ENERGY POLICY

ENGINEERING A NATIONAL ENERGY STRATEGY

IPENZ
Engineers New Zealand

FOREWORD

The Institution of Professional Engineers New Zealand (IPENZ) is the lead national professional body representing the engineering profession in New Zealand. It has approximately 10,000 Members, including a cross-section from engineering students to practising engineers to senior Members in positions of responsibility in business.

IPENZ is non-aligned and seeks to contribute to the community in matters of national interest giving a learned view on important issues, independent of any commercial interest. As professional engineers, we have not only a deep concern over New Zealand's energy issues, but also a particular set of skills with which to analyse these issues and propose solutions.

This contribution has been prepared by a working group of Members with particular expertise in this field, and peer-reviewed by a wider grouping within the Membership.

SUMMARY

The economic, social and environmental well-being of New Zealanders relies on the continuation of secure supplies of transport fuel, heat and electricity, and also on improving the sustainability of how we use and supply energy. New Zealand faces unique energy problems due to our geographical isolation and small size. We also have many opportunities for developing renewable sources, including solar, wind, marine and biomass. IPENZ believes that a comprehensive National Energy Strategy needs to be developed now. The goal of the strategy is to maintain the security of an economically viable energy supply and improve sustainability using a research-informed risk management approach.

Ongoing cost:benefit and risk:benefit analysis will allow the most useful government actions to be identified. The possibilities include clarifying market rules to ensure good quality decision-making and long-term investment by the private sector, promoting public education, requiring publication of information at key decision points of consumers, introducing minimum standards and targeted pricing policies. Rather than decide what technologies should be deployed, government should concentrate on public policy actions which provide certainty for those making energy-related decisions. In order to be effective these actions must have demonstrable net economic benefit and target minimum life cycle costs for consumers. The greater the certainty, the greater the likelihood of good long-term decision-making and investment by New Zealanders.

It is likely that when the necessary operational research is conducted, the level of intervention by government to manage energy demand will be greater than is presently implemented. Any moderation of demand growth will assist in improving security and sustainability. Likely ways in which New Zealand might better manage demand include improving the nation's vehicle fleet efficiency, introducing mandatory building and appliance performance standards, improving urban design and public transport, and stimulating research and development into potentially beneficial new technologies.

Improvement of long-term supply security is most likely to be assisted by ensuring we store sufficient transport fuel, and by ensuring that the markets for gas and electricity are effective and stable. To ensure new investment, it is particularly important that the structure of the electricity market is successful, including the role of the Electricity Commission (EC). Contingency plans for coping with all foreseeable short-term security problems must be developed and continually refined.

Improving sustainability will be fostered by incentivising or facilitating research to adapt or implement new or emerging technologies for increased energy supply from renewables, greater efficiency in using fossil fuels and demand reduction. By advancing research into new technologies, government will encourage the private sector to respond by undertaking feasibility studies. If these are positive, private sector investment will follow provided the market rules then encourage long-term investment.

A high degree of focus by both the Energy Efficiency and Conservation Authority (EECA) and the EC, and high levels of performance from both agencies are needed. The government agencies responsible for transport and building policies need to address key issues within their jurisdiction without delay.

THE ISSUES FOR NEW ZEALAND

Energy consumption falls into three broad but not mutually exclusive areas – transport fuel, electricity and heat. In recent times New Zealand has experienced steadily growing demand for energy, particularly for electricity and transport. Our energy intensity (energy use per economic output) is high relative to similar economies, partly because of the longitudinal nature of the country which makes our transport and electricity transmission needs larger than those of countries with higher population densities. Further, important growth areas of our energy economy (particularly the meat, dairy and wood processing industries and associated transport to reach the international market) are energy intensive through their use of thermally-driven dewatering. Nevertheless, there is significant potential for improving energy efficiency, thereby moderating future demand for energy.

Internationally, it is expected that the cost of oil and natural gas will rise as the most easily accessible stocks are depleted. Although New Zealand may discover ample fossil fuel resources, these resources are likely to be priced at international rates. As a result transport fuels, whether derived from oil or other sources, may rise in price disproportionately to other resources used in the New Zealand economy. Thus, through our geographic remoteness which creates a high dependency on long distance transport, we face a particular challenge in tackling energy issues whilst still encouraging economic growth.

New Zealand is a signatory to the Kyoto Protocol, thereby committing us to reducing our carbon dioxide (CO_2) emissions. The Resource Management Act has been implemented, which can lengthen the process by which new infrastructure is created. We have witnessed a lack of recent investment in new and replacement energy infrastructure and the depletion of the Maui gas field in a relatively short time. Even if replacements are found it should be realised that gas resources are finite.

For these reasons we consider that New Zealand needs a strategy that is implemented as a set of coherent long-term policies for ensuring both a secure and a sustainable energy system. Security of supply is important to ensure the well-being of New Zealanders through reliably supporting key social, environmental and economic activities at all times. Sustainability is vital so that the activities of present generations do not compromise those of future generations. The transition towards a sustainable society must be managed well to avoid either self-created penalties or lost opportunities for progress.

Sustainability

The total amount of known fossil fuel (coal, oil and gas) in the world is sufficient for at least several centuries, although oil and gas will become increasingly scarce and thus more costly. Whilst some technologies that create liquid or gaseous fuels from coal exist, the large-scale deployment of efficient and consequently environmentally friendly economic conversion plants is still some time away. At the same time, the global community is improving its ability to harness solar-induced energy flows both directly and through water and wind. Hence the real concern for sustainability is not whether we will run out of energy, or of particular energy forms, but whether we will adequately manage the transition to a sustainable energy society and whether the global ecosystem can cope with the consequences of the way we use energy.

The United Nations Framework Convention on Climate Change is the first stage of a risk management approach to limit the extent to which man-induced global warming might occur. Regardless of whether or not the Kyoto Protocol will make a large difference to greenhouse gas emissions, it has changed mindsets and raised global awareness.

The emission of carbon (C) is governed by the relationship:
(C emissions) = (GDP/capita) x (population) x (energy intensity) x (C intensity of the fuel mix).

As previously noted, New Zealand has a number of energy-intensive industries, some of which depend on historically low cost hydro-electricity to process imported raw materials. Our present electricity system has a relatively low average C intensity of fuel mix because of the high proportion supplied by renewables. There are real challenges in growing our economy whilst also reducing our C emissions.

Security

National energy security issues, relating to the temporary or short-term mismatch of supply and demand for particular energy forms, need to be addressed now. New Zealand faces real and potential medium-term security issues in relation to natural gas, electricity supply and transmission. We may also suffer if there are further international supply security issues in respect of transport fuels.

Further, in acting responsibly on behalf of its present and future citizens, New Zealand should take all reasonable steps to ensure the nation does not become unnecessarily dependent on the importation of energy in forms likely to experience unstable pricing through global supply security issues. This is an economic security threat.

Institutional arrangements in our energy sector

The three government agencies most associated with the implementation of energy policy and initiatives in New Zealand are the Ministry of Economic Development, the Energy Efficiency and Conservation Authority (EECA) and the Electricity Commission (EC). Other agencies that may be less directly involved include the Ministry of Transport, the Commerce Commission, Treasury, the Department of Prime Minister and Cabinet, and the Ministry for the Environment which leads the inter-departmental work programme on climate change.

The Ministry of Economic Development has the primary policy responsibility for developing a National Energy Strategy. EECA has specific functions related to the development of the National Energy Efficiency and Conservation Strategy (NEECS) and is a programme implementation agency.

Whilst the government has retained a fiscal interest in several energy companies, it has also attempted to create markets in which the publicly-owned entities compete against private institutions. Specifically, the government established the EC as an implementation agency with the goal of securing supply against a one in 60 worst case dry year, and also charged it with managing the wholesale electricity market. Although it currently lacks the autonomy of a conventional regulator, the EC is based on establishing a regulated market in which generation companies make commercial decisions. This is augmented by a process which allows the monopoly transmission system owner – Transpower – to provide transparent, open access to the grid to competing

generators, lines companies, retailers and large industrial customers. The EC also has the potential to make supplementary payments to the commercial operators to establish a capacity that they might otherwise not install.

Potential policy actions

We argue that a commitment to a sustainable and secure energy system for New Zealand will require government to take specific actions that go beyond facilitating competition within the various energy markets. Government interventions, either targeted or facilitated more generally through the Commerce Act, are already made in circumstances where it is considered that the free market would lead to outcomes that are not in the national interest. The only justification for interventions by government should be that they are clearly focused on achieving a public good that would not otherwise result. It is vital that any intervention does not create uncertainty for investors.

The long-term goals to which government actions can and should contribute are:

- leading the process for moving New Zealand progressively towards a more sustainable energy future
- improving our efficiency of energy usage to match global best practice for similar economies
- promoting effective and efficient energy markets to provide certainty that sufficient and suitable energy forms will be available to all New Zealanders on an ongoing basis
- ensuring social objectives are not compromised
- ensuring that New Zealand's natural resources are used efficiently, effectively and increasingly sustainably

In fulfilling its role, government may choose to act in five ways:

- providing an environment that encourages rational long-term decision-making in the private sector, including continuing clarification of price rules and planning rules (we will refer to this as *clarification of market rules*)
- providing public education that will ultimately lead to informed and subsequently better decisions on energy matters by consumers (*education*)
- requiring compulsory publication of information at points of decision on energy, thereby enabling high-quality decisions (*compulsory information*)
- introducing mandated government standards in circumstances where it is considered that, even after education and information dissemination at point of decision, the decision-maker is likely to make choices that are demonstrably against the public good, or would hinder achievement of national commitments on energy (*minimum standards*)
- applying targeted pricing policies or incentives where appropriate, for example through tax relief or below-cost pricing funded by the taxpayer or end-users of energy where there is sufficient public good (*pricing policies*)

Underpinning and informing these actions there should be a government commitment to:

- Supporting or facilitating operational research to quantify the total impact, benefit:risk and cost:benefit ratios for particular actions. There should be public confidence that the research is robust (through public scrutiny and expert peer review), that proposed interventions demonstrably have net economic benefit to New Zealand, and that they benefit (or at very least do not penalise) consumers affected by the interventions. This research will identify the best yield of the five types of intervention previously listed.
- Investing in or incentivising research that determines how overseas technology can be adapted to achieve maximum benefit in our local conditions, or enables particular opportunities for conservation of energy supply peculiar to New Zealand to be explored.

Professional engineering skills will be vital for undertaking both types of research.

Whilst New Zealand should rely as much as possible on markets, and avoid centralised planning, there may be a need for greater government intervention than that which exists at present. A National Energy Strategy and resultant government actions will affect the decisions and actions of energy producers and consumers, and may influence the energy forms we use in the future. If high-quality research is conducted there will be complementary and co-ordinated actions that achieve major change with minimal short-term disruption. In some cases, the primary justification will be benefit:cost but it might be benefit:risk for some security issues.

The nature of a National Energy Strategy

In light of the above, the overarching national strategy for a sustainable and secure energy future should be based on a co-ordinated research-informed risk management approach within which priorities can be regularly reviewed by relevant parties. We recommend a framework that identifies where each of the five types of possible government actions should be applied, within each of the three major energy end-use applications, to ensure outcomes that meet the security and sustainability requirements.

Research-informed benefit:cost and benefit:risk analysis can then be used to determine and prioritise the key governmental actions that will be most effective across the range of possibilities. Later in this document we present our view of the actions most likely to be beneficial. In doing so we have not attempted to quantify the benefits and costs of particular proposals, which is the role of the operational research discussed earlier. Rather, we have indicated areas which we consider should be the priority targets for research to identify the most beneficial governmental actions. We then consider the agencies that will be most effective in delivering the key actions.

TRANSPORT FUELS

New Zealand's use of transport fuels has been growing rapidly. Factors contributing to this trend include:

- a growing vehicle fleet relative to our population size
- increased purchase of less fuel-efficient vehicles in recent years
- lifestyle changes resulting in increased mobility of people
- the absence, until very recently, of pricing rules that can act to curb demand
- growth in population, satellite urban development and inadequate investment in public transport systems

The major risks for New Zealand due to an escalating demand for transport fuel are:

- it would be difficult to claim that we are meeting our global responsibilities unless we take reasonable actions to manage demand
- our economy may potentially be at risk if the price escalation for transport fuels is sustained
- we are increasingly vulnerable to any short-term fuel shortage, and the extent of potential resultant disruption is increasing

Sustainability

It is widely believed that travel demands are not very sensitive to transport fuel price. Hence, increasing sustainability can be achieved by lowering demand for travel, improved efficiency of transport vehicles, maximising use of public transport and developing new technology vehicles that do not necessarily require traditional fuels.

To make long-term advances on reducing demand we need enlightened leadership and a visionary strategy that takes account of the realities of current fleets and fuel infrastructure.

Demand management in transportation of people

It is important to manage urban design so that people do not become unnecessarily reliant on the need for inefficient or low value travel.

We recommend a whole of government, research-based approach to examining policies promoting: urban design of integrated communities to encourage living styles with little need for low value travel, including better utilisation of high bandwidth communications technology; support for group travel as opposed to single occupancy vehicle travel; and commitment to the creation, improvement and maintenance of public transport corridors. It is important that councils consider the implications surrounding planning rules and provide clarity to New Zealanders to enable them to make informed decisions.

National Policy Statements (NPSs) on public transport, preferential transport corridors and urban design should be considered. In giving effect to such NPSs under the Resource Management Act, local authorities would ensure improved urban design for the benefit of New Zealanders. It is important that the underpinning research is not framed in terms of present energy prices but considers likely changes in energy prices, relative to other resources, over several decades.

Possible actions: clarification of market rules, education

The Ministry of Transport and Land Transport New Zealand should urgently address the means to maximise travel on public transport, in multiple occupancy vehicles, and by foot or cycle. This might include capital and operating cost injections to ensure that transport systems are attractive to users from both quality and price perspectives. It is important to continue incentivising the use of public transport to increase patronage by maintaining positive attitudes and support for these modes within communities. Life cycle assessments of the various transport modes should be determined to ensure the appropriateness of applying pricing policies to compensate for costs that are not directly borne by users. The necessary operational research needs to take into account our small and distributed population (for example, solutions from Europe may not work here), the likely relative changes of fuels and other costs over several decades, and potential changes in passenger transport technology.

High speed internet access may reduce travel needs.

Possible action: pricing policies

Consideration should also be given to real time cost pricing including "time of day tolls" on high usage roads. In general, real time cost rules are more likely to lead to more responsible behaviour and better choices by users.

Possible action: pricing policies

Demand management in transportation of goods

There are three modes for transportation of goods: coastal shipping, rail and road. In general, subject to any long-term obligations of government to particular transport operators, the true costs of each form need to be reflected in the price so that rational decisions are made. Operational research (for example, scenario-based sensitivity studies) should be carried out by government to establish the long-term (life cycle) benefit of maintaining a national rail and coastal shipping network of high quality as a means of maintaining a secure goods transportation system at times of transport fuel price instability. As is the case with transportation of people, it is vital that the studies consider likely transport fuel costs over several decades. As the relativity between fuel and other costs rises, the optimal balance is likely to favour less road transport than is used at present.

We are not convinced that analysis has been carried out to ensure that the public capital expenditure is optimally distributed between roads and rail. If there is to be a subsidy towards rail it should be explicit and justified by robust economic analysis.

Possible actions: clarification of market rules, pricing polices

Vehicle efficiency

Purchasers of privately-owned vehicles rarely consider a vehicle's full life cycle costs for two reasons: consumers are not supplied with full cost information at the time of purchase; and, even if consumers can determine costs, they often do not own vehicles long enough for energy costs to be a major consideration. Therefore, although public education on how to balance operating and capital costs should be investigated, it is likely that higher level responses by government may be necessary to achieve net economic benefit. We recommend the consideration of compulsory publication of vehicles' expected energy costs at point of sale.

Possible actions: education, compulsory information

The relevant agency should urgently evaluate whether an even greater benefit would result from restricting the purchase of relatively inefficient vehicles which have high C emissions per kilometre travelled. This restriction could be imposed by applying a disincentive for particularly energy-inefficient vehicles, such as increased road user charges or the imposition of minimum efficiency standards which may restrict the importation of vehicles. In our view, the small cost of lost market freedom can be justified provided that any minimum standard that is introduced is designed to achieve minimum life cycle costs for the vehicle (considering utility, capital and energy costs) and has a net economic benefit for the country.

Possible actions: minimum standards, pricing policy

New technologies

Given that vehicle technology will continue to be the subject of large-scale research and development overseas, from a strategic viewpoint there is little sense in seeking to develop our own unique, new vehicle technologies. Rather, as new technologies such as fuel cells, electrical drives and hybrid powered vehicles become commercially available, operational research should be undertaken to evaluate the optimal level of government action in respect of the technology. In this way, New Zealanders, both individually and as a whole, can maximise the benefits.

An example is the recent move to cleaner (lower sulphur) diesel in New Zealand. This opens the way to an increasingly diesel-powered private vehicle fleet, using the much more efficient clean diesel motors now available internationally. A public education programme which also addresses negative perceptions about the smoothness of diesel engine behaviour might well change consumer behaviour. This is an achievable programme for EECA provided it is adequately funded.

Possible action: education

If there are worthwhile developments in vehicle technology in New Zealand by our private sector we should ensure they are not inadvertently impeded from coming to market by existing regulations. Similarly, if a unique opportunity for a New Zealand-specific vehicle technology was identified (for example, there is a fuel type that could be produced in New Zealand at low price) government might wish to invest in relevant research to develop the opportunity to a level at which it can attract private sector investment. However, whether or not the government assists development in such circumstances should be judged in the context of innovation policy.

Possible action: clarification of market rules

Supply of liquid fuel from renewable sources in New Zealand

Given that transport fuel is an international commodity, any New Zealand-based liquid fuel production (for example, biodiesel) should be viable in the global fuel market without protection. Public capital should not be put at risk, but private sector organisations should not be prevented from doing so.

As part of its policy of fostering economic development, the New Zealand government might support research aimed at making a valuable product (liquid fuel) that can be sold profitably. However, in our view, developing a liquid fuel supply industry in New Zealand that would need ongoing government support for its continued viability would be a mistake.

Possible actions: clarification of market rules, pricing policies

Security of liquid fuel supply

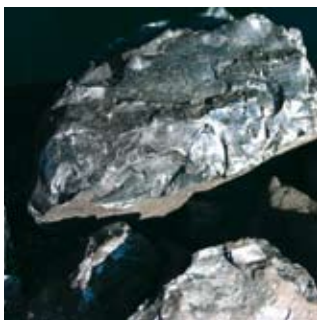
Oil is an international commodity. As the supply of relatively inexpensive oil and gas reduces, New Zealand can reasonably expect that coal liquefaction technology will be brought on line by international energy companies to ensure a sufficient supply of transport fuel. Whether that liquefaction occurs in New Zealand or overseas makes little difference to the global environmental impact. The likely actions by major international energy supply companies are likely to smooth any effect of the so-called peak oil. Thus, provided planning permissions for extraction and processing plants can be obtained at appropriate sites throughout the world on realistic timescales and political events are stable, sufficient international supply – albeit at steadily rising prices – would be expected.

Hence, for our isolated nation with a low population, security of supply is best addressed by two means. Firstly, we need to maintain sufficient onshore oil supplies. These may exceed the International Energy Agency's (IEA) recommended minimum.

Possible action: minimum standard

Secondly, as previously discussed, there is no intrinsic reason to risk public sector capital on transport fuel supply schemes. However, if the liquid fuel could be produced from a renewable source and in sufficiently large quantities, benefit:risk analysis might suggest that a marginally economic operation should be sustained through a market trough for security purposes.

Possible action: clarification of market rules



SOME POSSIBLE ACTIONS — TRANSPORT FUELS

Clarification of market rules

- NPSs on public transport, preferential transport corridors and urban design would limit the inadvertent selection of unnecessary, energy-inefficient urban designs by communities and individuals.
- The true cost of each type of transportation needs to be reflected in the price so that rational decisions can be made.
- Valuable vehicle technology developments by New Zealand businesses should not be impeded from getting to market by unclear or unnecessary regulation.
- Local liquid fuel production should not be subject to unnecessary regulatory impediments.
- If large quantities of liquid fuel could be produced from a renewable source, benefit:risk analysis might suggest that a market trough could sustain a marginally economic operation.

Education

- Public education should promote living styles with little need for low value travel, including better use of communications technology, creation of well-designed public transport corridors, and travel on foot and cycle or in multiple occupancy vehicles.
- Consumers should be made aware of full life cycle costs for vehicles.
- Public education programmes should be undertaken to address incorrect perceptions, such as negative perceptions of clean diesel engine behaviour, and highlight energy benefits of such technologies.
- Similar public education programmes should be undertaken as other efficient technologies become commercially available, for example, fuel cells, electrical drives and hybrid fuelled vehicles.

Compulsory information

- Consideration should be given to providing compulsory information outlining full life cycle costs of vehicles to consumers at point of sale.

Minimum standards

- Minimum standards could be used to restrict the purchase of inefficient vehicles, including those producing high carbon emissions.
- We need to maintain sufficient onshore oil reserves, possibly more than is set out in IEA guidelines.

Pricing policies

- Public transport should continue to be incentivised provided life cycle assessments demonstrate its appropriateness.
- Consideration should be given to real time cost pricing for high usage roads where capacity cannot easily be increased.
- The true costs of modes for goods transportation – coastal shipping, rail and road – need to be reflected in their price, subject to any long-term obligations of government to particular transport operators.
- Government needs to decide the optimum level of subsidy that is appropriate to maintain a national rail and coastal shipping network.
- Increased road user charges may be an appropriate disincentive for extremely inefficient vehicles, including those producing high carbon emissions.
- All fuel-related taxes should be used for transport.
- Government may support research aimed at making a valuable liquid fuel that can be sold profitably.

The bulk of process heat is used industrially, although commercial and domestic building heating are also significant. Industry relies heavily on the combustion of coal, gas and oil for process heat. Commercial and domestic heating is more reliant on electricity.

Sustainability

Industrial

Improvements to the efficiency of process heat and cooling usage within industry have been limited by the low cost of energy and, in industry sectors dominated by small companies, the lack of technical skills to undertake the necessary analysis and procurement of energy-efficient plant. This could be addressed in part by well-targeted education schemes. An expanded programme could be undertaken and promoted to industry by EECA if operational research demonstrated a positive benefit:risk ratio.

Possible action: education

Domestic and commercial

New Zealanders maintain their homes at temperatures that are low by international standards. Any move to bring them up to the norm, such as for health reasons, need not necessarily increase energy use provided heat loss standards are simultaneously addressed. Government should ensure that energy efficiency standards are also applied to the non-residential building stock.

Planning rules can play an important role in defining the potential for solar heating in homes and to a lesser extent in commercial buildings. In order to maximise the solar heating potential of buildings there needs to be planning rules that ensure sunshine is not unreasonably shadowed, and that in subdivision design the potential benefits of orienting homes to the sun is maximised. The development of a National Environmental Standard would ensure that councils give effect to these matters in their district plans, thereby assisting in lowering heating demand.

Even if the potential for solar access is maximised, the demand for domestic or commercial process heating (or cooling) is still heavily dependent on building design. Good design on a life cycle basis (for example, the selection of insulation levels, use of double glazing or laminated glass, and design to utilise the sun) is rare – both because good design standards are voluntary and because the owner of a commercial or investment building at the time of construction is rarely the owner as little as one year later. In support of the public good, more stringent minimum standards for items such as wall and ceiling insulation, window glazing, hot water systems and towel heaters should be introduced into the Building Code. As was the case for vehicle standards, any standard should be established on the basis of targeting minimum life cycle cost for the owner, as well as having a demonstrated net economic benefit to New Zealand. This would ensure that low energy-demand buildings are constructed in the future, irrespective of the economic drivers for those undertaking construction.

Similarly, the Building Code should include minimum energy standards that are much higher than today's for the thermal performance of removable building services, including water heating and air conditioning plant. In our view, this will be cost-effective in the long run for both building owners and New Zealand as a whole. This initiative should follow the recommendations of the New Zealand Green Building Council which has already undertaken extensive research in this area.

Possible actions: clarification of market rules, minimum standards

A different approach is required to ensure that both existing and new buildings use the most efficient means (on a life cycle basis) of supplying heating or lowering demand. Again, because of the short-term ownership issue, IPENZ recommends introducing minimum standards for energy efficiency for building service systems that might be retrofitted into existing buildings (again based on the criteria of minimum life cycle cost and demonstrated net economic benefit). All future purchases of heating or cooling equipment would therefore be of better quality. For example, rather than progressively banning solid fuel heaters, good design standards should be developed and implemented to ensure that they comply with existing legislation. The introduction of properly framed minimum standards for water heating and storage may lead to increased use of solar water heating, or other technology with equivalent or better efficiency – a change we would support.

It is worth investigating the benefit:cost ratio of introducing a requirement that, prior to sale, buildings are progressively upgraded towards present Building Code requirements for energy efficiency in new buildings. Such a requirement would effectively create a "warrant of fitness" for buildings, indicating that they are fit for purpose. This would not be unlike the requirements introduced for earthquake upgrading some years ago which are now well-established. This may be difficult and costly to implement, but if there were worthwhile reductions in heating demand there may be sufficient net economic benefit to make it worth pursuing.

Possible action: minimum standards

A mandatory labelling system to provide the general public with comprehensive running cost information for energy-using equipment and building thermal performance would be expected to modify consumer behaviour. A multi-star building rating system could be introduced as an education measure. Alternatively, publication of energy costs could be made compulsory when buildings are for sale. Education programmes will not be effective unless they are strongly promoted, highly focused and easy for consumers to understand.

Possible actions: education, compulsory information

Fuel sources

We should utilise energy sources such as gas and geothermal steam as directly as possible to avoid the need for multiple conversions between energy forms. This could be encouraged by a public education programme.

It is in the public interest that process heat is supplied as efficiently and sustainably as possible. This requires the encouragement of geothermal steam, natural gas and other direct uses where this can be reticulated cost-effectively. EECA could be required to publish consumer-friendly information to ensure consumers make well-informed decisions.

Possible action: education

Current government policy includes an energy efficiency and solar initiative. The intention is that government will bulk purchase domestic solar water heating units to reduce the costs through economies of scale, and pass savings on to the public. We recommend that a cost:benefit analysis is urgently undertaken to ensure that this intervention is really worthwhile, that is, it will lead to the lowest possible life cycle costs for supplying hot water and a net economic benefit to the nation. It may be that other actions, such as a National Environmental Standard on solar access, are at least as valuable or are needed to make the solar water heating proposal viable.

Possible action: pricing policy

Consideration should be given to incentivising research to evaluate and further develop or adapt novel heating and cooling systems. This will allow more accurate benefit:cost analysis by decision-makers.

Possible action: pricing policy

Security

In the short-term, security of supply can be best addressed by providing long-term clarity of government resource policy and regulations, thereby assisting commercial organisations to manage the considerable risks involved in exploration for gas and oil resources and bringing them on line.

Possible action: clarification of market rules

We should ensure that our research sector is evaluating the likely benefits of new technologies, such as cleaner coal technologies or CO_2 sequestration in coal beds, on an ongoing basis so we can make use of such technologies if necessary. Some public expenditure, in effect an incentive to research providers in this area, may be justified.

Possible action: pricing policy

SOME POSSIBLE ACTIONS — HEATING

Clarification of market rules

- Councils should consider the energy implications of implementing planning rules and provide clarity to their residents regarding such rules.
- Government should clarify policy affecting gas exploration.

Education

- Education could be undertaken to improve industry's uptake of more efficient process heating and cooling plant.
- A multi-star building rating system that is highly focused and easy for consumers to understand could be introduced.
- Education on the benefits of using energy sources such as gas and geothermal steam as directly as possible should be undertaken.
- Government should undertake education schemes to encourage the uptake of energy efficiency and technology upgrades.

Compulsory information

- A system of mandatory labelling could be introduced to provide consumers with comprehensive running cost information.
- EECA could be required to publish consumer-friendly information to ensure consumers make well-informed decisions.

Minimum standards

- Government should ensure that energy efficiency standards are applied to both domestic and non-commercial building stock.
- By giving effect to a National Environmental Standard, councils would realise the potential for solar heating when approving new residential developments.
- The Building Code should include minimum energy standards that are much higher than today's for the performance of removable building services, including water heating and air conditioning plant.
- Minimum efficiency standards should be developed for building service systems that might be retrofitted into existing buildings.
- Consideration should be given to developing a system whereby buildings are brought up to energy efficient standards before sale.

Pricing policy

- A cost:benefit analysis should be undertaken to ensure public expenditure on efficiency initiatives (for example, solar water heating) can be justified.
- Consideration should be given to incentivising research on the efficiency of heating options.
- Public expenditure may be justified to ensure that research evaluating new technologies is undertaken.

ELECTRICITY

New Zealand's electricity demand has been rapidly increasing in recent years. National electricity demand growth is in the region of 2% to 2.3% per annum. This represents the net effect of demand growth, countered to some extent by efficiency gain. There are some regional variations about this figure – recent growth has been higher in the upper South Island and the upper North Island.

This may be attributed at least in part to:

- new industrial development, especially in the food industry and wood chip production
- an increase in the development and use of electrical equipment and consumer appliances
- an associated rise in the inclination to leave appliances in stand by mode
- rapid growth in the use of air conditioning, even in relatively temperate climate zones
- an increase in population, including immigration

Additionally, retail electricity prices have been on the increase, both for domestic and industrial customers. In real terms, domestic electricity prices have increased 19% since April 1998. These increases directly impact on almost every home and may threaten the commercial viability of some industries.[1]

The increase in demand for electricity poses the following supply security risks:

- insufficient supply when renewable supplies are limited (for example, low lake levels)
- insufficient transmission capacity to supply peak demand in particular locations
- increased emission of combustion gases (if the increased demand is met by thermal generation) which could result in increased financial costs to New Zealand to meet our Kyoto Protocol obligations
- inability to adequately support the electronic economy

It should be noted that trends in electricity demand are intrinsically linked to changes in other energy consumption patterns. For example, a consequence of driving heating towards greater energy efficiency is often increased use of electrically-driven heat pumps, thereby increasing electricity demand. If hybrid-powered or totally electric vehicles become the mainstream of the passenger transport fleet then, on a long-term basis, electricity will be the most pivotal energy issue. As liquid and gaseous fuel stocks diminish there may be an increasing incentive to generate more electricity for transportation and to supply heat.

We foresee problems in electricity supply at the 10–15 year horizon if our demand continues to grow at current rates. There are regulatory and water allocation problems with hydro possibilities, wind generation is intermittent, gas supply is uncertain, the extent to which geothermal can be expanded is limited, coal-burning with current technologies has environmental consequences, and wave and tidal technologies are both intermittent and still in early development stages. As New Zealand becomes more dependent on generation from intermittent, renewable sources there may need to be investment in electricity storage technologies.

Sustainability

The broad approach to increased sustainability in electricity is to actively manage demand to the extent this is reasonably possible and, when generation capacity is added, to ensure that renewable energy schemes are appropriately evaluated. In addition, generation closer to the point of use from so-called distributed energy resources should continue to be encouraged and supported, by removing unjustified barriers to such investments.

If action is taken to reduce our carbon emissions due to transport, we could, if necessary, generate more electricity from fossil fuels without penalties under the Kyoto Protocol, at least as part of a transition to a more sustainable energy future.

Demand management

The electricity demand profile is the cumulative effect of many diverse activities.

There is evidence from IEA studies that, with a strong governmental commitment to energy efficiency based on minimising life cycle costs of electricity, end-users can seriously reduce the growth in demand for electricity without any economic loss to the nation. In general, the costs of well-targeted schemes are much lower than the costs of installing more generation and transmission, so an emphasis on demand management activities is justified.

The structure of the electricity market and the relatively high cost of the necessary metering do not enable the marginal cost of generation to be reflected to small-scale consumers who are prepared to make savings. This has resulted in a domestic electricity demand sector that has little incentive to invest in demand management or micro-generation schemes to supply some of their own needs. Thus, there is significant potential for conservation, as in domestic sectors elsewhere, but that potential is not easy to realise.

Moderating the rate of growth in demand and flattening the demand curve will increase the likelihood that new generation capacity will be sustainable. The later that new generation capacity is brought on line, the more likely it is that the cost of new and more sustainable generation technologies will match that of conventional generation technologies, because of the expected decline in the cost of the new technologies.

Public education needs to be undertaken so that the full life cycle cost of electrical devices can be considered by the consumer at the time of purchase and consumer behaviour can be consequently modified. Education programmes targeted at reducing unnecessary energy consumption from stand by systems in electrical goods could also be implemented. The EC has undertaken pilot schemes, such as the fridge replacement scheme, which could have been much more successful had adequate public education been undertaken concurrently, as was the case for the compact fluorescent lightbulbs (CFLs) scheme.

Whilst we support education efforts to raise public awareness, leading to an increase in the use of energy efficient techniques and technologies, we recognise that public education may not have the best benefit:cost ratio for reducing domestic demand.

Possible actions: education, pricing policy

[1] Ministry of Economic Development, Briefing to incoming Ministers 2005 – energy; available at: http://www.med.govt.nz/templates/StandardSummary____11206.aspx (16/11/05)

Minimising electricity demand can also be addressed by both ongoing energy consumption and/or cost labelling for major items, and the introduction of Minimum Energy Performance Standards (MEPS) for electricity-using equipment.

There is often a wide variation in efficiency of products available to the market. The introduction of MEPS would raise awareness of consumption, thereby helping to manage demand. Given that there are only weak linkages between the electricity market and prices paid by small-scale consumers, minimum standards are more likely to be effective than lower level government actions such as education in the domestic and light commercial sectors. There is sufficient public good to consider imposing such standards.

Possible actions: minimum standards, compulsory information

Supply

On a long-term basis, generation that is sustainable, reliable, economic and that produces less or no CO_2 emissions should be encouraged. None of the options currently available to New Zealand are without some disadvantages. Some forms of generation that are considered uneconomical now are likely to become relatively cost-effective as fuel prices increase. For example, technologies using wave or tidal movement and coal gasification may advance rapidly over the next two decades to the point they can be deployed economically and without increasing environment concerns. Carbon sequestration technology could be considered for future coal use. It would be worthwhile to direct research funds to ensure that evaluations of technology breakthroughs are completed without undue delay, even if the research must be incentivised.

Possible actions: pricing policy

IPENZ considers that, for the very long-term, there will be a need to re-evaluate nuclear electricity generation. Whilst it is relatively early for the debate to be opened, there would be benefits if the public were informed about the latest economic viability, safety and impact information for the technology during the next 10 years. We will then be better equipped as a nation to discuss whether the use of the technology in 20–30 years' time is advisable. We may face the eventual reality that, in order to generate all the electricity needed in an energy-hungry world without burning large amounts of coal, nuclear electricity generation will be implemented in many parts of the globe.

Possible action: education

Security

The major security issue is to ensure that installed generation capacity is adequate to supply consumers in a dry year when hydro generation will be limited. The government has set a criterion of one three-month period in 60 years as the acceptable risk (essentially establishing a minimum standard for supply security), and has empowered the EC to apply pricing policies to ensure that sufficient capacity will be built. However, the system is as yet unproven and some commentators consider that there are unresolved risks, arising either from design weaknesses or from the quality of performance by the EC itself. Ensuring there is no failure for either reason is vitally important.

Recently there have been discussions on the type of transmission security design employed in New Zealand. Careful consideration should be given before changing from the conventional deterministic basis to the probabilistic approach which may offer a lower level of protection. There is a public good in ensuring that the unmanaged risk is acceptable to government, as the representative of the people.

Possible action: minimum standards

New Zealand also needs a contingency plan by which short-term demand can be suppressed to avoid security problems in particular dry years. Demand may be managed in the short-term by measures such as supplying and utilising CFLs, encouraging variable heating of hot water cylinders via off-peak rates, and reducing the use of appliances by consumers via education. A properly engineered contingency plan, not dissimilar to an emergency management plan for natural disaster, is justified.

Possible actions: education, pricing policies

As part of that contingency plan, incentives to consumers should be considered where the use of energy efficient products would drop demand during a critical winter. For example, it has been estimated that if all incandescent lightbulbs were replaced with CFLs national savings would reduce the risk of short-term supply shortages, and substantial longer-term savings would be achieved.

Possible action: pricing policy

On a longer-term basis, and even if the most stringent energy efficiency measures are implemented, some expansion of demand is inevitable. It is vital that the EC's actions are sufficiently clear so that the generating companies will invest enough capital in a timely manner. It is also important that generators are clearly informed about the intentions of government in respect of more stringent efficiency measures.

Possible action: clarification of market rules

SOME POSSIBLE ACTIONS — ELECTRICITY

Clarification of market rules

- An NPS on transmission should be developed.
- Greater certainty on generation capacity should be provided through an NPS on generation.
- The EC should provide clarity with respect to capital investment and the intentions of government in relation to efficiency measures.
- Small-scale generators should not be prevented from accessing the electricity market by unnecessary barriers.
- Clarity in the market-place should be provided on follow-through costs.

Education

- Public education needs to be undertaken to provide consumers with life cycle costs at the time of purchase.
- Public education needs to be undertaken concurrently with any government-led pilot schemes.
- The public should be comprehensively informed about nuclear electricity generation.
- The public should be educated as to how their appliance use affects short-term demand.

Compulsory information

- Ongoing cost labelling should be introduced for major items.

Minimum standards

- MEPS should be applied to electricity-using equipment.
- Government needs to decide on an appropriate minimum standard for transmission security design.
- Minimum standards for domestic appliances (both for usage and stand by) should be developed and applied.

Pricing policies

- Research funds should be directed to immediately evaluate new technologies that reduce CO_2 emissions.
- Appropriate subsidies should be applied to ensure security in dry years.
- Measures such as supplying CFLs to consumers may be justified in managing short-term demand as part of a contingency plan.
- Incentives to consumers should be considered where they will decrease demand as part of a contingency plan.

PRIORITIES – IDENTIFYING THE BIGGEST GAINS

In setting out to establish priorities it must be recognised that New Zealand has considerable potential to increase renewable energy supply, but technology development or improvement is needed and economic risks must be managed by the energy supply industry if this potential is to be realised. All possibilities have both strengths and weaknesses and detailed engineering and economic analysis is needed to identify the best approaches. Investment in research, undertaken by those with relevant expertise, and co-ordination is vital to avoid a range of disconnected initiatives that do not create a coherent national strategy when implemented simultaneously.

The priorities amongst the various possibilities in the framework discussed earlier should be determined by cost:benefit and risk:benefit analysis. High cost:benefit proposals with high net economic benefit to the nation should proceed, as should proposals that significantly reduce national risk, even if they do not necessarily have a good cost:benefit ratio.

The priorities for supply security and those for sustainability will often be different.

Security

The three biggest security issues are: security of electricity supply, security of gas supply and security of liquid transport fuel supply. The required actions to address these issues are:

- ensuring that gas exploration in New Zealand is not delayed by concerns about risk in our regulatory and policy environment (clarification of market rules)
- ensuring that the EC functions effectively to address electricity supply issues
- ensuring sufficient onshore oil storage (set and meet a suitable minimum standard)
- maintaining contingency plans for public education to temporarily suppress electricity demand in dry years, if necessary augmented by pricing policies (incentives) to rapidly deploy energy efficient end-users

There are concerns in respect of the first and second points. Firstly, drilling equipment is in high demand internationally – we therefore need to ensure that drilling in New Zealand is considered favourably by investors.

Secondly, there is a need for effective leadership within the EC and for active performance monitoring by the responsible Ministries. Concerns about EC operations that may need to be addressed include:

- the governance rules are complex and do not clearly define responsibilities or participants, thereby creating uncertainty for investors
- the respective roles of the Commerce and Electricity Commissions may overlap and this impedes clear decision-making
- the present status of our generation and transmission system does not allow time for partial failure prior to rebuilding – it must work well immediately
- progress on harnessing the potential of distributed generation, renewables and demand side management systems has been slow
- some would argue that it requires a large number of players, each with different goals, to simultaneously act in relatively idealistic ways, and the probability this will happen is too low

Sustainability

There are two critical areas in terms of sustainability. The first is deciding the extent to which government will actively pursue energy efficiency measures designed to minimise life cycle costs for consumers. Government should decide the extent of its commitment, and then immediately act to implement its plans. An increased commitment to efficiency will include urgent actions on:

- minimum standards in the Building Code (under revision) to move our building stock, building products and building services plant to higher efficiency
- minimum standards for existing building upgrades
- minimum vehicle efficiency standards for obtaining import permits
- education of consumers to improve their decisions on homes and vehicles
- considering requiring compulsory publication of energy information at the time of purchase of vehicles and buildings

Any such action should be driven by the goal of moving consumer decisions to the point of lowest life cycle cost, and should have a net economic benefit for the country as a whole. In addition, any actions implemented must work together coherently to create a unified national approach.

The second set of actions relates to longer-term issues:

- incentivising research to improve understanding of the impacts of new technologies on both demand management and electricity supply – as technologies improve the potential to harvest and store energy from New Zealand's wind, major tidal and other water flows, small-scale hydro and biomass may well change
- incentivising research on how to adapt overseas solutions to New Zealand conditions, thereby maximising the potential for demand management or reducing the C intensity of our fuel mix
- clarifying market rules regarding urban design, preferred transport corridors and public transport
- clarifying market rules regarding real time costs for road transport

Critical success factors

In order to make progress on the high priority items, government should redefine the roles of relevant agencies (especially the EC and EECA), empower them, and demand high levels of performance from them.

There appears to have been a low success rate for some initiatives set up by some agencies. For example, few private individuals took advantage of the fridge scheme offered by the EC and the EECA finance assistance programme for solar water heating systems has not been as popular as expected. This is largely due to a lack of public awareness about the schemes on offer, the lack of incentives

for incumbent lines companies to implement the projects, and a lack of targeted education to private individuals.

We consider that EECA needs to achieve a high degree of focus, with highly targeted and well-planned programmes, including utilisation of a variety of media in respect of compulsory information publication. Once an appropriate regulatory framework is in place, it should roll out in parallel to education via EECA. If a programme of minimum standards is to be introduced, EECA is the logical agency to undertake development work, and to assist regulators in other government agencies with implementation. In our view, it should be aligned more to the Ministry of Economic Development than the Ministry for the Environment if it is to succeed in an expanded role. The effectiveness of energy efficiency and conservation measures relies more on exposure to market prices, an economic matter, than on the attitudes of New Zealanders to environmental matters.

Table 1: High priority actions

	Clarification of market rules	Education	Compulsory information	Minimum standards	Pricing policies	
Transport				Increase onshore oil storage		*security*
	Evaluate benefits of real cost, time of day tolls	Promote clean diesel vehicles	Publish energy life cycle costs of vehicles	Restrict low-efficiency vehicle imports	Review level of public transport subsidy	*sustainability*
Heat	Encourage gas exploration					*security*
		Promote industrial case studies	Introduce star rating of buildings	Introduce minimum energy standards (into the Building Code)	Incentivise research	*sustainability*
Electricity	Improve function of EC				Suppress demand by subsiding efficient products	*security*
		Improve consumer education	Publish energy costs of buildings and appliances	Introduce Minimum Energy Performance Standards	Incentivise research	*sustainability*
Critical success factors	Performance of EC	Quality of delivery by EECA	Government willingness to commit to strong programmes	Willingness of government to regulate		

The Department of Building and Housing and the Ministry of Economic Development should oversee the implementation of minimum standards for buildings. We are concerned that the focus of the former is very much on shorter-term issues like weathertightness and that energy may not get the attention that is urgently required.

In respect of clarifying market rules, there are concerns that these issues are overly politicised and subject to inter-party political agreements. Energy supply is a long-term issue, with paybacks on investment occurring over a number of years. The private sector will not make long-term decisions if they do not have clarity or confidence in the regulators. Bipartisan approaches and interdepartmental co-operation is needed, especially between transport and economic development agencies.

The following issues need to be addressed to ensure the EC's success:

- Increased certainty regarding transmission capacity needs to be provided through the development of an NPS on transmission so that, when local decisions are made under the Resource Management Act, national transmission needs are considered. NESs may also be required to ensure that local decision-makers do not set requirements for transmission passage through their region which are too stringent.
- The relationship between generation placement and demand placement, and the responsibility for generation required to overcome line losses needs further consideration. Further, the rules must support generation being located close to demand to minimise losses and overcome supply security bottlenecks. The EC is as yet unproven in terms of effectiveness in these respects.
- The government or the EC needs to provide clarity in the market-place on follow-through costs, such as transmission system charges. This would minimise the perceived risks of bringing gas into production, thereby adequately incentivising gas exploration.
- Research into innovative technologies which mitigate the costs of meeting peak demand or increase use of intermittent generation is required, for example using pumped storage or off-peak power from other sources.

Pricing policies, whether subsidies or grants, are also an area where there are risks. Bipartisan agreement is urgently required on long-term approaches to public transport subsidies, and the extent of any subsidy for the rail network. Research funding agencies need clear rules on expectations for the types of research outputs required to inform energy-related decisions.

CONCLUSIONS

In order to ensure that New Zealand has both a secure and an increasingly sustainable energy supply, government should demonstrate leadership by developing a National Energy Strategy for private and public sector agencies to implement, based on a risk management approach. Within this strategy, ongoing cost: benefit and risk:benefit analysis will allow the most useful actions – drawn from the possibilities of clarifying market rules, education, compulsory information, minimum standards and pricing policies – to be identified and then deployed. Thus, rather than decide which technologies should be deployed, government should concentrate on public policy actions which provide certainty for those making energy-related decisions. The greater the certainty, the higher the likelihood of good long-term decision-making to facilitate new investment in sustainable energy production and end-use systems.

Some high priority issues and possible actions, in particular improvements to institutional structures and the need for highly focused programmes, are identified as areas for immediate consideration. Provided there is net economic benefit to the nation and the measures taken are targeted to minimise life cycle costs to consumers, the introduction of compulsory requirements and especially minimum standards can be justified. On a longer-term basis, by ensuring that relevant energy research is supported or incentivised, economically viable improvements to both the security and sustainability of New Zealand's energy system will result without undue delay.