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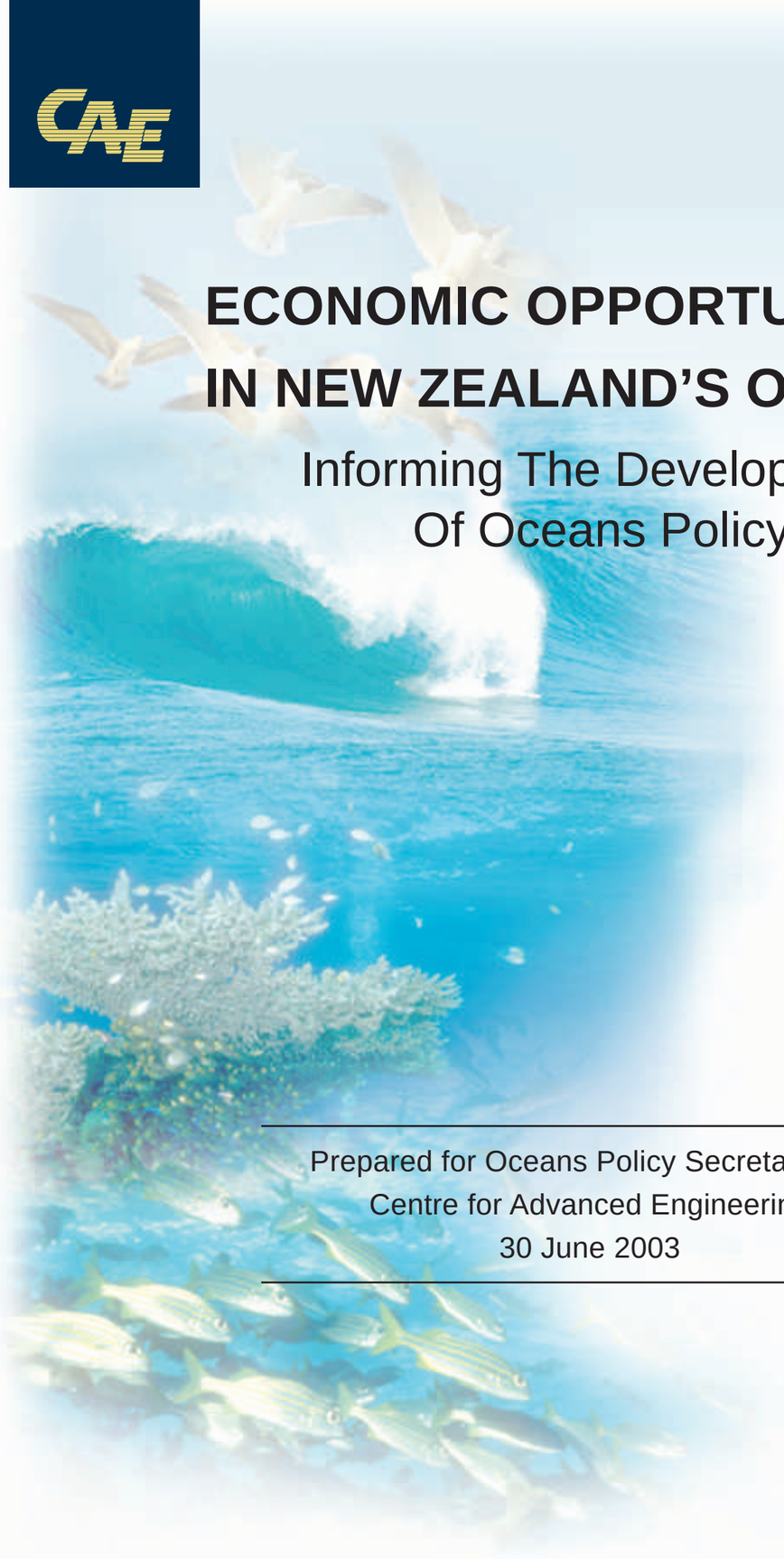
ECONOMIC OPPORTUNITIES IN NEW ZEALAND'S OCEANS

Informing The Development Of Oceans Policy



Prepared for Oceans Policy Secretariat by
Centre for Advanced Engineering
30 June 2003

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Executive Summary

New Zealand has an extensive ocean territory including its Territorial Sea, Exclusive Economic Zone and the anticipated Legal Continental Shelf extensions. Commercial activities related to the ocean have long contributed to the New Zealand economy, and the potential exists for significantly increased contributions in the future. The oceans are seen as having ample capacity to meet this challenge.

This study is focussed primarily on understanding the economic activities that take place in New Zealand's ocean territories so as to avoid barriers that might otherwise stand in the way of achieving best value in the future. This study is also concerned with assessing those factors that have been identified as vital to the facilitation of economic opportunities.

Part One reviews the significant contributions that ocean resources and associated services make to the New Zealand economy today, and considers opportunities that may arise in the future. A number of emerging sectors, considered likely to become significant in the future, are also discussed. Some important highlights emerge.

Seafood industries have grown significantly in recent decades and it is estimated that over 15,000 people are now employed in this sector. The advent of the Quota Management System has underpinned the growth of the fishing industry while ensuring sustainability of fish stocks. Aquaculture has emerged, particularly during the past decade, as an important additional contributor of economic value, with considerable potential for growth in several regions including areas situated well away from the coast.

New Zealand's coastal and marine environment are key features of the leisure and tourism markets, which are also forecast to generate long-term growth in economic value.

Much of the infrastructure essential to the overall performance of the New Zealand economy and trade also impinges on the ocean. This includes ports, the inter-island ferries and coastal shipping, the Cook Strait power cables and both, internal and international telecommunications cable networks, and the Maui gas field and its associated platforms, production facilities and pipelines. To sustain and grow the New Zealand economy, existing commercial activities in the ocean, and infrastructure services and networks, will have to continue and develop, together with the opportunities provided by new activities that can be expected to emerge.

For nearly 30 years, the Maui gas field has contributed about 25% of New Zealand's primary energy supply. Although the output from the field is now declining, a handful of gas and oil fields off the Taranaki coast await development, and more may be discovered there and elsewhere, including the extensive deep-water sedimentary basins within the EEZ. Alternative energy sources may also be developed. These include the substantial energy fluxes of tidal currents, waves and wind, and the very large resources of gas hydrate identified off the East Coast and elsewhere.

Active research programmes have, in recent years, begun to identify intriguing commercial possibilities in marine environments such as seamounts, active submarine volcanic vents, and canyons. Physical resources associated with some of these include metal ores and energy. Biological resources associated with extreme environmental conditions are also likely to contribute high-value commercial opportunities. As well as these, there will inevitably be other classes of opportunity that are as yet unforeseen.

As New Zealand transforms to an increasingly maritime nation, related service industries such as boat-building and marine engineering will experience sustained growth.

An indicated high-level objective of Oceans Policy is to provide for economic return from New Zealand's oceans. The views of industry stakeholders have been canvassed to seek their views as to the effective achievement of this goal.

The current situation of a moratorium on new aquaculture ventures is a key point of concern for several

stakeholders, including *iwi*. Moratoria are seen as an impediment to innovation and growth. The provisions of the Marine Reserves Bill are also seen by industry stakeholders as a potential restraint to sustainable development of ocean resources.

However, many features of the existing legal and policy framework are widely supported by industry. The Quota Management System is seen to have been a crucial factor in the sustainable expansion of the seafood industry. Although the operation of the Resource Management Act draws criticism in specific instances, its fundamental basis is well-regarded.

Discussion in Part Two of this report, which considers policy to provide for economic return from New Zealand's oceans, is built on both, the analysis of existing commercial activities, and the views and foresight of participants. While some existing sectors are currently growing, there will be a continuing development of new opportunities, not all foreseeable, for which provision needs to be made. Fostering technological development is considered a necessary key in providing for innovation and transforming the business process. Infrastructure development, including a strong knowledge and innovation system, is also crucial to attainment of policy goals.

Government will be expected to ensure that a well-balanced enabling policy, and statutory framework with clear and efficiently administered property rights, are provided. The essential principles identified by stakeholders for deriving economic opportunity from the ocean are that an oceans policy framework:

- is based on explicit and sound principles that are coherent and consistent;
- is supported by a well-developed and efficient infrastructure;
- allows for pro-active interaction by government when appropriate;
- provides for knowledge to be shared;
- is efficient in its administration;
- recognises the principles of the Treaty of Waitangi;
- recognises and enforces rights of tenure appropriate to each sector; and
- is durable and robust enough to provide for new opportunities that may arise from technological development, resource discovery, or demand, to be taken advantage of in an efficient and sustainable manner.

To support oceans policy and ensure that New Zealand's ocean territory is properly managed in the future, it is apparent that new structures and legislation will be required. Difficulties are seen, particularly in the development of suitable and workable consenting processes. The acquisition, management and application of knowledge, within a balanced economic and environmental policy framework, will be vital. Transparent and robust systems and processes will need to be developed and continuously refined in order to achieve international best practice.

The lack of consistent tools for assessing the environmental and other impacts of proposals, outside the limits of the territorial sea, is recognised. The principles underpinning the Resource Management Act 1991, which require proponents to provide an assessment of such effects, are seen to provide a sound basis for developing appropriate resource management tools.

In administering New Zealand's ocean, careful consideration also needs to be given to the form and allocation of property rights to foster sustainable commercial practices. *Iwi* have particular interests in the marine realm and can build on a strong involvement in the seafood sector to participate in other commercial opportunities as well.

The role of existing agencies in the administration of future oceans policy is recognised but there is a strong case for a national institution that is focused on all aspects of New Zealand's ocean territory and its effective management.

Among the critical components identified as being necessary for a successful oceans management are

provision for:

- integrated approaches;
- knowledge-based industries;
- property rights that enable access to opportunities;
- regulatory frameworks that attract investment;
- acknowledgement of the process of technology advancement and that what is known today will be different in future; and
- conservation rather than preservation.

The United Nations Convention on Law of the Sea, to which New Zealand is a signatory, requires states to provide for regulated exploitation of their marine resources. As a nation with a very large ocean territory in relation to its land mass, New Zealand should continue to take a leading role in the implementation of appropriate development frameworks, and reap the potential benefits of resource use and development on a sustainable basis.

Introduction

As a nation with a land territory entirely surrounded by a much larger expanse of ocean, recognising New Zealand's oceans as a source of economic opportunity is in no way novel. The earliest human settlers came by sea. They brought with them a degree of economic organisation that certainly included the harvest and husbandry of ocean resources, and the application of seafaring competence, to become established as *tangata whenua* in populating one of the last significant land masses on the planet.

New Zealand became a nation, first as a colony and then as a dominion, following several decades of economic exploitation by early European visitors and settlers. Early entrepreneurs sought resources, including marine mammals and such useful materials as kauri timber and flax fibre, and entered into informal but often substantial trading arrangements with the native inhabitants.

Throughout the subsequent history of New Zealand, economic development has been driven by a succession of growth sectors. Many of those upon which the nation was founded, including whaling, sealing and native forest harvesting, have successively fallen by the wayside, generally as a result of the unsustainable way in which they were exploited. For generations, it was the land that yielded the resources for growth sectors. But in the latter part of the 20th century, the oceans came back into focus through the successful development of a number of industries including:

- fishing, following reform through the Fisheries Act (1986);
- aquaculture;
- increasing urbanisation of the coast;
- increased sea-borne trade of primary and manufactured products;
- an explosion in communications via high-capacity cable systems;
- key underpinnings of New Zealand's energy infrastructure, including the development and production of the Maui gas field, and the transfer of electricity between the North and South Islands via the Cook Strait cable; and
- leisure services including key components of the New Zealand tourism sector, luxury craft design and manufacture, and popular recreational pursuits such as boating and fishing.

The Oceans Policy initiative, to which this report contributes, is explicitly searching for the best ways to pursue economic opportunities within New Zealand's oceanic territory, generally in accordance with accepted principles of sustainable development. The nation's economic growth will be driven by a few sectors at a time. If this is unnecessarily restricted, the opportunity for a sector to expand within the limits of sustainability principles may well be lost.

It is generally difficult to appreciate the potential for new economic pursuits to generate value and national economic growth, and this report does not pretend to comprehensively forecast future successes. What is important is to inform the crafting of a policy approach that will enable innovation to expedite value creation from whatever opportunities present themselves, subject to straightforward sustainability tests.

This report is presented in two parts:

Part One discusses present economic activity in New Zealand's oceans and the opportunities that may arise in the foreseeable future.

Part Two considers the policy framework necessary for realisation of the indicated policy goal: "Provide for economic return from New Zealand's oceans".

Part One is organised by sector. Those that are based on natural resources are examined in terms of the business processes through which technology and knowledge, and capital investment, leverage access to requisite resources to build and deliver value to end consumers. Infrastructure contributions to wealth creation are also described. The current growth trajectory of each sector and potential

longer-term directions are indicated. A number of emerging sectors are also discussed that have been identified as likely to become significant in future decades, subject generally to either technology development or increased commodity value.

Information for each of these sectors comes from a diverse range of sources. The basis upon which value figures are given vary from sector to sector and cannot be directly compared. For some sectors, there are few hard data available at all. This reflects, among other things, the varying maturity of individual sectors, the diversity of activity under some headings, or the difficulty in separating out the ocean-based component of some activities, such as tourism. In addition, the issues influencing economic opportunity in each sector vary widely. The result is that different sectors inevitably receive different treatment in Part One.

The analysis of ocean commercial sectors in Part One forms the basis for a consideration of those factors that are most likely to affect their success. In Part Two these are discussed following a synthesis of discussions held with a range of industry leaders, aimed at eliciting their views on the current policy framework and the ideal features of future Oceans Policy.

The oceans are expected to make an increasing contribution to New Zealand's economic performance and are seen as having ample capacity to do so. Suggestions in Part Two of this report for policy to provide for economic return from New Zealand's oceans are built on both the analysis of existing commercial activities and the views and foresight of participants.

Part 1: Current Economic Activities and Future Opportunities

Natural resources

Living and physical natural resources are important contributors to marine-based economic activities. Some, such as fishing, have had a long history. Some, such as oil and gas exploitation, are relatively recent, and others, such as biotechnology and ocean energy, are emerging future industries.

Oil and natural gas

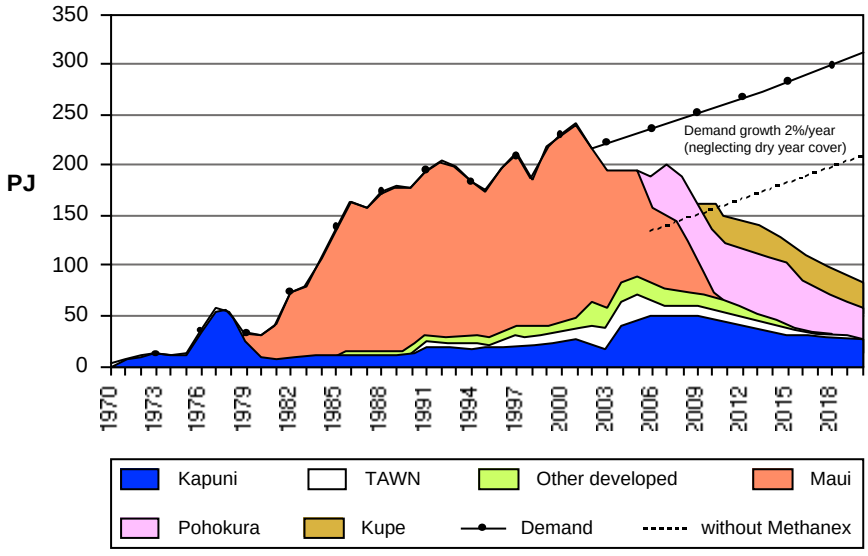
Since offshore hydrocarbon exploration began in New Zealand in the 1960s, oil and gas have been discovered in several parts of New Zealand's offshore territory, with the only commercial production to date arising from the development of the Maui field, 35 to 50 km off the Taranaki coast. At the time of its discovery, Maui was one of the largest identified gas fields in the world.

At Maui, oil and natural gas are contained within sandstones about 3000 m beneath the sea bed in 106 m water depth. Production is from 22 wells drilled from two offshore platforms. The gas, and the condensate that separates from it at the surface, travels by pipeline to processing facilities at Oaonui on the southern Taranaki coast. Here, the raw gas is separated into several products for distribution and sale: pipeline specification gas as well as liquefied petroleum gas (LPG), condensate and naphtha. Gas production began in 1979. Since 1996, oil has been produced into a separate floating facility from which it is transferred to tankers and exported.

Production for the year to June 2002 was 168 billion cubic feet (bcf) of gas, 5.5 million barrels (mmbbl) of oil, 6 mmbbl of condensate and 168,000 tonnes of LPG a year, accounting for about 75% of New Zealand's hydrocarbon production. The importance of offshore hydrocarbons as a key underpinning of the New Zealand economy cannot be overstated, and is demonstrated by the Maui component of New Zealand's gas supply.

The production value alone of Maui oil and gas in 2002 was about $370m. Royalties paid to the Crown were $14m in the same year, in addition to Energy Resource Levies of $88m.

Maui gas is sold to primary customers whose principal businesses are methanol manufacture, electricity generation, and gas wholesaling and distribution. Added value from Maui is distributed throughout the economy as a function of the contribution these resources make to energy inputs, which would be more expensive or unavailable in their absence.



New Zealand gas market

Value accrues downstream from each of these primary uses, especially for electricity and pipeline gas used for processing products from dairying, meat farming and forestry — New Zealand's three biggest primary produce export earners.

Even though methanol manufacture is likely to be an early casualty of a gas supply shortfall, an economic assessment carried out by BERL in 2002 estimated that Methanex generated more than $1.4 billion of gross output, $480m of value added, and contributed about 640 full-time equivalent jobs to the New Zealand economy. In 2003, Methanex's New Zealand production has dropped to around 40% of its capacity due to gas supply shortages.

The decline of the Maui field will impact on the New Zealand economy to an uncertain degree. For nearly 30 years it has contributed about 25% of New Zealand's primary energy supply.

The low price of Maui gas has contributed significantly to New Zealand's international competitiveness, and gas shortfalls resulting from its decline are already causing uncertainties in investment in electricity generation, primary produce processing and manufacturing generally. Gas prices are expected to increase significantly with the end of the Maui contracts.
To offset the decline of the Maui field, a number of other offshore oil and gas fields are being appraised and are likely to be developed over the next few years. Pohokura is expected to produce about 50 petajoules (PJ)/year for several years; Kupe about 25 PJ/year (By way of comparison, the total gas plus condensate production from Maui in 2001 was equivalent to 255 PJ). The new fields are expected to supply much of the gas on which electricity generation has become increasingly dependent. The Maari oil field is expected to be developed for production, probably via floating facilities, at a peak yield of several million barrels per year. A recent oil discovery at Tui, west of Maui, may also be developed depending on appraisal results.

The business process for discovery, development and production of oil and gas is driven almost entirely by oil company capital and know-how, with New Zealand exposed to investment decisions made in a highly competitive global market. Domestic drivers include the exploration efforts of New Zealand-based oil companies, which are reliant on attracting foreign investment, and the efforts of Crown Minerals of the Ministry of Economic Development, with limited resources, to promote New Zealand as an exploration destination.

Property rights are issued under the permitting procedures administered by Crown Minerals pursuant to the Crown Minerals Act, which gives permit holders spatial and temporal rights to explore for, develop and produce hydrocarbons in return for payment of a royalty to the Government on production.

Growth in the New Zealand offshore oil and gas sector, in terms of both production and maintenance of resource inventories, is currently strongly negative with serious economic impacts already discernible. Opportunity is not limited by resource potential, but by risk perceptions established by overseas-based oil companies, which are largely beyond New Zealand's control. Growth potential is good with huge economic upturn being the benefit of success.

The offshore area of New Zealand offers the greatest potential to offset the contribution that Maui gas has made to the country's primary energy supply and to reduce an increasing reliance on fuel imports. Favourable geological fundamentals need to be matched by higher levels of exploration investment if this is to be achieved, but there are plausible expectations for undiscovered resources worth billions of dollars.

Offshore oil and gas exploration is currently focussed on the continental shelf off Taranaki. However, there is potential in most of New Zealand's offshore basins and all those that are known have been subject to reconnaissance exploration to varying degrees. Beyond the continental shelf, the Deepwater Taranaki Basin has recently been delineated with indications of potential for very large discoveries. Within New Zealand's huge EEZ are other deepwater basins with hydrocarbon potential, with the added possibility of basins that are not yet discovered.

Deepwater discovery and development in the

Asia-Pacific region has been lagging behind the Atlantic margins. The promise of successful exploration and development of deepwater basins in New Zealand would be enhanced by lowered risk to explorers if large-scale gas discoveries could be economically exploited. Technology exists to enable production from situations such as the Great South Basin to the southeast of New Zealand. Gas-to-liquids (such as diesel and lubricants) conversion technology is also coming of age, and the critical scale of floating facilities required for LNG processing at remote offshore sites could be envisaged subject to discoveries.

In the long term, gas hydrates are another form of hydrocarbon accumulation with potential as a very large source of CO_2-efficient energy. Gas hydrates occur in the upper tens to hundreds of metres beneath the seafloor along some continental margins at water depths greater than 300-700 m. The amount of carbon stored in gas hydrates is estimated to rival that in all other non-dispersed fossil fuel reservoirs world-wide.

New Zealand has the most promising known gas hydrate resource potential in the Southwest Pacific. There are at least two large areas in the New Zealand EEZ that contain gas hydrates: the offshore margin of the East Coast of the North Island, and offshore Fiordland. A very rough estimate of the possible volume of gas in an area of 80 km^2 in Hawke Bay indicates that it may contain enough gas to replace Maui for about five years. Gas hydrates may be present elsewhere, but systematic assessment of their distribution is incomplete. Indications of gas hydrates are frequently not recognised, and gas hydrate deposits may have gone unnoticed even in well-explored areas.

Gas hydrates are an appealing energy source because they release less CO_2 than other energy sources, and they may provide a suitable feedstock for fuel cells. Programmes investigating the exploitation of gas hydrates are being undertaken in several countries. The commercial viability of these resources is still uncertain, and gas production from gas hydrates faces significant engineering challenges. Recent test results from drilling offshore Japan and the U.S. are encouraging. It is anticipated that production technology will take 10-15 years to develop.

Minerals

The extraction of minerals from New Zealand's oceans is currently limited to mining sand and gravel from coastal environments. Titanomagnetite sands are mined for export and to supply the Glenbrook steel mill. Silica sands are extracted for industrial use, and some aggregates are mined for local use. However, within New Zealand's extensive EEZ are other mineral deposits with long-term potential. Research is needed to determine how much of New Zealand's offshore mineral wealth might be economically viable, given continued improvement in the technologies of prospecting and mining. Development will depend greatly on whether the opportunities in relation to the costs and risks look attractive to investors. With the exception of aggregates, which can be expected to be increasingly derived from marine deposits, the growth path for mining other marine minerals is uncertain, and any exploitation of deep sea mineral resources is likely to be dependent on demand and substantial investment of foreign capital and technical knowledge.

Sand and aggregates

Although sand and aggregate are relatively low value commodities, due to high volumes they are, collectively, the most valuable products of the New Zealand mining industry. The 20 million tonnes produced, mainly from onshore resources, are worth $260m a year in sales.

Extraction of marine sands is now well-established in the Kaipara Harbour and on the east coast of Northland. Demand for construction materials from shallow sea bed sources is expected to expand as quarrying near the major cities becomes more difficult. Conflict between quarrying operations and amenity values in both urban and rural environments is seriously affecting access to aggregate resources on land and leading to higher transport costs from increasingly remote sources.

Well-managed marine dredging operations have clear environmental advantages over land-based quarrying operations, and are an increasingly attractive way of maintaining the supply of premium grade aggregates at affordable cost, particularly in the Auckland region where potential on-shore aggregate

resources are under intense land use and other environmental pressures. Such a development would have the additional economic benefit of reducing both the capital and maintenance costs of publicly-owned motorways and arterial roads.

The situation evolving in Auckland is similar to that which already exists in the southeast of England, where 30% of all aggregates produced are now mined from the sea bed. If the same proportion of Auckland's aggregate needs were to be dredged off-shore and unloaded at central distribution depots it would save, or drastically reduce the distance of, between 160,000 and 200,000 truck movements per annum on Auckland's congested motorway system.

Mineral sands

Titanomagnetite ironsand deposits occur along 480 km of coastline from Kaipara Harbour south to Wanganui on the west coast of the North Island. The total identified resource is over 850 million tonnes (Mt) of concentrate. BHP New Zealand Steel Limited produces about 2.4 M tpa of titanomagnetite concentrate from two mines south of Auckland. The value of this production is nearly $30m annually, and while the activity is not strictly oceanic, the deposits are coastal and the product of coastal processes.

At Waikato North Head, up to 6 M tpa of ironsand is mined and concentrated on site to produce 1.2 M tpa of titanomagnetite concentrate. Mining of the deposit began in 1969, and production to the end of 2000 is about 18 Mt of concentrate. The concentrate is slurried 18 km to the steel mill at Glenbrook where it is used to produce iron. About 12,000 t/yr of vanadium-rich slag (representing 1% of the world's vanadium production) is separated as a valuable by-product and exported to China. Recovery of the 7 to 8% titanium dioxide content is not currently economic.

At Taharoa, ironsand is mined to produce concentrate averaging 40% titanomagnetite. Annual production has been about 1.4 Mt since the operation opened in 1972. The concentrate is slurried through a 3 km-long pipeline to an offshore loading facility for export.

Titanium-bearing ilmenite deposits have been commercially investigated at several localities on the West Coast of New Zealand, although there has, so far, been no titanium oxide production. Ilmenite-rich black sands, with locally economic concentrations of gold, are present at intervals along 320 km of the west coast of the South Island. The largest deposits are at Barrytown (6.9 Mt of ilmenite) and near Westport (5.5 Mt of ilmenite). Westport ilmenite has been successfully treated on a pilot scale to produce high purity synthetic rutile (Tio_2), but the titanium dioxide content is not competitive with deposits in other countries.

Gold

Very fine gold is concentrated with other heavy minerals into lenticular beach placers on the west and south coasts of the South Island. Offshore deposits of placer gold occur in places off the Coromandel Peninsula and Hokitika. While some exploration of these resources has taken place, the gold is difficult to recover with existing technology.

Phosphates

Extensive phosphate nodule resources in about 400 m of water on the Chatham Rise have been commercially investigated and were valued in 1995 at $10 billion gross. This figure should be regarded as speculative. A commodity value shift or improved technology would be required for mining to become commercially feasible. The principal potential use is as agricultural fertiliser.

Polymetallic nodules

Polymetallic nodules, also known as manganese nodules, are sea floor concretions containing varying amounts of manganese, iron, cobalt, copper and nickel. They may also contain small quantities of gold, silver, platinum, molybdenum and zinc. Polymetallic nodules occur at various deepsea localities throughout New Zealand's EEZ. The largest concentration extends for 1700 km along the south of the Campbell Plateau, 1100 km south of New Zealand, at depths of 4 to 5.2 km.

The main minerals of economic interest are copper, nickel and cobalt. Mining is technologically feasible, and there has been considerable commercial and industrial interest

in their exploitation, but current metal prices are too low for commercial deep-sea mining to be viable in the immediate future. Feasibility studies of the rich nodule fields of the central Pacific suggest that deep ocean mining of nodules could become economic once the concentration of copper, nickel and cobalt exceeds 2-3%, a level that does not appear to be met by New Zealand deposits. However, data on the New Zealand occurrences are very sparse, and a 1995 provisional gross value of $80-250 billion is speculative.

Volcanic massive sulphides

Polymetallic massive sulphides are being deposited from hydrothermal vents on active submarine volcanoes along the Tonga-Kermadec arc, a section of the plate boundary between the Pacific and Australian plates that extends for 2500 km northeast from the North Island to Tonga. The 1200 km-long Kermadec arc is the southern part of this arc and lies mainly within New Zealand's EEZ. Of several mineral deposit types present, hydrothermal chimneys or 'black smokers' are almost pure metallic sulphides with high concentrations of base metals and gold. The deepsea mining potential of these deposits is being commercially and scientifically investigated. The deposits are at about 120-1800 m depth, much shallower than the 2400 m typical of similar deposits in other oceans. A mineral prospecting permit issued under the Continental Shelf Act over part of the Tonga-Kermadec arc is currently held by a private Australian company.

There are currently substantial barriers to commercial mining of these deposits, including low commodity prices and the difficulties of operating in offshore ocean environments. Nevertheless, it has been predicted that mining polymetallic massive sulphides from the oceans will become economically viable within 10-15 years. Proposals have also been made for oceanic production of hydrogen fuel using vent systems.

Salt

Salt is produced at Grassmere, south of Blenheim, by solar evaporation of sea water. Low rainfall, high sunshine hours and adequate wind all assist in the evaporation of the sea water with a resulting salt production of about 60,000 tonnes each year. There are associated refineries on the same site and at Mount Maunganui, supplying raw solar and vacuum-dried salt to the domestic market for use in chlorine manufacture, as edible salt, and for water treatment, tanning, dairy and agricultural usage.

Ocean energy

Tidal and oceanic currents, wind-induced waves, and thermal gradients in the sea all create opportunity for capture of clean renewable energy. The majority of technologies to extract ocean energy are currently immature and may require at least ten more years before commercialisation. The hostile nature of the environment for man-made structures also imparts high potential costs on the fabrication, operation and maintenance of ocean energy devices.

There is potential for New Zealand to benefit from ocean energy sources, with its high-energy oceanic environment, long coastline and a largely coastal population. However, with the exception of offshore wind farms, ocean energy is only likely to be competitive with conventional energy sources (gas, coal, fuel oil) in niche applications, e.g. remote communities and small islands, either by connection to the transmission grid or as stand-alone schemes. Ocean energy schemes could also contribute to hybrid energy developments, in which a number of renewable but intermittent energy sources are integrated with storage devices to provide a constant energy supply.

There are four principal but contrasting approaches to the extraction of energy from the ocean: offshore wind farms, tidal energy, wave energy, and ocean thermal exchange.

Offshore wind farms

Offshore wind farms have and are being extensively developed in countries surrounding the North Sea, enhancing the technologies and reducing the costs. The benefits of offshore wind farms compared with locations on land are enhanced wind strength and reduced visual, noise and other environmental intrusion. Transmission losses from offshore locations, the cost of setting foundations for

large wind turbines (now up to 2 MW), and water depth all limit the distance that such wind farms can be established offshore. Existing technologies are such that offshore wind farms can be developed in water depths up to 40 m and up to 30 km from the coast.

Offshore wind farms could be implemented in the near future in New Zealand although they are likely to be preceded by further onshore installations. Failure to secure resource consents at onshore wind farm sites might provide incentives for early offshore developments, although they would require lengthy (› 1 year) site-specific wind data recording.

Ocean currents

Ocean currents occur as bottom currents and as tidal currents at river and estuary mouths.

Marine currents flowing at about 2.5 m/second are attractive and predictable by comparison with tidal, wind and wave energy, thus offering high load factors (up to 80%). Ocean bottom current energy can be captured, in much the same way as wind energy, by installing 'underwater windmills'. The technology is at an early stage of development and its performance and costs are still to be determined. A 60 MW scheme involving 20 underwater windmills is currently being constructed in Norway. There are narrow coastal passages such as Cook Strait and the Marlborough Sounds where such schemes could be considered in New Zealand.

Energy from tidal currents can also be captured by building a semi-permeable barrier across an estuary, thus impounding the incoming tide and creating a head on the ebb tide. A 240 MW tidal barrier scheme has been operating in northern France for over 30 years. No schemes have been proposed in New Zealand, which has a relatively low tidal range. However, interest has been raised in areas where there are large-volume tidal movements, e.g. the Hokianga, Kaipara, Aotea and Raglan harbours on the west coast of the North Island. Tidal energy schemes could be constructed in association with bridge schemes, e.g. the current proposal to bridge the Hokianga Harbour. Because they have a land connection, such energy schemes are likely to have high capital costs, but lower operational and maintenance costs than other marine energy extraction schemes.

Wave and swell energy

Wave and swell energy devices extract kinetic energy from the passage or breaking of ocean waves. There are three generic concepts for energy extraction:

- Shoreline devices use different methods to focus and trap waves breaking on the shoreline. Overtopping devices focus and trap waves and extract the energy by returning the seawater through a turbine system. Other devices trap the wave in a closed chamber and use the oscillation of the air/water column in the chamber to drive a turbine.
- Bottom-fixed submarine devices use a variety of methods to extract energy from passing swells in moderate water depths (30-50 m). A relatively large number of such devices has been proposed but the most advanced are still at the pre-commercial stage.
- Floating devices use a range of techniques, including overtopping and oscillating water columns to extract energy.

There has been significant investment in development of wave and swell energy devices. There are active R & D programmes in a number of countries, including the United Kingdom, Eire, Japan and Australia. However, only five devices have reached the full-scale prototype stage and none has been declared commercial. Costs for wave energy devices have, however, declined by an order of magnitude since the early 1980s.

New Zealand is blessed with some of the most powerful wave energy environments on earth, particularly on south- and west-facing coasts. Wave energy schemes could make a moderate contribution to the national energy supply, particularly in avoiding transmission/ distribution infrastructure costs by supplying isolated communities. New Zealand's regional wave energy resource is well known, but wave energy schemes will be developed to site-specific factors for which there are few data. Several factors have constrained New Zealand investigations including low electricity prices, uncertainty over development as a result of the

Resource Management Act, and lack of active Government support until recently.

Ocean thermal exchange

This technology extracts thermal energy from the ocean by a heat exchange process using the temperature difference between warm surface water and colder water at depths greater than 1000 m. Research to date has shown that a temperature difference of more than 20º C is required. The technology is based on a closed-cycle heat exchange system, using warm seawater to heat a volatile fluid, which then drives a turbine linked to a generator before being condensed by the cold seawater. The technology is still at an experimental stage of research and development. Because of New Zealand's latitude range, seawater temperature differences in domestic waters are less than 20º C. The process is thus likely to be very inefficient here and unlikely to be economically attractive.

Fisheries

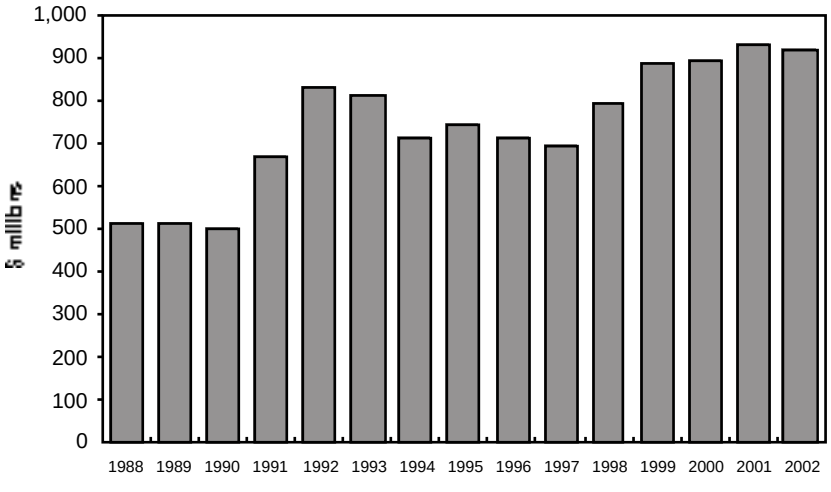
In under 30 years, the commercial fishing industry has expanded from a small domestic industry to being New Zealand's fourth largest export earner (behind dairy, meat and forestry) at $920m (excluding aquaculture) for 2002, a figure that has been fairly constant for the last 10 years.

The seafood industry (excluding aquaculture) provided over 7000 full-time equivalent jobs through direct employment in 2002. Many workers are part-time, and it is estimated that over 15,000 people are employed in the industry (including aquaculture). Employment growth in the mid-1990s was a direct result of the increasing proportion of the catch taken by New Zealanders and increased investment in added-value processing. As a result of various initiatives, Maori are now a major force in a modern fishing industry and play a significant role at all levels with concomitant economic benefits.

Since the advent of the Quota Management System, control of New Zealand's fisheries resources has been increasingly held by New Zealand and New Zealand companies. About 55% (greenweight) of the catch was taken by New Zealand-registered vessels in 1999-2000, with much of the remainder working under charter to New Zealand companies to catch the high-volume, deep-water species such as hoki, southern blue whiting and squid.

About 90% of the New Zealand catch is now exported, mainly to Japan ($318m for the year to December 2000), the United States ($258m), European Union ($219m), Hong Kong ($168m), Australia ($167m) and other Asian countries ($215m). New Zealand accounts for less than 2% of the world seafood trade.

More than 1200 species of fish are known to exist in New Zealand waters, about 100 of which are commercially significant. Hoki, orange roughy, rock lobster and snapper are the main species by dollar value.



Source: Statistics New Zealand

Figure 1: Fish exports

Despite the size of New Zealand's EEZ, its waters are relatively deep and not particularly rich in nutrients, so that the productivity of its fishery resources is relatively low. Fisheries range from numerous, mainly small resources of sub-tropical species in the north, to moderate resources of many warm temperate species on the continental shelves, to large resources of a few cool-water species on the extensive submarine plateau to the east and southeast of the main islands. New Zealand's offshore fisheries are among the deepest in the world. Species such as orange roughy, which live at depths of up to 1500 m, present special challenges for fishing and stock management.

The business process for wild fisheries is dependent mainly on New Zealand capital and knowledge. Fisheries within New Zealand's EEZ are a 'common property' resource and the government has an important role in ensuring sustainable harvesting. The main management device is the Quota Management System (QMS) which sets catch limits and rights to harvest through Individual Transferable Quota (ITQ). Catch limits, known as Total Allowable Catches (TACs) and Total Allowable Commercial Catches (TACCs), are reviewed annually. Quota is a tradable property right, which together with fishing vessels and processing facilities, comprise the invested capital in fishing businesses. The QMS has enabled New Zealand to maintain its fisheries in excellent biological and economic shape, and the sustainable management of New Zealand fisheries has considerable potential as a marketing tool.

Imposition by the government of full cost recovery of fisheries management and related research costs on industry has stimulated reorganisation of commercial stakeholder interests into a range of new bodies that focus on management and research needs of particular fisheries. The new organisations have generally been established as companies, with structures to represent the interests of quota owners and other commercial interests. The industry invests over 2% of its gross returns in research and development.

The New Zealand wild fishery is arguably approaching limits of exploitation with few prospects for expansion, with growth potential mainly dependent on added value from processing and marketing gains. Since the development of deepwater fisheries in New Zealand's EEZ in the 1970s and 1980s, few new fisheries resources have been developed or exploited. Much of the EEZ has now been explored by modern fishing and research vessels, and it does not appear that there are many undiscovered fishing resources of significant size. Most inshore fishery resources are also considered to be fully developed, with little potential for commercial expansion.

Few new fisheries resources have been developed over the past 15 years, mainly because of the inability to introduce new species into the QMS over the period 1987-2001. In 1987, a number of iwi and Maori organisations were successful in obtaining a court injunction preventing the inclusion of more species within QMS. Following the eventual settlement of that litigation in 1992, further delays in introduction were caused by the absence of appropriate legislation. Concurrently, the Government sought to stop the development and expansion of fisheries outside of the QMS, firstly by regulatory mechanisms in 1989 and then, in 2002, by way of a legislative moratorium on new permits. The permit moratorium for non-QMS fisheries remains in place today. These factors have led to a substantial under-utilisation of many non-QMS fisheries resources over a long period.

However, there are other economic opportunities. There is scope for better management, more efficient utilisation, improved quality and better marketing for many traditionally caught species that have not, so far, been highly valued. The New Zealand Seafood Industry Council believes that there is potential to increase value by $590m by 2010 (excluding aquaculture) by these means.

The industry is unsubsidised and has to overcome substantial trade barriers to compete in a global market with operators who are heavily subsidised by their governments. Market access restrictions, tariffs and subsidies are estimated to cost the New Zealand seafood industry at least $100m annually.

Aquaculture

Aquaculture first became established in New

Zealand in the early 1960s with oyster farming in Northland. Since then the industry has grown rapidly. Exports have increased from $170m in 1988 to $450m in 2002. Freshwater fish farms, marine farms and spat catching areas currently occupy about 4725 ha. Mussels, salmon, oysters and paua are the mainstay species. There are small or fledgling industries for flat oyster, freshwater crayfish, grass carp, Malaysian prawn, spiny lobster and seaweeds.

Mussels are the major component of the industry, with farms covering about 3000 ha, mainly in the Marlborough Sounds, Coromandel, Golden Bay, Stewart Island, Banks Peninsula and Northland.

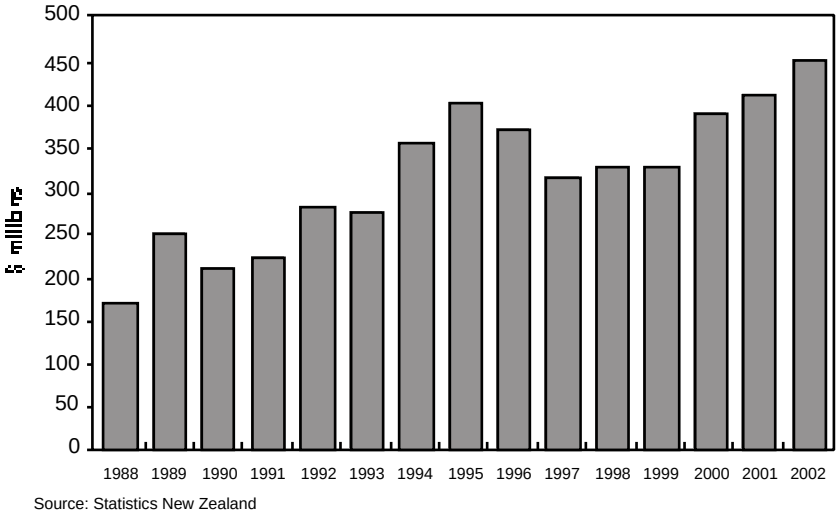
Aquaculture is the fastest growing sector of the global seafood industry, expanding at 15% a year. Nearly a third of the world's seafood is now produced by aquaculture, a trend that is expected to continue as wild fisheries become increasingly unable to meet growing demand for marine-sourced protein. Within a few decades, traditional harvesting of wild fisheries may be overtaken by sustainable aquaculture operations.

New Zealand is well-placed to benefit from these trends. The country is particularly well-endowed with suitable aquaculture environments: high quality coastal waters along 17,000 km of coastline provide abundant opportunities to increase production. The industry produces high-value products characterised by a high return on capital once production and marketing are perfected. The New Zealand Aquaculture Council believes there is potential for export earnings of $1 billion by 2020 if expansion to 17,000 ha can be achieved.

The industry is involved in research to extend the range of species and the knowledge and technologies involved in solving the biological problems that need to be overcome. Other species with potential for aquaculture include rock lobster, freshwater crayfish, snapper, seaweeds and sponges, kingfish, paddle crabs, turbot and eels. Technology will have a vital role in the development of aquaculture.

With no over-arching legislative framework, aquaculture had been subject to 14 overlapping and sometimes contradictory pieces of law. Coastal plans, subsequent to the RMA, failed to anticipate the explosive growth of aquaculture in New Zealand, which was perceived as a small niche industry with limited growth potential, despite being larger than the wine industry. This expansion gave rise to growing concerns about an industry out of control, and there was general acceptance that regulators, applicants and environmental interests would benefit from streamlined procedures with greater clarity.

In March 2002, the Resource Management (Aquaculture Moratorium) Act was passed, the culmination of a legislative process that began with announcement in November 2001 of a



Source: Statistics New Zealand

Figure 2: Aquaculture exports

two-year ban on consents for new aquaculture industries, effective immediately but to last for two years from the Act coming into force. At the time, decisions on 287 applications remained outstanding with considerable expenditure incurred in their preparation.

The effective length of the moratorium is uncertain, but there is no doubt that there is an economic cost. The NZ Institute of Economic Research estimated the cost of the moratorium at $200-400m, a figure which was rejected by Government. The new regime places the onus on regional councils to find solutions to re-open application consents by first establishing Aquaculture Management Areas (AMAs). There is general concern that regional councils will be unable to revise their coastal plans to include AMAs within two years, thus effectively extending the moratorium on processing consents. Delays beyond two years are widely expected, and delays of six to ten years feared.

Other barriers to expanding aquaculture productivity include uncertainty of secure tenure on seabed leases giving inadequate security for investment.

There are different visions of what the medium-term future holds for aquaculture in New Zealand. One view is that growth will be quite slow, limited particularly by AMA delays, and that new species will make up most of this modest growth. Another view is that growth will be significant, even if there are delays, and that most wealth increases over the next two decades will come from species already under cultivation. Development of new markets should absorb large increases in production and falling prices. Furthermore, domestication of the main shellfish species (mussels, oysters and possibly paua) could transform the industry, creating a diversification of products.

Offshore aquaculture sites are not affected by current constraints. These potentially add massive new areas which, even if productivity is lower than inshore sites, will contribute large increases in production. Substantial investments are being made in deepwater aquaculture. Pegasus Bay Aquaculture has lodged a permit for a 10,664 ha marine farm 10 km off the north Canterbury coast. A related company has spent $9m upgrading processing facilities in anticipation of increased production, with 600 jobs and an estimated $100m a year in export earnings at stake.

The aquaculture moratorium in some ways encapsulates the way in which New Zealand is dealing with tensions between environmental concerns and the effects of economic development across several sectors. The moratorium is intended to avoid environmental problems caused by an industry that was growing rapidly, some would say chaotically. The downside is the commercial and economic costs of regulation, including a potential loss of competitiveness against foreign operations. The environmental arguments tend to take pre-eminence over economic arguments, and there is widespread frustration that Government's stated commitment to regional development and economic growth is accompanied by considerable resistance to specific initiatives. It remains to be seen whether addressing the concerns arising from expansion of aquaculture will eventually result in long-term sustainability and profitability of the industry.

Biotechnology

Marine organisms occupy a wide spectrum of ocean environments and represent very diverse, adaptive life forms. Many species produce complex chemical compounds such as carotenoids, polyunsaturated fatty acids, ultraviolet blockers, as well as a whole range of enzymes with a wide range of potential applications in the production of new pharmaceuticals and nutraceutical products. These compounds can in some instances be produced by biosynthesis more efficiently than by complex industrial processes. Some 90% of US investment in biotechnology is currently in bioreactors which can be described as biological breweries making bioproducts that do not need to use the original source organism again.

Biodiversity is a driver of bioproduct opportunity. Marine micro-organisms include microalgae, bacteria, archaea and extremophiles. The latter live in extreme environments such as hydrothermal vents, and have developed biochemical means to protect themselves from the effects of these environments. Extremophiles are potential sources of robust enzymes used as antivirals, antibiotics, anti-cancer agents,

thermoprotectants and osmoprotectants.

The development of marine bioproducts is characterised by a long and technologically challenging value chain from exploration for highly bioactive organisms (bio-prospecting), through identification of candidate organisms, screening for valuable biochemicals, extraction of the target product, devising the method of supplying the product, to the actual production of bioproducts.

There is economic potential at all points along this chain, and New Zealand is well-placed to become involved. New Zealand has an extremely diverse marine flora and fauna, with its EEZ representing one of the world's most extensive and varied marine environments. New Zealand also has strong intellectual assets and a long-standing record of experience in high technology farming, including aquaculture. These strengths present New Zealand with huge potential in bio-prospecting and contribution to an emerging global industry. There is added economic potential through the development of bio-products for New Zealand's other aquatic environment-based industries.

There are uncertainties in the business process that relate to issues surrounding complex property rights. At the bioprospecting level, there is vulnerability to legislation protecting biodiversity, and even indigenous rights, e.g. there is currently a three-year moratorium on bioprospecting in Hawaii. Further down the value chain there may be complexities that arise from the industry being based at the molecular level, although the determination of the chemical structures in new biochemicals allows for the protection of intellectual property through patent applications.

The commercial value of biotechnological applications arising from bioprospecting is somewhat speculative and tends to be indicated in the billions of dollars, with forecast growth rates around 15-20% per year. However, the potential for New Zealand to benefit from these opportunities is limited by its small market and low level of biotechnology investment. Development of a specific product from bio-prospecting can take 10-15 years and require development costs of US$300-500m.

New Zealand opportunities in the biotechnology sector will require foreign investment and expanded domestic research capacity. The economic potential for biotechnology has been recognised by research funding agencies, and companies are developing collaborative business arrangements for research and overseas marketing.

Marine-based infrastructure, industry and services

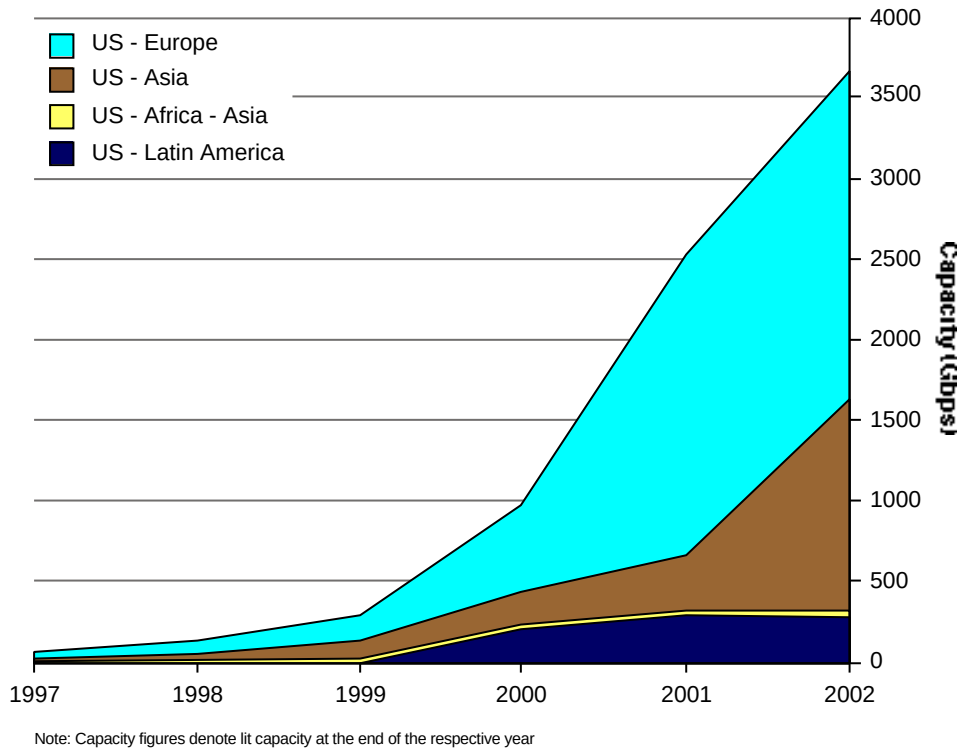
Submarine cables and pipelines

Communications

Marine communications is one of the fastest growing areas of ocean technology world-wide. During the 1970s and 1980s, much of the increase in demand for international telecommunications services world-wide was met by satellite technology, but use of this technology has steadily declined with the introduction of fibre-optic submarine cable technology. The majority of services carried on submarine cable systems today consists of data in the form of email and Internet traffic. This is a major change from the situation of about 10 years ago when the majority of international traffic was telephone communications. The role of satellites for telephone communication and data is declining, except over lower traffic routes like some Pacific Islands.

New Zealand has had a dependence on submarine cable systems for international communications since 1876. The business process involves very expensive capital investment in cable and associated electronic infrastructure, recovered by low-cost, high-volume toll returns. By world standards, New Zealand enjoys the latest technology in telecommunication systems employing fibre-optic digital transmission that relies on 'state of the art' international submarine cable systems. Around 90% of international telecommunication services with New Zealand are carried on submarine cable systems and the remainder via satellite. Domestically, Cook Strait cables provide communication links between the North and South islands.

While marine communication systems are generally taken for granted, there is a major



Total inter-regional submarine cable capacity by route

impact when services fail. In particular, interruptions to 'e-commerce' services now have a major impact on New Zealand's ability to conduct business, which means a submarine cable failure could have a serious impact on the New Zealand economy. Risks to cables exist from anthropogenic and natural causes, making it imperative that the economic security of global cable networks be maintained through adequate protection measures and appropriate levels of redundancy. Disruptions to the integrity of submarine cable systems can potentially cost cable companies millions of dollars in cable repairs and lost revenues from e-commerce and telecommunications. Cooperation from other ocean users is essential to help minimise the risks of interference.

Electricity

The New Zealand electricity market trades about $12.5 billion annually. The integrity of the national grid system is essential to the operation of the electricity market. Transpower operates the Cook Strait high-voltage direct-current (HVDC) electricity link, which consists of:

- three 350,000 volt DC power cables; and
- two fibre optic telecommunication cables that are a necessary part of the HVDC control system as well as being used by both Telecom NZ Ltd., and TelstraClear Ltd.

The HVDC link provides a fundamental economic benefit to New Zealand, particularly in terms of energy security and the ability to use hydro-electric power in place of thermal generation. Maintaining the integrity of the link is vital to the national power grid, and a protected zone is in force along the length of the cables.

Pipelines

The most important submarine pipelines in New Zealand are those servicing the Maui gas field off Taranaki. These pipelines have been a vital component of primary energy supply since gas and condensate started to flow to shore in 1979. These pipelines are likely to become less significant economically as supplies from the Maui field start to taper off, although there is potential for them to be used in other gas projects.

Offshore slurry pipelines are used to load

ironsand concentrate at Taharoa on the West Coast of the North Island. There also are many off-shore submarine pipelines around the New Zealand coastline used to transfer wastewater into the ocean environment. These are relatively short in length, typically ranging from just a few metres to about a kilometre.

Ocean transport

Shipping

Despite advances in other forms of transport, shipping remains a relatively inexpensive and efficient method for large volume goods. The oceans surrounding New Zealand provide the medium that allows ships to carry exports to, and imports from, overseas and also the distribution of products to coastal communities. But the oceans are also a barrier to international trade by restricting options in terms of moving goods (and tourists) between New Zealand and other countries. The extent to which New Zealand's trade is reliant on shipping is also reflected in the cost associated with being an island nation.

The oceans also provide important, but not absolute, biological protection for New Zealand. To the extent that border controls restrict the passage of pests and disease into New Zealand, this boosts trade in goods (particularly agriculture) and tourism.

New Zealand's domestic shipping industry is based almost entirely around coastal shipping services linking the main centres and some regional ports. Coastal shipping provides an important inter-island link for the national road and rail network, and also in the distribution of various commodities including petroleum products and cement.

The New Zealand coastal merchant fleet currently comprises 16 vessels: two oil tankers, three bulk cement carriers, two rail/passenger ferries, one fast ferry, and eight cargo ships. Of these ships, 11 are New Zealand registered. The others are foreign-flagged, authorised for New Zealand operation by the Minister of Transport under Section 198 of the Maritime Transport Act, to carry coastal cargo. The 'restricted limits' sector (charter craft, harbour ferries, tugs, water taxis, etc.) comprises some 2300 vessels. Around four million passengers are carried every year, mainly across Cook Strait and on harbour commuter services.

In the 1990s, New Zealand shipping policy reflected the philosophy that the country's interests were best served by catering for a ship-using, rather than a ship-operating nation. This policy sought to ensure for New Zealand exporters and shippers unrestricted access to the carrier of their choice and to the benefits of fair competition among carriers. In 1994, the Maritime Transport Act introduced measures that allowed foreign vessels transiting the New Zealand coast, in the course of their international voyages, to carry coastal cargo. The government of the day also supported the opening of trans-Tasman shipping to international competition and foreign-crewed ships. This trade had historically been the preserve of vessels crewed by Australians and New Zealanders through maritime union accord.

The Maritime Transport Act 1994 also regulates ship safety, marine liability and marine environmental protection, the latter now manifesting itself in growing resistance to allowing the entry of vessels carrying ballast water from foreign sources and certain types of anti-fouling coatings. The Maritime Safety Authority of New Zealand, which is a Crown entity, has various response functions under the Act. Its principal objective is to undertake activities that promote a safe maritime environment and provide effective marine pollution prevention and an effective marine oil pollution response system, at reasonable cost.

Ports

The large investment in New Zealand's port infrastructure is the key to maintaining shipping links with international markets. The 13 major commercial ports are predominantly local government-owned, although six are partly privatised and further private ownership is encouraged by the government. The ports are in strong competition with each other, attracting ongoing investment in infrastructure and cargo handling systems. The importance of ports is further emphasised by the possibility of major investment in additional new port facilities such as those proposed at Clifford Bay and the West Coast.

The critical strategic and economic value of

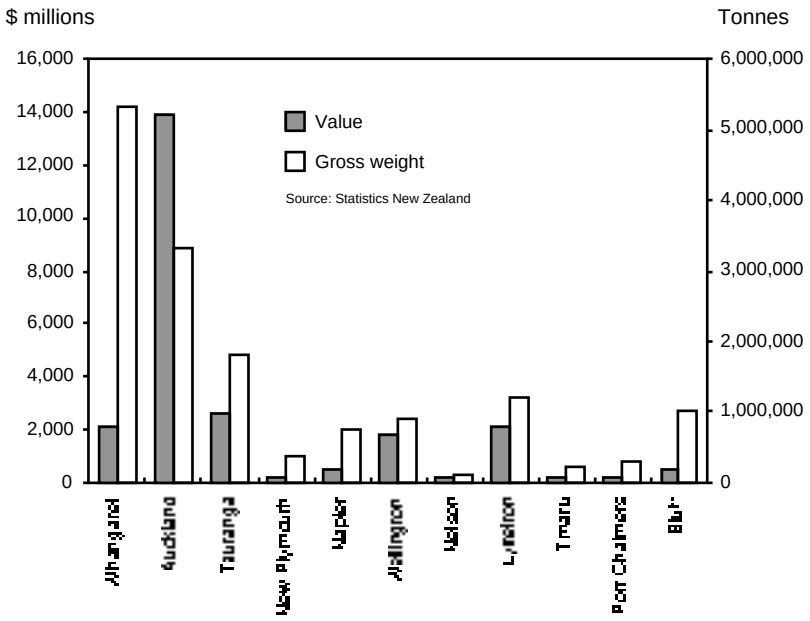


Figure 3: Imports by port

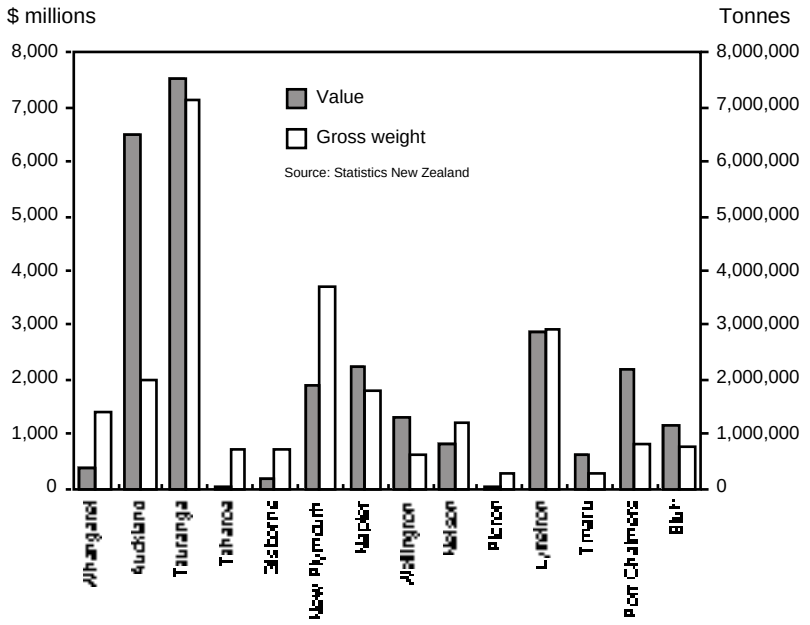


Figure 4: Exports by port

New Zealand's ports is illustrated by the fact that almost 85% of New Zealand exports by value (99% by volume) are carried by sea. Imports, on the other hand, account for around 75% by value (also 99% by volume).

Exports weighing 24.5 million tonnes and valued at $28.1 billion were loaded at New Zealand seaports during the year ending June 2002. This represented an increase of 9.2% in weight and 0.4% in value over the previous year. Logs and wood products were a significant contributor to the increased export weight, and meat and edible offal also made significant contributions to the value increase. Imports weighing 15.5 million tonnes and valued at $24.3 billion were unloaded in the same year, representing a 9.8% increase in weight and 3.9% in value compared with the previous year. A total of 5190 full-time equivalent employees work in sea transport-related industries centred around the 13 main ports.

Although international trade has been steadily increasing and is forecast to double in the next

15 years, there is a trend towards larger vessels and, therefore, a reduction in the number of ship visits. The nature of ports is also evolving, with 'hubbing', where international vessels visit fewer ports, likely to become more usual. There are two indications of this trend in New Zealand. The Port of Tauranga has operated Metroport Auckland, an inland port in south Auckland, since 1999. Tranzrail links to the Port of Tauranga connect with international shipping lines. Late last year three New Zealand ports won contracts with international shipping lines for the new generation 4100-TEU container ships, which dock only at designated ports. Substantial capital investment was made to accommodate these ships, including powerful tugs, high-speed container cranes, straddle carriers and new software systems.

Unlike many countries, New Zealand trade is not restricted through either lack of coastline or port capacity. The potential for increased volume of goods transported by sea through New Zealand's oceans is virtually unlimited.

Boating industry

The marine pleasure and commercial boat service industry is the largest non-primary product manufacturing-based industry in New Zealand, comprising over 400 companies of which 160 are involved in export-related operations.

The industry includes the design, building, sales, storage and servicing of boats up to 123 metres in length. Annual turnover is estimated to be in excess of $700m per annum, of which approximately 50% is in exports. It is estimated that half these exports are completed boats, and the balance includes New Zealand manufactured equipment, drive units (e.g. Hamilton Jets), sails, rigging, boat designs, servicing, refits and specialist marine clothing. Exports have doubled since 1997 enjoying a 23% compounding growth rate per annum. The industry estimates potential turnover of $1 billion by 2005. Up to 7000 people are directly employed in the industry with 4000 directly involved in building boats.

The business process is largely driven by domestic requirements and New Zealand's international reputation, both of which encourage investment in mainly small- to medium-sized businesses based on New Zealand knowledge, technical capability and capital. Growth is reliant on a corresponding increased supply of skilled labour. The branding awareness through New Zealand holding the America's Cup for eight years was a valuable marketing tool and will continue to be so. A favourable exchange rate is also important for the ongoing growth of the industry by providing value for international clients. New Zealand's reputation as one of the world's leading superyacht building locations is evidenced by the 20 superyachts currently under construction.

Marine service industry

Another important component of the marine service sector comprises marine engineering and related activities including diving and salvage, marine cable laying, dry dock facilities, vessel servicing, and heavy marine engineering. In particular, there is a cluster of world-class expertise and experience in engineering, design, construction and maintenance of offshore oil and gas structures based in Taranaki. One prominent current project is the front-end engineering development for the Pohokura gas-condensate field, the offshore components of which include a number of offshore wellhead platforms and subsea pipelines to onshore production facilities.

Marine engineering servicing is a diverse group of activities and its economic value has not been assessed.

Tourism

Assessing the contribution that ocean-based activities make to tourism earnings is difficult for two main reasons: the intangible component of attraction that an island nation offers as a tourist destination regardless of the activity actually pursued, and a paucity of data directly related to ocean-specific activities.

The sea hosts a range of commercial activities that deliver recreational and other services. The business process, driven by New Zealand capital and skill, is varied as a consequence, and may involve rights established through an exclusive concession obtained from the Department of Conservation (DoC) for activities

such as sea kayaking, or a non-exclusive license such as is required for charter fishing.

Leaving aside the value of domestic tourism, export earnings from tourism are calculated from expenditure by international visitors in New Zealand and through international airfare receipts of New Zealand carriers. In the year to March 1999, tourism export receipts were measured as being $4.7 billion or 15.3% of New Zealand total export receipts. This contribution placed tourism as New Zealand's second largest export industry at $4.9 billion or 15.9% of export earnings.

The most recent and detailed information on tourism activities is from the Tourism Research Council's International Visitor Survey (IVS) report for the year to September 2002. Activities and attractions surveyed that are connected with the marine environment include beaches, scenic cruises, swimming, dolphin and whale watching, the Americas Cup yacht regatta, sea/coastal fishing, game fishing, seal colonies, bird watching, Milford Sound, Doubtful Sound, and other water sports.

Of these, beaches and scenic cruises account for 5% each of visitor activities while all others are 1% or less. At face value, this indicates that ocean-based tourism is a relatively small component of the international tourism sector in New Zealand, comprising niche activities such as cruises in the Bay of Islands and Doubtful Sound, whale and dolphin watching, game fishing and eco-tourism. However, hospitality and transportation are not usually directly marine-related, but are necessary adjuncts to any marine-based tourist experience and can be considered as part of the economic benefits accruing from the attractions of the marine environment to tourists.

No dollar values are attached to the figures on individual activities identified in the IVS report. These are too small and too inclusive of other activities to simply divide into overall tourism earnings or average expenditure per person to indicate the value of ocean-based tourism. Nevertheless, there are obviously significant economic benefits, e.g. for the year ended September 2002, 260,000 international tourists are estimated to have gone on scenic cruises. If these tourists each spent only $100 on this activity alone, earnings would have been $26m. Domestic ocean-based tourism would be a significant additional component to all of these ocean-based activities; for example, the Leigh marine reserve north of Auckland receives 200,000 visitors annually, many of whom contribute to local businesses.

The growth path for ocean-based tourism is dependent on a range of factors, some external to New Zealand and some internal. International tourist numbers are more dependent on global or regional economic issues than marketing, and matching New Zealand investment in tourism infrastructure is exposed to external risks. Some marine tourist destinations in New Zealand are becoming heavily over-used, and restrictions on visitor numbers to these places may impact growth.

Part 2: Discussion of Policy Frameworks

Introduction

This study is focussed primarily on understanding the economic activities that take place in New Zealand's ocean territories so as to avoid barriers that might otherwise stand in the way of achieving best value in the future. This study is also concerned with assessing those factors that have been identified as vital to the facilitation of economic opportunities. To do this, it is important that the issues are looked at in their totality and not simply at an individual sector level. Optimal regulation will not arise without an understanding of the interaction between the different sectors. The analysis approach taken has thus sought to develop an integrated view of the policy settings critical to long-term sustainable development.

Part One reviewed the significant contributions that ocean resources and associated services make to the New Zealand economy today. The New Zealand economy is currently facing the challenges of a significant transformation driven by a combination of factors that are both internal (e.g. pending exhaustion of relatively cheap energy from the Maui gas field) and external (e.g. uptake of new opportunities such as biotechnology, and the expansion of potential markets such as China).

Whereas the ocean was paramount during the earliest development of New Zealand, for over a century the nation has looked mainly to its land for new opportunities to drive growth. The UN Convention on the Law of the Sea (UNCLOS) was instrumental in raising awareness of the potential associated with a newly-vested continental shelf from about the 1970s. With the discovery and development of Maui gas, and the expansion of seafood industries and tourism, it became clear that the ocean would feature strongly in the ongoing transformation of New Zealand's economy.

Oceans policy seeks to facilitate economic growth, among other objectives, because of the unrealised opportunities (evident and unknown), and the imperative for growth to sustain and improve the relative living standards of New Zealanders. Some existing wealth-generating activities have limited scope for further growth and may decline. New sectors with disproportionate growth potential will be needed to achieve healthy aggregate growth levels.

Wealth from ocean resources can probably be generated with lower net environmental impact than from the existing stock of land-based resources. New Zealand's potential ocean territory is some 20 times its land area, and has been subjected to much less exploitation. While there is enormous potential, there is only limited development experience in New Zealand's oceans, and the policies that are established now will have far-reaching consequences.

Industry views

To address the extent to which current policy frameworks are facilitating the generation of economic value from the ocean, now and in the future, spokespersons from a representative range of industries were consulted. Their views were canvassed to identify perceptions within industry of current and ideal future policy frameworks, and the issues each considered most important.

The actual expectations of many of those interviewed were not especially ambitious. In some cases there was a degree of cynicism evident where it was felt that political expediency was likely to limit the achievement of an ideal framework. In articulating 'worst' and 'best' cases, respondents fell into two modes. A few responded, on the basis of their specific sector interests, that retention of certain existing features is paramount and a swing towards one or more competing interests would be deleterious. Others emphasised the need for one or both of the following policy features:

- implementation of sustainable development principles; and

- efficient processes that, as far as possible, enable realisation of commercial opportunities without compromising reasonable environmental standards.

Current policy settings include features that are popular with interviewees, and several that drew criticism.

Interview process

Structured interviews were conducted with 16 representatives from a range of industries with interests in the ocean, particularly policy analysts associated with umbrella organisations.

The interviews were structured according to the following guidelines:

- Ensure the interviewer understands the scale and business of the company or organisation represented by the interviewee.
- Ascertain interviewee's awareness of the Oceans Policy process. Supplement that understanding where necessary.
- Gauge interviewee's satisfaction with the process. In some cases this has either improved or deteriorated over the course of the process.
- Elicit a range of scenario outcomes of the policy process, by specifying worst case, best case, and most likely outcome scenarios from the interviewee's point of view.
- Ask for examples of shortcomings with the status quo: recent or historic examples of what the interviewee considers to be bad policy.
- Ask for examples of features of the status quo that the interviewee feels should be preserved, or extended.
- Elicit specific issues that the interviewee feels must be addressed by the Oceans Policy process.

Date (2003)	Person	Organisation	Relevance
7 March	Peter Whitehouse	Business New Zealand	Policy analyst, major umbrella organisation
13 March	Jacob Haronga	Federated Farmers	Policy analyst, major umbrella organisation
13 March	Mike Patrick	Petroleum Exploration Association of New Zealand	EO, major industry association
20 March	Nici Gibbs	Seafood Industry Council	Policy analyst, major umbrella organisation
26 March	Neil Bromley	Transpower	Operates Cook Strait DC cable and associated communications system, and national power grid
26 March	Dave Hercus	Southern Cross Cable	Owner and operator of large international telecommunications cable system
27 March	Ian Miller	Carina Laboratories Ltd	Entrepreneur, developer of personal products from seaweed
1 April	Eric Barratt	Sanford Ltd	CEO of major fishing company
3 April	Roy Weaver	Westgate Transport Ltd (Port Taranaki)	CEO of significant regional port
4 April	Bill Day	Seaworks Ltd	Founder of marine contracting firm
8 April	Doug Gordon	NZ Minerals Industry Association	EO, major industry association; long personal involvement in oceans policy
10 April	John Auld	Auld Brewer Mazengarb McLean	New Plymouth lawyer involved with several ocean industries and regional interests
11 April	Paul Morgan, Nadia Kimberley	Federation of Maori Authorities	Umbrella organisation for Maori commercial entities
14 April	David Barnes	Tourism Industry Association	Policy analyst, major sector organisation
16 April	Darryl Sykes	Rock Lobster Industry Council	Policy analyst, major sector organisation
2 May	Mike Franklin	Babcock NZ Ltd	CEO, operator of Devonport dockyard; chair, Marine Exporters group

About half the interviewees were following the Oceans Policy process very closely and almost all the others were moderately well aware of progress. Only two indicated limited prior awareness. Satisfaction is highly variable, and some interviewees expressed increased concern after earlier positive impressions, feeling that Stage Two is being undertaken on too short a timeline for a good result. Their concerns include a perceived difficulty in achieving appropriate focus and balance, particularly in respect of the risk that the Oceans Policy process may be captured by 'special interests' (sometimes explicitly identified as environmentalists and associated organisations).

Aspects of the current framework that received negative comments from those interviewed, and then aspects that drew strong support, are discussed in the following section.

Critical views

Much of the criticism was focussed on aquaculture reform, in particular the moratorium on new resource consents. The need for aquaculture reform is generally acknowledged but is seen as a failure of processes under the Resource Management Act. Even with a modern statute, consenting authorities have failed to anticipate demand for coastal space for marine farming when regional coastal plans were drawn up. The moratorium is generally accepted as necessary to provide breathing space for the issue to be resolved. However, there is widespread concern that significant capital is tied up in stalled projects, and that a strong growth sector is being curtailed. Furthermore, none of the interviewees with knowledge in this area expressed satisfaction with the direction of the reform. Fishing industry representatives submitted that allocation of rights with respect to aquaculture should be consistent with the Quota Management System.

Consequences of the aquaculture reform process for iwi was another aspect to receive unfavourable comment. Iwi-based commercial enterprises, with widespread involvement in commercial fishing and seafood processing, and discrete coastal areas of interest (i.e. their respective rohe) that are seen now to offer aquaculture opportunities, have been moving into this industry. To the extent that the reforms create a new class of property right, which will realise a value in accordance with the returns that can be expected to arise from it, iwi wish to secure a reasonable proportion of this opportunity.

Moratoria, in general, are seen as an indicator of an inadequate statutory and policy framework. The moratorium on genetic modification was cited as an example by one interviewee. While current policy settings are directed at fostering growth and innovation, government is felt to be resistant to commercialisation of research in relation to ocean resources. Publicly funded research mechanisms received some criticism as failing to effectively deliver on sustainable economic development objectives.

Retrospective measures are naturally unpopular in that they tend to become executive actions, taken in the absence of consultation (such as the closure of selected seamounts). Some industry spokespeople feel that environmental interests are often inappropriately indulged, especially in cases where the Minister of Conservation has the power to restrict certain activities in the coastal marine area that would otherwise be permitted, apparently on the basis of perceived but often unsubstantiated environmental effects.

Most other negative comments addressed the Resource Management Act, usually the way in which it has been implemented by regional and local authorities rather than the Act itself. Strengthening central government leadership is seen as at least a partial solution. The New Zealand Coastal Policy Statement (1994) presents some obstacles to projects and activities that are seen by some as being unduly onerous. Infrastructure operators expressed concern at the uneven administration of the RMA around the country, and several instances of poor balance between local effects and nationally distributed benefits. Objectors, including those perceived as having dubious standing in some cases, were widely seen to be unduly empowered by the Act, leading to a 'payoff' culture that is widely considered to be unsavoury. There was also concern on the part of some rights-holders that

public benefits (e.g. access, or no-take reserves) are allocated at private expense, with inadequate or no compensation.

A particular concern expressed by some of those interviewed is the effect of the Marine Reserves Bill, currently under consideration. This is part of a broader frustration at the fitness for purpose of biodiversity measures generally. No interviewees took a position against biodiversity as an objective. However, industry faith in the Oceans Policy process is significantly compromised by evidence of new, blunt instrument measures that curtail the ability to sustainably harvest marine resources without demonstrable, and certainly without targeted, biodiversity benefits. 'No take' is seen to be put forward as an end in itself, and the explicit exclusion of consideration of impacts on rights-holders is seen as inconsistent with other statutes, including the Resource Management Act. It is seen to be more consistent with the Conservation Act, which is perceived by many affected parties to effectively 'lock up' resources that could otherwise generate wealth without necessarily compromising the principles of sustainable development.

Support for current policy

In responding to the question of what features in the current statutory and policy framework ought to be retained, two particular items received repeated and consistent mention.

Firstly, the Quota Management System is valued by people in the fishing industry. They feel that it provides a sound basis for, as far as possible, self-regulation to efficiently balance pursuit of wealth with sustainable fish stock levels. It is strongly supported, notwithstanding a range of identified weaknesses such as government's inability to integrate meaningful provisions for 'recreational' take (which includes some significant commercial activities such as charters). The strength of the system lies in its enabling of resource harvesting within a sustainable yield level.

Secondly, the fundamental basis for the Resource Management Act, in requiring consideration of environmental effects of proposed activities, is widely supported even by those who express frustration at various outcomes and practices. The RMA, however, has no jurisdiction in the ocean beyond the coastal marine area, the outer limit of which is the seaward boundary of the territorial sea as defined by the Territorial Sea and Exclusive Economic Zone Act, 1977.

Views on optimal policy frameworks

In practical terms, industries operate within a subset of the complex framework of legislation[1] governing the ocean (while subject to all of it). In general, each sector has a 'core' statute and agency, as well as being influenced by other statutes and agencies to varying degrees. The Resource Management Act is probably the main 'umbrella' element of the status quo and is of either primary or secondary (as opposed to incidental) importance in nearly all cases. It is limited only by the extent of the territorial sea which while being a relatively minor proportion of the area of New Zealand's ocean territory, contains most of the human activity.

The main industry perspectives on the suitability of existing policy frameworks for deriving 'best value' from the oceans, now and in the future, can be summarised as:

- satisfaction with the core statutes such as the Fisheries Act, the Submarine Cable and Pipeline Protection Act, and the Crown Minerals Act;
- general satisfaction with the Resource Management Act, with the proviso that there are a number of issues that need addressing; and
- a degree of dissatisfaction with one or more other statutes and policy initiatives that impinge on particular sectors.

In general, industry representatives acknowledge that the status quo lacks coherence and over-arching principles. However, there is some concern that in fixing this, government could potentially implement a framework that was deleterious to their commercial interests.

Industry stakeholders are pragmatic in their expectations of the Oceans Policy process. They expect some issues to prove 'too hard'. If policies are well-constructed, however, this

[1] summarised by Oceans Policy Secretariat (2002)

does not need to be true. Stakeholders hope to see a framework that is:

- based on explicit sound principles, and are thus reasonably predictable;
- efficient in its administration;
- recognises and enforces the rights of tenure as appropriate to each sector; and
- is durable and robust enough to provide for new opportunities that may arise from technological development, resource discovery, or demand, to be taken advantage of in an efficient manner.

Policy to facilitate economic opportunities

As the Part I analysis demonstrates, New Zealand's ocean territories have made, and continue to make, significant contributions to the economy. The analysis also points to some likely future contributions from a range of knowledge-based and technology-orientated activities. These future opportunities have an essential technology component that will, in some cases, require substantial capital investment and consequently a strong economic argument to offset the significant risks involved.

A coherent and consistent regulatory framework, and a strong national infrastructure, will be required to facilitate the continuation of existing sectors' contributions and the realisation of new opportunities. This is essential if a viable and sustainable industry base is to be promoted within the oceans sector. Integration across all segments will also be required, otherwise the industries of today could act to minimise the wealth-generating capacity of tomorrow's industries.

The Part 1 analysis and engagement with industry representatives, as part of this project, identified several key issues with regard to facilitating the generation of the potential economic value that need to be addressed in the development of oceans policy.

International law

International law, in particular the UN Convention on the Law of the Sea, 1982 (UNCLOS), provides an essential underpinning for oceans policy. UNCLOS mandates that states provide for regulated exploitation of the resources that exist within their claimed jurisdiction. New Zealand has one of the highest per-capita exposures of any nation to this responsibility and opportunity.

New Zealand was heavily engaged in negotiating UNCLOS during the 1970s and, subsequently, in a state of some tension between 'coastal states' (generally, less developed nations with coastline length providing for significant offshore territorial expansion) and 'maritime nations' (developed economies with substantial capabilities in such areas as ship-building, shipping, and resource exploitation that perceived a threat of exclusion from future economic opportunities). At the outset, New Zealand's cultural identification was with the latter, but a dispassionate analysis came to suggest otherwise.

UNCLOS implicitly recognises that there are net global economic gains where the technological capital of one country (a 'maritime nation') can be combined with the natural resources of another ('coastal state'), and that the latter has the sovereign right to establish a fair means of sharing in the wealth so created. New Zealand statutes, including the Continental Shelf Act, the Crown Minerals Act and the Fisheries Act, all provide for such developments within the EEZ, and the participation of foreign and multi-national corporations. Shell in petroleum, and Nissui in fishing, are successful examples. The development of new sectors, such as biotechnology or volcanic-related mineral deposits, will depend on similar frameworks that create secure and tradable property rights in respect of which capital investment can secure attractive returns.

Several other international conventions, either in place or under negotiation, will bear on the shape of oceans policy. The extensive processes by which these conventions are drawn up undoubtedly benefits New Zealand, and New Zealand should continue to engage proactively in such processes.

Sustainable development

Economic growth needs to be understood as a component of sustainable development. Sustainable development requires investment

to fulfil the aspirations of the present population while not compromising the interests of future generations. A despoiled environment is not an acceptable legacy for future generations, but neither is a non-competitive economy with possible attendant social disorder and inequities, which may also correlate with a greater level of threat to the environment.

There is a common view amongst industry that maintenance and enhancement of environmental standards, concurrent with expansion of economic activities, need not be a zero-sum equation. Modern technology and ethical business practices fully recognise the essential conditions for optimising environmental performance. Moreover, the stronger the industry base, the more likely that individual enterprise will act to minimise environmental degradation and deliver on societal aspirations. Therefore a level of economic growth should be viewed as a necessary, not merely desirable, goal of government policy development.

It is clear that some of the likely future opportunities identified in Part One of this report, and probably several unforeseen opportunities, will become commercially viable within the foreseeable future. The impediments are varied: some opportunities await technological development, others will replace commodities currently supplied relatively cheaply from more accessible resources that are being depleted. Aquaculture is a case where resources, technology and markets are clearly all available. Improved definition of the rights necessary to establish commercially sustainable production facilities remains to be effectively addressed before further growth will be achieved.

Weaknesses exposed in infrastructure development arising from under-investment, for example in the discovery and development of oil and gas resources, are an example of the negative consequences of a national policy that falls short of optimising economic performance. This is a critical component for attracting the levels of investment that will be needed if New Zealand is to take advantage of the development of the new oceans technologies.

It is becoming recognized within such government-sponsored initiatives as the Growth and Innovation Advisory Board[2] that proactive measures may be necessary. In this policy climate, there is a case for government facilitation of initiatives that will allow ocean resources to be commercialised subject to sustainable development principles.

Linkage to growth and innovation framework

With the development of a growth and innovation policy framework the basis for selective government facilitation has been restored. A strong case can be made that ocean resources provide such a significantly valuable opportunity that proactive promotion of commercial development, over and above simply an enabling framework, is justified.

The need for government catalysis in relation to such opportunities is, in large part, a function of investment risk at a level for which New Zealand's limited domestic capital market has little appetite. Foreign investment will no doubt be an important component of the realisation of new sources of value, but there is no need for foreign capture of a disproportionate share of the wealth created.

The ocean policy framework will become an important component of investor thinking in respect of New Zealand's ocean resources and the attractiveness of future investment. Set against the potential return on major capital investment is a range of risks: technical, commercial, and execution. Well-conceived government programmes can lower the barriers associated with each of these. Applied research addresses technical risk and may also contribute to a pool of specialist expertise that can minimize execution risk. Healthy capital markets and robust, transparent, regulatory and fiscal frameworks are attractive in terms of investment risk. New Zealand should build the strongest possible linkages with other nations that have established best practice in these areas; in particular, science and technology linkages to facilitate the development of an appropriate knowledge base and culture for its application.

[2] New Zealand Herald, May 6, 2003

Property rights

Policies with respect to economic activities and opportunities need to take careful account of the tenure, allocation, and administration of participants' essential rights. A clear and, ideally, fully tradable property right is an essential incentive to those making the capital investment required for the business opportunity (including infrastructure development). Property rights are also essential tools to limit commercial activity within sustainable practices. Secure property rights generate a long-term interest, on the part of holders, in the sustainability of the resources and in the environment needed to support them. Their investment decisions and implementation then become aligned with national and global scales of sustainability.

Much wealth has, in fact, been generated in the absence of clear property rights, as a result of innovations in technology or business processes that have been unforeseen (or often initially belittled: for example, telegraphy) before rapidly establishing substantial niches in the national or global economies. As described in Part One of this report, aquaculture is a contemporary example in New Zealand.

One of the potentially intractable issues to confront the achievement of the goal set for ocean policy is likely to be the variety of ways by which existing rights (including formal tradable property rights) are defined. Private land title is a deeply-embedded element of the New Zealand economy and its British antecedent, but does not apply offshore. The relatively modern entity of fishing quota is similar in its tradability but is not exclusive in terms of either access to fish or access to space. This lack of exclusion can cause vulnerability to erosion of the value of commercial fishing quota. Further potential erosion by growth in recreational take, and other factors beyond the control of the holder, remain to be resolved equitably.

Another relevant form of property right is the system of prospecting, exploration and mining permits issued under the Crown Minerals Act. While tradable, these are for finite terms and subject to escalating risk investment, leading to a different business process than if they were permanent, or tendered for a cash consideration, for example. Within Taranaki Basin, after several decades of exploration and the development of successful discoveries, this system operates reasonably effectively. It was shown to be capable of adaptation in 1996 when, in the light of low exploration activity levels, a shift from competitive tendering to the 'first-in, first-served' provisions of the Acceptable Frontier Offer system was implemented. With increasing activity, Crown Minerals have now reverted to competitive bidding. In less explored, frontier areas, the first-in first-served system still applies, but with limited participation because the tenure of permits is considered by industry to be too short considering the large risks and costs faced. The result is that vast, nominally prospective deep water areas remain unexplored. These areas cannot yield discoveries without considerable exploration investment, and some change to the nature of title, such as longer tenure, would be required to stimulate investment unless some other factor changes materially.

The nature and allocation of rights to develop 'new' resources such as gas hydrate and volcanic vent-hosted minerals need to be considered very carefully, well in advance, to optimise the benefits to the nation. These opportunities are being led by public-funded research, mainly into resource characterisation. In the present framework, title in the form of an exclusive right to develop any discovery arising from commercial exploration is available to whichever visionary entrepreneur is first prepared to make an application. The potential leverage is tremendous but the probability of sustaining title until development proves commercial, and raising the required capital, is very low. The model has many precedents throughout the history of the oil industry and in many other sectors such as satellite broadcasting, but it does result in potential capture of a disproportionate share of the value by the visionary provider of high-risk capital. Without government intervention, this is unlikely to come from within New Zealand.

Alternative approaches to title definition and allocation for 'new' resources should be examined with the specific goal of facilitating their commercialisation while securing an

optimal return to the Crown. Other policy objectives, such as iwi participation, could also be addressed.

In addressing the issues associated with property rights, attention to the parallel policy goal of providing for public access will need to be taken into account. There is a risk that measures to deliver on public access will compromise the value attached to property rights, which could have the effect of devaluing such property rights, limiting the capital investment that value-generating activities require. Several current examples could be cited. Government has the sovereign opportunity to erode private rights through legislation but, constitutionally, is generally expected to compensate for attendant losses. Of course, setting fair value is not straightforward.

The tenure of land and water space occupied by ports is of finite duration. As the date for renewal or renegotiation of such tenure approaches, it will inevitably affect the business strategies and development investments, potentially to the detriment of the nation's infrastructure. This is similar to the case of renewal of water rights for major hydroelectric facilities. Impacts of these issues on port development could have flow-on effects similar to the current deferral of major investments in energy-intensive sectors such as wood processing. Tenure in perpetuity over land and resources employed for such essential infrastructure may become appropriate in future.

Although it is probably not achievable to fully integrate property rights across all ocean sectors, there is a need for transparent mechanisms for making trade-offs between different rights and interests. The governance and administration of each sector needs to be well informed about the activities of other sectors (including new activities) that may impinge on the space, or on the fixed or mobile resources upon which they are based.

Maori participation in commercial activities

There appears to be a tendency to treat Maori interests in respect of resource management policy rather narrowly, as little more than the exercise of kaitiakitanga. This generally casts Maori as habitual objectors to proposed development. Conversely, the implementation of the Fisheries Act as well as the settlement of major Treaty claims by fishing quota has, within that sector, aligned several iwi entities with industry. The generation of wealth through sustainable development within the Quota Management System has created the sort of virtuous circle appreciated by many Maori as a means of restoring an equitable status in New Zealand society.

There are calls to provide for iwi participation in other sectors with high growth potential, including but not limited to aquaculture, and these should be considered as a potential means of delivering on the principles of the Treaty of Waitangi. However, it is very important that this is done in a way that does not increase uncertainty, but protects existing property rights and incentives.

Providing for the unforeseen

Strategic planning, whether at business, sector, regional, or national levels, endeavours to develop foresight as a basis for making appropriate investment and regulatory or policy decisions in an efficient manner. However, it has chronic limitations due to an inherent inability to fully perceive the future.

It is likely that significant economic growth will come from opportunities that are not yet apparent. Despite what has gone on before, the oceans represent largely untapped potential and oceans policy can be reasonably expected to have to cope with increasing, and to some extent largely unforeseen, development opportunities.

It is thus important that policy is sufficiently flexible to provide for currently unforeseen future opportunities (as well as speculative, foreseeable ones), as the ability for new opportunities to establish an initial high-growth trajectory will be a key determinant of aggregate economic growth and strength. The policy will have succeeded emphatically if New Zealand can achieve a sustainable internationally competitive advantage in being able to launch new economic activities within a robust sustainable development framework. Recent and ongoing moratoria on aquaculture

and genetic modification exemplify what would be avoidable (or minimised) in an ideal policy framework.

Knowledge management

Information and knowledge are critical inputs to sustainable development. New knowledge and improved integration of existing knowledge and information lead to new opportunities that are available for creation of economic value. The uptake of that value depends on an adequate knowledge base for assessment of environmental and other impacts of the activities involved. This study has demonstrated the vital need to build capabilities in this area, a deficiency that has been recognised in earlier analyses[3]. There is tremendous scope for improvement in the processes and systems by which knowledge is generated and managed.

Within the combined public and private sector systems of New Zealand, knowledge is distributed in a very complex way within a generally inefficient institutional framework. Certain elements have their own bureaucracy, e.g. the Public Good Science Fund, which is the major 'purchase agent' for the research that brings forth new knowledge, the Crown Research Institutes, which conduct most of that work under contract, and agencies such as Land Information New Zealand, the Ministry of Fisheries, and the Crown Minerals unit of the Ministry of Economic Development. All of these have specific sectoral or functional responsibilities with commonly tenuous incentives for moving knowledge among them.

It is well beyond the scope of this analysis to prescribe an effective reform, but the potential gains justify a serious continuing effort towards a goal of better enabling the generation of knowledge and its management and uptake. In the Oceans Policy context, particular focus needs to be given to making ocean-based knowledge widely available so that information can be integrated for maximum benefit to all. PGSF-funded research outputs need to be public, not captured by CRIs and on-sold for commercial gain, as is widely perceived to be the case at present.

[3] Parliamentary Commissioner for the Environment (1999)

Tertiary level education resources relevant to oceans research and knowledge in New Zealand are poor. There is, for example, no ocean engineering department at any New Zealand university.

The marine environment and the Resource Management Act

Although there is widespread criticism that the Resource Management Act causes delays and imposes other burdens that have the effect of curtailing investment, the transparency of its processes represents an important and attractive feature compared to alternatives. The RMA, however, only applies within the territorial seas, as far as the oceans are concerned. Provisions for this area, otherwise defined as the Coastal Marine Area, impose additional restrictions (as against those on land) on activities such as reclamations and certain structures, in the form of Restricted Coastal Activities (RCAs) that require the consent of the Minister of Conservation. Concern has been raised by local authorities and others as to whether or not the Minister's involvement in such consents ensures effective consideration of such matters as national importance. The requirement for RCAs is presently encapsulated in the New Zealand Coastal Policy Statement 1994 (NZCPS), which is currently subject to a review process. The need for ocean policy to be consistent with (or perhaps even replace) the NZCPS will be apparent.

A strong view bought forward from industry stakeholders was that beyond the 12 nautical mile limit of the territorial sea, where the RMA does not apply, there is a lack of consistency in provisions for control of environmental or other impacts in the form of principles such as those underpinning the RMA. This is not to say that there are no controls. The provisions of the Fishing Act extend out to the edge of the EEZ, or beyond in some cases, and incorporate environmental principles that provide a similar basis for managing impacts from fishing to those contained in the RMA for other activities. There are also a range of constraints on human activities including The International Convention on Prevention of Pollution for Ships 1973 (MARPOL), and the London Dumping Convention 1996 Protocol,

which actually goes further than the RMA. Nevertheless, the principles of the RMA, in requiring proponents to assess environmental and other impacts of their proposal, and for activities to require consent unless permitted by rules, provide as sound a basis as any for developing effective resource management tools.

There is also a serious question raised about where the natural boundary, to which the RMA (as a land-based statute administered at the local and regional levels) applies, ought to extend. The current 12 nautical mile extent includes a significant component that is, in effect, 'open ocean', which would be better administered at a national level. Conversely, regional councils could, arguably, take full responsibility for the truly coastal marine area without the over-riding authority of the Minister of Conservation (except in respect of classified conservation land). The optimal division between regional and national interests deserves to be clarified. Any fundamental change to current jurisdictions will require much more analysis, and the development of effective agencies at all levels. The case for an appropriate pan-sectoral central government agency is developed further below.

The nature of impacts of human economic activities on the marine environment can and should be considered in both a spatial and temporal framework, with cumulative and collateral effects taken into account. Aggregate economic growth can be expected to be driven by a few sectors at a time, some of which may decline to the point of restoration of a near-pristine environment over the course of a few decades. The Maui gas field is a likely example. Installation of a submarine cable may involve significant localised disruption over the course of a few days, but negligible continuing interference with the host environment. Conversely, cities and ports can be treated as permanent alterations of their immediate environments.

On land, the Resource Management Act requires proponents of activities that do not hold the relevant and current consents to identify any environmental effects and to propose measures that will avoid, remedy or at least mitigate them. There is no reason why the same approach should not apply in the ocean. However, the extent to which the marine environment is understood, both generally and in respect of sub-environments such as seamounts, may constrain the ability to properly assess effects. It is often asserted that the Precautionary Principle should be applied as a result.

Several industry stakeholders consulted in the preparation of this report expressed concern about interpretation and use of the Precautionary Principle. The principle is often raised in submissions against a new development and the way in which it is applied to policy development deserves considerable analysis and debate so as to strike an optimal balance between the environment and the economic and social health of the nation. Simply put, the Precautionary Principle requires that when a decision is required in circumstances of significant uncertainty, exposure to potential negative consequences should be avoided as far as possible. Counter to the intended consequence of this (avoiding low-probability but still plausible negative consequences) is that positive outcomes are sometimes foregone or deferred. Formal risk management methodologies exist to achieve the same end as the Precautionary Principle, and should be refined and applied with a goal of continuous improvement and the attainment of best practice. To allow the Precautionary Principle to overtly obstruct development is inappropriate. If such an approach is given credence, an incentive to avoid improvement in knowledge is created that would have inappropriate consequences for the quality of environmental management and the economic well-being of the people of this country.

The objective in the decision-making process should be a balanced, optimal outcome. This will inevitably produce a political challenge because of technical complexity and because of overlays of qualitative, values-based positions in addition to scientifically objective treatment (which is not in practice always free of prejudice and special interest).

A dedicated oceans agency

Among the various strands of thinking that have emerged from this analysis, is an embryonic case for a dedicated central agency

for managing ocean territory and resources. In particular, several contributors to the workshop held as part of the project were strongly supportive of the concept. It is not a universal view, however, and neither does it suggest that existing agencies are necessarily failing to deliver particular outcomes in oceans management. Although it is not within the scope of this study to develop the role of such an agency and how it might relate to existing agencies and emerging policy directions, the concept is considered important enough to be raised.

In reality, the optimal structure for achieving policy objectives may fall somewhere on a continuum between a high-level networking amongst a multitude of mainly existing agencies, and a new, strong central institution focussed on all aspects of the ocean. The more robust and durable the policy framework, the greater the potential advantage of the latter.

An effective central agency seems more likely to optimise delivery on the goal of providing for creation of economic wealth from New Zealand's ocean territory, even considering the simple fact that the present Exclusive Economic Zone has an area of 4 million sq km, which is about 15 times the size of the landmass, and the extended zone somewhat more than that. Optimisation of this goal will be necessary for the resources of the ocean to contribute to New Zealand's continuing economic transformation according to goals set by government in terms of competitiveness within the OECD.

The range of functions of an oceans agency could be quite broad and may include:

- information management and knowledge brokerage;
- regulation and administration of marine activities beyond the immediate coast;
- co-ordination and policy leadership of regional council processes in respect of the immediate coastal area;
- design, allocation and administration of property rights;
- maintenance of acceptable standards of biodiversity;
- a key role in biosecurity management;
- health, safety and environmental performance of offshore activities;
- adequate offshore infrastructure performance; and
- promotion of New Zealand as a true maritime nation.

Conclusions

This analysis has reviewed the economic opportunities and value that could be generated from New Zealand's oceans now and in the foreseeable future, and how an oceans policy could help New Zealanders optimise current and future economic opportunities. The essential principles identified by stakeholders for deriving economic opportunity from the ocean are that an oceans policy framework:

- is based on explicit and sound principles that are coherent and consistent;
- is supported by a well-developed and efficient infrastructure;
- allows for pro-active interaction by government when appropriate;
- provides for knowledge to be shared;
- is efficient in its administration;
- recognises the principles of the Treaty of Waitangi;
- recognises and enforces rights of tenure appropriate to each sector; and
- is durable and robust enough to provide for new opportunities that may arise from technological development, resource discovery, or demand, to be taken advantage of in an efficient and sustainable manner.

Economic benefits from the ocean will arise from the drive to add greater value to natural endowments. The oil and fishing industries are well-established, but new developments are likely to require clusters of enterprises, supported by a strong oceans policy, that are focused on innovation, significant improvement in the cost-effective application of knowledge and on the development of high skill levels. Technological development will be a key to innovation and transforming the business process, with great potential for a stronger New Zealand economy benefiting from ocean-based economic development.

While some existing sectors are currently growing, there will be a continuing development of new opportunities, not all foreseeable, for which provision needs to be made. Government will be expected to ensure that a well-balanced enabling policy, and statutory framework with clear and efficiently administered property rights, are provided. Infrastructure development, including a strong knowledge and innovation system, is also crucial to attainment of the policy goal.

The marine environment is far from being completely understood. The quality of information is often highly variable, leading to decision-making sometimes under considerable uncertainty. This limits the confidence with which potential impacts can be considered against a baseline scenario (for example, with respect to fishing and mining on seamounts). The acquisition, management and application of knowledge, within a balanced economic and environmental policy framework, will be vital. Transparent and robust systems and processes will need to be developed and continuously refined in order to achieve international best practice.

The lack of consistent tools for assessing the environmental and other impacts of proposals, outside the limits of the territorial sea, is recognised. The principles underpinning the Resource Management Act 1991, which require proponents to provide an assessment of such effects, are seen to provide a sound basis for developing appropriate resource management tools.

In administering New Zealand's ocean, careful consideration needs to be given to the form and allocation of property rights to foster sustainable commercial practices. Iwi have particular interests in the marine realm and can build on a strong involvement in the seafood sector to participate in other commercial opportunities as well.

The role of existing agencies in the administration of future oceans policy is recognised but there is a strong case for a national institution that is focused on all aspects of New Zealand's ocean territory and its effective management.

Among the critical components identified as being necessary for a successful oceans policy are allowances for:

- integrated approaches;
- knowledge-based industries;
- property rights that enable access to opportunities;
- regulatory frameworks that attract investment;
- acknowledgement of the process of technology advancement and that what is known today will be different in future; and
- conservation rather than preservation.

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