



The Future is Here

**New Jobs, New Prosperity
and a New Clean Economy**

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Cover photo: The New Zealand land mass is ancient. Geologists estimate that it separated from the ancient supercontinent of Gondwana around 80 million years ago as a single land mass, which geologists call Rangitata.
© Jacques Desclotres, MODIS Land Rapid Response Team at NASA GSFC

The opportunity

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The world is witnessing a historic, global shift in the way we power our economies, our businesses and our homes.

Huge opportunities are emerging from a new global understanding that the environment and the economy must be viewed as a whole, not in competition.

Governments and businesses have been responding to the two fundamental economic forces of our time: climate change and the end of easy to reach, conventional fossil fuels. They are investing in technologies that reduce waste, cut pollution and protect, rather than exploit, natural resources.

This is the story of the 21st century – a global clean energy revolution is underway. And the race is on between nations to position their economies as leaders in this new global clean technology economy.

In 2011 the world invested nearly US\$280 billion in renewable energy (BNEF, 2012) and the global market for clean technologies is valued at more than US\$5 trillion (Innovas, 2009). Investment in clean energy has resisted both global financial crisis and pressure from the oil and gas lobby. The most prosperous economies are gaining from this new economic activity, delivered through the commitment and leadership of those progressive governments backing this growth.

The challenge now for New Zealand is: are we willing to capture a share of this enormous market?

If the answer is yes, New Zealand can move confidently into a new era of sustainable economic development that is as significant as the economic wealth created for the country by the invention of refrigerated shipping in the 19th century.

This report demonstrates the huge wealth that can be created for New Zealanders by building an economy based on 100% renewable energy, energy efficiency and sustainable transport. In doing so, we can build strong export industries and jobs based on clean energy technologies. We have the natural resources and people to make this happen.

This report goes beyond adding green growth to our current economic and political paradigm. It challenges the political mindset. The challenge is for our Government to commit wholeheartedly to a cleaner, safer way of doing business. Only when our Government creates the right economic environment will New Zealand businesses and workers be able to capture the wealth and job opportunities that will flow from building a clean economy.

This report is based on the most up to date and leading analysis of clean technology development and economic growth from around the world. It relies on the expertise of globally renowned economists and policy makers, as well as New Zealand entrepreneurs, business leaders and industry experts. It is borne of the necessity to create a new vision for our nation.

We have commissioned modelling from one of the world's leading energy market analysts at the Institute of Technical Thermodynamics of the German Aerospace Centre (DLR) to develop a pathway towards achieving 100% renewable energy by 2050. It shows that by achieving this target we can create many thousands of jobs and billions of dollars of investment for our economy.

This report reminds us that we are good at renewable energy. We are good at innovation. We are good creating in our garden shed and taking products to the world. But we could be much, much better. Our economic vision needs a revolution. That's why, at this critical juncture in history, we need strong political and policy leadership to take our rightful place in the global clean energy race.

After many years of working with New Zealand business, innovators, scientists, investors, commentators and local and national politicians, Greenpeace is confident that the nation can rise to the challenge, and in doing so bring a prosperous future to New Zealand.

New Zealand will have a prosperous and clean future if we choose it.



Solar power technology has developed exponentially over the last 10 years.

The analysis in this report shows that New Zealand can:

- Have 100% renewable electricity by 2025;
- Create tens of thousands of jobs across the clean energy sector;
- Within 22 years New Zealand will be virtually oil free for road transport through efficiency gains, improved public transport and sustainable transport fuels;
- By 2035 save over NZ\$7 billion per year in oil imports (at today's value);
- Realise export economic opportunities in our geothermal industry that could be worth up to NZ\$4.4 billion per year;
- Become a world leader in developing ocean energy;
- Reduce our carbon dioxide emissions by 94% on 2009 levels.

If New Zealand fails to grasp these economic opportunities, the failure will be recorded in New Zealand history as the key turning point towards our economic decline.

A GLOBAL SNAPSHOT

In 2011 the world invested US\$280 billion in renewable energy and the global market for clean technologies is valued at more than US\$5 trillion.

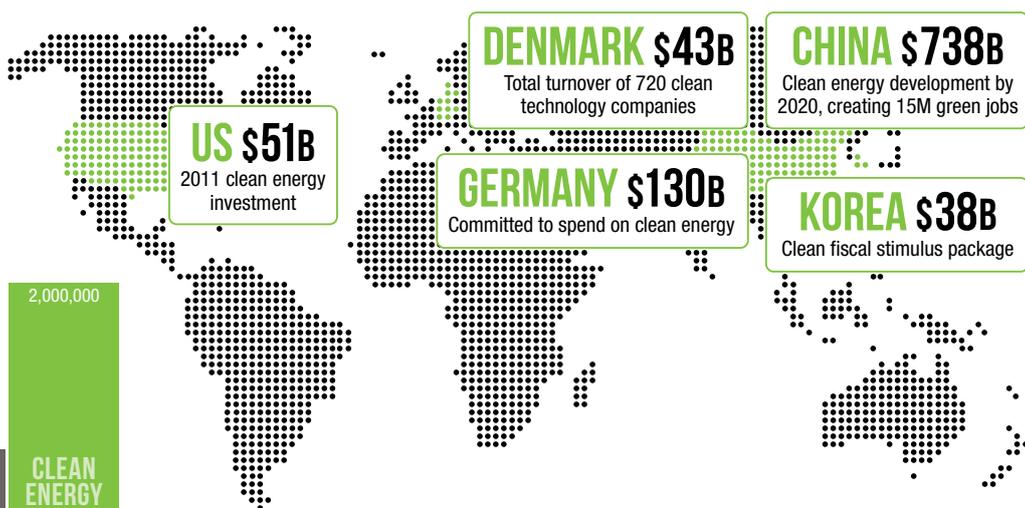
INVESTMENT

In Clean Energy (\$ Billions)



JOB

Created With \$100 Billion Investment



THE RIGHT ENERGY PATH FOR NZ

GEO THERMAL

SMART ELECTRICITY

SMART TRANSPORT

A cleaner, smarter economy will bring us future prosperity. Pollution will decrease and our global clean green reputation will be strengthened. Our energy supply and economy will be improved and huge local job opportunities will be gained.



NZ IS A WORLD LEADER IN GEO THERMAL ENERGY



GEO THERMAL GENERATION



WIND POWER GENERATION



PV PANELS / SOLAR WATER



OCEAN ENERGY



BIOMASS GENERATION



SMART GRID UPGRADE



BUILDING EFFICIENCY & RETROFITTING



MORE PUBLIC TRANSPORT



FUEL EFFICIENCY IMPROVEMENTS



MORE ELECTRIC TRANSPORT



BIOFUELS FROM WOOD BIOMASS



50% OF JOBS RELY ON NZ'S CLEAN GREEN REPUTATION



70% OF EXPORTS RELY ON NZ'S CLEAN GREEN REPUTATION



GREEN ENERGY CREATES 4X MORE JOBS THAN OIL

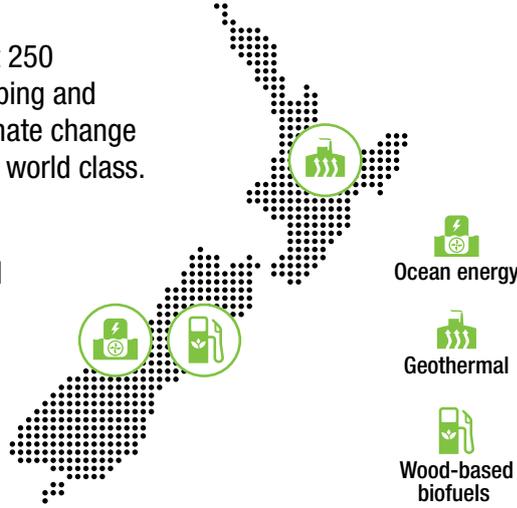
A MULTI-BILLION DOLLAR OPPORTUNITY

WORLD CLASS COMPANIES

Investment New Zealand has estimated that 250 of our organisations are researching, developing and commercialising clean technologies and climate change solutions. At least 60 of these are potentially world class.

A MASSIVE MARKET SHARE

In 2009, PricewaterhouseCoopers estimated New Zealand's potential market share could be between NZ\$7.5–22 billion annually. Investment New Zealand estimated we can go further and create a NZ\$150 billion high-value, low-carbon export economy by 2025.



60
World class companies

\$7.5-22B
Potential annual market share
Source: PricewaterhouseCooper, 2009

\$150B
Potential export economy 2025 value
Source: Investment New Zealand



\$163B NZ share of world market

EXPORT OPPORTUNITIES: \$4.4B EVERY YEAR

100% Renewable electricity supply

CREATES AT LEAST **5,800 JOBS**

\$600M Saved in generation costs

\$7B Saved per year in oil imports

96% Oil free in road transport

92% Fossil fuel free in all energy

CREATES OVER **20,000 JOBS**

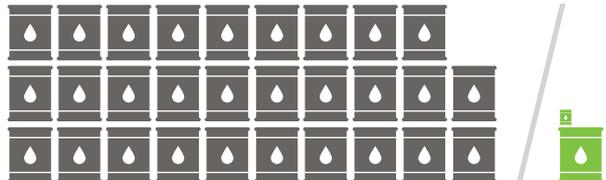
NZ's Carbon Dioxide Emissions From All Energy Use In 2050 (Million Tonnes)

Business as usual (25) / Clean energy future (1.8)



Annual Oil Imports For Road Transport By 2035 (Million Barrels)

Business as usual (29) / Clean energy future (1.2)



GREENPEACE

The New Zealand story

100 MW Geothermal Power Plant at Kawerau, New Zealand. © Rjglewis

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Our great nation, Aotearoa New Zealand, is uniquely placed to seize upon the opportunities that will arise from the global shift towards clean energy. We have all the best cards in the pack.

We are endowed with a wealth of world-class natural renewable energy resources, and with our expertise in geothermal and bioenergy technologies we could become a global centre for incubating clean technologies. We are a people who innovate, solve and succeed in overcoming challenges.

In New Zealand the economic advantages of renewable energy are proven. New Zealand historically has had some of the lowest electricity prices within the developed world due to a large share of renewable energy within the mix. New Zealand businesses have developed world-leading expertise in generating and distributing electricity from renewable sources, as well as innovative energy efficiency technology and practices. This expertise gives New Zealand a distinct advantage in a world that is moving towards New Zealand's way of doing things. We already have a unique global reputation for being clean and green.

Opportunity lost, opportunity cost

There is a real opportunity cost in failing to act at this point in history.

According to figures from Statistics New Zealand, our global clean, green brand has been valued at over NZ\$13 billion and almost half of New Zealand's jobs and more than 70% of our goods and services exports rely on our clean green reputation. We have a lot to lose if we drop this reputation – and a lot to gain by building on it.

Investment New Zealand has estimated that approximately 250 companies and organisations are researching, developing and commercialising clean technologies and climate change solutions in New Zealand. It's believed that at least 60 of these companies are potentially world class.

In 2009, PriceWaterhouseCoopers estimated New Zealand's potential market share could be between NZ\$7.5 to 22 billion annually. Investment New Zealand estimated we can go further and create a NZ\$150 billion high-value, low-carbon export economy by 2025.

Many of our businesses are doing their best to seize new clean tech opportunities. But they are hampered by perverse policy settings and lack of government interest.

Conventional economic and political thinking in New Zealand is bound by doctrine and a crisis of confidence.

The Government is doggedly focusing on digging and drilling for fossil fuels for short-term gain. It has been weakening climate change laws and unnecessarily expanding our roads.

The nay-sayers claim there is no alternative way forward. This report demonstrates that this is nonsense. New Zealanders have a positive choice to make that will bring a brighter, more prosperous future.

Growing a cleaner, smarter economy

The fundamental economic drivers defining the 21st century are the threat of climate change and the risk of ever higher oil and gas prices.

New Zealand needs to stop ignoring these fundamental forces. The New Zealand Government's 'dig it up and burn it' fossil fuel agenda is being questioned and opposed by various sections of New Zealand society. The issue has now become a national debate about the future direction of the New Zealand economy.

We can choose to change the fundamental economic direction for the country from one based on fossil fuels to one centred on creating a 100% renewable energy nation and on exporting clean energy technologies.

As the late Sir Paul Callaghan said: "We need to discover what works for us, what gives us our global advantage. Find what is best in our society and nurture it". His clarion call and legacy to the nation is easy: grow our 'smart' industries.

Greenpeace New Zealand shows in this report that this choice will provide more jobs and more wealth for New Zealand, as well as improving the quality of our environment and way of life for decades to come.

All New Zealanders must make a positive choice for a smart, clean energy future, and must tell all our political parties to get behind it because we need strong political leadership and we need the vision to last.

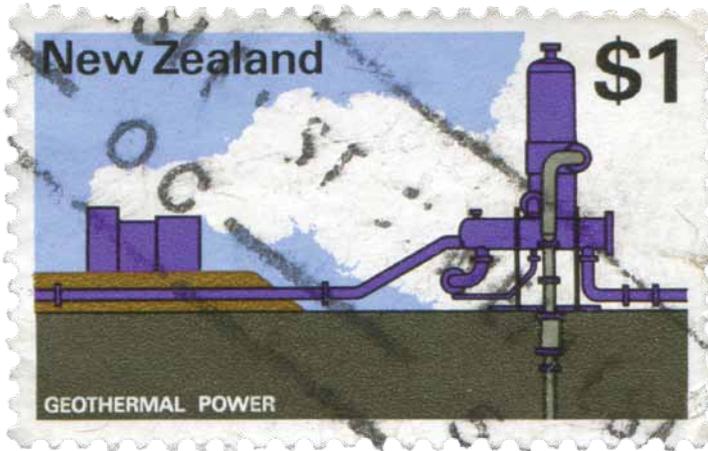
Employment and economic benefits

From a policy perspective, there are strong reasons for moving to a clean economy. Investing in a cleaner economy will:

- Up-skill our workforce and create better paid, lasting, high quality jobs;
- Provide our young people with a bright future and job opportunities in this country;
- Access one of the fastest growing sectors of the global economy – the clean technology sector;
- Add value to our 'clean, green' reputation, safeguarding income from primary industry exports and international tourism;
- Improve economic resilience by diversifying into high-value and knowledge-based exports and industries;
- Gain a better trade balance from growth in our renewable industries;
- Increase direct investment in our clean technology industries;
- Improve energy independence and security;
- Reduce our exposure to risks such as escalating foreign oil and resource costs, carbon costs and tariffs (legislated and market-led);
- Position New Zealand as a global leader in effectively responding to climate change.

**New Zealand could
create a NZ\$150 billion
low carbon export
economy by 2025**

New Zealand pioneered geothermal power generation in the 50's. We now have the opportunity to take our pioneering spirit to the world.



If the race has begun, where are we at?

The current Government has been widely criticised for weakening climate change policy. In the final months of 2012 it further weakened the Emissions Trading Scheme, handing a get-out-of-jail-free card to the nation's biggest polluters, and withdrew from the Kyoto Protocol.

The New Zealand Emissions Trading Scheme (ETS) is intended to provide a price incentive for people and businesses to reduce carbon emissions. The Government 'reformed' the ETS in a way that prices carbon at the lowest available global price, regardless of the quality of the carbon credit, by repealing restrictions on the type of credit that can be surrendered under New Zealand's Kyoto obligation. Our restrictions were similar to the EU's restrictions. Now we have no restrictions.

The Government's policy is "to ensure businesses and households do not face additional costs" from the ETS. This defeats the price signal purpose of having an ETS, so the policy is now merely window dressing.

Earlier the Government repealed the 'thermal ban' clause of the ETS legislation, which restricted new thermal electricity generation. It halted the introduction of a vehicle fuel economy standard that would have lowered the carbon dioxide emissions from our vehicles. It also repealed a very modest biofuel sales obligation.

The Government has focused heavily on promoting petroleum and minerals exploration and extraction. This disproportionate focus on attracting petroleum investment has meant other areas of our energy portfolio with potential for growth have been neglected. Most other parts of its energy strategy have not been adequately funded.

In 2011, the Government made a cursory nod in the direction of green growth. It established a Green Growth Advisory Group on the premise that "New Zealand is well positioned to tap into opportunities for 'greener' growth and development, and find solutions for the large challenges involved". It focused on helping exporters make the most of a 'clean, green' New Zealand brand, making smarter use of technology and innovation, and moving businesses to a lower-carbon economy (MED, 2012).

The Advisory Group delivered a strategy that proposed the introduction of green policy into every area of government activity, rather than pursuing a separate green growth agenda.

These recommendations have now, in part, been bolted onto the Government's Business Growth Agenda to build growth and jobs from sustainably using our natural resources. Unfortunately, this can be only viewed as a cynical veneer. The Government's economic policy settings continue to favour fossil fuels. The continued extraction and use of natural resources such as oil, coal and gas is not compatible with green growth.

The Government's policies and reliance on these carbon intensive, polluting industries is taking New Zealand down a short-sighted and ultimately, poorer economic path.

The global story

3



What is green growth?

Green growth is economic growth that also reduces pollution and greenhouse gas emissions, minimises waste and inefficient use of natural resources, and maintains biodiversity. Green growth places environmental and societal concerns, especially climate change, at the heart of economic planning. Green growth creates decent, well-paying jobs. It is large, and it is growing fast.

What is clean technology?

Clean technology is any service, process, or product that promotes green growth. Clean energy sectors include solar, wind, bioenergy, geothermal and ocean energy. It also includes technology that improves efficiency in buildings, transport and within the electricity system. Clean technology also includes areas other than energy, such as water filtration. This report focuses on clean energy technologies.

Investments in clean energy technologies resisted the global financial crisis better than any other sector, because the principal drivers that propelled those investments were still at work – climate change, energy security, and fossil fuel depletion (UNEP, 2009).

Green jobs are good jobs

Green jobs are defined by the Organisation for Economic Co-operation and Development (OECD, 2004) as jobs that “measure, prevent, limit, minimize, or correct environmental damage to water, air, and soil, as well as problems related to waste, noise, and ecosystems. This includes activities, cleaner technologies, products, and services that reduce environmental risk and minimize pollution and resource use”.

Green jobs tend to be high value, long-term jobs. These jobs are pivotal for achieving economic and social development that is also environmentally sustainable.

Green jobs go beyond the renewable energy industries (Pollack, 2012). Many are manufacturing jobs. These jobs create and service energy-efficient equipment, appliances, buildings and vehicles. Green jobs also involve:

- Pollution reduction and removal, greenhouse gas reduction, and recycling and reuse;
- Sustainable agriculture and forestry;
- Soil, water, and wildlife conservation;
- Government and regulatory administration;
- Education, training, and advocacy related to clean technologies and practices.

A transition to a low carbon and sustainable economy will create large numbers of green jobs across many sectors of the economy.

Dafeng Power Station, China's largest solar photovoltaic-wind hybrid power supply. © Greenpeace / Zhiyong Fu

Investing in New Zealand's renewable industries will strengthen our clean green reputation and provide quality jobs for more New Zealanders.



Global investment in clean energy increased by a factor of six between 2004 and 2011

Green jobs outnumber fossil fuel jobs

Globally, the clean economy employs more workers than the fossil fuel industry and the job numbers continue to grow (Brookings Institution, 2011). Tens of millions of green jobs have been created around the world.

The clean economy will create more jobs. The Political Economy Research Institute's Green Recovery report estimated that in the US \$100 billion spent on clean energy over a 10-year period could create two million new jobs, compared to just 500,000 jobs if the money were invested in oil and gas-related industries. More broadly, investing US\$1 million in clean-energy activities would create more than three times the number of jobs that would be created by investing the same amount in fossil fuels (PERI, 2010).

In other words, money invested in clean energy creates between two to four jobs for every one job created if the money were spent on fossil fuel industries.

It would be smarter to invest our limited financial capital in areas where the greatest economic wealth and job creation can be achieved.

Investment in clean technology also yields better paid jobs. A US study showed that the median wage received by workers in the green economy is 13% higher than the median wage in the overall US economy and that while jobs in the carbon economy were lost during the financial crisis, job growth in the green economy remained strong (Brookings Institution, 2011).

In general, the clean economy improves economic benefit. On a per-job basis in the US, the clean economy generates twice the export value of typical jobs.

Global investment in clean technology

In 2011 global investment in clean energy was a record US\$280 billion – almost six times higher than the US\$53 billion invested in 2004 (Bloomberg, 2012). In 2011, more money was invested around the world in clean electricity generation than in new fossil fuel electricity generation (UNEP / Bloomberg, 2012).

The global market for low carbon goods and services in 2007/8 was worth US\$5 trillion. Asia accounted for 38% of this total, Europe 27% and the Americas 30% (Innovas, 2009). China is now the world's number one investor in clean energy (UNEP, 2012).

One tenth of the US and UK fiscal stimulus packages, one third of China's and 80% of South Korea's were devoted to measures with environmental co-benefits (HSBC, 2009). The UK Government has estimated that investment in clean technology is projected to reach US\$7 trillion per year by 2015.

Government action creates leaders

The countries whose governments are proactively driving this transition to clean up their economies are realising the greatest growth benefits and opportunities.

It takes an active choice to transition from a high carbon economy to a cleaner economy. Government leadership is necessary. The countries leading the clean energy race have committed large-scale, long-term government public investment in clean technology and backed the investment up with a strategic vision, complementary laws and policies. These governments have created the space for their businesses and investors to thrive and grow – and jobs have followed.

United Kingdom:

Jobs in the low carbon and environmental goods and services (LCEGS) sector are forecast to increase by 45% between 2008 and 2016, adding another 400,000 jobs as a result of the UK Government's Low Carbon Industrial Strategy. So far 881,000 jobs have been created in this sector. This includes 162,000 jobs in alternative fuels, 107,000 jobs in building technologies, 104,000 jobs in alternative fuels for vehicles and 87,000 jobs in wind energy (IPPR, 2009).

South Korea:

Korea's US\$38 billion (NZ\$48 billion) fiscal stimulus package, part of its 2009-2013 five-year plan, devoted 80% of its budget to green initiatives. This spending is almost 2% of GDP. It is expected to generate additional economic output of US\$162.7 billion and over 1.6 million new jobs (OECD, 2010). The move to a low carbon economy is a response to the financial crisis and to Korea's over-dependency on carbon-intensive energy imports.

Australia:

The Australian Government announced its Clean Energy Future plan in July 2011 to provide assistance for businesses and industry to reduce emissions and invest in clean energy. The plan, which could see up to AU\$100 billion dollars invested in clean energy projects over the coming decades, introduces a carbon price, promotes innovation and investment in renewable energy and encourages energy efficiency.

Singapore:

In April 2009, the Government of Singapore invested more than US\$740 million in a five year 'green plan' (EDB, 2012). As a result, clean energy is being targeted in Singapore to generate US\$1.7 billion in value-added exports and 7,000 jobs by 2015 (Low and Cheong, 2008). Solar PV cells, fuel cells and bio-fuels are all expected to be target areas of investment.

Denmark:

Since 1980, Denmark has managed to increase its GDP while maintaining a nearly stable energy consumption level, without increasing greenhouse gas emissions. The Danish Government's target is to cover Denmark's entire energy supply with renewable energy by 2050. Denmark's Agreement on Green Growth (2009) combines a high level of environmental, nature and climate protection with modern and competitive agriculture and food industries. As a result, Denmark has 720 clean technology companies, with a total turnover of €43 billion (Sovndal, Friis Bach, Lidegaard and Auken, 2012).

Finland:

The Finnish Government has a target of sourcing 38% of its energy consumption from renewables by 2020, up from 25% today. Bioenergy, hydropower, wind power, geothermal and solar energy are all important aspects of Finland's renewable resource base. Finland has feed-in tariffs (FiTs) in place for energy producers in the wind, biogas, forest chips and wood-based fuel sectors.

China:

The Chinese Government committed 10% of its stimulus funds specifically to clean technology, and is driving the demand for renewable energy through laws and mandates. Low carbon investment in China reached US\$52 billion in 2011, a ten-fold increase on 2006 investment levels (UNEP, 2012). The Chinese Government plans to spend US\$738 billion on clean energy development by 2020, creating 15 million green jobs (Deutsche Bank, 2011). By 2020, the low carbon economy will account for 15% of China's GDP and by 2030, China's renewable energy and electric vehicle exports values are expected to be US\$229-395 billion. Between 4.4 and 7.8 million new jobs will be created. These jobs will be more skilled and will pay higher wages than equivalent high carbon economy jobs (World Bank, 2012).

In 2012 China's growth strategy to 2030 stated China's goal loudly and clearly: the traditional model of development is no longer feasible. China will be establishing an international competitive advantage in the renewable energy industry over the next 20 years. China sees the green economy as a way of securing long-term resilient growth whilst improving its environment and the health of its population.

The successful policy mix

It is useful to understand the mix of policies, besides direct investment, these governments are putting in place to enable this green growth. The mix includes:

- Carbon pricing;
- Direct financial incentives for clean technology, such as feed-in tariffs;
- Energy efficiency incentives;
- Renewable energy and energy efficiency standards for buildings and products;
- Pollution reduction targets.

The New Zealand Energy Revolution: a future we can choose

*The wind project West Wind, located 15km west of Wellington, includes 62 Siemens wind turbines with a full capacity of 140 MW, supplying up to 70,000 homes with clean energy.
© Siemens press picture*

4



Introducing the New Zealand Energy Revolution

Greenpeace New Zealand commissioned a report from the Institute of Technical Thermodynamics of the German Aerospace Centre (DLR), to model the complete energy system of New Zealand into the future and to identify the economic opportunities in moving towards 100% renewable energy supply.

The extensive modelling report outlines a possible future for New Zealand to 2050. The Energy Revolution modelling is compared to a reference scenario of business as usual. Different assumptions are used to forecast the outcomes for each scenario.

The report's modelling shows the economic and employment gains that will result if New Zealand builds a clean economy to meet two key objectives:

- By 2025 provide all electricity from renewable energy sources;
- By 2050 provide all areas of energy (electricity, transport, heating, industrial use) from renewable energy sources.

The report is based upon the latest information about renewable energy technologies and energy market development. The DLR is one of the world's most authoritative analysts of future energy trends. In May 2011 the United Nations Intergovernmental Panel on Climate Change (IPCC) published a ground-breaking "Special Report on Renewables" (SRREN). This report showed the latest and most comprehensive analysis of scientific reports on all renewable energy resources and global scientifically accepted energy scenarios. The Global Energy Revolution 2010 by DLR was among three scenarios chosen as an indicative scenario for an ambitious renewable energy pathway.

In this chapter we present an overview of results from the Energy Revolution modelling, and propose the first steps required to set New Zealand on this energy revolution pathway.

The Energy Revolution modelling shows we get carbon savings...

The Energy Revolution modelling projects that by 2050 New Zealand's carbon dioxide emissions from all energy use will decrease from 30 million tonnes in 2009 to 1.8 million tonnes – which is a 94% reduction on 2009 carbon dioxide emissions.

These reductions will be achieved despite an increase in the total population from 4.5 million in 2009 to 5.7 million in 2050. The annual carbon dioxide emissions per capita in New Zealand will reduce from 6.8 tonnes to 0.3 tonnes by 2050.

This will mean New Zealand will have one of the lowest per capita carbon dioxide emissions in the world.

The carbon footprint of products made in New Zealand will be one of the lowest in the world which will give a huge market advantage to a wide range of New Zealand businesses.

New industries and businesses will be attracted to New Zealand because of the low carbon make-up of our energy supply, increasing jobs and investment.

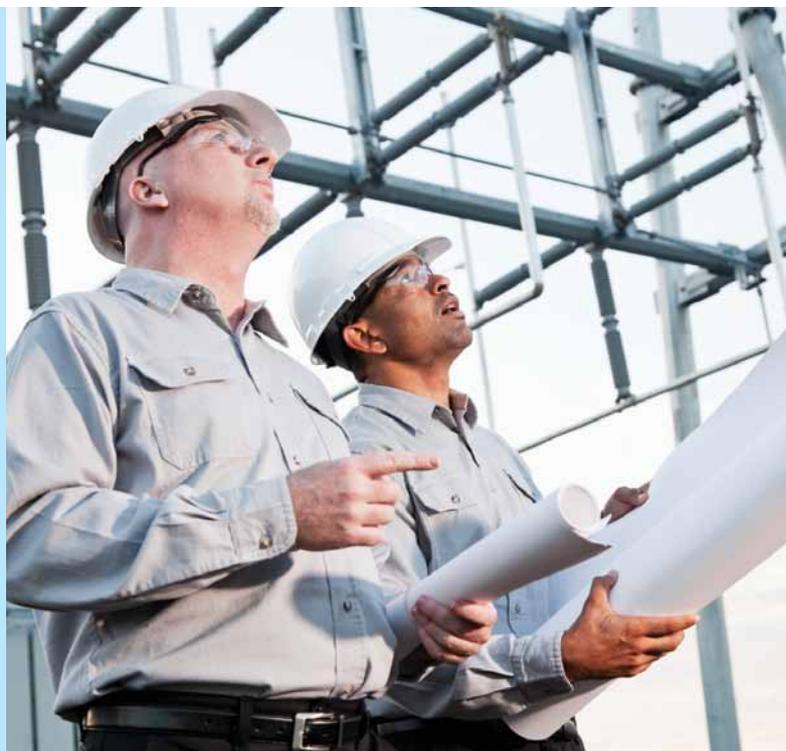
...and jobs

The number of direct jobs in renewable electricity and heat supply will increase by over 5,800, from 4,900 in 2010 to over 10,700 in 2030.

The actual amount of new jobs created is likely to be far higher than this figure, as these job calculations, carried out by The Institute for Sustainable Futures at the University of Technology, Sydney, only take into account direct employment and do not cover indirect jobs. Jobs in other sectors such as transport and energy efficiency are not included.

For example, developing liquid fuels from production forestry will help create a bioenergy sector that will generate up to 27,000 jobs (BERL, 2011).

The opportunities for New Zealand are even greater than these figures suggest. Capturing a share of the world market in clean energy, such as geothermal power and heat, would realise thousands more New Zealand jobs.



Jobs in the Electricity and Heating Sector	Business as usual Scenario		Energy Revolution Scenario
	2010	2030	2030
Renewable	4,900	5,300	10,700
Oil & Gas	700	400	200
Coal	600	400	100
Total Jobs	6,200	6,100	11,000

The full employment modelling breakdown is included in the [New Zealand Energy Revolution report](#)



Opportunities in transport

A modern, fast-moving, economically efficient transport system is central to a thriving economy. However, conventional transport has also been the most rapidly growing source of greenhouse gas emissions, and leaves us dependent on the global supply of oil.

The Energy Revolution modelling shows a pathway to 2050 where New Zealand:

- Reduces people's need to use high energy intensity transport modes;
- Shifts people and goods from using high energy intensive transport to low energy intensive modes;
- Makes energy efficiency improvements (technology improvements) to all modes.

The modelling demonstrates that transport energy can be shifted almost entirely to renewable sources by:

- Far greater use of public transport, largely powered by electricity;
- Use of electric and hybrid vehicles for personal transport and smaller commercial vehicles;
- New Zealand produced wood-based liquid fuels replacing diesel in heavy transport and industrial uses.

To achieve this scenario, the Government must adopt a radically different transport strategy, and shift investment from unnecessary new roads to rail and mass transit infrastructure. New Zealand needs to prioritise imports of hybrids and electric vehicles. The potential for a local manufacturing base in electric vehicle technology should be explored. Regional transport strategies must align and shift local infrastructure investment to make public transport more convenient and reliable than private cars for most uses.

To create the right economic climate for private investment in liquid fuels from forestry, the Government needs to reset the economic incentives affecting supply and demand. The Energy Revolution modelling shows that within 22 years New Zealand road transport can be virtually oil free. Instead of using over 29 million barrels of oil in 2035, road transport will use just 1.2 million barrels per year – a reduction of 96%.

By 2050 aviation, marine shipping and rail in New Zealand reduce fossil fuel consumption by more than 50%. This is achieved by using biofuels for aviation and shipping, whilst using more electricity for rail.

New Zealand could save more than NZ\$7 billion each year in oil imports

The economic benefits of this path

The economic benefits of shifting to a low carbon transport system are compelling. By 2035:

- New Zealand will save over NZ\$7 billion per year in oil imports for all sectors (at today's value). This is equivalent to more than two-thirds of New Zealand's current account deficit in the year to September 2012;
- 27,000 jobs are created in New Zealand's bioenergy sector, with the majority from producing liquid fuels from New Zealand's production forestry;
- The New Zealand economy will be immune to future oil price shocks and future high oil prices – no more sharp increases in pump prices hitting people and businesses in the pocket;
- Road transport will be 30% more efficient, cutting household and industry transport costs;
- 18% of all road transport energy consumption will come from electricity;
- 75% of road transport energy needs in 2035 are met by New Zealand produced liquid fuels from production forestry;
- New Zealand's total transport emissions of carbon dioxide in 2035 are reduced by over 85% compared to 2009. By 2050 these emissions are reduced by 95%;
- The savings in oil imports reduce the exchange rate exposure risk to the economy. This gives future governments flexibility to adopt monetary policies that promote exchange rates beneficial to New Zealand exporters and manufacturers, without increasing oil import costs.

Sustainable liquid fuels can replace diesel

It has been projected by BERL that New Zealand can create 27,000 new jobs in the bioenergy sector and build an independent energy future by developing liquid biofuels from forestry to replace imported fuels. They have calculated that such a bioenergy strategy can contribute NZ\$6.5 billion to New Zealand's GDP by 2040 (BERL, 2011).

New Zealand has a significant amount of unused woody biomass residuals that could be used as feedstock for conversion to liquid fuels. In addition detailed analysis by New Zealand Crown Research Institute, SCION, estimates that afforesting New Zealand's most eroded and degraded lands can provide up to 1.4 million hectares of new production forestry for the bioenergy industry (SCION, 2009).

With existing skills and technology it is technically and economically feasible to convert woody biomass into 90 Petajoule (PJ) per annum of liquid fuels by 2035. What is needed is the right policy framework, which the Government must provide.

The long range electric Holden Volt.



The main priority of converting wood to liquid fuels is to replace the diesel that some transport and industrial processes currently rely on. This scenario assumes the Government will ensure that the wood based biofuels be used to substitute for local diesel use.

It has been calculated that these liquid fuels can be produced at costs cheaper than petroleum products before 2035. These domestic fuels are less subject to price volatility, and free of exchange rate risk. Using these fuels will provide a major economic advantage to the economy. It will improve trade balances and New Zealand's energy security.

As well as making a significant contribution to meeting New Zealand's energy needs, bioenergy from production forestry provides opportunities to increase revenue for farmers and landowners. It will significantly reduce New Zealand's greenhouse gas emissions and could be done in a way that improves water and air quality. It will boost regional economic development, providing employment in rural communities.

*Wairake geothermal power station, built in 1958, was the first of its type (wet steam) in the world, with a total capacity of 181MW
© fotosearch.com*



Opportunities in geothermal energy

Our geothermal industry can help the world discover and harness the heat beneath our feet.

New Zealand's geothermal energy reputation is the ace in our clean-technology pack. We have the potential to build an export-led geothermal energy industry that will rival the dairy and tourism sectors in international dollars brought home to New Zealand.

Use of geothermal energy is already well established in New Zealand and will continue to grow. The enormous potential lies in developing geothermal energy projects in other countries.

Geothermal electricity development is entering a new global boom

Geothermal energy is heat from the earth. It is used for electricity generation, heating in industrial processes, and domestic heating.

The world is on the cusp of a sustained boom in the development of geothermal electricity in all the world's thermal hotspots. This boom is expected to last for at least 40 years.

In 2010, installed geothermal electricity generation totalled 10,700MW across 24 countries, including in the USA, China, Europe, Japan, Indonesia and the Philippines. New Zealand had 630MW of this total (IEA, 2011). The scientific and engineering skills of New Zealand businesses have contributed to over 2,000MW of the total geothermal power developments globally (NZTE, 2012).

By 2020 the global installed capacity of geothermal electricity generation is projected to double and be worth \$US40 billion (NZTE, 2012). By 2050 the International Energy Agency (IEA, 2011) projects the total installed capacity of conventional geothermal to be over 100,000MW. This represents a total capital value of US\$310 to 400 billion.

There is an even greater opportunity from new technology still being developed, called Enhanced Geothermal Systems (EGS), from lower temperature geothermal resources. The IEA predicts that EGS will become commercially viable by 2030. Based on detailed country by country assessments, the 2012 global energy scenario report produced by the DLR projects that by 2050 there could be 660,000 MW of installed geothermal electricity, the majority from lower temperature resources using technology (ER2012).

Direct heat technology is also a valuable new market

Huge global growth is also projected in developing geothermal energy for general heating and industrial process heat applications. The DLR scenario projects direct geothermal use for heat supply by 2050 at being 47,500 PJ of energy each year – equivalent to 35% of the global heat supply in 2009 (ER2012).

The total investment projected by DLR 2012 in geothermal direct use for heat is projected to be an average of US\$165 billion every year from now until 2050 (ER2012).

We are exporting our expertise now

New Zealand is well placed to capture a sizeable share of this part of the geothermal market. New Zealand has been generating geothermal electricity since 1958 and was an early world leader.

New Zealand's geothermal businesses are doing their best to export their talents.

Right now more than 70 businesses based in New Zealand have extensive geothermal expertise in all areas of geothermal development, from resource mapping and exploration through to design, project management, operation and even manufacturing heavy industrial components for geothermal power stations. Some New Zealand companies are investing in other countries to develop their resource and obtain flow-back into the New Zealand economy. For example, Mighty River Power is investing in projects such as the 49.9MW Hudson Ranch geothermal power station in California, USA.

To build a high temperature hydrothermal geothermal power station, two-thirds of the capital cost is in the engineering and construction of the steam gathering infrastructure and power plant. The rest of the cost is connected to well drilling, site establishment and grid connection. New Zealand geothermal businesses are able to supply all parts of this chain.

The opportunity for New Zealand

A conservative market share for New Zealand geothermal businesses of 10-15% of the global market up to 2050 is estimated within conventional geothermal electricity technology. This market share represents a total of US\$31 to 60 billion (NZ\$44 to 86 billion) of the total global investment in the geothermal market.

EGS and direct use of geothermal heat will partly rely on successful development of new technologies. New Zealand needs to substantially increase research, development and demonstration project investment into Enhanced Geothermal Systems within New Zealand in order to capture a higher proportion of projected EGS global projects. If New Zealand were to capture only 0.5% of the global market share in EGS electricity generation and direct use geothermal heat up to 2050, this would be equivalent to US\$54 billion (NZ\$77 billion) up to 2050.

In total, the potential New Zealand share of the global geothermal energy market up to 2050 could amount to over US\$85 to 114 billion (NZ\$121 to 163 billion). This is equivalent to NZ\$3.3 to 4.4 billion each year.

The Energy Revolution modelling shows that the development of projects in the geothermal industry in New Zealand will employ over 1,500 people by 2030. This number of jobs could be added to substantially by gaining a significant global market share in geothermal energy in the near future.

New Zealand's geothermal industry global market share could be worth over NZ\$4 billion every year

Government is supporting geothermal development...

It's fair to say that work is underway to explore our global geothermal opportunities. The Government, through New Zealand Trade and Enterprise, has given its backing to Geothermal New Zealand (GNZ) to extend the diverse skills of New Zealand's geothermal expertise to other countries. This is an important first step.

...but a much greater level of support is required to reach our potential

For the New Zealand geothermal industry to capture a sizeable share of the global market, government activity must be increased several times over.

To capture the full potential, we propose the Government:

- Increases support for research and development and link it to funding from industry;
- Trains new generations of New Zealanders in geothermal science and engineering;
- Prioritises geothermal projects in the Government's international trade negotiations and agreements whilst providing the necessary economic and trade underpinnings. This could include an expanded export guarantee scheme to enable New Zealand geothermal businesses to secure development contracts that can become worth hundreds of millions of dollars each year;
- Takes a strategic approach to help New Zealand manufacturing companies gain a higher share of the geothermal value chain, especially in areas of heat exchange technology and within the power plant. The NZ Heavy Engineering Research Association (HERA) has proposed setting up a geothermal manufacturing cluster in New Zealand in order to specialise in capturing a higher proportion of geothermal power plant and steam gathering component manufacturing;
- Focuses on developing new technology and intellectual property rights within the geothermal industry;
- Substantially increases research, development and demonstration project investment into EGS within New Zealand to capture a proportion of projected EGS global projects.

*The PELAMIS, based off Orkney in the UK, absorbs the energy of ocean waves and converts it into clean, green electricity.
© Pelamis Wave Power*



Opportunities in ocean energy

Wave and tidal generation, referred to as ocean energy, are nascent renewable technologies with huge global potential for future growth. Both industries are in the early stages of development and New Zealand has an opportunity to become a major player in this growing field.

The development and cost curves for wave and tidal are very similar to those followed by the wind industry and therefore offer the potential for significant jobs and exports in the medium term.

Much of the global investment in ocean energy in the next decades will go into research and development (R&D) and testing of new wave and tidal technologies.

The challenge for New Zealand is to get a foothold in this new technology space. As an island nation surrounded by high energy oceans, our natural resources provide us with an advantage.

We propose the Government develop a technology and intellectual property roadmap that mirrors the successful implementation of the UK wave and tidal programme. Central to that programme has been the development of the European Marine Energy Centre (EMEC) in Orkney, Scotland, which so far has been responsible for generating 250 direct jobs and NZ\$4.8m (£2.5m) into the local economy in 2012, while stimulating a further 500 marine energy jobs elsewhere in the UK (EMEC).

New Zealand has wave and tidal resources similar, if not better, than Orkney, and therefore could become the Southern Hemisphere centre for ocean energy research, project demonstration, certification and commercialisation.

With the right policy settings New Zealand could become a global wave and tidal technology incubator – a testing ground for researchers all over the world to test their new devices.

New Zealand could set up wave and tidal energy parks where consent has been granted for R&D and for medium to long term deployment; where only the specifics of a device require further consent. Investment in these parks could be coupled with a feed-in tariff guarantee that encourages developers to leave devices in situ and tied to the grid.

We can transition existing skills in traditional maritime and offshore industries into this new industry. This sector will have high value jobs in design, manufacturing, certification as well as in device deployment and servicing.

The commitment from New Zealand's business sector is there and companies are seeking opportunities. Dozens of ocean energy projects have been proposed for New Zealand, but only one, WET-NZ, has a consistent record of domestic deployment. (EECA, 2008).

Once again it's up to Government to create a strategic setting to bring development opportunities home to New Zealand.

Ocean energy potential

The potential installed capacity for wave and tidal electricity generation in New Zealand has been estimated at 8,000MW, which is nearly equivalent to New Zealand's total current electricity demand.

The Energy Revolution modelling estimates New Zealand will install 20MW by 2020 and 400MW by 2050. This will capture 5% of New Zealand's currently identified resource potential and contribute up to 2% of New Zealand's electricity supply by 2050.

The DLR's 2012 Global Energy Revolution report projects that by 2030 world-wide ocean energy will produce some 560TWh – equivalent to almost the total electricity production of Germany in 2009. By 2050 ocean energy is projected to produce 2,053TWh – equivalent to almost the total electricity production of the Euro Zone in 2009. The total projected investment in ocean energy to 2050 is US\$1.5 trillion.



Changes to our electricity system

Obviously a commitment to 100% renewable electricity generation by 2025 will mean changes to New Zealand's electricity system. The Government already has a target of 90% renewable electricity by 2025, although it has claimed it would be too expensive to go to 100% renewables. But the Energy Revolution modelling shows 100% renewable electricity will in fact cost the economy less than a business as usual projection.

The Energy Revolution modelling shows that the potential electricity cost savings to the country in 2025 are NZ\$600 million after the costs of energy efficiency measures are factored in.

Demand curves under the Energy Revolution modelling differ slightly from the reference case. More electricity is needed for electric vehicles and heat pumps, but with efficiency gains, by 2050 the country will be using 2% less electricity than projected under the reference case.

The Energy Revolution modelling predicts by 2025 the electricity generation mix will be as shown in the table below:

Electricity source	2025			2050		
	Percentage of mix	Amount generated	Installed capacity	Percentage of mix	Amount generated	Installed capacity
Hydro	50%	25TWh/year	6,100MW	42%	27TWh/year	6,400MW
Geothermal	20%	10TWh/year	1,500MW	25%	16 TWh/year	2,300MW
Wind	22%	11TWh/year	3,500MW	21.7%	14 TWh/year	4,800MW
Wave and tidal	<1%	0.3 TWh/year	100MW	2%	1.3 TWh/year	400MW
Solar PV	<1%	0.3TWh/year	200MW	3.4%	2.2TWh/year	1,600MW
Biomass	7.4%	3.7 TWh/year	700MW	5.9%	3.8 TWh/year	1,100MW
Total	100%	50.3TWh/year	12,100MW	100%	64.3TWh/year	16,600MW

Supply reliability

The Energy Revolution scenario will result in a manageable share of fluctuating power generation sources (photovoltaic, wind and ocean) of 22% by 2025. Due to its non-fluctuating supply and a grid load available almost 100% of the time, geothermal energy supply will be a key element in ensuring system stability is maintained on renewable sources. In total 78% of the generating supply in 2025 will be from geothermal and hydro sources which are able to respond to changes in demand to maintain power system security.

An expansion in smart grids, demand side management, and storage capacity will support better grid integration and power generation management. Electricity system storage capacity may be enhanced by smart management of electric vehicle battery storage capacity.

Shifting investment towards a cleaner economy

5



Banking on our future

To move to a green economy, as the saying goes, “we need to put our money where our mouth is”. In this transition, Government is the first mover. Government can direct public funds into green infrastructure and can also mobilise private investment. Businesses cannot bring this kind of leverage to making a transition on their own.

A publicly-owned Green Investment Bank will be instrumental in rewiring our economy.

A Green Investment Bank would unlock the high levels of both public and private investment needed to move New Zealand towards a cleaner, more prosperous economy. It could play a vital role in addressing the market failures affecting green infrastructure and technology.

Investment creates jobs. Investment in clean technologies creates green jobs and also leads to future clean investment opportunities for private investors.

Some claim there is no public money to spend – this is not the case. The Government is proposing to spend more than NZ\$12 billion on the roads of national significance (RONS). It is not a shortage of capital, rather where capital is being invested that is the issue.

New Zealand would not be the first to set up a green investment bank or invest heavily in clean technologies. Many of our global strategic partners have set up similar banks and earmarked multi-billion dollar investments in clean energy to deliver the benefits that transitioning to a low carbon economy will bring (OECD, 2011a).

The bank's roles and priorities

The roles of a Green Investment Bank will be to channel public investment, mobilise private capital investment, and ensure the clean technologies sector is properly capitalised to deliver a low carbon economy (Vivid Economics, 2011). This investment can be raised from a mixture of green bonds, pension funds, carbon taxes, and the redirection of resources held in other part-public owned banks.

The bank's priority will be to finance a new low-carbon infrastructure for New Zealand. This will include new and renovated low-energy building stock, a multi-scale, multi-technology renewable energy power system to achieve 100% renewable generation by 2025, and a clean, efficient, transport network with a hugely enhanced role for mass public transit.

The bank's investment criteria could require that a minimum proportion of private capital would have to be levered for the investment to be made (E3G, 2009).

A Green Investment Bank could:

- Help to structure, in partnership with the private sector, the financing of major projects;
- Provide initial capital or guarantees as part of multi-bank project financing for major renewable energy projects, if private capital markets are unwilling to take on the whole risk;
- Create green investment (or investment savings accounts) bonds to access the very large pools of capital held by institutional investors and ‘mum and dad’ investors;
- Broker innovative financial solutions between Government policy makers and the investment community to help achieve the cleaner economy vision.

Pension funds

Using pension funds for investment in clean infrastructure will work because there is an appropriate match between the long-term investment objectives of pension funds and the long-term capital needs of infrastructure-type projects. It will also reduce the exposure of those funds invested in high carbon assets.

The pension funds are substantial and large sources of capital are required. Globally, with an estimated US\$28 trillion in assets, pension funds – along with other institutional investors – could play an important role in financing such green growth initiatives (OECD, 2011b).

New Zealand's own pension fund KiwiSaver holds funds under management valued (as at 31 March 2012) at NZ\$11.26 billion. Currently there is no obvious clean investment option available to KiwiSaver investors.

Green investment bonds

Bonds are a regular means for governments, institutions and even large corporations to raise debt (borrow money) from the capital markets. Governments can also invest capital accumulated in sovereign wealth funds and government pension funds into private sector (market) assets.

A “climate bond” is a type of green bond issued to raise capital for investments in projects aimed at tackling climate change. The labelling is designed to make it easier for investors to preference fixed income products that specifically address their macro concerns about climate change risks. These instruments have allowed governments to raise capital or support the private sector in raising capital. The capital is used to build renewable energy generation and its enabling infrastructure, implement energy efficiency measures in cities and industries and support adaptation measures that will boost the economic development of communities in the face of climate change (Corfee-Morlot et al, 2012).

It's working there...

- In 2010, the UK Government established a Green Investment Bank to support low-carbon and renewable energy infrastructure projects. In May 2012 the bank was capitalised with £3 billion. The initial sectors in which the bank must invest at least 80% of its funds to 2015 are offshore wind, commercial and industrial waste, energy from waste, commercial energy efficiency, and support for the Green Deal. Up to 20% of the funds may be committed to other green sectors.
- Germany's national infrastructure bank KfW is facilitating renewable energy and energy efficiency investments in Germany. In 2012 it committed over EUR 100 billion (over US\$130 billion) over the next five years with most funding going to small-scale initiatives. It could also improve the financing situation for grid connections. This boost is intended to decrease investment risk and accelerate the country's move to renewable energy. Germany is the world's largest photovoltaic market and leading wind energy generator in Europe.
- In the United States, the Connecticut General Assembly established the nation's first fully funded green investment bank in 2011. Like other green investment banks, it aims to provide low-cost financing for clean energy and efficiency projects. Connecticut's Clean Energy Finance and Investment Authority (CEFIA) will function like an investment bank or fund that can leverage its capital to provide low-cost financing to clean projects that a commercial bank wouldn't likely touch.
- The Clean Energy Finance Corporation (CEFC) - Australia's Green Investment Bank equivalent - will function as part of the Government's Clean Energy Future Package which seeks to “cut pollution and drive investment, helping to ensure Australia can compete and remain prosperous in the future”. The AU\$10 billion CEFC will provide investment and green loans to businesses in three focus areas: renewable energy, energy efficiency and low emissions technology, and will complement the government's Renewable Energy Target (RET) and carbon pricing both of which began on 1 July 2012.
- Australia is also investing AU\$200 million in a Clean Technology Innovation Program. This is a competitive, merit-based grants program that will support applied research and development, proof of concept and early stage commercialisation activities. The program will provide grants between AU\$50,000 and AU\$5 million on a co-investment basis of one dollar of government funding for each one dollar of the applicant's investment.

Government leadership

6



Government leadership is essential for the economic vision and benefits outlined in this report to be achieved.

The overall goal is a prosperous economy built on a 100% renewable energy future. A 100% renewable energy target cannot be met if we keep extracting and using fossil fuels. To achieve the economic benefits of a clean economy, government must shift the economic settings to encourage private investment to shift into clean technologies.

Policies that don't fit this goal must be dropped. For example, any money spent building an unnecessary new motorway is taking us further from building energy-efficient infrastructure and diverts valuable resources.

The goal must be backed by a broad array of supporting policies. The funding for these policies will partly come from shifting investment away from current policies that don't fit this vision, and partly from mobilising private investment.

The countries leading the low-carbon economy all have governments with intentional, ambitious, long-term goals and significant public investment. We must learn from these strong leaders. New Zealand has been crippled by a mind-set that says government should not try to influence the economy. But Government policies influence the direction of the economy all the time.

Many businesses are already doing their best to capture economic wealth from green growth opportunities. Without a supportive government framework, they will capture only a small fraction of the economic benefit the 2013 Energy Revolution modelling shows is possible.

Committed, strong, and long-lasting leadership is necessary to reform the patterns of pricing, regulation, and public investment. Without political stability, regulatory certainty and administrative simplicity, business will be reluctant to invest. The market must be confident that the Government is serious about green growth.

Strong, practical, targeted policies

A strong set of concrete and ambitious policies is needed. Policies must be practical and targeted, with measures that break down barriers to change (structural, financial and social) and create incentives for positive action.

We propose the Government adopt these top-level policies:

- **Set goals:** New Zealand should get all its energy from renewable sources by 2050. This domestic renewables target will reform and focus the energy and transport sectors, and encourage innovation and collaboration;
- **Re-set investment costs:** by ending perverse subsidies for fossil fuel exploration and setting an economy-wide price for carbon emissions and other pollutants;
- **Actively support investment in renewable technologies:** by increasing financial incentives for developers such as a feed-in-tariff or guaranteed price system, and setting up a Green Investment Bank;
- **Reform transport planning:** aiming for integration between road, rail and port infrastructure, particularly at the urban level, and for improving the energy efficiency of transport. Promote local investment in liquid fuel alternatives, feeding the longer term transition to low carbon transportation;

A coherent investment strategy

To attract institutional private investment, we propose the Government assess and resolve barriers preventing or discouraging institutional investors, especially pension funds, from investing in infrastructure which will enable greener growth.

We propose the Government initiate a scoping study to identify mechanisms for capitalising a green investment bank and establishing a safe and secure environment to encourage private investment in the bank. The study could look at:

- Increasing the stringency of the Emissions Trading Scheme;
- Introducing a low-cost capital programme funded by green bonds raised from private investors by the Green Investment Bank and then blended with public subsidy;
- Reforming fiscal policy to channel funding to a green investment bank.

We also propose the Government establish a committee to set up a Green Investment Bank. The committee should investigate potential roles for the bank, such as:

- Providing support for businesses to commercialise low-carbon and renewable energy technologies;
- Reforming the energy market to boost investment in renewable energy and energy efficiency;
- Financial innovation to deliver these markets at scale;
- Developing new products for institutional and retail investors;
- Locating how additional funding could be raised for public financing of low carbon infrastructure and energy efficiency programmes.

The aim is to create a virtuous circle of public and private investment. The Government has to make the first move.

Focus on innovation

We need to be innovative to transition to a green economy.

We propose the Government focuses on innovation, including:

- Creating an R&D and commercialisation strategy aligned to the green growth vision;
- Being a catalyst for innovation by linking government, researchers, and the business sector;
- Providing public funding and related interventions to bridge the commercialisation “valley of death” experienced by many promising new technologies that fail to get to market at later stages of development;
- Building strong and lasting links between New Zealand-based enterprises and researchers and overseas research and commercial partners.

New Zealand deserves to be a world leader. And this country deserves a prosperous future. This report shows how we can achieve this. Doing so will see a multi-billion dollar boost for our economy. Tens of thousands of new Kiwi jobs will be created. And we can build a thriving, cutting-edge export industry.

Having a cleaner, smarter economy will protect the air we breathe, the water we swim in, and the future of our children.

But that's not all.

It is also about creating a twenty-first century economic success story. Right here. In New Zealand.

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Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

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