure that they receive timely advice to prevent poor information and misconceptions from becoming entrenched
4. developing a training programme for regional councils around the Taranaki Regional Council's expertise in offshore resource permits, in order to address the reported processing inconsistencies across other councils
5. centralisation of the approval process for offshore consent applications is a further intervention for streamlining the consent process, to ensure consistency of application of the RMA across the regional councils
6. the policy framework to prevent the emergence of a wild-west scenario for wave and tidal energy previously seen in the aquaculture industry ('first come, first served', squatting, overlapping permits). One mechanism may be to implement an oil and gas exploration-type work programme regime or fishing quota-type regime
7. facilitating wide consultation around the development of a Code of Practice to test RMA and identify issues specific to wave and tidal projects.

### **RESOURCE INFORMATION issues**

8. FRST support for a National Wave and Tidal Resource Database should be investigated. An estimate of \$4.6m over 5 years has been provided for the development of a nationwide wave-rider buoy network that could provide data for wave and tidal, hazard investigations, navigation advisory, hydrodynamic modelling, marine structure design analysis. The precedence for FRST support for such an initiative has been set by its funding of the National Water Resources database established in the 1950s. Benefits would include more moderate competition for sites by allowing closer matching of technologies and generation capacities with specific sites.

## INVESTMENT issues

9. Addressing the policy issues discussed above will probably resolve the sovereign risk issues affecting inwards investment.
10. Government should probably consider mechanisms to facilitate information sharing regarding wave and tidal or renewable energy funding programmes;

## INFRASTRUCTURE issues

11. Government could facilitate discussion around industry funding the development of a 'Marine Energy Park' similar in concept to Wave Hub UK or the European Marine Energy Centre (EMEC).
12. This Marine Energy Park could operate as a technology incubator, testing ground for new devices and perhaps as a conduit for commercial energy parks located in close proximity. It could be expected that establishment of a tank testing facility onsite would be integral to the Energy Park.
13. Government should be facilitating discussion between wave and tidal proponents, other power companies and the transmission company to develop a grid access protocol, and also issues around the scale and responsibility for back-up storage facilities.

## g. Commercial Opportunities

14. The establishment of a Marine Energy Park in New Zealand with a technology incubation focus could attract more wave and tidal R&D and demonstration projects from overseas. A number of respondents reported approaches from overseas companies interested in conducting wave and tidal R&D projects in New Zealand on the basis that New Zealand's lower population density will provide better access to test sites than Europe.
15. Respondents have also suggested that government support for an international conference on wave and tidal energy, given the current interest in the industry and the number of devices currently being commercialised, could go some way towards establishing New Zealand as a centre for wave and tidal energy R&D. *We note that government may have other priorities under its Growth and Innovation Strategy in respect of where New Zealand might reasonably expect to achieve world class performance in new technology development.*

## Summary and Conclusion

Based on the interest and activity in the industry, and the range of devices currently being commercialised, the study team's provisional conclusion is that one or more business cases are about to emerge that could establish the platform for the growth of the wave and tidal energy industry in New Zealand.

In the short to medium term, the early wave and tidal energy projects are likely to address niche opportunities by seeking to offset some level of financial return against the opportunity to leverage, or demonstrate the technology and/or secure access to the marine resource. Their underlying business cases are likely to be sub-commercial (or commercial only on a small scale), where their economic value is likely to be in terms of supporting network reliability rather than from pure generation potential.

While the respondents have indicated a preoccupation with resource issues, it is the study team's position that the wave and tidal energy industry represents a technology rather than a resource opportunity. We believe that technology risk issues, rather than access to the wave and tidal resource, will form the main impediments to fully commercial deployment.

Finally, the study team suggests the following areas for further investigation:

1. a review of the development of the wind power industry to provide a relevant 'guide' or critical success factors for the development of the wave and tidal energy sector (more so than the Maui success story used for this investigation)
2. an analysis of the impact of relevant marine legislation and policy, and the Marine Reserves Act in particular, on the economic implications to the economy from the exclusion of optimal wave and tidal energy sites from commercial use
3. a review of the aquaculture sector to provide lessons towards the development of an allocation regime for the wave and tidal industry, that would encourage development of the industry while sanctioning inefficient use of the resource and anti-competitive use of the consent process.

## CASE STUDY 4: ISSUES AND BARRIERS IN THE DEVELOPMENT OF A GAS HYDRATE SECTOR

### a. Introduction

Surveys have indicated the potential presence of large volumes of gas hydrate on the Hikurangi Margin off the East Coast of New Zealand's North Island, and the Fiordland-Puysegur Margin on the West Coasts of the South Island. Yet the study team was unable to identify any participants in the oil and gas sector currently involved in, or planning in the near term, participation in the economic development of the gas hydrate resource.

Consequently, this case study is based on feedback provided by members of the science community, in particular GNS and the National Institute of Water and Atmospheric Research.

### b. Methane Hydrates

Natural gas hydrates are solid, ice-like materials containing predominantly methane and small quantities of other gases bound in a lattice of water molecules formed at moderate high pressure and at temperatures close to the freezing point of water. They are found in high concentrations in the 'Hydrate Stability Zone', which are permafrost regions onshore and in ocean bottom sediments in water depths exceeding 450 m.

One of their unique characteristics is that at sea level and standard pressure, gas hydrates will disassociate or dissolve and the methane component of the hydrate lattice or cage will expand to 163 times its 'frozen' volume.

Gas hydrates have attracted a lot of interest in the past decade because:

- natural gas is expected to be the fastest growing primary energy source in the world over the next 25 years<sup>21</sup>
- methane hydrates constitute a potentially vast, relatively climate-friendly and efficient source of natural gas, with large deposits located in close proximity to expected growth demand areas (eg, Japan and India) compared to current resource areas for conventional gas<sup>22</sup>
- significant methane hydrate deposits have been discovered within the jurisdiction of countries currently without indigenous oil or gas resources (eg, Japan, India, Korea).

The 'Central Consensus' estimate of the potential size of the methane hydrate resource worldwide is approximately 742,000 trillion cubic feet (tcf) of gas, compared to the estimated 13 million tcf natural gas resources (excluding methane hydrates).<sup>21</sup> Irrespective of the actual figures involved, the magnitude of the potential resource base of gas hydrates could, if successfully commercialised, power the world for centuries.

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<sup>21</sup> Energy Information Administration (1998). *Natural Gas – Issues And Trends*, p 73.

<sup>22</sup> Pecher, IA & Henrys, SA (2003). 'Potential Gas Reserves in Gas Hydrate Sweet Spots on the Hikurangi Margin, New Zealand'; *Science Report No 23*, Institute of Geological & Nuclear Sciences.

### c. Importance of Methane Hydrates to New Zealand

New Zealand shares with the rest of the world, an ongoing and increasing demand for natural gas. The depletion of the Maui gas field and the lack of capacity from both existing wells and lack of recent discoveries to meet anticipated demand in the future, will force the introduction of new strategies to meet the energy supply gap. One potential opportunity may be the economic development of New Zealand's considerable methane hydrate resources.

New Zealand has the most promising known gas hydrate resource potential in the Southwest Pacific, the Hikurangi Margin in particular deemed to be one of the most promising gas hydrate provinces in the world.<sup>23</sup>

The Hikurangi Margin covers an area of approximately 50,000 km<sup>2</sup>, extending from offshore Gisborne on the East Coast of the North Island southwards to offshore Marlborough. A recent study by Pecher & Henrys (2003) suggests a methane hydrate resource base of approximately 228.5 km<sup>3</sup> of gas, with approximately 813 trillion cubic feet or tcf potentially recoverable. More importantly, Pecher & Henrys suggest that up to 10% of this area may be covered by 'sweet spots' or areas with very high gas hydrate concentrations. They have further suggested that these sweet spots collectively could contain recoverable gas more than six times the size of Maui and more than 16 times the size of New Zealand's known gas reserves as of June 2002.<sup>24</sup> One sweet spot in particular is estimated to contain recoverable gas equivalent to 10% of the original volume of the Maui field.

Notwithstanding the technical complexities of extraction and production and a number of environmental concerns, gas hydrate sweet spots could provide an economically viable opportunity for New Zealand.

### d. Gas Hydrate Research

Despite the huge potential economic opportunity, funding for gas hydrate research in New Zealand is not on par with the levels of research funding in Japan, Canada or the US.

Japan is the current leader in gas hydrate research, with an annual research budget of US\$50m and a target of commercially viable production of natural gas from gas hydrates by 2016. Since commencing in the mid 1990s, the Japanese programme has developed two exploration test wells: one onshore in the McKenzie Delta in the Canadian Arctic in 1997 and one offshore in the Nankai Trough, Japan in 2000. There is also an onshore production 'concept' well in the McKenzie Delta in 2002. It is worth noting that as recently as March 2006, the Japanese programme has claimed that they expect to achieve their target of commercial production of gas hydrates within a 2-year window of 2016.<sup>25</sup>

United States gas hydrate research is close behind Japan, with US\$50m in gas hydrates research funding committed over a 5-year period by the Federal Methane & Hydrate R&D Act 2000. The US research programme includes two dedicated Ocean Drilling Programme (ODP) legs at Blake Ridge on the US East Coast (which commenced in 1995) and at Hydrate Ride, off the coast of

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<sup>23</sup> Pecher, IA (2006). *Gas Hydrates-Fuel Of The Future: A New Zealand Perspective*, Presentation to MfE Workshop, Wellington, 13 March.

<sup>24</sup> Pecher, IA & Henrys, SA (2003). 'Potential Gas Reserves in Gas Hydrate Sweet Spots on the Hikurangi Margin, New Zealand'; *Science Report No 23*, Institute of Geological & Nuclear Sciences.

<sup>25</sup> Pecher, IA (pers comm).

Oregon (which commenced in 2002). The US collaborates with Japan and Canada in exploration activities on Alaska's North Slope.

The US Geological Survey has estimated Alaska's North Slope methane hydrates resources at 590 trillion cubic feet, with an additional 32,375 trillion cubic feet in the nearby Beaufort and Chukchi Seas. The location of methane hydrates near proven conventional gas reserves ensure that Alaska's North Slope will be the premier area for methane hydrate research and future production in the near future.

India, Korea and China are also involved in gas hydrate research, predominantly into its characterisation as a potential energy source.

## **e. Gas Hydrate Research in New Zealand**

Notwithstanding the relatively low levels of gas hydrate research funding, the quality of New Zealand research appears to be internationally recognised and valued. Evidence of this may be found in the participation of New Zealand researchers in a number of international research projects. They also play key roles in driving and securing international support for the development of an 'International Gas Hydrates Research Corridor' on the Hikurangi Margin.

Two key Crown-funded research projects are currently underway:

- an investigation into the characterisation of New Zealand's gas hydrates as a potential energy source, funded by the Foundation for Research, Science and Technology (FRST) between 2003 and 2009;
- an investigation into the relationship between the disassociation of natural gas from gas hydrates into the ocean under natural conditions and seafloor stability, sponsored by the Marsden Fund.

The GNS gas hydrate Task Force led by Dr Ingo Pecher, a marine seismologist, currently heads New Zealand gas hydrate research. Members of the Task Force include from GNS: Stuart Henrys (marine seismologist), Susan Ellis (modeller), Kevin Faure (geochemist); and Jens Greinert, University of Ghent, Belgium (currently undertaking an European Union Fellowship at GNS, geochemist).

The Task Force is currently in collaboration with:

- Otago University: Andrew Gorman (geophysicist), Gareth Crutchly and Miko Fohrman, (PhD candidates and geophysicists)
- NIWA: Helen Neil (paleoceanographer) and Steve Chiswell (oceanographer)
- GeoForschungsZentrum in Potsdam, Germany: Nina Kukowski (modeller).

International collaboration in 2006–08 includes:

- a joint US-New Zealand funded expedition on the NIWA research vessel *Tangaroa* in 2006 to conduct high-resolution seismic and piston coring of the Hikurangi Margin
- a German-funded expedition on the German research vessel *Sonne* in 2007 to address some of the objectives of the Marsden and FRST projects.

In the medium to long term, New Zealand researchers hope to leverage their research capabilities by:

- expanding existing collaboration arrangements with Chile and Korea
- establishing an ‘International Gas Hydrates Research Corridor’ on the Hikurangi Margin
- developing new collaboration opportunities through attendance at relevant international conferences.

## **f. Reported Issues and Barriers**

### **POLICY**

- The significance of the potential economic value requires policy debate now, and potentially the development of appropriate allocation regime to protect the resource while encouraging the development of a gas hydrates industry. Gas hydrates represent truly frontier opportunity, with limited information and high technical risk. Consequently, a robust yet risk tolerant regime will be required to facilitate development of the opportunity.
- Attention was drawn to the Marine Reserves Act 1971 which would potentially strand new opportunities as it prohibits protected areas (eg, national parks) from prospecting and other commercial activities.

### **RESOURCE INFORMATION**

- Although the Hikurangi Margin has been surveyed to some degree, more research is still required to map and appraise gas hydrate sweet spots in the area, and prioritise sweet spots for future development when the technology becomes available.
- More research into the characterisation of the New Zealand gas hydrate resource is also required as methane compositions in hydrates can vary geographically, with resulting implications for extraction and production.

### **TECHNOLOGY AND EQUIPMENT**

- Commercial production technology is currently unavailable, although conventional oil and gas technologies could be adapted.
- Significant technical issues currently exist around extraction and transportation of gas hydrates.

### **INVESTMENT**

- The high levels of gas hydrate research may be an indicator of the potentially high cost of extraction and production technology when they become available.
- Access to the technology may require some level of government involvement or support, as occurred with the development of Maui.
- Attracting inwards private investment on the scale anticipated will require attractive policies and incentives, or better promotion of the higher prospectivity of the New

Zealand gas hydrate resources relative to Alaska and Gulf of Mexico (the current focus of hydrate research by USA, Japan and Canada).

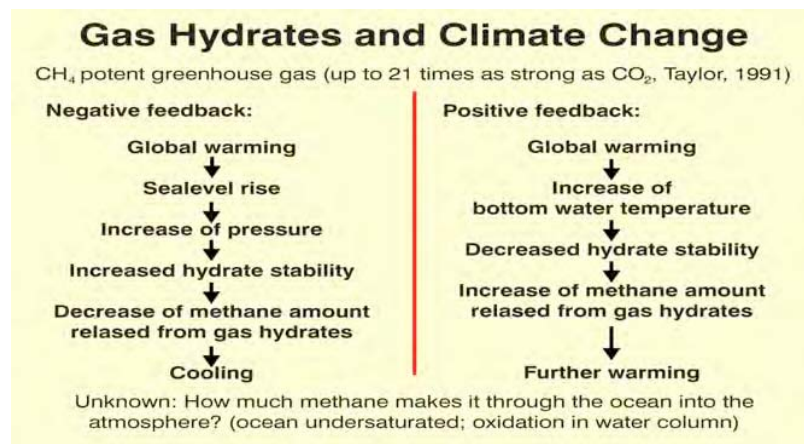
## INFRASTRUCTURE

- Existing onshore Taranaki infrastructure could be utilised if the technical issues around extraction and transportation are successfully addressed.
- There may also be a business case for the development of new infrastructure on the East Coast of the North Island to be in closer proximity to the sweet spots on the Hikurangi Margin. Such infrastructure is likely to follow successful petroleum development in the region.

## ENVIRONMENTAL

There are a number of environmental issues currently being debated internationally around gas hydrates.

- The ‘Smoking Gun’ hypothesis suggests that the release of methane into the atmosphere from disassociating gas hydrates creates one of two climate change scenarios (Fig C4.1):



**Figure C4.1: Gas hydrates and climate change scenarios (source: Ingo Pecher: Presentation to MfE Workshop 13/0/2006 )**

- There is also the ongoing debate around the proposition that the extraction of gas hydrates from the seabed could affect seabed stability and lead to landslips or slides, resulting in tsunamis.
- Finally, there are ‘chemo-synthetic’ bio-organism colonies associated with gas hydrate deposits that not well understood or researched. This lack of information will have a bearing on the ability of pioneers to secure resource consents under the present consent regime.

## g. Suggested Interventions

1. Respondents have suggested that government should lead a national or international discussion on gas hydrates, while the industry is still in a formative stage, to identify issues pertinent to economic development of New Zealand's gas hydrate resource to ensure adequate debate and encapsulation of issues into policy.
2. Respondents have suggested that policy should ensure that relevant Ministers retain their discretion to permit new or novel opportunities, such as gas hydrates, to emerge in New Zealand's ocean territories. *The key point here is that the regulatory environment needs flexibility to provide for new activities.*
3. Given the potential economic significance of gas hydrates, respondents and the study team agree that policy needs to be set before 'trail blazing' should be allowed to commence.
4. We agree that the policy environment should attract inwards investment for exploration, discovery and development. Gas hydrates could provide a long-term opportunity to replicate the skills and engineering base which development of Maui catalysed and which New Zealand has developed into a significant export opportunity since.
5. The respondents, participants at the MFE workshop and the study team agree that a closer integration of science policy (eg, mapping sweet spots and characterising hydrates) and a 'national' engineering policy (ie, to develop 'enabling' skills and technologies) with Oceans Policy in the short to medium term should occur as a strategy to facilitate the eventual commercial development of the gas hydrates opportunity
6. We concur that in support of the development of a gas hydrate industry in New Zealand, government should actively facilitate the opportunity development continuum from science investigation, to resource mapping, through a pre-commercialisation stage. At this point the typical oil and gas field development process can kick in prior to commencing commercial production.
7. Finally, a strategy needs to be developed to ensure that the mapping and quantification or appraisal of hydrate reserves, including intensive testing of sweet spots on the Hikurangi Margin, becomes a strategic national priority.

## Summary and Conclusion

The economic development of New Zealand's gas hydrates resource represents a truly classic frontier opportunity, involving high risk and potentially higher rewards on a scale vastly larger than the other case studies investigated.

Given the significant economic potential of its successful commercialisation, the study team suggests further investigation into the following issues:

- **To what extent and in what timeframe does New Zealand need to prepare for the economic development of this resource?** Given that technology is not currently available for extraction and production, should New Zealand wait till it becomes available to begin developing policy; or should discussion on an appropriately risk-tolerant policy framework begin now?
- **At what point and in what role should government become involved in the development of the industry?** Using the analogy of gas hydrates as a 'ripening crop' waiting to be harvested, it is important to note that pioneers may be prepared to accept

‘green fruit’. Consequently, there is a dynamic that has to be actively managed between ensuring that policy enables pioneering activity, while simultaneously protecting the national interest to the extent that ‘picking winners’ does not prevent an optimal development of the resource opportunity. *Again, the key point is that the regulatory regime needs flexibility to allow unfettered entry and exit;*

- **Are gas hydrates governed by the Crown Minerals Act and if so, are the provisions appropriate to the sector?** As gas hydrates fall within the ‘hydrocarbon’ definition of the Crown Minerals Act, prospecting permits can be granted under the current regime. However, an analogous case has arisen in respect of minerals (notably gold) associated with active and extinct volcanic vents. In 2002 a very large permit covering virtually all of New Zealand’s potential resources of this type, was given to an Australian entrepreneur. While this may or may not lead to the emergence of a viable new industry, the possibility of a monopoly situation. That limits other potential entrants should exploration prove successful and may be undesirable; this consideration needs to be carefully balanced with the need for a property right of sufficient scale to encourage investment.

Additionally, the conventional permitting regimes may need to be adjusted as the development of the gas hydrate opportunity is likely to fall outside the timeframes that apply under the current act (ie, a 10-year permit term) thereby requiring a more flexible permitting regime

- **What is the optimal regime to enable the Crown to capture a benefit from the development of the resource?** Will a unique regime be required or will the existing regime support the expected ‘low margin, high volume’ business case? Without an appropriate regulatory framework in place, there may not be the required allocation and environmental management regimes to maximise their resource potential.
- **What is the optimal policy framework for gas hydrates?** Given the size of the potential economic opportunity and the international interest, the Study Team suggests that it needs to be based on clear principles, contains codes of practice that constrains proponents to act competitively, and also provides clear certainty that projects will not be compulsorily acquired, nationalised or taken over.

## BIBLIOGRAPHY

- Anonymous (no date). *Success Story: In Pursuit of Petroleum*. News item on website of Foundation for Research Science & Technology.  
[www.frst.govt.nz/research/Success\\_Stories/Oil\\_and\\_Gas\\_Exploration.cfm](http://www.frst.govt.nz/research/Success_Stories/Oil_and_Gas_Exploration.cfm)
- Centre for Advanced Engineering (1996). *New & Emerging Renewable Energy Opportunities in New Zealand*.
- Centre for Advanced Engineering (2001). *Our oceans: A journey of understanding*. CAE Comments Series 1.
- Centre for Advanced Engineering (2003). *Economic Opportunities in New Zealand's Oceans*. Report to the Oceans Policy Secretariat, Ministry for the Environment, p 3.  
[www.mfe.govt.nz/publications/oceans/economic-opportunities-oceans-jun03/economic-opportunities-oceans-jun03.pdf](http://www.mfe.govt.nz/publications/oceans/economic-opportunities-oceans-jun03/economic-opportunities-oceans-jun03.pdf)
- Crown Minerals (1991). *Petroleum Systems of New Zealand*. [www.crownminerals.govt.nz/petroleum](http://www.crownminerals.govt.nz/petroleum)
- Energy Efficiency and Conservation Agency (no date). *Fact Sheet No 5: Marine Energy*.
- Energy Information Administration (1998). *Natural Gas – Issues And Trends*, p 73.
- Hart Energy Publishing (2006). *Kiwis Help Exploration*. News item on website of Hart's E&P net, January. [www.eandpnet.com/articles/newsAndComments/4187](http://www.eandpnet.com/articles/newsAndComments/4187)
- Hooper, RJ (2006). *Medium Term Vulnerabilities Within The New Zealand Gas Market*, Paper to New Zealand Petroleum Conference, p 8.
- Huckerby, J (2005). *Wave & Energy Conversion*. Presentation to the Maritime 21 Oceans of Opportunities Workshop, Lincoln University, February.
- Huckerby, J (2006a). Maritime 21 Presentation, February.
- Huckerby, J (2006b). Presentation at inaugural AWATEA Meeting, 10 February. Aotearoa Wave and Tidal Energy Association.
- Ministry for Economic Development (no date). *Taranaki Basin Producing Fields*, p 22.
- Pecher, IA & Henrys, SA (2003). 'Potential Gas Reserves in Gas Hydrate Sweet Spots on the Hikurangi Margin, New Zealand'; *Science Report No 23*, Institute of Geological & Nuclear Sciences.
- Pecher, IA (2006). *Gas Hydrates-Fuel Of The Future: A New Zealand Perspective*, Presentation to MFE Workshop, Wellington, 13 March.
- Sherman, M & Fisher, GW (no date). *The Current Status of Wave & Tidal Energy*, Pacific Clean Energy, p 2.
- United Kingdom Trade & Investment website, Oil & Gas Exploration page:  
[www.uktradeinvest.co.nz/services/trade/sectors/oilandgas.htm](http://www.uktradeinvest.co.nz/services/trade/sectors/oilandgas.htm)
- United Kingdom Trade & Investment (no date). *The Oil And Gas Market in New Zealand, a Sector Summary*. p 7.

## APPENDIX

### LIST OF RESPONDENTS

| Name                         | Organisation         | Contribution   |
|------------------------------|----------------------|--|
| Brian Gundersen & Don Turley | Kensington Swan      | RMA / Legislation / Maui                                 |
| Tara Ross-Watt               | Maritime NZ          | RMA / Oceans Policy / Oceans Jurisdiction / Wave & Tidal |
| John Huckerby                | AWATEA               | Wave & Tidal   |
| Murray Hill                  | Meridian Energy      | Wave & Tidal   |
| Gavin Fisher & Micah Sherman | Pacific Clean Energy | Wave & Tidal   |
| Paul Henson                  | Pearson Innovation   | Wave & Tidal   |
| Anthony Bellve               | Crest Energy         | Wave & Tidal   |
| Dennis Jamieson              | NIWA                 | Wave & Tidal   |
| Paul Hazledine               | NGC                  | Exploration / Maui / Gas Hydrates                        |
| Geoff Cassells               | Ex Shell             | Exploration / Maui                                       |
| Clyde Bennett                | Tap Oil              | Exploration  |
| Dr Mac Beggs                 | GeoSphere            | Exploration  |
| Ingo Pecher                  | GNS                  | Gas Hydrates   |
| Ian Wright                   | NIWA                 | Gas Hydrates   |

### ADDITIONAL WORKSHOP PARTICIPANTS

|                  |                                 |
|------------------|---------------------------------|
| Daniel Brown     | Ministry for the Environment    |
| Dr George Hooper | Centre For Advanced Engineering |
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| Kevin Chong      | Nexus Consulting                |
| Peter Apperly    | Meridian Energy                 |
| Darryl Thorburn  | Crown Minerals, MED             |

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