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ENERGY RESEARCH WORKSHOP

Organised by: The Energy Federation of New Zealand

Venue: Foundation for Research Science and Technology
6th Floor, Clear House, Murphy Street, Wellington
Date: December 8th 2000

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WELCOME BY TREVOR BURLING (MTA) CHAIRMAN

Our intended outcome is to take from this workshop some key initiatives that will become the basis of a strategy for collaborative and practical projects that will be of benefit to the Foundation's clients – the wider energy industry. Our main resource in the process is the input of the industry experts assembled here today and we have structured the day so as to allow for the interaction and participation of everybody.

Ian Wells of the Foundation for Research Science and Technology will lead us into the day's activities by illustrating the four major strategic objectives

- Energy Production and Supply
- Distribution and Utilisation
- Environmental Impacts
- Risk Management

of the Energy Research Portfolio.

We will then hear 10-minute presentations from twelve industry and research provider representatives giving their views of the energy future and some of the research needed to bring about that future. After that we will separate into four discussion groups to identify the strategic issues contained in the morning's presentations, which are common to the strategic objectives. A spokesperson for each group will present the findings of each group.

Current Foundation Policy On Energy Research

Ian Wells
Foundation for Research, Science and Technology

The aim of this talk is to highlight the current policy for research investment, and to introduce and explain the four major Strategic Directions of the Energy Strategic Portfolio Portfolio Outline. However it is important to understand the context in which these directions sit. And so I will start off by talking about the Foundation's investment framework and portfolio development.

Policy Documents

There are a number of documents that guide the Foundation's investments. These are the:

- *Foundation Act,*
- *Blueprint for Change,*
- *Statement of Intent,*
- *Strategic Portfolio Outlines (SPOs)).*

The Government's *Strategy for Innovation* sits within this wider framework and explicitly targets value-added, internationally competitive exports and emphasises certain modes of delivery, such as private public partnerships. Part of this also emphasises the move to managing research portfolios as opposed to individual research programmes or R&D projects. The Foundation's purchase agreement also requires the purchase of "balanced portfolios". Collectively these documents guide the Foundation's behaviour and investments.

New Directions

We have seven key objectives as we consolidate our new role as an investor, facilitator, catalyst and integrator. Over the next year we will:

1. Develop our innovation strategy that enables our investments to move towards higher value areas, in particular emerging future sectors;
2. Build partnerships to leverage our investment, including working with government to develop new investment methods;
3. Develop and communicate a new investment process to improve our responsiveness to emerging opportunities;
4. Base our investments on research strategies developed with stakeholders rather than on negotiations with individual research providers;
5. Upgrade our evaluation capabilities to support our investment decisions;
6. Invest in building and better coordinating research that underpins social policy development;
7. Integrate economic, environmental and social research investments to create wealth and help 'close the gaps'.

We will consult with stakeholders as we build our new innovation strategy — covering both investment and divestment.

What is a Portfolio?
Our investment decisions will be made via strategic portfolio outlines. But they will be managed as portfolios of research.

Portfolios can be defined as *a coherent suite of research programmes and / or R&D projects contributing to an outcome or set of related outcomes.*

It should also be noted that the term "portfolios" has different meanings to different groups. To MoRST portfolios are related to target outcomes, while providers often relate them to programmes contracted during the transition year.

Portfolios must be of a size and coherence that is:

- Amenable to analysis.
- Allows relevant investment approaches to be managed with stakeholders.

For the Foundation's purposes portfolios are aligned to the Strategic Objectives in an SPO. SPOs are research investment strategies that are designed to deliver outcomes. SPOs are based on stakeholder inputs, are far sighted and aim to encourage changes in research, science and technology (RS&T) investment behaviour (change market structure, encourage the development of skills for successful innovation) rather than set specific goals. SPOs are "living documents" and will change over time. They are currently the focal point for interaction between the Foundation, end users and the providers of research.

It is important to note that most portfolios cut across a number of SPOs.

A criticism of SPOs is that they do not provide measurable goals and are too large to negotiate in detail. While they set broad investment directions they need to be further segmented into portfolios. The development of portfolios will allow specific milestones and /or behaviours to be set.

Prioritisation of portfolios will be required with the need to use negotiations effectively. Negotiations covering disinvestment to the identification of priority areas and long term needs allows a strategic view of the investment to be taken.

The Energy SPO
The Foundation's Energy SPO comprises four strategic directions for research that are based on the energy value chain:

- **Energy Production and Supply,**
- **Distribution and Utilisation,**
- **Environmental Impacts**
- **Risk Management**

Research targeting each of these should be consistent with the relevant Target Outcomes, the Strategic Directions, the Strategic Objectives and the priorities in the SPO. In addition, a culture of innovation is also recognised as a long-term goal.

Priority for investment of Public Good Science and Technology funds in this sector will be determined at a later stage, however, it would be helpful for sector representatives to identify any obvious (potential) science and technology "push" areas and likely portfolios there might be within the energy sector — this relates to a strategic vision.

Prioritisation of Strategic Objectives

Since the mid 90's energy research funded from FRST has undergone a shift in focus from fossil fuels and traditional renewables to non-traditional renewables and energy efficiency. The Foundation will continue to place greater emphasis on research that will contribute to clean energy technologies.

Priority will be given to research that is oriented toward the New Zealand situation and is unlikely to be done elsewhere. In addition there will be increased emphasis on incorporating the human dimension into this type of research.

In developing portfolios the Foundation will place particular emphasis on sustainability and ameliorating environmental impacts as the immediate priority directions because FRST investment can contribute directly to achieving these.

It is expected that research within portfolios will provide an understanding of the impact that various drivers will have on the sector. These drivers include, but are not restricted to -

- Globalisation and its impact on changing market demands;
- Increasing eco-awareness and consequent changes in consumer behaviours;
- Technological advancements;
- The impact of Government policy and regulatory regimes (both current and proposed) on the sector — including environmental sustainability-related issues and regulations.

Energy Production and Supply

The Foundation will place particular emphasis on sustainability and ameliorating environmental impacts as the immediate priority directions because FRST investment can contribute directly to achieving these. Ensuring the environmental sustainability of the sector's activities will include, but is not necessarily restricted to:

- use of renewable energy systems,
- reducing embodied energy costs and
- mitigating any negative impacts of the sector's activities on society and the environment.

In Future, attention will be focussed on integrating new and efficient energy conversion technologies, appropriate to the New Zealand context, which extend and reinforce the conventional infrastructure.

The emphasis will also be on research where New Zealand has a unique or specific role to play in GHG emissions reduction in relation to energy. Underpinning research in this area is necessary to support New Zealand's international obligations to treaties, conventions and other inter-governmental agreements. Key research areas will include:

- Understanding the key factors that control or reduce greenhouse gas emissions from conventional energy sources
- New energy technologies that reduce or eliminate GHG emissions
- Clean energy technologies

An emphasis within the energy production and supply area will be placed on frequent and effective communication with the physical technologies-based research programmes and the stakeholders (refer to cross portfolio issues). This will be necessary to ensure future technological developments are informed and responsive to emerging demands

Distribution Systems & Networks
The energy distribution networks are complex and encompass the electricity grid, oil and gas pipelines, and the various other methods for transportation of either energy or energy carriers. An energy carrier is defined here as something that has an intrinsic energy potential; e.g. liquid and solid fuels. Key research areas in this part of the chain include:

- Research into network economics
- Storage of energy at the local level
- Efficient energy transmission systems e.g. superconductors and HTS wire.

Energy Utilisation
Utilisation refers to what is done with the energy once it has been extracted from the resource. It is therefore at this stage in the chain that the greatest links and flow-on through to other SPOs and sectors will occur.

Energy research at this end of the chain will concentrate on energy technologies not specifically covered in other SPO's. The guiding theme will be efficiency, conservation and reduction or removing the need for energy. Greater emphasis for future needs will be placed on the demand-side of energy requirements and distributed generation

Risk Management
Risk management is integral to all parts of the value chain. It has been separated out though to highlight its importance for the ongoing operation, function and economic returns of the sector.

Research into risk management will be diverse and may include:
- Reduced demand for energy via new and improved end-use technologies.
- Security of supply through improved integration of end-use with supply systems.
- Economic analysis of market structure development and legislative changes.

Key issues for the sector to consider:
1. Does the vision and strategic direction as stated in the relevant sector strategy still hold true? What changes are required?

2. Is there a need for migration of market competitiveness based on price toward competitiveness based on quality, functionality, performance etc.

3. What are the important areas of research (not specific programmes) needed in your area of the energy sector? An example may be 'improved switching technologies'.

4. What key objectives are needed to achieve the strategic directions?

5. What are the priority areas/objectives?

6. How does the sector obtain and use the outputs from research?

SUMMARY OF PRESENTATIONS

Presentation 1 : New Zealand Energy Scene and Research Priorities.

Ram SriRamamaratnam
Ministry of Economic Development.

Ministry of Economic Development projections show:

- an overall 1.1% annual growth rate for total energy demand through to 2020.
- greatest demand increase in the area of transport (2% annual growth rate)
- a large increase in electricity demand (1.8% annual growth rate).

Issues and Research priorities to arise from these projections include:

- greater need for information on new and emerging technologies (including those for electricity generation).
- research into alternative transport fuels, technologies and transportation strategies.
- research into energy efficiency gains and energy efficient technologies.

It was noted that the models used to generate the projections would benefit from:

- improved quality and degree of detail on end-use requirements, sub-sectors and modes of transport.
- improved information on future costs and quantities of renewable fuel based generation.
- improved understanding of the current high level of uncertainty of non-CO_2 greenhouse gas emissions.

Presentation 2 : Research Issues – Oil and Gas/Geothermal

Richard Sykes
Geological and Nuclear Sciences.

For oil and gas it was noted that:

- between them they account for 62% of New Zealand's Total Primary Energy Supply (each contributing approximately 30%).
- New Zealand is declining in self-sufficiency in oil..

Desired Outcomes for Oil and Gas therefore are:

- Continued self-sufficiency in gas.
- Self-sufficiency in liquid fuels (becoming a net exporter by 2010).
- Oil/gas production from four or more basins.

Research priorities and Issues for Oil and Gas to help bring about these Outcomes therefore are:

- To understand new basins and shed new light on old ones.
- To understand the resource potential of New Zealand's Economic Exclusion Zone.
- To delineate and model petroleum systems.

For geothermal it was noted that it:

- Accounts for a steady 14% primary energy supply.
- New Zealand contains the single largest direct user of geothermal energy in the world.
- The resource is there to provide significantly greater quantities of New Zealand's energy in future.

Desired Outcomes for geothermal therefore were:

- Increased use of geothermal (electricity generation and direct use).
- Increased overseas earnings from export of geothermal expertise.

Research Priorities and Issues for Oil and Gas to help bring about these Outcomes therefore are:

- Improved understanding of geothermal systems including the sub-surface impacts of developmet.
- Improved methodologies for enhanced and extended use of existing geothermal resources.
- Development of technologies for direct use of geothermal heat and fluids.

Presentation 3 : The Energy Challenge
Coal/Biomass/Climate Change

Rob Whitney
CRL Energy Limited

It was noted that

- the energy of the future (in New Zealand and internationally) must be produced in a sustainable fashion.
- sustainable energy means not depriving future generations of the energy resources they will need while managing environmental impacts and maintaining economic development.
- climate change will be the main research driver. Localised environmental issues such as trace element emissions will also be a research driver. Resource depletion will not be.

The most desirable research outcome is that coal/biomass fired energy plants of the future will be "zero emission plants" characterised by;

- Increased energy efficiencies (to reduce CO_2 emissions)
- Increased move toward integrated, decentralised energy systems
- Fuel flexibility (coal, biomass, fuel rich wastes)
- Emphasis on using the hydrogen component as fuel (the hydrogen economy)
- Emphasis on capturing and sequestering of the carbon component (as CO_2).
- Emphasis on leading edge clean technologies (combustion, gasification and fuel cells).
- Use of hydrogen burning gas turbines.

A range of research issues required to achieve the outcome of the "zero emission" coal and biomass fired plant were identified. These included:

- Identification of best gasification conversion technologies and improved catalysts.
- Variable fuel plant capability.
- Advanced computer simulation technologies for process testing
- High temperature gas separation (CO_2 capture and separation)
- Development of appropriate CO_2 capture and sequestration options for New Zealand.

Further information available through www.worldenergy.org www.epri.com www.fe.doe.gov/coal_power/vision21/index.shtml

Presentation 4 : New Zealand's Energy Future - Energy Management Research

Gerry Carrington
University of Otago

It was noted that:

- A key driver for energy research in New Zealand is the greenhouse gas issue
- A mix of technological and political solutions are available to control greenhouse gas emissions and help meet international commitments in regard to them.
  - Improved energy management is a key element of New Zealand's response to GHGs.
  - Effective energy management includes energy conservation, but goes further. The focus is on the service end of the energy value chain, in order to provide the service required in the most effective way.
  - Energy management deals with the entire end-use system, including better integration of technology, application and end-user practice.

A major desirable research outcome is:

- An environment for growth in the energy management industry providing
  - Cheaper delivery of energy-mediated services
  - Reduced environmental impacts
  - Contributions toward meeting international greenhouse obligations
  - Contributions toward a sustainable energy future
  - A sustainable research environment/pool of expertise.

Research priorities for reaching this outcome include:

- Overcoming barriers to the growth of the energy management industry through
  - Reviewing barriers to technology uptake & establishing better mechanisms to overcome them
  - Developing skills and technology in energy management which match New Zealand's needs
  - Improving rate of uptake of effective energy end-use technologies.
  - Focused research programs with active industry linkages
  - Improved practice for managing research through to commercialisation.
- More diverse and innovative commercialisation models
- Research-based education programmes which also promote science and technology commercialisation.

Presentation 5 : Energy Technology – A Transport Perspective by the MTA

Nick Hill
Motor Trade Association

It was noted that:

- Most of the innovative changes will occur, at least initially, in the high volume, light vehicle area.

- Advances will occur predominantly in the areas of diesel, LPG, hybrid and fuel cell powered vehicles.

- In the long term the fossil fuels will be overtaken by the renewable fuel resources.

- Economic success depends on high volumes of vehicles and there will always be a training and investment requirement to promote and encourage the necessary degree of change.

A desired outcome is to have available a range of low emission, economically sustainable, transport vehicle options.

To realise this outcome, research should be focussed to help bring about:

- Technical advances/improved efficiencies in diesel technology for light vehicles (getting around the smelly, noisy image)

- Technological improvements/ exploring all options for hybrid vehicles

- Engines dedicated to, and able to better utilise LPG.

- Hybrid technology development including the necessary convergence of skills to cater for this technology.

- Development of fuel cell technologies.

Presentation 6 : Energy Efficiency Strategy

Robert Tromop
Energy Efficiency Conservation Authority

It was noted that:

- The Energy Efficiency and Conservation Act 2000 came into force July 1 2000.
- The purpose of the Act is to promote energy efficiency, energy conservation and use of renewable energy sources in New Zealand.
- The National Energy Efficiency and Conservation Strategy is required by the Act, which defines the development and key components of the strategy.
- The Strategy is being developed by a wide ranging process of seeking input and then comments through submissions. A draft strategy will be released by the Minister of Energy by April 1 2001 for public submission. A finalised strategy will be released on October 1 2001.

Some major issues facing strategy development include:

- How to address the need for energy services rather than energy supply.
- The need for better data and analysis of current and future energy use and trends.
- How to make energy efficiency a key driver of the decision making process?
- How to best understand and grapple with issues relating to transport (a large and fast growing energy sector).
- Updates on the strategy at EECA's website www.eeca.govt.nz or email strategy@eeca.govt.nz.

Presentation 7 : Energy Supply – Research Needs

Grant Smith
Meridian Energy

It was noted that current trends in electricity supply are towards

- smaller scale, higher efficiency plants
- operation under a far more complex business environment

and away from the current single product/ simple service model toward a multi-utility model.

It was also noted that

- Presently there are approximately 200 distributed small scale sites around New Zealand. Prediction is that through the next decade this could reach 10,000.
- A significant increase in electricity used for E-commerce (demanding high quality electricity available with close to 100% reliability – much higher than the 99.9% tolerated by other technologies).

Research should address issues such as:

- Identifying and constructing small scale packaged networks/systems.
- The right mix of technologies with the fuel cell, photovoltaics, microturbine options likely to have increased roles in filling the small scale end of the spectrum and the possibility of economic small scale coal/biomass systems being developed.
- Developing smart systems for getting the technologies into the system for lowest cost, getting best value from a highly distributed generation system and integrating supply and demand requirements.
- The need for international technology alliances was also stressed.

Presentation 8 : Energy Transmission/Distribution

Bruce Smith
TransPower

It was noted that:

- No "official future" has been defined for energy transmission and distribution systems but environmental and economic factors will be the prime drivers guiding their emergence.

- The hydrogen economy will play a significant role in the long term. The initial development and demonstration of hydrogen based technologies (e.g. fuel cells) will be in the transport sector but will have a major flow-on into the transmission/distribution arena. It is unclear whether this will lead to an increase or decrease in demand for grid services. The effect on grid services will depend to a large extent on the development of natural gas resources in the long term.

- There will still be a transmission and distribution system but it will be considerably more dynamic than the present one. Is it possible to have a highly distributed system without any large central/stable system to support it?

- Rapid demand –side response, a significant amount of distributed generation, and improved energy storage will be features of the new system.

Research Issues:

- Ability to control a very dynamic power distribution system – rapid response and smart systems required.

- Innovative transmission solutions – likely convergence of technologies to produce the most effective systems.

- Ability to model new technologies and systems.

- Development of improved energy storage systems.

Presentation 9 : New Energy Technologies

Kevin Duckworth
Industrial Research Limited

It was noted that

Three factors, not formerly present at any one time, are the main drivers for change.

- increased energy demand (2 to 3% per annum globally, 1 to 1.5% in New Zealand)
- global warming, and
- emerging energy technologies (including wind, biomass, microturbines, fuel cells).

The results are already being seen in the trend, particularly well-established in the US, toward smaller power production units matching in part the parallel trends towards lower unit power consumption as required by communications and IT devices. Low pollution technologies suited to small scale production such as fuel cells, microturbines and photovoltaics will become increasingly important components of the energy future.

New Zealand has yet to catch up with this potential economic boom sector. It needs to plan for these inevitable changes toward small scale distributed sustainable energy systems. It also needs to plan for changes toward cleaner energy carriers. Of the substitution or replacement options for oil (methanol, ethanol, LPG, natural gas and hydrogen) the only carbon free prospect is hydrogen. (Plan for small scale and the hydrogen economy).

Technological advances will be determined by what comes out of transport developments. If the technology works in cars it will work for small stationary units. Hydrogen refuelling stations for fuel cell driven cars will be one of the first tangible signs of the change toward a pollution free energy carrier.

Research issues related to small scale distributed sustainable energy systems and cleaner energy carriers include:

- How best to integrate / connect up a potentially vast number of sites (both within rural and urban settings).
- Improved fuel cell technologies
- Improvements in hydrogen storage – integration of existing energy resources into a low pollution energy carrier infrastructure.
- Improved use of existing electricity network for integrating distributed energy resource and demand.

Presentation 10 : Issues for Wind Energy in New Zealand

Simon Faulkner
PB Power

It was noted that:

- Wind Power is generally the most economic renewable energy resource. It is abundant and sustainable.

It is also faced with many short and long term barriers to its uptake. These include

- Primarily the price gap between cost of energy and the average pool price and price of new thermal generation (gas)
- Pricing uncertainties associated with a deregulated electricity market
- Uncertainties in how the RMA legislation will be applied when considering new wind based proposals.
- Uncertainties in project evaluation

The most desirable outcome for the wind power option is the removal of the barriers to uptake.
This would be facilitated by

- Mandatory target, other such market adjustment (CO_2 tax, tradable certificates, green pricing, change in gas contracts)
- Developing robust guidelines to enable Councils to apply the RMA framework in a consistent manner when considering new wind power proposals.
- Fostering greater appreciation of the environmental benefits offered by wind power – particularly in helping New Zealand meet its greenhouse gas targets.
- Reducing uncertainties in project evaluation.
- Re-think of the electicity industry to meet environmental needs and changes in technology (distributed generation)

Other desirable outcomes include:

- Determining the most efficient means of meeting international emissions commitments.
- Manufacture of wind turbines in New Zealand.
- Export earnings associated with world-class expertise in wind-based energy production.

Presentation 11 : Renewable Energy Strategy

Fiona Weightman
Energy Efficiency and Conservation Authority

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It was noted that:

- New Zealand has significant levels of natural renewable resources particularly in wind and biomass.
- These are, generally speaking, higher cost energy options than the more conventional sources but the potential for CO_2 reductions and attendant benefits are not costed in.

Desirable outcome from research into these and other renewables (including solar) is their optimal inclusion into an energy future commensurate with government objectives and outcomes of:

- Efficient, fair, reliable and sustainable supply of energy services.
- Lowest possible cost energy, affordable to all consumers.
- Prices that reflect the full costs of supply including environmental costs.
- Continued improvements in energy efficiency with a progressive transition to renewable sources of energy.

Research issues identified to help realise these outcomes for the bioenergy option include:

- Better assessment of resources and costs of delivery.
- Improvements in biofuel consistency.
- Identifying best plant and equipment to suit New Zealand conditions.

Research issues identified to reach these outcomes for the wind energy option include:

- Understanding impacts of increased wind energy generation on the electricity system.
- Increased understanding of public attitudes toward wind energy.
- Integration of embedded customer owned wind energy generation with the surrounding local network.

Research issues identified to reach these outcomes for the solar energy option include:

- Demonstrating commercial viability of new solar technologies in New Zealand conditions.
- Integration of solar thermal and solar PV technologies
- Development of robust methodologies for determining improvements in building energy performance associated with passive solar design technologies and improved transfer of knowledge regarding advanced building energy technologies.

Presentation 12 : The Personal Power Station

David Moriarty
Whispertech

It was noted that major developments are happening in the international energy scene. So much so that energy may be likened to telecommunications in the early 1980s – on the verge of major and fundamental change. The factors shaping the global energy future have implications for New Zealand. Factors include:

- Increasing demand for electricity.
- Moves away from centralised generation toward smaller scale distributed generation.
- Increased demand for mini- and micro scale combined heat and power co-generation systems. By "micro-scale" is meant individual households (1kW electricity/5kW heat).
- Rapidly increasing demand for energy to power electronic equipment. Internet power usage was 8 to 13% of the electricity inventory in the US in 1999 and predicted to account for 50% by 2010.
- Trend toward deregulation of the energy industry leading to increased competition for market share, growing customer sophistication, lower margins and a more favourable circumstance for innovation and technology development.
- Changing lifestyles (increased leisure and affluence) leading to changes in where energy is needed. Wilderness and mobile applications increasing.

These trends bring new challenges. For example:

- Greatly increased energy reliability demands. Internet Power sought by E commerce requires better than 99.9999% reliability (compared with the 99.9% for which the aging grid system was structured).
- Uncertainties in market economics.
- Development of suitable technologies for micro combined heat and power individual residential systems.
- How to interface the new technologies with the existing grid system – smart control systems.

SUMMARY OF FINDINGS OF DISCUSSION GROUPS

Group One:
Tony Clemens (Facilitator)
Ram SriRamamaratnam (Presenter)
Simon Faulkner
Nigel Isaacs
Michael Patrick
Bruce Smith

The approach taken by this group was to identify the most commonly raised issues raised during the morning session and attempt to align these to one (or more) of the four strategic objectives of the Energy SPO.

Many of the issues identified related to both the **Energy Production and Supply** and the **Distribution and Utilisation** strategic objectives. These included:

- Greatly improved ability to match energy supply and demand. This encompassed both the ability to do so short term and long term. Closely allied to this requirement is the ability to integrate small systems into an existing grid system. Research needed into identifying the dynamic, smart systems best suited to meet this future requirement.
- Small systems could also include mobile systems (e.g. cars) which were seen as becoming an increasingly important part of the smart electricity supply future.
- Ability to identify, evaluate and adapt technologies (conversion, utilisation, distribution) for New Zealand conditions.
- Improved computing ability to model complete systems.

It was recognised that diversity of supply options is a major factor in **Risk Management** and in order to achieve that diversity it is essential to remove the barriers toward uptake of new technologies. Removal of barriers was seen as a particular issue for renewables although it was recognised that new and emerging technologies apply to all resources. It was suggested that the barriers are well enough known – the mechanisms for their removal are unclear. It was also recognised that the increasing move toward computerised global economic transactions is almost certain to gain momentum and the demand for 99.9999% or better quality of supply will become a reality in this country.

It was recognised that a major **Environmental** driver is the climate change/greenhouse gas issue and that research geared toward enabling the decarbonisation of energy production is a priority. Alternative systems based on hydrogen as the energy carrier were seen as a likely replacement.

Group Two:
Ian Wells (Facilitator)
Michael Wright (Presenter)
Fred Davey
David Moriarty
Robert Tromop
Rob Whitney

This group began by considering some of the common themes from the morning presentations and aligning them with the strategic objectives of the Energy SPO. But they quickly identified an aspect (under **Energy Production and Supply**) that had been raised by many but not specifically commented upon during the morning session – the need to better understand and model the demand side of the energy equation. It was noted that this side of the Energy spectrum was not represented among the participants of the workshop.

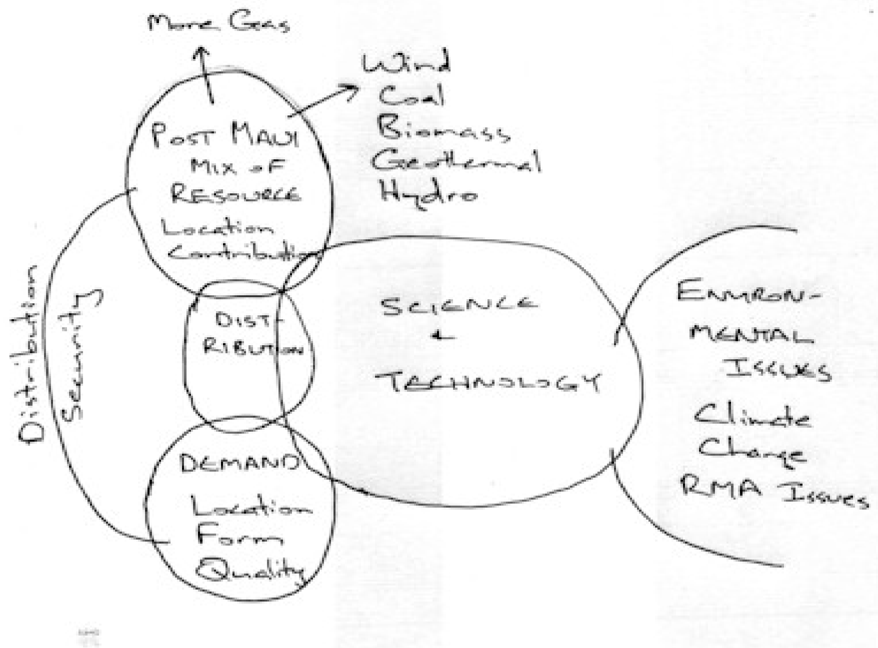
From here the discussion concentrated on identifying how groups of issues could be fitted together to form a coherent Energy Research Future.

The group identified three research portfolios that between them would encompass future Energy research. These were the Energy Demand Side portfolio, the Energy Sources Portfolio and acting as a link between these two, the Technology Direction (or Emergent Technologies) portfolio.

In its simplest terms the energy research of the future will need to address one (or more) of the following – where will the energy be required, when will it be required and how high a quality must it be, where are the energy sources that could supply that energy, how best to securely distribute that energy to the places where and when it is needed (suggestion here that energy delivery may need to be as targeted as, for example, an Email message) and the technologies needed to produce, deliver and utilise that energy.

It was agreed that the process should start from the demand side and, having clarified those issues work back through the distribution and delivery systems and then to the sources from where the energy was produced. In an ideal world the demand side answers would be well identified in advance although it was recognised that in reality all three aspects move along together and may even influence each other along the way.

Overlapping with the Technology Portfolio, were parts of a large Environmental Issues Portfolio. Those of most relevance to Energy were identified as issues relating to climate change and the Resource Management Act and its impacts on future energy options. The group produced a sketch of how they saw all these components merging together to form a coherent energy research package. It is reproduced below.



REPRODUCTION OF SKETCH PRODUCED BY DISCUSSION GROUP 2.

Group Three:
Richard Hamilton (Facilitator)
Barry Blackett (Presenter)
Kevin Duckworth
Jenny Dickinson
Matthew Everett
Nick Hill

This group identified the following themes among the presentations:

- The trend away from fossil fuels toward renewable energy sources.
- The trend away from larger energy sources toward small scale, even microscale, technology.
- The focus on sustainable energy.
- Demand for and pressure on increased reliability of supply.

Research is needed in order to provide better big-picture information and to remove the barriers preventing uptake of new technologies.

Strategic Issues:
It was suggested that the best way to identify the important issues was to identify the demand side (energy utilisation) requirements and work backwards through distribution to the various options for energy supply. Consideration of environmental impacts and risks could then be

used to help determine the selection of alternatives. It was noted that this process would benefit from more participation of energy end-users. It was also noted that there was a need for government to provide more strategic direction. In the area of renewables this could be provided, for example, by cost minimisation or incentives.

Adding Value:
Generally speaking, New Zealand should use global knowhow for core technologies and R & D effort is better directed at adapting these to New Zealand conditions. There is limited scope in New Zealand for development of sophisticated energy-using technologies – "too small to dance with the elephants" – although some opportunities may exist in the domestic sector. Niche opportunities for New Zealand based manufacture also exist and those likely to bring an economic return should be supported. Knowledge development and overseas sale of New Zealand developed expertise were seen as likely spin-off opportunities.

Group Four:
Trevor Burling (Facilitator)
Peter Calderwood (Presenter)
Gerry Carrington
Justin Ford-Robertson
Paul Hodgson
Richard Sykes

Major issues related to energy production and supply revolved around gas supply in the Post Maui era for 2010 and beyond. This needed to be balanced by looking beyond gas to other sources of energy supply. The need to diversify energy sources was crucial to risk management and was also seen as a means to reduce transmission costs. A significant risk was identified in a lack of skills required to manage energy demand.

It was noted that although the energy mix may change rapidly and the trend toward small scale distributed energy supply would continue gaining momentum, it may take 20 to 50 years to turn over the energy infrastructure system. In the interim there would be significant issues relating to how to make most efficient use of the energy given that an aging grid distribution system is likely to retain a place within the energy scene for a considerable time to come.

CO_2 related issues and developments arising from the Kyoto protocol were seen as of critical importance. The impact and interpretation of the RMA and the actions of environmental authorities will play a significant role in the energy future and it is crucial that they are well informed on all relevant issues. Hydrogen based energy was seen as a possible practical means for reducing greenhouse emissions.

Access to international connections were seen as important to advancing research related to any of the identified issues.

Other Issues:
Need for greater representation from Energy Users and the demand side of the Energy equation.

The issue of the role of "public good" investment in research for underpinning good policy decision making was raised and links between work presently funded in this area by FRST and similar work funded by the Economic Development and Environment Ministries.

Little explicit emphasis given to the creation of wealth for New Zealand aspect of Energy research.

Summary:
The meeting brought together a diversity of industry players and research providers and a wide range of concepts and ideas were put forward. The meeting identified streams of idea and actions generally supportive of the framework identified by Foresight and encapsulated within the Energy SPO document. Much of the discussion remained at a fairly high level but the meeting did provide some important insights into potential directions and measures for strategy development and shifts to the current investment profile.

Research targeted toward issues such as:

- Improved understanding of energy demand

- Developing distributed generation systems to best respond to energy demand. (dynamic smart systems).

- Facilitating introduction of new sustainable energy technologies (removal of barriers to their uptake)

- The decarbonisation of energy production and use, for example the use of hydrogen based technologies including fuel cells for vehicle and domestic use and biomass and wind for domestic use.

- Mitigation or elimination of all environmental impacts associated with energy production and use.

The next stage in the process will be the release of draft portfolios for Energy Research. It may be expected that some of the findings of this workshop will be reflected in those documents.

APPENDICES

Following is a summary of a paper regarding the role of BioEnergy in the New Zealand Energy scene. It was not presented at the Workshop but is an invited additional contribution.

ENERGY AND BIOENERGY IN NEW ZEALAND

Justin Ford-Robertson & John Gifford
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BACKGROUND

Energy contributes about 2.7% of the gross domestic product and currently employs about 8,000 people. New Zealand is self sufficient in electricity, gas and coal and was 36% self-sufficient in oil in the year ended March 2000 (Dang, 2000).

The electricity and wider energy markets have undergone substantial change since 1996 as New Zealand has followed an international trend in terms of energy market reform. This process involved corporatisation and the establishment of a wholesale electricity market, which provided transparency of electricity pricing. This market is one of the world's only voluntary, self regulated systems. The market was opened for private investment, the national generator was split into three competing state owned enterprises and a separate transmission company was established.

Principal legislation governing electricity generation and trading includes the Resource Management Act 1991, Commerce Act 1986 and the Electricity Industry Reform Act (EIRA) 1998. However, New Zealand electricity has relatively few legislative and government restrictions compared to other countries.

The market has progressed from a situation where price was being set by a monopoly supplier, to becoming fully competitive. Buying and selling electricity at wholesale prices is via a pool and the physical spot market is supplemented by the trading of a range of forward contracts. Major users buy from the pool for their own consumption, while suppliers buy from the pool for sale to retail customers.

Through all of these changes, the price received by generators for electricity sold on the New Zealand Electricity Market has dropped to a typical range of 2-4c/kWh. Simultaneously, the average retail price for electricity has been held at around 11c/kWh, made possible because rising domestic costs have been offset by falling commercial costs. These costs of electricity have made it difficult for bioenergy systems to compete.

Up until recently, the lines charge pricing regime coupled with restrictions on lines companies to have generation capacity has discouraged embedded generation including renewable energy schemes. Recently proposed regulations, however, indicate that the generating restrictions on line companies will be removed and therefore encourage their investment in distributed systems.

Primary Energy Supply

The total primary energy supply has increased from 1980 to 1999 from 408 to 770 (Petajoules) PJ with quite a marked increase occurring from 1995 to 1996 when it grew by over 4% or 32PJ. The current total primary energy supply shares by fuel type for the year ending December 1999 were oil 251PJ (32%); gas 223PJ (29%); geothermal 105PJ (14%); hydro 84PJ (11%); coal 56PJ (7%) and other renewables 51PJ (7%). In total fossil fuels contributed 530PJ (69%) and renewables 240PJ or (31%).

Energy Demand

The use of energy within New Zealand increased by 41% between 1978 (296PJ) and 1998 (424PJ). By 1999 consumer energy had increased to 438PJ. The increase from the late 1970s was largely due to the development and expansion of a number of energy-intensive industries such as aluminum smelting and petrol-chemical industries. The population over the same period increased by around 20%. Figures 1 & 2 show the total consumer energy by fuel and sector respectively.

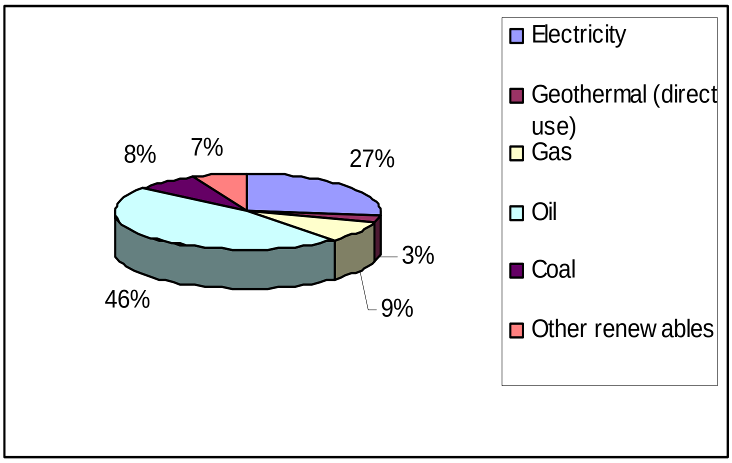

Figure 1. Total consumer energy by fuel type

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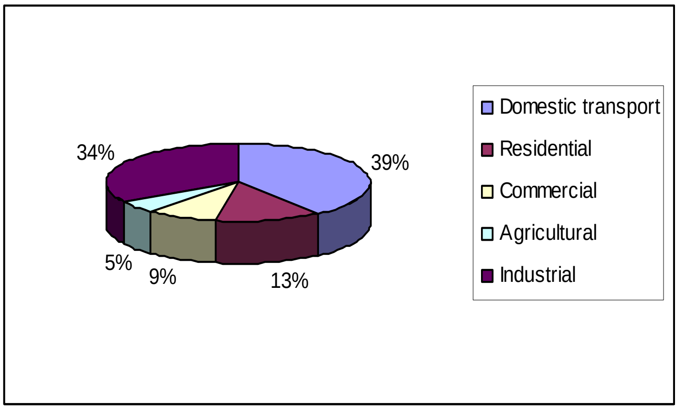

Figure 2. Total consumer energy by sector

The major energy uses in New Zealand are domestic transport and industrial uses representing approximately 39 and 34% respectively.

New Zealand has 11 companies generating electricity and four of these produce around 80% of the total electricity supply. Co-generators produced about 8% with the remaining 13%

coming from independent generating companies. Of the 135PJ of electricity generated for the year to the end of March 2000, 84PJ (62%) were from hydro, 34PJ (25%) from gas and 9PJ (6.3%) from geothermal.

Renewable energy and bioenergy

In the 1999 year around 25% of New Zealand's consumer energy was from renewable sources. In primary energy terms hydro accounted for 35%, geothermal for 44% and wind, biomass and wastes make up the balance of 21%. Biomass (mainly as woody biomass) contributes around 35PJ on a primary basis and this provides about 29PJ of consumer energy. Based on estimates of energy consumption within the wood processing industries around 86% (25PJ) was used within this sector. The pulp and paper industry used approximately 21PJ largely for heat, panel and veneer industries used 1 PJ and the sawmilling industry used around 3PJ for timber drying. Electricity generation from co-generation facilities amounted to around 1PJ. Of the energy consumed using biomass, 52% was sourced directly from the use of solid woody biomass fuels derived from wood processing, the remainder was from black liquor in the pulp and paper industry.

New Zealand use of bioenergy is underpinned by a significant forest industry with the current planted area for plantation pine being about 1.7 million (M) ha and an annual harvest of 18 Mm^3 roundwood. The harvest is expected to increase to about $30Mm^3$ by 2010. Most of the harvest was used within the sawmilling and peeler industries, for pulp and paper production and also exported as unprocessed logs. The rapid increase in harvest of production forest will give rise to a large potential forestry derived source of woody biomass.

Detailed information on the installed capacity for biomass energy plant is currently unavailable, however, Hooper *et al*. (2000) indicated that the installed capacity at the larger wood processing sites is around $600MW_{th}$, this does not include the black liquor recovery boilers at Kinleith and Kawerau. There is currently no exclusive electricity generation using wood or forest residues in New Zealand, and no immediate prospect of any such plants being built for economic reasons. In addition, few co-generation projects have been able to be commercially justified. Heat production is now recognised as the primary reason for investment in boiler plant and further co-generation is marginally economic under current conditions.

It is generally recognised that most growth for bioenergy in the foreseeable future will be in the heat market largely within the wood processing sector. Preliminary scenario modeling[1] (based on a business-as-usual scenario taking into account a marked increase in forest harvest) suggests that the amount of consumer energy sourced from wood process residues within the industrial sector (largely wood processing) will change from around 15PJ now to about 23PJ in 2010 and increasing further to 25PJ by 2020. The most significant growth is envisaged being in the lumber drying market where the energy consumption will increase from about 4PJ to 9PJ. There is also a marked increase in the amount of new potential energy that could be produced from an increase in the quantity of wood process residues that would be surplus to the anticipated requirements for the wood processing sector. This potential increase is from 1.4PJ now to almost 5PJ by 2020. The availability of this material provides a significant opportunity for further expansion of bioenergy into alternative industrial sectors other than wood processing.

[1] The preliminary scenario modeling has been undertaken by Forest Research and was based on predicted log harvest data, assumed log end-use, estimated volumes of lumber dried, assumed fuel mixes and information on energy intensities available from EECA. The conclusions from this modeling should be regarded as indicative. To improve the data quality more intensive data collection is required along with detailed analysis.

Conclusions

New Zealand's current TPES is 770PJ and total consumer energy is around 440PJ. The energy industry has undergone substantial restructuring over the last 5 years to give rise to a more flexible and competitive market. This market has not been conducive for the introduction of bioenergy projects for electricity production. Expansion of the use of bioenergy has occurred in the heat market within the wood processing sector.

New Zealand has a substantial forest resource and the harvest from production forests is predicted to increase markedly over the next 5 to 10 years. Commensurate with this harvest will be significant quantities of forestry derived residues. The use of these residues for energy presents an opportunity to expand New Zealand's renewable energy resource. Legislative and environmental developments are likely to reduce the barriers for the rapid uptake of bioenergy into the New Zealand energy market.

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Sector Strategy as Developed by the 1998 Foresight Process

Energy Sector Strategy
VISION FOR 2010

The New Zealand Energy Sector will be thriving, efficient and environmentally responsible. It will provide customers with secure supplies of energy at internationally competitive prices to enhance national economic growth and social wellbeing.

New technologies and growing environmental awareness have created tremendous drivers for change. They have built on the synergies and tensions between:

Driver One: Open competition driving the development and utilisation of a more diverse set of energy resources and supply chains, with continuing downwards pressure on prices and a growing emphasis on value-added services and innovation based on new technologies.

Driver Two: Increasing local and global political and consumer focus on enhanced sustainability, resource efficiency, and environmentally and socially responsible outcomes.

Activities within the energy sector occur within a regime that gives full recognition to the crucial need for sustainable development and the interdependence of social, economic and environmental objectives. Enthusiasm for co-generation systems and integration of energy production with solid and liquid waste management is at an all time high. Individual end users, small and large businesses and even local and regional councils are now making decisions to invest in high efficiency low emissions energy plant and equipment.

Small scale and renewable energy sources have become widely accepted in the community as low impact reinforcements have been embedded within existing networks. They have become very competitive options as alternatives to network expansion and replacement. Distributed resources, which includes energy supply, storage and load shifting at or near point of use, are taking over the power market and complementing the existing infrastructure. Low capital and operating costs have substantially reduced the need for large-scale venture capital and lowered investment risk. Advanced power electronics, power management, and network operations management have enhanced the quality, security and reliability of electricity supply. Demand side management has become a feature of utility asset management using intelligent metering and distributed reconciliation systems. Intermediate energy storage systems are now well enough developed for commercial processes to substantially reduce peak capacity demand.

A healthy conventional energy base of existing large hydro-electricity generating plant, large scale onshore and offshore oil and gas fields, geothermal fields for electricity generation and direct heat supply, gas fired generation and New Zealand sponsored breakthroughs in clean coal technology has underwritten economic growth. The effect of the adoption of small-scale electricity generation, and combined heat and power plant technology located at the point-of-use, has released bulk supply to support growth in energy intensive industries, such as wood processing. Improved knowledge of New Zealand's diverse natural hazards, and the establishment of a nationwide real time monitoring system, has contributed to improved risk management of the energy infrastructure.

Advances in new energy related technologies, engineering, and materials science have provided a platform for innovation and rapid development of New Zealand's niche energy products and services. High temperature superconductivity, small scale fusion systems, fuel cells, bioenergy, wind, solar-thermal and photovoltaic systems have all benefited from local research. Kiwi ingenuity has led to the rapid adaptation of competitive new global technologies in conventional energy to fit specific New Zealand market needs. Improved demand side management in transport has reduced urban congestion and improved access, made driving more efficient and reduced gross transport air emissions.

A sophisticated lighthanded regulatory regime has been formulated to ensure that the appropriate safeguards in social, economic and environmental policies are maintained whilst encouraging optimum use of assets, removal of barriers to entry of existing, and new, energy efficient and economic resources, and increasing security and diversity of energy supply.