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COMMERCIAL AND CONFIDENTIAL

Renewable Energy Survey

Final Report

Mail: Private Bag 4800, University of Canterbury Campus
Street Address: 39 Creyke Road, Ilam
Phone: 03 364 2478 Fax: 03 364 2069 e-mail: cae@cae.canterbury.ac.nz www.caenz.com

Prepared by: Dr Eric Scharpf, Blueskin Services Ltd

Approved by:

RJ (George) Hooper

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Acknowledgements

For Study direction and project evaluation:

Dr Bob Lloyd, Director, Energy Studies, University of Otago

Prof. Gerry Carrington, Head Department of Physics, University of Otago

Scott Caldwell, Projects Co-ordinator, CAE

For evaluation of projects:

Andy Cunningham, Business Cosultant, University of Otago

Dr John Huckerby, Director, Power Projects Ltd

Murray Ellis, Director, Dialogue Consultants Ltd

Kevin Chong, Principal, Nexus Consulting Group

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Centre for Advanced Engineering, University of Canterbury Campus, Private Bag 4800, Christchurch, New Zealand

Phone +64 3 364 2478 Fax +64 3 364 2069 e-mail cae@cae.canterbury.ac.nz www.caenz.com

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Final Report

Prepared for:

New Zealand Trade and Enterprise
PO Box 2878
Wellington

Prepared by:

CAE, Centre for Advanced Engineering
University of Canterbury Campus
Private Bag 4800
Christchurch
NEW ZEALAND

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CONFIDENTIAL INFORMATION

This document contains confidential information provided to NZTE solely for the purpose of evaluating commercial development activity in the renewable energy sector. The information in the document is not intended to be, nor should it be, used otherwise, nor should it be disclosed to other parties.

Additional background information on survey responses can be found in the following confidential supporting documents:

Interim Renewable Energy Survey Long List report
Study Background Notes (non-published supporting document)

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STUDY OVERVIEW

This report contains an assessment of Renewable Energy (RE) projects in NZ noting their commercialisation potential, collaboration opportunities, time to commercialisation and current status.

In undertaking the study, a number of common issues were identified that are important in interpreting the results. Notable amongst these was the fragmentation of the industry and the seemingly low status that investment in this area has within the broader New Zealand technology investment arena. Whilst, both publicly funded research institutions and private commercial organisations are conducting renewable energy development work in NZ, the scale of this activity can best be characterised as emergent.

Projects were found to cover a wide range of renewable energy technologies with most of the traditional RE sectors being represented. In particular projects involving biomass conversion, geothermal, hydro and ocean energy technologies were well represented.

Given the substantial wind resources in NZ it is probably a matter of some concern that only a small number of wind energy development projects (as distinct from wind energy projects using imported technology) were noted to be forthcoming. Similarly, research and development in solid fuel combustion technologies were minimal with regulatory restrictions and uncertainty about the future regulations cited by the respondents as the main reason for the limited commercialisation efforts in this area.

Despite this, our analysis identified several clusters of matching projects suggesting a potential for collaboration; where currently, collaboration doesn't exist. Although competition is useful to weed out non-viable projects, the small size of the RE sector in NZ may indicate an increased need to facilitate collaboration in the short to medium term. The particular clusters identified were:

- commercial biomass gasification for power or heating;
- residential biomass heating;
- small scale hydro; and
- solar-thermal hot water systems.

The original scope proposed to identify all significant active RE projects in New Zealand for initial assessment. However, overall responses to this survey of renewable energy activity were lower than hoped due in part to the reticence within the technical community in NZ to respond to surveys of this type. Limits to budget and work scope also precluded extensive follow up despite the wide initial survey. In particular, many early stage projects, which have not yet moved to the consolidation phases of commercial development, would have almost certainly been omitted. Such omissions would include pure science activity, low profile projects, and some that simply did not make themselves know through the normal channels.

Although every effort was made to ensure that the survey reached is intended audience, there was no way the investigation could compel target technologies to participate in the process by registering formal interest. This remains an issue for New Zealand. However, when discussed with our expert assessment panel, they were of the opinion that no significant projects, with the kind of short-term commercialisation potential targeted by New Zealand Trade & Enterprise (NZTE) were omitted.

As noted in the "*long list*" report previously submitted to NZTE, there was only a moderate level of commercial development in the renewable energy technology sector that is open to the prospect of formal NZ government support. Projects assessed by this study were put forward both by individual developers as well as substantial companies with large staff and financial resources. An overview of these projects suggests that little attention has been given to international market opportunities, with emphasis predominantly at the domestic level.

There was also a very wide range in the quality of the projects in terms of both the likelihood

that they would be successful as well as the potential benefits to NZ should they be successful. A large number of proposals include technology that incorporated substantially imported hardware (or IP) to be adapted for the New Zealand environment. Based on the remit from NZTE, such projects were not thought very useful for future dissemination to overseas markets as the original IP mostly resided outside this country.

BACKGROUND

The assessment was commissioned by New Zealand Trade & Enterprise (NZTE) as an initial scoping study to identify current technology development and commercialisation activities in New Zealand within renewable energy with a focus on activities that might be commercial within two years. The definition of commercial was taken to be projects leading to product or service sales to external customers at an operating profit.

An important aspect of the study included an evaluation of which developments were either near-to-commercial or could quickly become so with collaboration and leverage from other projects. By so doing, it was expected that the survey would provide an initial assessment of where NZ's international competitive advantage might lie in the field of renewable energy technologies. NZTE have indicated that the results would then be used by it and the Foundation for Research Science & Technology (FRST) to explore the potential for possible assistance in the commercialisation process within the sector.

The methodology employed is set out below. In completing this work, the report authors would like to acknowledge the assistance and cooperation of all who responded to the initial survey and participated in the more detailed study assessments. It is hoped that through this participation, the study will help to facilitate a greater degree of cooperation within the wider renewable energy community in NZ.

METHODOLOGY

Study Objectives:

The detailed brief for the assessment can be found in the original *Terms of Reference* as attached in Appendix A, in particular the study sought to:

- Conduct a survey of renewable energy research and development activity in NZ and to document this in a "*long list*" of active projects
- Develop assessment parameters for determining the potential for commercialisation of these active projects along with a corresponding ranking system for the projects on the long list
- Provide a summary of relevant commercial activities in the renewable energy sector
- Note collaboration and leverage opportunities where they were present
- Evaluate the various technology developments in the "*long list*" and provide a report profiling the commercialisation potential of a "*short list*" of the most highly ranked technologies and projects.

Initial Survey

This first stage evaluation incorporated a high-level assessment of the renewable technology development activities in NZ based on a voluntary publicly available survey. The survey was widely distributed to participants in the energy and technology sector, compiled from extensive in-house date bases and direct enquiry via industry representative organisations and sector groups. Available government research and technology databases were also employed.

The outputs from this phase were summarised and reported in the interim *"long list"* report submitted to NZTE on the 20th January 2006, and covered;

- A short profile of each renewable energy project including the
  - major research objective and technology and market solution
  - project size and funding
  - project leadership and contact details
  - status of research project (proof of concept and demonstration)
  - linkages to market and investors if any.
- A short profile of relevant commercial activities in renewable energy

The study team undertook an initial assessment of the survey replies and developed a preliminary short-list of projects for further investigation. This evaluation was performed by first defining the scope of the project with respect to what is or is not renewable energy and then applying the study team's assessment on the likelihood of whether or not the technology was appropriate for the purpose envisaged.

As noted in the revised long list report, the following definition for a renewable energy project was applied based on guidance and input from NZTE:

- Include all projects incorporating direct generation of heat or power from:
  - wind
  - biomass
  - geothermal
  - hydro
  - solar
  - ocean wave/current/tide
- Include projects incorporating supporting technologies in the value chain leading to direct heat or power generation as listed above.
- Exclude projects which simply improve the efficiency of existing energy uses.
- Exclude projects which require fossil fuels as their substantive inputs.

A set of preliminary scaling parameters was then used to provide a simple ranking of the projects from a near-to-commercialisation perspective. There were four main criteria, rated on a scale of 1 to 3 by the study team based on the information provided by the project representatives:

- Inherent product/service value to customers (1 low value to 3 high value)
- Market size including competition aspects (1 low market to 3 large market)
- How much competition exists (1 as a lot to 3 as almost none)
- Business risk to achieve success (1 as a high risk to 3 as low risk)

From the resultant ranking of projects on the long list, 25 projects were chosen for a further in-depth phone interview and consideration by a team of technical and business development experts in a workshop context.

One of the issues identified in developing the methodology and survey approaches was the uncertainty and lack of definition as to what constitutes renewable energy. It is recognised that the definition applied by the study team excludes some potentially productive commercial development of technology with a substantive New Zealand component. Where possible this was taken into consideration in the workshop assessment process.

Workshop

The preliminary short list was then workshopped in a second stage using a panel of invited experts in renewable energy technology and business development plus the original consultant team. In addition NZTE representatives were present to assist the process and make sure the process was as transparent as possible. This team was put together for their wide ranging expertise across the RE sector. The make up of the expert panel is given in Appendix B, Detailed information about the qualifications of these team members may be found in the proposal documentation.

The criteria for assessing the commercialisation potential of the different projects was consistent with the criteria as needed by NZTE in their terms of reference and the relatively limited quality and quantity of information provided by the companies on the preliminary short list. As such there were four main criteria, rated on a scale of 1 to 5 by the assessment team, using the indicators as given below:

- Inherent product/service value to customers (1 low value 5 high value)
- Market size including competition aspects (1 low market 5 large market)
- Technical risk to achieve success (1 as a high risk 5 as low risk)
- Business risk to achieve success (1 as a high risk 5 as low risk)

Members of the consultant team presented the information from each of the short listed projects to the expert panel in turn. Then the overall ranking of each criterion, for each project, was determined by averaging the anonymous individual opinions of the expert panel. In addition the team estimated the time they thought was needed until the first fully commercial sale of each project's product or service would occur, based upon development stage and technical complexity. Completion risk is a significant factor often underrated by the technology sponsor and thus, in this context, it was important that an independent view be reached by the panel itself.

Conflicts of interest were declared for each project to identify panel member personal bias.

In the one case where one of the reviewers had a direct participatory interest in one of the projects the reviewer absented himself from the room during the evaluation of that project. There were no other cases of any significant conflict of interest and the wide range of backgrounds within the panel was thought sufficient to minimise the risk of any individual bias influencing the outcome.

RESULTS

Initial Survey Summary:

The results of the initial survey were presented in the interim report to NZTE on 20th January 2006 but for completeness, key findings are summarised in this section as well. The interim report provided a list of the respondents and their replies to the survey. A major issue identified was respondent concerns in respect of commercial confidentiality and thus, in some cases, only partial responses were provided by respondents. This was addressed through individual follow up as required.

The two graphs that follow provide a sector profile based on the survey replies. As can be readily seen, the predominant source of innovation and commercial activity in the renewable energy sector came from manufacturing and research and development. Examination of the R&D grouping shows that the majority of these were private companies. Although this shows the private sector leading technology uptake, a number of these projects were known by the team to have their roots in publicly funded research.

For successful technology development, it is well understood that it is important to have a span of activity sufficient to encompass a dominant part of the delivery chain. An examination of the distribution of renewable energy development activity in New Zealand by energy field suggests that, in this respect, New Zealand probably falls short of this ideal. Four technology clusters were identified as having a sufficient critical mass to be potential targets for future market development. These involve; commercial and residential biomass systems, small scale hydro, geothermal and solar thermal.

These opportunities are discussed further in this report.

Assessment of Commercial Potential

The results of the second stage assessments of the preliminary short list projects along with recommendations and comments are listed in the tables that follow. The final short list includes the projects in Tables 1A and B, 2 and 3. The projects were ranked in order of the sum of their scores for each of the four potential and risk assessment criteria.

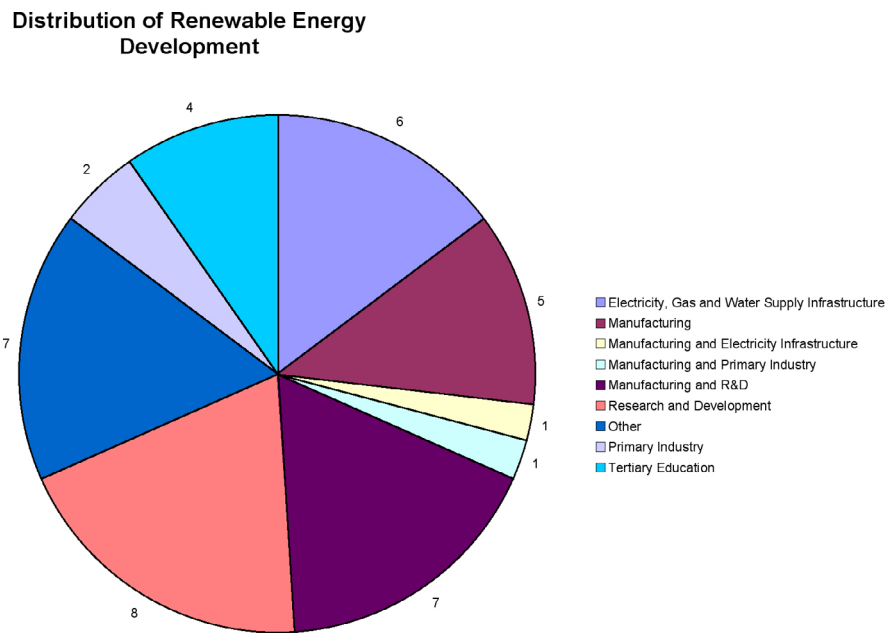

Figure 1: Distribution of Survey Respondents by Business Sector

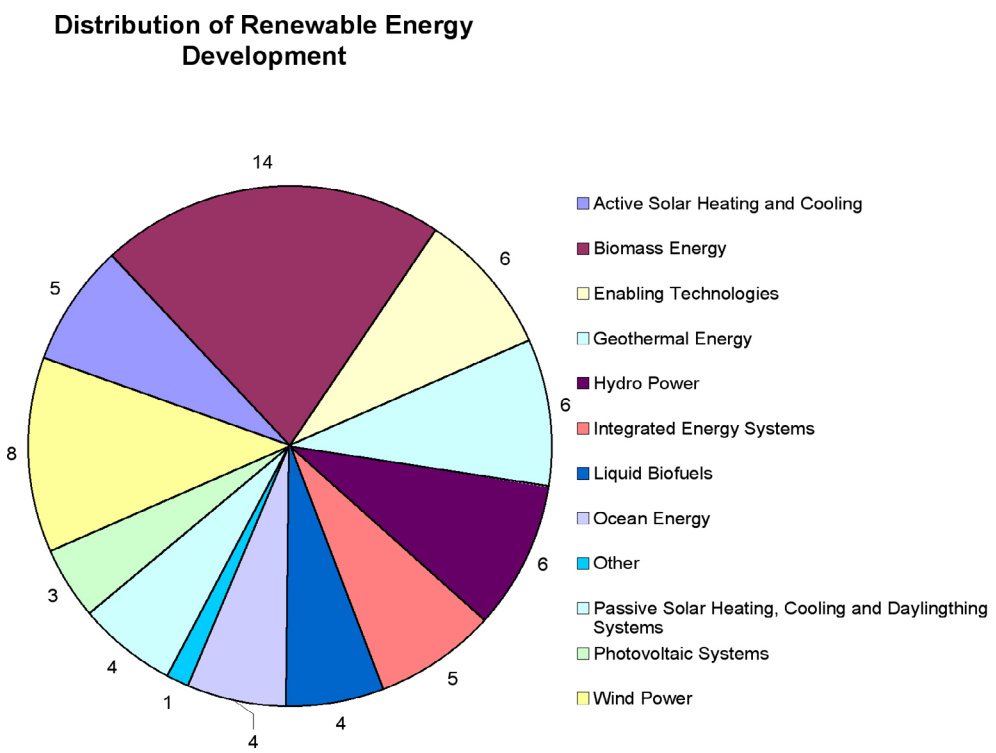

Figure 2: Distribution of Survey Respondents by Energy Field

It is important to note, however, that the uncertainty associated with the scores of each ranked entry were thought to be of the same general order of magnitude as the difference in scores between each ranked entry. Thus the exact ranking in the list should not be seen as the basis for funding decisions. As directed by the original terms of reference from NZTE, the criteria generally tended to favour projects that were closer to commercialisation based on the generally reduced technical and business risk associated with bringing these to market. Thus the final project scoring does not strictly correlate with the inherent "quality" of the projects, but instead reflects the brief from NZTE to focus on projects able to be bought to commercialisation in a relatively short time frame.

In recognition of this distinction and the uncertainties inherent in the selection process, the workshop results are presented so that the range of projects evaluated were segmented instead into three tiers; depending on their assessed readiness for commercialisation and development pathway rather than providing individual rankings of the different projects.

Finally, it must be recorded, that the panel agreed that the exclusion of projects which were not renewable energy by the definition developed from the NZTE brief (specifically those projects which provide energy efficiency benefits) should not exclude those projects from further consideration or other listings of projects which will improve the sustainability of New Zealand residential, commercial and industrial energy consumption.

The following Table 1A lists the tier one group of projects deemed most able to be brought into full commercialisation in a relatively short time frame.

Further details concerning the projects listed in Table 1A are presented in Table 1B. In reviewing Table 1B, it is useful to note that a yes (Y) in the *RE* column and in the *Path to Commercialisation* column confirms that the project meets the overall entry criteria enabling it to be further evaluated. The *Product Value* and *Market Size* assessments indicate the potential value of the project outcome. The *Technical Risk*, *Market Risk* and *Time to first sale* are indicative of the project risks. The complexity of many projects and the limited identification of the types of engagement possible with NZTE, however, means that NZTE will need to

Company Name	Survey Contact	Project Description
Easteel Industries Ltd	David Mc Gregor	Biomass fired industrial energy plants
Genesis Research & Development	Dr. Jim Watson	Process and system to convert woody biomass to produce ethanol, lignin and xylose
Hydro Works Ltd	Rik Hothersall	Small-scale hydro turbine schemes
Natures Flame Ltd	Andy Matheson	Pellet maker importing and installing domestic and light industrial wood pellet burners.
Norske-Kaeser New Zealand Ltd	Edwin Cywinski	Heat pump hot water system for residential use with passive solar heat recovery
Page & Macrae Ltd	Ian Macrae	Biomass gasifier and boiler system for medium scale industrial applications
Sola60 NZ Ltd	Lindsay Richards	Solar hot water system for domestic use
Thermocell Ltd	Arthur Williamson	Domestic solar hot water heating
Waste Solutions Ltd	Dr. Jurgen H Thiele	Gas cleaning and biological digestion to produce a renewable energy stream
Windflow Technology Ltd	Sheralee Mac Donald	0.5 MW wind turbine two blade teetering hub synchronous generator

Table 1A: First Tier Projects

pursue further dialogue with the tier-one companies to determine the best way to assist them (if at all).

The second tier projects listed in Table 2 were assessed as being on the low side of a significant gap in the ranking between them and the tier-one projects. They were generally thought to be less amenable to development by the panel, based on both a lower overall score and/or on a particularly low score in one or more specific criteria. Such projects may be in a relatively early phase, or a considerably long way from commercial development. There may be some potential for these projects to be successful but the low scoring specific criteria should be addressed before they would be expected to be viable.

The third tier projects listed in Table 3 fall on the low side of a further significant gap in scores relative to the second tier projects. They are thought to require major changes in a number of areas or significant further development before they would be viable or ready for commercialisation.

In terms of potential collaboration, in addition to the general areas noted earlier, one particular possibility was identified in regards to technical standards:

- Residential solar hot water heating – collaboration between hardware developers and control developers. The Solar Energy Industry Association (SEIA) is currently investigating this aspect of solar hot water heating development and it is clear that the potential performance of these devices is being hindered by lack of suitable control technology.

There may well be other areas where collaboration would be useful. However, whilst the potential for collaboration in other areas was thought to exist it is not easy to see how this might come about in the competitive environment that early stage developers operate in within New Zealand. This would be a useful area for further exploration and analysis. It is clear that whilst we see some support from government agencies to renewable energy industry associations and technology interest groups, these support mechanism have yet to advance to collaboration around standards and performance.

Summary of Assessment Criteria used in the following tables:

1. Is the project renewable per the following definition?

   Renewable energy projects include direct generation of heat or power from:
   - Wind
   - Biomass
   - Geothermal
   - Hydro
   - Solar
   - Ocean wave/current/tide

   - They also include supporting technologies in the value chain leading to direct heat or power generation listed above.
   - They do not include projects which simply improve the efficiency of existing energy uses.
   - They do not include projects which require fossil fuels.

2. Is there a plan to commercialise the project result?

3. Averaged score for evaluations using a relative rating on a 1-5 scale for:

   - Inherent product/service value to customers (1 is low perceived value to customer and 5 is high perceived value)
   - Market size including competition aspects (1 is small relative market share/size and 5 is a large relative market share/size)
   - Technical risk to achieve success (1 is high risk of not completing technology development due to significant technical hurdles still to solve and 5 is low risk of not completing)
   - Business risk to achieve success (1 is high risk of not reaching market potential due to business factors such as experience and support mechanisms and 5 is low risk of not reaching potential).

4. An estimate of time to 1st truly commercial sale of the project result.

Note:

Code - refers to the survey response designation used in the study data base and the previous Interim Renewable Energy Survey Long List Report.

Project - refers to the short form identification of the organisation and brief project summary.

Code	Project	RE? Y/N	Path to Comm'n ? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
U	Windflow	Y	Y	3.88	4	2.88	2.63	<1 yr
	0.5 MW wind turbine two blade teetering hub synchronous generator		Present path is though sales to itself to vertically integrate power productio n	Size of turbine is a disadvantage relative to international market.	Market size is large in NZ and international. But competition is very strong.	Windflow is doing it the hard way developing a machine virtually from scratch. The technical risks are high as illustrated by recent failures. Getting certification is a high priority	Business risk is high as it is all in house competing against established manufacturers	Sales of 5 units but to itself without open competitio n.
Com-ment:	Windflow is a classic example of a local NZ company that could have usefully been afforded assistance in the early stages of the development but for whatever reasons did not get government interest. The task now is either to go for the large scale wind farm market presently dominated by 2MW or above machines or revert to the niche markets of developing country/remote wind diesel. NZTE already engaged.							
M	Page Macraes	Y	Y	3.38	2.88	4	2.88	1-2 yrs
	Biomass gasifier and boiler system for medium scale industrial applications			Reasonable value based on lower capital cost and improved emissions relative to conventional burners	moderate since significant potential competition from international sources	Demonstration unit in place with significant experience and also reasonable engineering skills in house to support production	Limited business planning but existing company with a reasonable (10%) moderate level of resources invested	Early units will probably be engineere d to order.
Com-ment:	Do not appear to have much understanding of international competition from established vendors in this market. Could benefit from marketing support.							
E	Genesis Research & Development	Y	Y	3.88	4.14	2.63	2.38	4-8 yrs
	Process and system to convert woody biomass to produce ethanol, lignin and xylose	Cane willow coppicing biomass conversion to ethanol etc.	Plans to develop and rollout appear to be understo od and clear	Significant alternative to petrol as a fuel, especially with modern cars; long-term cost benefit for consumers. No major consumer adjustments, unless legislation mandates high % ethanol in mix	Almost whole transport fuel market, NZ appears to have limited product development in this field to date. Also envisages large markets in Asia based on this technology. China specifically mentioned. Note land use may limit potential markets.	Project already through lab and initial demonstrator phases. Pre-commercial phase funding required. Main tech risk is in validating scale issues. Questions about whether a full technology path is in place.	IP protected. Path to market reasonably clear. Slight engine modification needed. Funding appears to be main current obstacle, business appears realistic as to expectations	This refers to full scale commerci al plant output, pre-commerci al phase plant could be operationa l by end-2007 if funding forthcomin g. 2011-12 noted as full commerci alisation.
Com-ment:	Access to cash to drive the project appears to be a major issue as investors want to see next-stage rollout [i.e. the pre-production plant] before committing. Cost to support could be substantial. NZTE to look at how much funding will be provided by commercial interests contingent on pilot plant proof. Further engagement recommended to understand kind of support needed. Also some uncertainty in technology; further viability assessment needed.							

Table 1B: First Tier Projects

Code	Project	RE? Y/N	Path to Comm'n ? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
G	Hydro Works Ltd	Y	Y	3.25	2.25	4.13	2.88	<1 yr
	Small-scale hydro turbine schemes	Irrigation race turbines	Appears to be understood, as do major obstacles	Hydro power with limited adaptation of the local environment, hence lower cost; portable turbines allow redeployment of capital	Based on estimates the market in Australia/NZ is around $25m based on inherent limits on technology. Chinese competition is seen as a major potential threat.	Technical issues resolved and has major power company [Trustpower] in support.	Market is limited, RMA appears to inhibit sales significantly at present. Potential prospects in overseas markets if these can be researched and developed. Limited IP so international aspects are challenging.	First installation is in place; water not yet run through.
Com-ment:	NZTE could have a valuable asset here but a great deal of effort will need to be put in to support the overseas sales and marketing effort, especially as there is no IP protection and therefore speed to market is essential. May benefit from market development support to broaden technology.							
R	Thermocell	Y	Y	3	2.63	3.88	2.8	<1 yr
	Solar hot water heating	Direct use of low temperature solar thermal	Has been a commercial product for around 20 years but company wants to improve product in particular the controller	Flat plate pumped collector with low level of manufacturing automation uses heat pipe technology to extract energy from panel to a manifold.	Medium potential market in NZ but significant barriers small existing market possibly around 2000 units per annum Lots of competition emerging especially from Chinese imports. Market could be larger if international exports developed further.	Technical risk of existing unit is small the main risk in terms of maintaining quality control in what is essentially a very small production line	Existing profitable business but competition emerging via imports No plan or desire to go global. Risk based on NZ focus of business plan.	Existing units being sold
Com-ment:	This a small, relatively successful family business and appears content in remaining so. Unclear what assistance is needed possibly matching to a control manufacturer. Possible additional NZTE help if goals can be expanded beyond NZ.							
L	Norske Kaeser	Y	Y	3.13	3.25	3.13	2.63	1.4 yrs
	Heat pump hot water system for residential use with technical connection to passive solar heat present in cold heat source	Passive solar element deemed to meet criteria	Reasonable but question on economy of scale relative to previous Hot Shot system from 1980s	Moderate since existing domestic heat pumps are much more expensive but potential for Chinese imports limits. Question on what is included in price. Purchase on replacement or new deployment.	Moderate since significant potential competition from international sources	Relatively low since core technology is relatively old with some current modification.	moderate since some answers in market aspects part of the survey indicate uncertainty	less than 1 year
Com-ment:	Their request for support is in areas where NZTE may be able to help such as business development planing and connection development							

Table 1B: First Tier Projects (continued)

Code	Project	RE? Y/N	Path to Comm'n? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
C	Easteel Industries Ltd	Y	Y	2.88	2.25	4	2.63	<1 year
More Information required with out interview	Biomass fired industrial energy plants	Burns on site generated waste streams, mainly for wood processing plants	In existence 10 years, sales made, IP protection in place	Provides direct source of power to wood processors; capital cost issue and some structural adaptation required?	Limited to corporate with waste products that have capital available to acquire the technology. Significant competition.	Already in existence and operational. No comments offered about efficiency of current technology	Dependent on market [see Market Size], and trends in other industries over which manufacturer has no control	Sales already happening
Com-ment:	Initial questionnaire only available; NZTE would need to assess the market issues to understand whether this is worth supporting							
S	Waste Solutions There appear to be two technologies gas cleaning which would be an enabling technology and biological digestion which would produce a renewable energy stream	Y	Y	3.13	3	3	2.5	<1 yr
		Biological digestion using animal waste focussed on export to third world companies .	The company is owned by Downer Edi Australia Ltd a multinational. The parent apparently is not putting significant resources into the NZ Waste Solutions project	Product will be mainly attractive to developing countries emphasis is on low capital cost	Large market but a lot of competition in the third world difficult to see how NZ could compete in such a market but not to be ignored.	Technical risk is presumably being carried by an arrangement between the parent and the local company . In general biological digestion systems can be high risk	Difficult to gauge the risk appears to be mainly borne by the local company	6 prototypes in the market
Com-ment:	This is one of the few companies reviewed dedicated to the international market and not NZ. The cost of bringing the device to market would be modest as it is inherently a low cost device. Risk sharing with the parent company would be needed.							
P	Solar 60	Y	Y	2.63	3	2.75	3.13	<1 yr
	Solar hot water system for domestic use	Direct use of low temperatur e solar thermal	Has been a commercial product for around 20 years but company wants to improve product	Flat plate collector with medium level of automation uses imported absorber coating system uses existing storage tank. Will need to improve product to provide positive value.	Large potential market in NZ but significant barriers small existing market possibly around 2000 units per annum Lots of competition emerging	Difficult to assess as existing unit is in production. No existing plan to involve professional assistance regarding redesign. Small production runs entail quality control risks	Existing profitable business but competition emerging via imports No plan to go global	Existing units being sold new units imminent -
Com-ment:	Note Otago Energy Studies has tested the existing unit as part of a FRST funded grant the results were not encouraging. We would agree that an improved technology is needed - worry that they seem to want to continue with the existing absorber surface which has been problematic in the tested unit. Will need outside technical support to improve the system.							
K	Natures Flame	Y	Y	2.88	2.38	3.5	2.5	1-2 yrs
	Pellet maker who wants to increase uptake of pellets by importing and installing wood pellet burners at domestic to light industrial.		Existing company seeking to enhance their scope of supply but significant import path does not provide maximum benefit to NZ	Moderate since pellets require significant processing relative to straight wood burners. Questions on emission requirements and how well pellet fires perform.	Limited market since NZ specific with no new exportable technology	Limited since there are a number of import options	Main barrier appears to be reluctance to invest to get the imported burners certified by each regional council	Less than 1 year expected by project team
Com-ment:	Question as to why NZTE should support this since they should be capable of doing this as a government owned subsidiary of Solid Energy							

Table 1B: First Tier Projects (continued)

Code	Project	RE? Y/N	Path to Comm'n? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
D	Fluidyne Gasification	Y	Y	2.5	2.5	3.13	1.38	< 1 yr
	Biomass Gasifier	Electrical power generation using engines fuelled with producer gas made from wood. Requires significant feed preparation.	Technology licensed, no manufacturing or active sales now being undertaken. Limited future prospects for development in New Zealand.	Markets very specific, may be climate driven. Capital cost issue and significant structural adaptation required?	Limited: corporates with waste products that have capital available to acquire the technology; local DIY schemes appear to have greater potential [no data]	In development in Canada and Ireland, turbine link to create electricity not defined in response	Dependent on market [see Market Size], trends in other industries over which manufacturer has no control, and own marketing position which is now 100% passive	Demonstration Scale already agreed in Canada and Ireland. No plans for further growth, looking at alternative products for local DIY markets
Com-ment:	Major question over past frustrations and whether anything other than wholesale NZTE support would get this product levered further forward.							
N	WET-NZ	Y	Y	3.29	3.71	1	1.29	>8 yrs
	(Wave Energy Technology NZ) Ocean wave electricity generator developed in NZ or imported from overseas			Will depend completely on cost to supply relative to other renewable technologies	Potentially quite large but balanced by high level of international competition	Many hurdles exist since 1/20 scale demo unit is several years away	As for tech risk, many hurdles exist since the final product is likely to be a high capital cost system selling into a risk averse market	
Com ment:	Support to develop research links to overseas efforts may be most helpful at this point. But time to develop is so long, direct business support is premature. Many millions of dollars will be needed to establish NZ as a substantive player in this. Costs, risks and potential rewards are all huge. Numerous overseas projects have failed.							
H	IRL	Y	Y	1.88	2.25	3.38	1.75	2-4 yrs
	Low power inverters for generalised applications	Enabling technology which can be applied to RE	Relies almost totally on delegation to partner company	Limited since other units support the PV market and the inverter size limits the value relative to the cost	Significant competition from international products in related applications	Strongest element of the project but not much information provided	Not developed at this point. There is a huge lag in timing relative to advancing technology elsewhere.	long path is forecast by project team
Com ment:	Business plan and value are lacking.							
J	Natural Systems Hydroventuri	Y	Y	2.5	1.75	3	2	2-4 yrs
	Air turbine used as part of a small hydro generation system	Importer and adapter of UK producer with NZ licence heads of agreement	Looking for stock issue and eventual float of company to develop this. May not meet criteria for import substitution.		Limited since licenser into NZ and no export potential. Significant modification for river applications.	Moderate since UK is in demonstration and some NZ issues	Plan is present but there are a number of disconnects relative to the technology path and poor understanding of competition	Project team expects less than 1 year but this appears unlikely
Com ment:	Brian Tolley connection with controller to link it to the grid. Also linked to BiogenCool project by same company with concern about limited project synergy and dilution of effort for a startup.							

Table 2: Second Tier Projects

Code	Project	RE? Y/N	Path to Comm'n? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
I	Natural Systems BiogenCool	Y	Y	1.88	1.88	2	1.88	2-4 yrs
	Biomass to gas to electricity to refrigeration/ice for dairy farms		Looking for stock issue and eventual float of company to develop this.	Limited since grid power backup will set max pricing with utilisation questions remaining as well as uncertain value of effluent reduction.	limited with specialized requirements of dairy farm operation International development faces challenges in competition.	Many elements of technology required to come together but these are noted	Plan is present but there are a number of disconnects relative to the technology path. Also business model relative to grid does not fully hang together.	expect a few years but complexity makes this longer
Comment	Waste Solutions listed as partner as well as using Thermocell heat exchangers and Whispergen power. Not sure how much help NZTE can provide.							
O	R&G Energy Systems	Y	Y	2.13	2.38	1.75	1.13	1-2 yrs
	Solar hot water heater for domestic use with novel controller	Solar heater direct use of low temperature solar thermal Controller enabling technology	German controller brought in to supplement US solar system with NZ integration	Flat plate pumped collector with low level of manufacturing automation uses US painted top coating system uses existing storage tank	Large potential market in NZ but significant barriers small existing market possibly around 2000 units per annum Lots of competition emerging. Difficulty to supply export market with limited NZ tech input.	High risk due to lack of professional testing and evaluation - not tested little professional input	Self assessed lack of expertise in this area	A couple sold but not at a profit
Comment	Difficult to see this venture being successfully commercialised - confused over role of PV telephone call follow up suggested that a PV panel was to be used to power the controller but this will not generate excess electrical energy controller has links with German product but did not seem to have a well defined control strategy							

Table 3: Third Tier Projects

Code	Project	RE? Y/N	Path to Comm'n? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
T	Whispertech	**Y**	**N**					
	Currently produces a Stirling engine electricity and hot water source using gas or diesel fuel. Project is to convert current technology to biomass	With biomass option only	Current technology has a strong path to commercialisation especially in Europe but biomass option is not part of their active plan.	Fossil fuel driven product relies on market subsidies in the UK mainly so biomass system is of questionable value	Niche market unless costs can be reduced relative to existing fossil fuel unit.	Current fossil fuel product is selling well but high risk for the renewable fuelled product	Current fossil fuel product is selling well but high business risk for renewable product	Orders for around 100,000 units with fossil fuels but biomass uncertain
Comment	Difficult to see where this product goes in the future if converted to biomass fuel. Its main claim to fame so to speak is the automated nature of the process. The deal with Solid Energy may be the best route forward in this regards using pellet fuels							
A	Brian Tolley Corp Ltd	***Y***	**N**					
	Active Network System, TWAX Two way power line communication and advanced metering	Enabling technology not RE as defined	No technology development present. Stated sole barrier is government policy.	Significant capital saving to industry. Lower costs may be passed to consumers? Little behaviour change required	Significant. Competition aspects are structural - no indication that market will align to allow product to be realised in NZ? Possible application for solar systems.	Needs to refine system to 50HZ market from 60HZ. Genesis has prototype.	Structural changes to market infrastructure required. Some interested stakeholders indicated.	See Business Risk comments
Comment	Seems almost to be using the questionnaire response as part of his lobby mechanism. Australia is moving in this direction. NZTE will not be able to add value.							
B	Crop & Food Research Ltd	**Y**	**N**					
	Identifying optimal plant species for biofuel production in NZ	Value Chain supporting technology, and platform information for large-scale biofuel use	Not perceived as a commercial project, but a 'public good' project through dissemination of information. Thus no path is defined.	Part of platform for biofuel production in NZ, no direct consumer changes required.	Market is significant, but 'public good' approach means commercial potential - of this project - is extremely limited	Technology for biofuel production exists elsewhere	Not seen as a business opportunity by CFR	Commercial potential not being derived from this project
Comment	Potentially more value within the MED sustainable energy strategy development than for NZTE exploitation							
F	Harris Flame Technology	**N**	**Uncertain**					
	Introduce biodiesel for home heating burners	Swiss burner seller seeking biodiesel supplier in NZ. Not a technology provider.	Plans to develop and rollout appear to be understood but frustrated. Project team has made no assessment of ease of sales or pricing.	Emission advantages of biofuels over diesel equivalents. No major consumer adjustments, capital equipment can be readily adapted to the new fuel	Consumer market for diesel stoves, less those who will not convert. Likely to be localised, no clarity provided over market potential	Manufacturer confirms that stoves burning diesel will convert to bio-diesel, no local trials have been undertaken	No clear path to develop the market, as operates within local markets selling technology manufactured elsewhere. Cannot source fuel at present.	Achieving a reliable fuel source is the primary requirement.
Comment	A wholesaler/retailer whose major benefit would be through local PR impact and possible encouragement for local manufacturers to consider home-developed burners							

Table 4: Other Projects

Code	Project	RE? Y/N	Path to Comm'n? Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale
Q	Solvent Rescue	**N/Y**	**Y/N**					
	Two projects: waste to liquid fuels wave power	Waste to liquid fuels concentrates on hazardous waste that is mostly non renewable there is potential to use technology for renewable inputs but this seems unlikely to be implemented tidal power is renewable	Waste to liquid fuels has a path but tidal power is a concept only	The product is a UK product that is still in the prototype stage. SR claim to be able to construct a copied device in NZ and that the difficulty obtain rights to the seabed for testing are the main detractors	The future market for electricity in NZ is likely to be large	Technical risk is high as the UK device is still in prototype stage	SR has no prior experience in tidal power, sea bed rights is apparently a large issue and therefore risk	Decades
Comment	The tidal project is really a cause to be pursued rather than anything close to a concrete proposal. Waste to liquid fuels does not meet renewable energy criteria.							

Table 4: Other Projects (continued)

COMMENTS ON COMMON ISSUES AND CONCLUSION

During the course of this study, the study team identified a number of common issues that have the potential to significantly affect New Zealand's ability to create a successful renewable energy sector capable of exploiting international market opportunities. Further investigation will be needed to properly assess and potentially address these comments but they are presented here to promote further improvements in the renewable energy research, development, demonstration and deployment pathway.

- New Zealand has a relatively low current capacity for research along with a similarly low level of development activity in the renewables area. This is somewhat surprising in light of the abundance of New Zealand's renewable energy resources but most likely is the result of historically low domestic energy prices.
- With current higher energy prices and increasing environmental interest in renewables providing a more receptive market, one might expect a natural increase in this capacity over time. But, natural growth alone will probably NOT be sufficient to help New Zealand increase its position in the world market relative to its trading partners.
- The New Zealand renewable energy sector is very fragmented, lacks scale and there is a general lack of collaboration between projects with strong potential synergies. Certainly an observation can be made that NZ effort tends towards the low-end of technological complexity with many participants lacking the necessary science and engineering background critical to successful global scale implementation.
- It was very difficult to obtain a high level of response for this survey that may indicate a need to improve the relationship between the research and development community, renewable energy investors and the government.
- There are only a few connections between leading research organisations and the industries that commercialise such research. We have received feedback that commercialisation vehicles are difficult to find and if they can be found the connections are very difficult to develop and maintain. The funding mechanisms which support many of these individual efforts are often not well suited to developing these linkages.
- The current focus of many in the research community is with international publication as supported by PBRF criteria for example in preference to meeting NZ based needs with no clear pipeline for technology dissemination into industry.
- Government research support lacks a coherent set of priorities which translate into clear and stable criteria for access to this funding.
- The leading projects from this assessment tended to be strongly applied and internally driven. Based on our own knowledge, a number of them have developed out of previous government supported research efforts. Most appeared to be based on previous research efforts which were applied to current business opportunities while a smaller number were directly led by a research effort integrated into the product development process.
- These structural and cultural issues identified in the renewables sector act as strong barriers for industry building which often requires a high level of connectivity both domestically and internationally, particularly in cases where the technology is capable of adding significant value.
- There is a need to create an environment for innovation and business development where either government or the venture capitalisation sector can identify potential winners more readily so that they can have access to the resources and expert knowledge they need to succeed, and from and early stage.

In conclusion this study has indicated a strong case for NZTE to expand its initial scope into a further study to provide more robust assessments of the product value and commercial potential of the identified RE technologies. We note that a number of informal comments were received from different respondents in respect of the efficacy of being able to select near-to-market technologies with the potential to be

matched to the international market place. The generally held view was that it would be more effective to maintain an active portfolio of projects at various stages of development so that individual projects could leverage of each other and core areas of competency identified and recognised through government programmes. This is an area deserving further consideration.

The results of the study also suggest the need for NZTE (and government generally) to maintain better linkages with the RE sector. The challenge is to move beyond yet another survey or industry meeting. Through better detailed characterisation and understanding of the delivery chain, its essential skills and knowledge competencies, and though active support that allows better tracking of prospects and more efficient sharing of market and sector intelligence, the commercialisation potential of sector can only but grow.

The "do-it-ourself" and "crusader" attitudes that are currently present in the sector will not survive in today's market environment. Increased participation at levels appropriate to the global market is vital to the sector, as is our capacity to showcase near-to-market RE technologies to potential commercialisation partners and world markets.

The study team recommend further work with NZTE to more clearly identify specific paths to market and market opportunities, rather than just considering the general aspects of commercialisation as was done in this study. This complementary process could significantly expand the range of projects considered to have commercial potential but more importantly provide for more effective and targeted developmental support.

Further informal discussion is proposed with NZTE to follow up these recommendations and to establish the relative merits of an industry approach that links government research & development goals with international market opportunities.

Workshop Assessment Scores

Code	Project	Renew-able Y/N	Path to Commercial -isation Y/N	Product Value	Market Size	Tech Risk	Business Risk	Time to 1st Sale	Total Score
U	Windflfow	Y	Y	3.88	4	2.88	2.63	<1 yr	13.4
M	Page Macraes	Y	Y	3.38	2.88	4	2.88	1-2 yrs	13.1
E	Genesis Research & Development	Y	Y	3.88	4.14	2.63	2.38	4-8 yrs	13.0
G	Hydro Works Ltd	Y	Y	3.25	2.25	4.13	2.88	<1 yr	12.5
R	Thermocell	Y	Y	3	2.63	3.88	2.8	<1 yr	12.3
L	Norske Kaeser	Y	Y	3.13	3.25	3.13	2.63	1.4 yrs	12.1
C	Easteel Industries Ltd	Y	Y	2.88	2.25	4	2.63	<1 year	11.8
S	Waste Solutions	Y	Y	3.13	3	3	2.5	<1 yr	11.6
P	Solar 60	Y	Y	2.63	3	2.75	3.13	<1 yr	11.5
K	Natures Flame	Y	Y	2.88	2.38	3.5	2.5	1-2 yrs	11.3
D	Fluidyne Gasification	Y	Y	2.5	2.5	3.13	1.38	< 1 yr	9.5
N	WET-NZ	Y	Y	3.29	3.71	1	1.29	>8 yrs	9.3
H	IRL	Y	Y	1.88	2.25	3.38	1.75	2-4 yrs	9.3
J	Natural Systems Hydroventuri	Y	Y	2.5	1.75	3	2	2-4 yrs	9.3
I	Natural Systems BiogenCool	Y	Y	1.88	1.88	2	1.88	2-4 yrs	7.6
O	R&G Energy Systems	Y	Y	2.13	2.38	1.75	1.13	1-2 yrs	7.4
T	Whispertech	Y	N						
A	Brian Tolley Corp Ltd	Y	N						
B	Crop & Food Research Ltd	Y	N						
F	Harris Flame Technology	N	Uncertain						
Q	Solvent Rescue	N/Y	Y/N						

Note: these scores should be treated with caution

The following items will be included in supporting documents, separate from the final report:

- Telephone Survey Guide
- Telephone Survey Summaries
- Workshop Comments

APPENDIX A: ORIGINAL TERMS OF REFERENCE

New Zealand Trade and Enterprise

RENEWABLE ENERGY SCOPING STUDY

Terms of Reference

1. Background

The changes in the balance of supply and demand signal the commencement of a new era in the global energy market. Energy has emerged as restraint upon economic development in a number of countries (especially in China and India) while there have been major price increases for critical fuels on world markets. Many national electrical supply systems are operating at near to peak demand levels. In this environment, significant new investment is taking place, and alternatives to fossil fuel energy systems have received a significant improvement in their relative cost effectiveness, leaving aside environmental issues and the impact of investment markets on traded prices. The environment for the building of alternative energy industries is currently very favourable.

For some time, there has been ongoing research into renewable energy technologies in New Zealand. This project is an initial scoping study to identify the major research and technology development activities in New Zealand, and to assess whether any are near-to-commercialisation, or could become so if there were collaboration and leverage with other projects. The results will be used by NZTE and the Foundation for Research Science & Technology (FRST) to explore the potential for them to assist in the commercialisation process of the identified projects.

2. Tasks

The contractor is to undertake a survey of the renewable energy research in NZ, and to implement a process for assessing the leading projects in terms of their technological and market potential, and (potential) commercialisation status. It is envisaged that the project will require the establishment of a cooperative relationship with the members of the renewable energy community in NZ.

The process should result in an initial assessment of where NZ's international competitive advantage might lie in the field of renewable energy technologies.

3. Deliverables

The project will establish a process for the assessment of the renewable technology development activities in NZ, and conduct an initial assessment. The outputs will include;

- a short profile of each renewable energy project (the long list) including,
    - major research objective and technology and market solution

- project size and funding
- project leadership and contact details
- status of research project (proof of concept and demonstration)
- linkages to market and investors if any.

- a short profile of relevant commercial activities in renewable energy
- projects where collaboration and leverage opportunities should be explored,
- a ranking of the projects from a near-to-commercialisation perspective
- a profile of the leading technologies to be considered for accelerated development including
  - a profile of the leading technologies to be considered for accelerated development including their
    - status with respect to proof of concept and demonstration
    - IP protection and strategy
    - commercialisation potential with respect to
      - price/performance points and targets
      - market applicability
      - ability to become world class
      - indicative scale of investment and margins
      - prospects for the development of a NZ industry based around the technology
    - potential champion and business partners
    - links to investor community, if any
  - a recommendation as to where market exploration might best be focussed.

4. Timing

NZTE wishes to have the initial profiles of the short listed renewable energy projects by December, but it would prefer the study to provide inputs on an ongoing basis. A draft of the final report should be submitted to NZTE for comment on or before 31 January 2006. The final report should be completed by the end of February.

5. Resources

This scoping study is estimated to cost up to $40,000 excluding GST and disbursements. The Foundation for Research Science and Technology has stated that it will assist the project by providing a schedule of the renewable energy projects in which it is investing.

6. Proposals

The proposal process will be conducted in 2 stages. Respondents are requested to submit an Expression of Interest not exceeding 2 pages setting out how they would undertake and manage the project, and the key resources that they would assign to it. This should be e-mailed to Paul Frater at NZTE on Friday 30 September 2005 at: paul.frater@nzte.govt.nz

NZTE will contact all respondents within 2 working days, and shortlisted firms will be invited to submit a full proposal of no more than 9 pages setting out their proposed methodology, work plan, project team, experience and costs. The process for the consultation upon and ranking of the candidate technology projects should be identified. A Respondent Profile should also be submitted ~ refer to the Request for Proposals document which is attached. Additional annexes may be attached.

Three copies of respondents' proposals should be submitted to NZTE by 5pm on 11 October 2005.

The address for delivery is

RFP Renewable Energy Scoping Study
Commercial in Confidence

For attention of Paul Frater
New Zealand Trade and Enterprise
Level 15
The Majestic Centre
100 Willis St
PO Box 2878
WELLINGTON

Tel 04 910 4300

Each copy of the proposal must be signed by the person(s) duly authorised to sign on behalf of the respondent. NZTE may, at its sole discretion, accept or decline any late response.

It is intended that the contract will be awarded, and the initial engagement meeting will be held by 31 October 2005.

7. NZTE Contact

The contact for information and questions relating to this proposal is

Paul Frater
Tel - 04 910 4320
Mob – 021 80 80 91
Email – paul.frater@nzte.govt.nz

Mail – PO Box 2878, Wellington.