

Energy





Objectives

1. Energy demand is moderated and energy that is needed is produced, distributed and used efficiently so as to reduce impacts on the environment and to make effective use of limited energy resources.
2. An increasing proportion of energy is provided by sources that are renewable.
3. Adverse local and global environmental effects of energy production, transportation, transmission, conversion and end use are avoided, remedied or mitigated.

Doing well

- Five councils in the region are members of the Energy Efficiency and Conservation Authority's EnergyWise Councils Programme.
- Renewable energy production from wind looks set to increase within the region.

Must improve

- Finite fossil fuels continue to be the largest, and growing, source of energy, with an increasing proportion coming from imported oil.
- Transport is the sector showing the most growth in energy use, and the main source of energy-related carbon dioxide emissions.
- Energy data for the region is very poor but the objectives of greater energy efficiency and more renewable energy production appear to have not been achieved during the last ten years.

Introduction

Dry winters and low hydro lakes have loomed large in the national headlines in the last few years, but today's energy stories are global; "Oil prices highest so far", "Is climate change already with us?"

In New Zealand, energy – where it's coming from next and the costs of our appetite for it – has assumed a high press and public profile. We have enjoyed cheap, abundant energy for so long that we rarely stopped to think about where it came from or how much we used. As long as we had enough to power the burgeoning array of "essential" home appliances, keep the machinery, lighting and air conditioning going at work, and fill the tank of the car, we were fine.

Until now.



We've been used to cheap, readily available petrol... but for how much longer, and what are the real costs?

But even today, we still tend to think less about energy itself and more about the things we want to use it for. The demand for "more power" diverts our thinking about what sort of energy we need, and where it comes from. Most current energy sources for transport, for example, are from finite fossil fuels imported from overseas, and burning these fuels creates all sorts of local pollution problems, besides contributing to climate change.

Constant, reliable energy is crucial to our economy and way of life.

So what route do we want to take through this hazy, uncertain situation? How best to plan ahead? To answer questions about our energy future, we need to know more about our energy present.

Where we are now

Energy is a global issue. Oil continues to drive world politics, even as nations argue about measures to reverse the impacts of its use on the Earth's climate.

In New Zealand, energy is one of four government priorities under the Sustainable Development Programme of Action. A National Energy Efficiency and Conservation Strategy (National Strategy) sets targets for improved energy efficiency and renewable energy production, and the Resource Management Act 1991 (RMA), was amended in 2004 to give formal recognition to the benefits of renewable energy and the effects of climate change.

Other central government initiatives include the New Zealand Transport Strategy, which promotes energy efficiency and greater use of renewable transport fuels, and a national environmental standard requiring greenhouse gases from large landfills to be "collected and destroyed or utilised."

A raft of other proposals aim at cutting greenhouse gas emissions - through a carbon tax, for instance - and positive financial incentives for renewable energy projects, such as offering carbon credits for suitable schemes.

One of the functions of the Electricity Commission, established in 2003, is to ensure that electricity is produced and delivered in a fair, reliable and environmentally sustainable manner.

In the Wellington region, the Regional Policy Statement offers objectives and policies for sustainable energy management that closely mirror the National Strategy, seeking to:

- moderate energy demand
- be efficient in the production, transmission and use of energy
- increase the proportion of energy from renewable resources
- manage the adverse effects of energy production, transmission and use, both locally and globally.

The Regional Policy Statement sets no specific targets, but the National Strategy calls for a 20 per cent gain in energy efficiency by 2012, and an increase in renewable energy generation of 22 per cent – or 30 petajoules – by the same date.

In light of rising demand for energy, it's increasingly important to know how well – or how badly – we are responding to the obligations, goals and targets in these various measures.

How well are we doing?

Reliable energy data for the Wellington region is very difficult to get, so this chapter draws mainly on national figures with an assumption that most of the conclusions hold true for the region as well.

The chapter examines:

- Total energy supply, or **primary energy**. Primary energy is the raw material – coal, gas, oil, geothermal, hydro, wind – that is then processed, transformed or refined to a form of energy we can use.
- Energy actually available to consumers - **consumer**, or **delivered energy**. Consumer energy is less than primary energy because during the processing, transformation and transmission of the primary energy supply, some of the value of energy is “lost”.
- How energy is used (**end use**), including some information about vehicle fuel use in the Wellington region.
- Energy produced and used from **renewable sources**.
- The production of **greenhouse gas emissions** from energy production, conversion and use.
- How efficient we are in our production and use of energy (**energy efficiency**).

All quantities used in the chapter are given as petajoules unless otherwise specified. As a rough guide, one petajoule (PJ) is about equivalent to the electricity used in a city the size of Porirua – around 40,000 people - in a year.



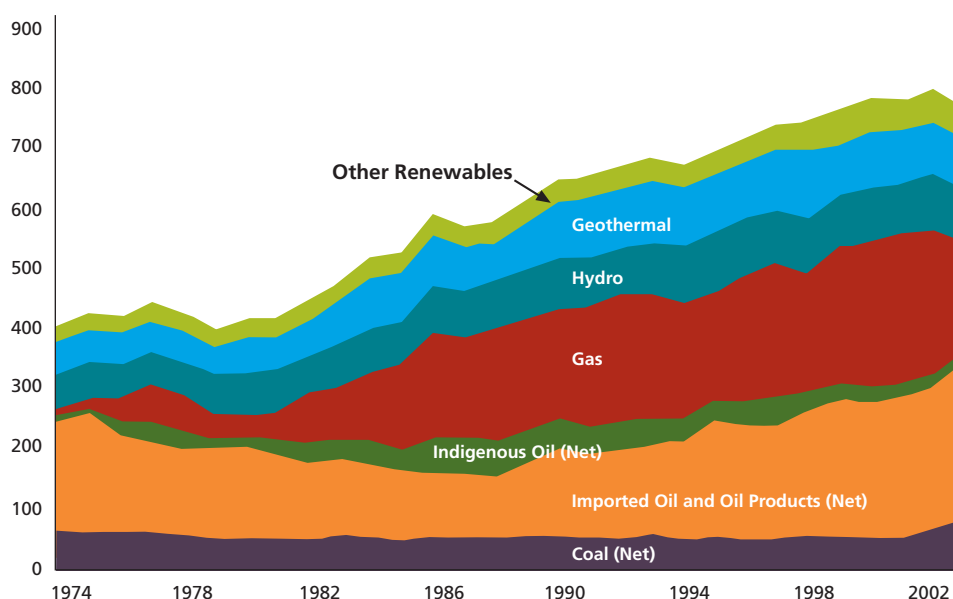
Primary energy supply

Energy is an essential input for our economy but energy demand has outpaced economic growth. New Zealand's total primary energy supply (see Figure 9.1) has gone from under 400 PJ in 1974 to 750 PJ in 2003, an increase of 87.5 per cent. Over the same period, the economy (as measured by GDP) grew by only 75 per cent.

Our use of fossil fuels (oil, coal, gas) jumped from around 150 PJ a year in the mid-1980s to 270 PJ in 2003, with an increasing proportion coming from imported oil.

Gas has been a significant primary energy source in recent years – 247 PJ in 2001 – but the Maui field is nearly exhausted and its contribution will fade. Hydro and geothermal have generally been steady sources of supply since the late 1980s (with the occasional hiccup with the hydro lakes). In recent years, renewables (hydro, biogas, industrial waste and wood) have actually been decreasing as a component of primary energy, both in actual numbers (slightly) and as a proportion of the total (more substantially).

Figure 9.1:
Total Primary Energy Supply,
New Zealand, 1974-2003.



Consumer or delivered energy

Thirty three per cent of primary energy is “lost” in processing (e.g. refining crude oil), conversion (e.g. using coal to generate electricity) and transmission (e.g. carrying electricity through power lines) to the “consumer”. For New Zealand in 2003, this meant about 750PJ of primary energy supply became 500PJ of useful energy actually delivered to the consumer.

Of the energy delivered to the various sectors of the economy, all showed some growth but the domestic transport sector swallowed up the greatest increase between 1995 and 2003 – an extra 45 PJ, or 28 per cent. Proportionally too, the sector grew from 38 per cent to 42 per cent of the consumer/delivered energy total (see Figure 9.2).

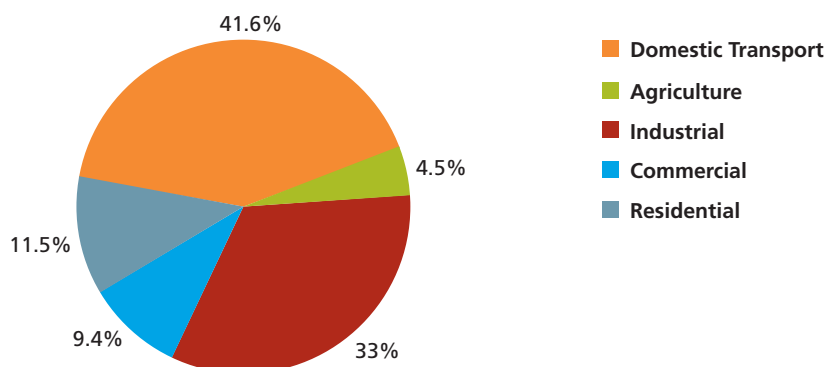


Figure 9.2: Total Consumer Energy by Sector, New Zealand, 2003.

Source: Energy Data File, January 2005; Ministry of Economic Development.

End use energy

“End use” refers to how much effective energy, or “work”, we get from our machines, appliances and so on. How much “work” we get from equipment, cars or cooling systems depends partly on what type of energy they use and partly on how efficient the piece of equipment, or vehicle, is in using the energy it gets.

The result of this second loss of useful energy means that of the 500 PJ of energy delivered to the “consumer”, only about 200 PJ of it gets to do the job we want it to do – propelling the vacuum cleaner, heating the workplace or propelling our car from A to B. Vehicles are especially inefficient in this regard, using only a fraction (about 15%) of the energy we pour into them to meet the desired end use – getting around. Household appliances and office equipment tend to be better at using the electrical energy put into them.

In the Wellington region for the year ending March 2002, there was a 60 per cent loss between delivered and end use energy – from about 43 PJ to about 18PJ (see Table 9.1 for a comparison of Wellington with some other urban regions of the country).

Fuel Type	Wellington		Auckland		Canterbury		Waikato	
	Delivered	End Use	Delivered	End Use	Delivered	End Use	Delivered	End Use
Biomass	4.82	2.05	13.46	5.72	7.15	2.82	4.42	1.7
Electricity	10.81	8.39	29.41	22.41	14.57	11.86	10.67	8.48
Fossil fuel (non-transport)	8.78	5.09	45.35	18.85	9.8	4.19	13.01	6.49
Fossil fuel (transport)	18.92	2.65	61.22	9.27	26.34	3.9	19.23	2.79
Geothermal	0	0	0.02	0.01	0.01	0	0.15	0.11
Totals	43.33	18.18	149.46	56.26	57.87	22.77	47.48	19.57

Table 9.1: Delivered consumer and end use energy, by fuel/energy type, for Wellington and selected regions, March 2001-02

Source: Energy Efficiency and Conservation Authority End Use Database.

Congestion is costly, in both time and fuel wasted. We like our freedom to go where we like when we want to. But can we just look in the rear-view mirror and project more of the same sort of picture in the future? More cars, more roads, more trips, more emissions. With future oil supply uncertain and climate change approaching, are we at a cross roads for how we meet our energy needs for transport?



A major “end use” of energy, and the only one showing significant growth in demand for energy, is transport. Our “drive” for improved accessibility relies almost totally on finite oil derivatives, the burning of which contribute significantly to greenhouse gas emissions. As noted above, the internal combustion engine is not a very

efficient user of energy and for New Zealand as a whole, 196 PJ of delivered energy goes into the transport sector but translates to less than 30 PJ of end use energy.

For the Wellington region, vehicle fuel sales are the highest they have been after rising by 8 per cent between 1998 and 2004 (see Table 9.2). A slight overall decline in the region between 2002 and 2003 was bucked by the Wairarapa, where sales have steadily increased every year. Furthermore, car ownership keeps climbing, as do the number and length of our car journeys.

Table 9.2:
Vehicle Fuel Data (in litres)
for Wellington region:
1998-2004.

Source: Data collected by Wellington City Council (for the western part of the region) and by Masterton District Council (for the Wairarapa districts) for the purposes of the local body fuel tax.

Year	Totals	Petrol	Diesel
1998	425,429,290	301,497,615	123,931,675
1999	437,999,158	307,764,741	130,234,417
2000	444,787,603	305,064,407	139,723,196
2001	442,445,892	300,570,072	141,875,820
2002	458,333,632	310,440,684	147,892,948
2003	451,598,272	312,516,040	139,082,237
2004	458,984,817	313,001,234	145,983,583

Renewable sources

Nationally, renewable energy production dipped slightly between 1995 and 2003 – from 134.6 PJ to 128.4 PJ – mainly due to a small drop in hydro output between those two years. Only a small decline, maybe, but any decrease in renewable electricity supply makes it harder for us to meet the targets set for renewable energy production in the National Strategy or the policies in the Regional Policy Statement.

Wellington has a lot of wind. Indeed, from a wind energy perspective, it’s one of the best places in the world to generate electricity. But for those people living nearby, landscape and noise are important issues, so careful siting of wind farms is essential.
Photo: Dave Hansford.



Better news may be on the horizon, depending on your viewpoint, with the development of wind farms. Nationally, wind energy production capacity has increased by more than 200 per cent since 2000. There are several proposals for wind farms in the Wellington region. Other forms of renewable generation which offer some promise, such as wave power and solar, are considered uneconomic for large-scale production at present. However, solar offers potential for greater use at a domestic scale in the near future.

Greenhouse gas emissions

Carbon dioxide is a gas that contributes to climate change (a “greenhouse” gas) and is released into the atmosphere when we burn fossil fuels, such as oil and coal.

The Kyoto Protocol is an international agreement that aims to limit greenhouse gas emissions. Carbon dioxide emissions from energy use jumped by 40.7 per cent between 1990 and 2003. This translates to an annual increase of about 2.4 per cent. However, between 2002 and 2003, the increase was 4.1 per cent. As greenhouse gas emissions rise, and we move further away from the Kyoto Protocol targets, the likelihood of controls being introduced to meet our Kyoto reduction targets becomes greater.



Domestic transport was responsible for 46.1 per cent of New Zealand’s carbon dioxide energy emissions in 2003, while industry accounted for 18.6 per cent and electricity generation (from gas, coal and geothermal conversion) a further 21 per cent.

New Zealand is exceptional in that the equivalent of 49 per cent of our greenhouse emissions comes from agriculture, mostly in the form of methane from stock.

A contented cow might make good milk, but also methane. Methane is produced by ruminating animals and is a greenhouse gas that we also need to manage.

Energy efficiency

There is ample scope for more efficiency in all stages of energy production, conversion, transmission and end use. In a sense, energy saved through efficiency is an additional energy “source”. The financial and other environmental benefits from improved efficiency can come to us as individuals from simply changing our behaviour, or from modest capital expenditure on energy efficient technology.

While improved efficiency is a good thing, it is almost impossible to accurately measure gains that are being made. The National Strategy seeks a 20 per cent improvement in efficiency across the economy by 2012. However, because of the assumptions that need to be made about the economy and uncertainties about energy use, the assessment that there has been a one per cent improvement in efficiency over the first two years of the National Strategy is a rather fuzzy finding.

What’s being done

We all use energy, so we can all ease demand by using it more efficiently. We can insulate our homes and water systems, and install double glazing. We can use public transport more often. We can make greater use of renewable energy, such as domestic solar water heaters or by designing our homes for passive solar gain.

But as individuals we can only do so much; initiatives have to come from all sectors of the economy.

The National Energy Efficiency and Conservation Strategy

The National Strategy recognises that different activities and sectors each have parts to play, and has action plans that set out roles and initiatives specifically for:

- central and local government
- energy supply
- industry (including agriculture)
- buildings and appliances
- transport.

Other measures

The Energy Efficiency and Conservation Authority (EECA) is responsible for getting results from the National Strategy, and EECA also runs other programmes to boost energy efficiency and promote renewable energy production:

- **Improve** – a programme to encourage commerce and industry to adopt energy efficient technology and practices, mostly through energy audits and management systems
- **Energy Intensive Businesses** – a programme to help energy-intensive businesses invest in energy efficient plant and technology
- **EnergyWise Home Grants** – funding for retro-fitting home insulation and other energy efficiency measures to pre-1977 rental and low-income housing
- **Travel Behaviour Change** – programmes that encourage people to change their commuting habits.

EECA sponsors the EnergyWise Rally to promote eco-efficient vehicles and good driving practice. The rally runs from Auckland to Wellington, and features celebrity drivers and surprisingly good performances by the vehicles, both in terms of fuel economy and general driveability. Photo: Dave Hansford.



In and around the Wellington region

Greater Wellington is helping fund bus and train upgrades in the region, and promoting public transport – alongside alternatives such as walking and cycling. *Be the Difference* is a Greater Wellington social marketing campaign which encourages people to take personal responsibility for a sustainable environment, and has recently focused on public transport use.

Greater Wellington, Wellington City, Kapiti Coast, Masterton and Carterton district councils are all members of EECA's EnergyWise Councils programme. All have adopted a range of initiatives to manage their energy consumption. Greater Wellington calculates its "carbon footprint" – a measure of how much carbon dioxide it produces as an organisation as a result of its energy use.

The Wellington region boasts the country's first wind turbine at Brooklyn, in Wellington and its first wind farm at Hau Nui, in the Wairarapa. There are now proposals for at least three more wind farms that, if built, would add approximately 270 megawatts of renewable capacity to the region's electricity supply.

Where to from here?

A growing wind energy industry, hybrid cars, improved insulation standards and some capture of greenhouse gas emissions at landfills, are all signs of progress on sustainable energy management. However, the contribution of renewable energy sources to our total supply is flatlining, and energy efficiency is not improving as it should. Above all, our fossil fuel use keeps climbing.

Overall, we're moving away from, rather than towards, the objectives and targets set out in the Regional Policy Statement and the National Strategy. Economic growth and the lifestyles we pursue continue to put great demands on energy.

So what's to be done? By being more energy efficient and easing energy demand, we can make our current supplies last a little longer and reduce our reliance on external – and vulnerable – international sources. We can save some money at a time of ever-rising energy costs, postpone the need for new energy developments, and curb the environmental impacts of extra energy production, transmission and use.

If we must satisfy rising energy demand, we could get a major contribution from renewable sources. Wellington offers one of the best wind resources in the world – appropriately sited wind farms could meet some of that demand.

Wellington enjoys over 2040 hours of sunshine per year, and solar energy – which gets more cost-effective every year – could provide domestic and commercial water and space heating. Photovoltaic cells could drive small-scale domestic electricity generation.

Waste and woody biomass, and "energy crops" may be further options in the next decade, while waves, tides and ocean currents are longer term possibilities.



Solar power is free and probably going to be around for a while... Take-up of this resource is more likely to occur at a domestic level, where house owners can individually choose to add solar technology that will help with their water heating and electricity needs. Photo: Dave Hansford.

What's stopping us?

As noted in the last *Measuring up*, market mechanisms and personal commitment can only do so much to foster sustainable energy management. For a long time, artificially low prices have given fossil fuels an advantage over renewable sources. As long as environmental and other costs are left off the price of fossil fuels, renewable sources will continue to be branded “uneconomic”, hampering their acceptance and practical development.

Recent surveys show growing support for renewable energy as the wider costs of traditional energy sources become obvious. Incentives – and disincentives – such as carbon credits (a system developed under the Kyoto Protocol) and the carbon tax respectively - could help drive a groundswell of change.

In the end, achieving a sustainable energy regime will depend on what each of us does; as individuals, as a part of households, as a part of society. Technology offers a practical way forward, but we also need government- and industry-led initiatives to help us make the switch.

To truly sustain our quality of life, and that of our children, we need to think now about the type and amount of energy we consume to support that way of life. Are we prepared to make some changes?

More importantly, what will happen if we don't?

More information

Holmes, John 2005. *Energy – background report*. Greater Wellington.