

EDUCATION PLAN

FOR

SUSTAINABLE ENERGY IN THE

DOMESTIC & COMMERCIAL BUILT ENVIRONMENT

Prepared for the Tertiary Education Commission

by

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for
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This plan and the National Certificate in Renewable Energy (Level 4) were developed within the Sustainable Energy in the Domestic & Commercial Built Environment (SEDCE) project initiated in response to the 2007 New Zealand Energy Strategy and the New Zealand Energy Efficiency and Conservation Strategy. The plan continues to align with revised versions of these government strategies released on 30 August 2011.

For ESITO :



Tim Densem, Chief Executive,
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Able Solar
Alphatron Pacific
Christchurch Polytechnic Institute of Technology (CPIT)
Electricity Supply Industry Training Organisation (ESITO)
ElectroComms and Energy Utilities Industry Skills Council Ltd (EE-Oz)
Electrotechnology Industry Training Organisation (ETITO)
Energy Management Association of New Zealand (EMANZ)
Energy Options Ltd
Genkit
Hoskins Energy Systems
Integrated Systems Design Ltd
PowerTech
Smart Sparky
Southern Institute of Technology (SIT)
Sustainable Electricity Association New Zealand (SEANZ)
Waikato Institute of Technology (Wintec)
Waikato Regional Energy Forum

The following organisations directly contributed information and advice contained in this plan.

Government organisations

Energy Efficiency and Conservation Authority (EECA)
New Zealand Qualifications Authority (NZQA)
Tertiary Education Commission (TEC)

Industry Training Organisations

Electricity Supply Industry Training Organisation (ESITO)
ElectroComms and Energy Utilities Industry Skills Council Ltd (EE-Oz)
Electrotechnology Industry Training Organisation (ETITO)
Industry Training Federation (ITF)

Industry training providers

Christchurch Polytechnic Institute of Technology (CPIT)
Southern Institute of Technology (SIT)
Waikato Institute of Technology (WINTEC)

Industry associations and peak bodies

Energy Management Association of New Zealand (EMANZ)
Institute of Professional Engineers New Zealand (IPENZ)
New Zealand Council of Trade Unions (NZCTU)
New Zealand Green Council (NZGC)
Solar Industries Association (SIA)
Sustainable Electricity Association New Zealand (SEANZ)

The following organisations were not directly involved during development of the Certificate or Education Plan but were consulted during the project

Agriculture Industry Training Organisation
Aoraki Polytechnic
Bay of Plenty Polytechnic
Building & Construction Industry Training Organisation
Creative Trades Industry Training Organisation
Eastern Institute of Technology
Electrical Contractors Association of New Zealand (ECANZ)
Extractives Industry Training Organisation
Infratrain
Joinery Industry Training Organisation
Manukau Institute of Technology
Master Plumbers Gasfitters Drain layers (MPGD)
Nelson Marlborough Institute of Technology
New Zealand Horticulture Industry Training Organisation
Northland Polytechnic
NZ Flooring Industry Training Organisation
Otago Polytechnic
Plumbing, Gasfitting, Drainlaying & Roofing Industry Training Organisation
Tai Poutini Polytechnic
The Open Polytechnic of New Zealand
Unitec Institute of Technology
Wairariki Institute of Technology
Wellington Institute of Technology
Western Institute of Technology at Taranaki
Whitireia Community Polytechnic

Acknowledgements also go to owners of public domain websites containing relevant reports and information referred to during development of the Plan and referenced in footnotes throughout this document.

Executive Summary

This education plan describes the current and foreseeable environment for training in trade skills associated with design, installation, commissioning and servicing of small scale renewable energy systems.

Preliminary assessments by eight Industry Training Organisations in the building and associated trades sectors led to the decision to focus initially on the competencies and training requirements needed for the generation of electricity from renewable sources. However this education plan and the qualification developed as part of the SEDCE project are structured so other technologies can be included in the future.

New Zealand is late in adopting small scale renewable energy systems because it has lower power prices and an abundance of renewable energy resources at the national level. Even so, there has been a steady increase in installations of photovoltaic (PV) and other renewable energy systems since prior to 2007. The number of installations will increase significantly as grid price parity is surpassed. This has already occurred in jurisdictions such as Italy, Hawaii and Southern California, and is predicted to occur in New Zealand as early as 2013.

The proposed renewable energy qualification framework positions trades training as an extension of skills at level 4. The structure follows the model of the New Zealand Diploma in Engineering (NZDE) with common core subjects, discipline core subjects and optional strands within disciplines. This allows for cross-trade training and caters for progression to higher level qualifications such as the National Diploma in Engineering and other sustainable energy career options. It also aligns with the government's aim of amalgamating similar qualifications.

An outcome of the SEDCE project was the development of an initial qualification – the National Certificate in Renewable Energy (Level 4). Developed by the Electricity Supply Industry Training Organisation, Electrotechnology Industry Training Organisation and industry representatives, this qualification is intended to be a cornerstone for further development of training material for other technologies and trade sectors.

An important objective was to achieve compatibility between New Zealand and Australian qualifications. Evidence requirements in the Certificate mapped against three Australian categories of recognition indicate almost 100 percent compatibility.

Entry to sustainable energy courses will normally be from a specific trade background although others who meet prerequisite knowledge requirements may also enter. In line with this, the normal pathway to the National Certificate in Renewable Energy (Level 4) for school leavers is via an existing underpinning trade.

Southland Institute of Technology, Christchurch Polytechnic Institute of Technology, Waikato Institute of Technology (Wintec) and Waiariki Institute of Technology are known possibilities to be the first provider of the qualification. However, none of these providers are in a position to develop training material until demand is proven.

Australian experience suggests up to 150 electrical trainees per cohort could be expected to take up the National Certificate in Renewable Energy (Level 4). However this sort of demand is unlikely to eventuate until there is a publicly recognised certification of competency like the Australian Clean Energy Council accreditation system.

Further activities identified for future actions are:

- development of a strand covering only grid-connected PV as requested by the Sustainable Electricity Association of New Zealand
- a recommendation to add further renewable energy options to the New Zealand Diploma in Engineering
- a recommendation to the Electrical Workers Registration Board to accept the National Certificate in Renewable Energy (Level 4) as a qualification towards registration as an Electrical Installer – renewable energy systems.
- a publicly recognised certification of competency for renewable energy designers and installers
- development of qualifications for other renewable energy technologies, larger scale systems at industrial, local body and national levels, and sustainable energy in building construction.

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1 Introduction

1.1 Background

In 2007, the government issued the New Zealand Energy Strategy and the New Zealand Energy Efficiency and Conservation Strategy.¹ These were replaced by the New Zealand Energy Strategy 2011-2021 and New Zealand Energy Efficiency and Conservation Strategy 2011-2016 released on 30 August 2011.²

Examples of passages in the latest strategy statements indicating government recognition of the need for training of small scale renewable energy competencies include:

“The Government recognises that uptake of new energy technologies also depends on the trades and service sectors being capable of supporting new technologies. Where lack of capability creates a barrier to uptake, the Government will consider options to increase sector capability.”

“In addition, the Government will work with industry to identify and develop a range of market measures targeting the energy productivity of New Zealand’s homes.”

“The Government will continue to support improvements to the capability of the wider home building sector (such as architects, engineers, developers, product suppliers, installers, and builders) through information, training and accreditation programmes.”

¹ <http://www.eeca.govt.nz/node/2639>

² <http://www.med.govt.nz/upload/77402/NZ%20Energy%20Strategy%20LR.pdf>

Policy – Refers to supporting:

- “The future role of distributed generation and barriers to its deployment.”
- “System requirements of smaller-scale generation technologies.”

The Sustainable Energy in the Domestic & Commercial Built Environment (SEDCE) project, initiated under the 2007 strategies continues to align with objectives in the 2011 versions.

The broad objective for the SEDCE project was to ensure training resources for sustainable energy related competencies were in place at trade level in all building and construction sectors involved in residential and commercial scale buildings. Just how much specific training on sustainable energy related skills was required within respective trades was to be determined within the scope of the project.

Training standards of the trades concerned are set by seven³ accredited Industry Training Organisations (ITO). Two ITOs (Flooring and Infrastructure) withdrew following an initial review indicated the project would have negligible impact on their sectors. Another three ITOs (Building & Construction, Joinery and Plumbing, Gasfitting, Drainlaying & Roofing) were unable to undertake sustainable energy related course development in the period allocated for the first phase of the project. However, with the possible exception of solar water heating, sustainable energy related skills were not expected to require any significant extension from current skill sets covered by these ITOs.

³ Originally eight ITOs but Creative Trades ITO ceased to operate and its areas of coverage dispersed to other ITOs.

The remaining two ITOs (Electricity Supply and Electrotechnology) committed to working collaboratively with industry and training provider representatives to develop an initial qualification.

As the project evolved, the focus changed from “sustainable energy”, implying both energy efficiency and energy generation, to “renewable energy” covering only energy generation. It was within this sphere that a qualification was developed. Due to the electrical nature of the initial development, the term “renewable electricity” is used frequently throughout this plan to differentiate from other renewable energy technologies such as solar water heating and biogas.

Registered with the New Zealand Qualifications Authority (NZQA) as the National Certificate in Renewable Energy (Level 4), this qualification covers on-job and off-job training for design, installation, commissioning and servicing of small scale photovoltaic (PV), wind and mini-hydro renewable electricity systems. Although the initial version is limited to small scale renewable electricity technologies, this qualification is intended to be a cornerstone for further development of training material for other trade sectors. This could be achieved through extension by adding optional units or strands. Alternatively, the qualification could be a model for other stand alone qualifications in sustainable energy.

Adding optional strands would be the preferred approach because sustainable energy installations sometimes involve overlap or crossover between traditional trade demarcations. It also aligns with the government’s policy of combining similar qualifications to reduce the number of qualifications on the New Zealand Qualifications Framework (NZQF) which is being implemented by the New Zealand Qualifications Authority (NZQA) through the “Targeted Review of Qualifications (TRoQ)”⁴ process.

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<http://www.nzqa.govt.nz/studying-in-new-zealand/nzqf/targeted-review-of-qualifications/>

1.2 Structure of the education plan

This education plan (the Plan) progresses from analysis of demand requirements through to education pathways and proposed fulfillment matters. Although there is a focus on the National Certificate in Renewable Energy (Level 4), possibilities for future development of additional subjects, including expanding into wider sustainable energy fields are also discussed.

Throughout the Plan, references to public domain websites containing relevant information can be found in footnotes.

2 Demand and Supply

2.1 Scope of training in sustainable energy competencies covered by this education plan

The technical scope of the Plan is defined within parameters of building categories, trade categories, sustainable energy characteristics, and size of installations.

The residential and commercial built environment refers to residential and commercial buildings. Industrial buildings are excluded although many techniques and practices covered within this plan will apply to this category.

Sustainable energy refers to the provision and use of energy that meets present needs without compromising the ability of future generations to meet their energy needs. There are two components:

- energy efficiency – reducing energy useage
- renewable energy – generation from renewable energy sources.

Within the Plan, energy efficiency refers to the use of construction and finishing materials, fittings and practices that provide

buildings with inherent characteristics that reduce energy useage, including embodied energy, when compared to traditional construction.

Renewable energy refers to on-site small scale generation of energy from renewable sources like solar photovoltaic (PV to 100kW), wind (to 10kW), mini-hydro (to 6.4kW), geothermal, and biomass

All building construction and associated trades may have a part to play in energy efficiency or renewable energy in residential or commercial scale buildings. The list of trades potentially involved includes: building, joinery, electrical, plumbing, gasfitting, roofing, drainlaying flooring, surface coverings, masonry and bricklaying.

This plan provides a structure to accommodate both components but addresses only renewable energy in detail.

2.2 Trade career opportunities in sustainable energy

In the current New Zealand environment, the majority of sustainable energy skills are either self taught or developed within traditional trade sectors as adjuncts to a trade's core competencies.

Sustainable energy considerations have little impact on existing knowledge and skills in some trades such as flooring, and considerable impact on others such as electrotechnology. As a result, the likelihood of a career in sustainable energy within some trade sectors is unlikely while in others, specialists in either energy efficiency or renewable energy are appearing. For example, there are a now companies and individuals specialising in design, installation and maintenance of residential PV, wind, and min-hydro power generation, in solar

water heating, and in heat pump air and water heating systems.

An example of why competent PV installers are essential was shown by a June 2011 audit of 658 systems in western Sydney. Eighty three percent of installations had defects with eighteen point five percent having major defects.^{5,6} The main defect was direct current (DC) breakers incorrectly wired and creating potential for fires. Several electricians lost their license as a result.

5

http://www.solardaily.com/reports/A_standard_solution_to_PV_safety_fears_999.html

6

<http://www.solaraccreditation.com.au/acccecc/consumers/DC-circuit-breaker-info>

The scarcity of trained and competent installers of renewable electricity systems was recognised in the following two passages from a report to the Ministry of Economic Development (MED) in 2009.⁷

“Installation of PV systems involving voltages greater than 120VDC or 50VAC requires a registered electrician. More than 50% of installers are not believed to be registered electrical workers and as such are capable of working [legally] only on the extra low voltage (ELV) component of Stand Alone Power Systems. Electricians, while well qualified for the installation of electrical systems generally, have limited exposure during training to the specific requirements of photovoltaics, battery installations, ELV/DC wiring practice and safety aspects including working at heights (many PV arrays are installed on the roof of dwellings). Many of those working in the industry are therefore self-taught, with some training acquired through suppliers of equipment. There is only limited knowledge and application of the relevant design and installation standards and, as a result, a varied level of work quality and system performance. There are few courses run in New Zealand for the design and installation of photovoltaic systems. SEANZ recently announced a competency based training and accreditation scheme for installers and designers of small scale renewable energy systems. The Electrical Worker Registration Board (EWRB) is currently proposing a category of limited registration as an Electrical Service Technician (EST) for the installation of renewable energy systems [since implemented].”

“7.7.3 Competency and Standards

There are currently no means of identifying competent system designers or installers. Customers who have had a poor experience with inferior system design, installation or product may cite the technology as inadequate, unsuitable or the industry as not having sufficient competency. News of poor experiences and poor product performance tend to circulate quickly via word of mouth and it can take many years to re-establish community trust in a technology. The current set of standards for PV system installation is referenced in the NZ wiring rules AS/NZS 3000:2007. However there is generally limited knowledge of these standards and their practical application, resulting in a wide range of system quality and conformity, as well as significant variations in performance and price. With limited understanding of how to identify a good system over a bad, many consumers opt for the lowest cost solution, which may not perform to expectations. The lack of workers skilled in direct current work, battery installations and renewable energy systems is reducing the ability of companies to offer high quality, safe and well performing systems. The lack of appropriately skilled workers has the potential to reduce the ability of companies to grow. Solutions include:

- *Promotion of design and installation standards and training in their practical application would help to improve system performance, quality and safety.*
- *Trade and university based courses on PV system design and installation should be instigated, with associated certification. Businesses with certified designers and installers would then be able to advertise as such.”*

⁷ “Assessment of the Future Costs and Performance of Solar Photovoltaic Technologies in New Zealand” by IT Power Australia Pty Ltd and Southern Perspectives Ltd — April 2009
<http://www.med.govt.nz/upload/67238/PV%20in%20New%20Zealand.pdf>

Although sustainable energy occupations tend to originate from a traditional core trade, skills from other trade sectors are often needed. For example, solar water heating is most closely associated with the plumbing trade but involves electrical pumps and controls and constructional components for roof or frame mountings. Heat pumps, based on refrigeration technology, also require electrical and plumbing skills. Table 1 indicates the range of trade skills involved in the installation of small scale renewable energy systems.

It is therefore possible that the renewable energy industry will spawn new trade categories with competencies drawn from more than one traditional trade. This is likely to result in a reduction in the range of personnel from different trades needed to install some sustainable energy systems.

ITOs and other educational organisations need to be aware of potential industrial demarcation issues resulting from merging of trade skills. Where this possibility exists, the New Zealand Council of Trade Unions recommends the inclusion of trade union representatives on industry advisory groups during course and qualification development.

It is also relevant to note that occupations that involve cross-trade competencies could be impacted by government acts and regulations that require workers to be registered and hold current practicing licenses to perform certain tasks. For example, electrical, plumbing and gasfitting trades.

Table 1 Cross-trade linkages with small scale renewable energy technologies (design, installation, practices)

Renewable energy technology	Electrical	Plumbing/ roofing	Building	Joinery	Generic
PV panels	Sizing location orientation PV panels cables controllers, inverters batteries grid connection	Roof integrity Water tightness	Fittings and fixings Load bearing considerations Water tightness Orientation Electrical safety Electrical registration limitations	Battery cabinets Controller/inverter cabinets Electrical safety	Health & Safety Dangerous goods (acid) Disposal of materials
Building Integrated Photovoltaics (BIPV)	Sizing Location Orientation PV Building elements Cables Controllers, Inverters Batteries Grid connection	Roof integrity Water tightness	Roof & wall BIPV components PV building elements Electrical safety Electrical registration limitations	PV window glass Battery cabinets Controller/inverter Cabinets Electrical registration limitations	Health & Safety Dangerous goods (acid) Disposal of materials
Wind power	Sizing Location Orientation Wind generators Cables Controllers, Inverters Batteries Grid connection	Roof integrity Water tightness	Fittings & fixings Load bearing considerations Water tightness Noise/vibration dampening Orientation Electrical safety	Battery cabinets Controller/inverter Cabinets	Health & Safety Dangerous goods (acid) Disposal of materials Environmental impact Social impact
Small scale hydro (SWH)	Sizing Positioning Hydro generators Cables Controllers, Inverters Batteries Grid connection	Pipework sizing Pipework selection Plumbing fittings Installations: Pipework Fittings Pumps	Fittings & fixings Load bearing considerations Positioning Electrical safety	Battery cabinets Controller/inverter Cabinets	Health & Safety Dangerous goods (acid) Disposal of materials
Solar water heating	Pumps (electrical) Controllers	Sizing Location Orientation SHW panels Pumps Water cylinders Pipework Insulation/lagging Plumbing fittings Roof integrity Water tightness	Fittings & fixings Insulation/lagging Load bearing considerations Location Orientation Water tightness Plumbing registration limitations	Battery cabinets Controller/inverter Cabinets	

2.3 Demand drivers for small scale sustainable energy systems and practices

Demand for sustainable energy systems and practices is driven either by legislated requirements as found in the Building Act, local body bylaws, standards, or by consumer demand.

Requirements related to building construction such as the specification of insulation levels, double glazing, air-tightness and ventilation normally fall within the legislated category. These are mandatory requirements to be met before the building receives a certificate of compliance.

Conversely, in New Zealand the decision to install renewable electricity generating technologies and computerised energy management systems is a free choice made by building owners. Some install renewable electricity systems for environmental reasons or enthusiasm for new technologies, but those that consider the economic proposition compare the price of small scale generation with grid supplied electricity. Financial feasibility is determined by government policy, cost of components, cost of installation, operating costs, life cycle costs, relative cost of energy supplied from public networks, and remoteness from an energy distribution network. Currently the amortized cost of PV generation exceeds grid supply rates and there are no financial incentives for consumers located close to electricity distribution to install their own generation.

Renewable electricity system costs are however moving towards grid price parity (also called grid parity). This is driven by improvements in production methods, increasing manufacturing levels to meet growing global demand, improvements in conversion efficiencies of PV modules and increasing tariffs for grid supply electricity. Compared to building a feeder line, the financial viability of remote stand-alone renewable electricity technologies improves with distance from the distribution network.

Government policies have a significant impact on adoption of renewable electricity systems in residential and commercial settings. Countries less well endowed than New Zealand with renewable electricity resources at the national level have higher electricity generation costs due to reliance on non-renewable fossil fuels which also incur carbon emission charges. Many of these countries (63 in April 2010)⁸ encourage the installation of small scale renewable electricity generation through incentives such as feed-in tariffs where consumers who generate electricity are paid for any excess they export to the grid. There are several nuances and variations from country to country but typically rates paid for exported electricity range from one to three times those for imported electricity. Some countries are reducing or removing incentives as they reach planned targets for PV penetration and the cost of PV generated electricity approaches grid parity.⁹

Successive New Zealand governments have not supported incentives such as feed-in tariffs for small scale renewable electricity installations because this country has abundant renewable electricity resources at the national level. Therefore growth in small scale renewable electricity systems, and demand for the associated trade skills, will be determined by normal free market forces under a business as usual scenario.

⁸ <http://www.solar-facts-and-advice.com/feed-in-tariffs.html>

⁹ <http://energybusinessdaily.com/renewables/solar-power/european-solar-subsidies-being-rolled-back/>

2.4 Timing of demand growth for renewable electricity systems

Based solely on economics, increased uptake of PV installations would not be expected until grid parity is reached. However as evidenced by the following figures, other benefits motivate many consumers to adopt renewable electricity systems and they are prepared to pay a premium for them.

- There has been a steady increase in installations of photovoltaic and other renewable energy systems since prior to 2007.¹⁰
- “GreenPower in Australia has achieved a market penetration of around 350,000 customers (4.5 percent of households) at a price premium of approximately 15%, ...”¹¹ GreenPower is a system whereby electricity produced from renewable sources is sold over the national grid. In New Zealand, a report in 2007 stated “Research has shown that the percentage of environmentally driven consumers in New Zealand increased from 26% in 2005 to 32% in 2007 ...”¹²

Appendix A discusses results from research of published projections of grid and PV generated electricity costs in cents per kWh to the year 2030. Depending on the weighting placed on many variable factors influencing the price of both grid tariffs and PV generation costs, there is wide variance in the predicted timing of grid price parity. This is demonstrated by predictions from the two New Zealand organisations with arguably the greatest focus on the subject – SEANZ and the Energy Efficiency and Conservation Authority (EECA). SEANZ predicts grid parity for small scale (less than 10kW) PV systems in 2013 and EECA makes a more conservative prediction of

2020. It should be noted that EECA’s predication is based on the assumption that there won’t be any major technology breakthroughs.

Globally, Italy and Hawaii have reached grid parity and other countries with high sunshine hours and heavy reliance on fossil fuels for electricity generation are close to it. Southern California has now reached grid parity with peak electricity prices and many European countries and southern states in the USA expect to reach grid parity before 2015.^{13,14}

Although an increase in renewable electricity installations can be expected as grid parity approaches, there are already a growing number of installations occurring. These are mainly carried out by self-taught installers as described in Section 2.2.

From the above discussion and figures presented in Appendix A, demand for renewable electricity installations can be expected to increase during 2012 in tandem with the approach of grid parity and beyond.

¹³ <http://www.twst.com/yagoo/zaman15.html>

¹⁴ <http://energybusinessdaily.com/renewables/solar-power/european-solar-subsidies-being-rolled-back/>

¹⁰ New Zealand Ministry of Economic Development Report : Assessment of the Future Costs and Performance of Solar Photovoltaic Technologies in New Zealand <http://www.med.govt.nz/upload/67238/PV%20in%20New%20Zealand.pdf>

¹¹ Hydro Tasmania report to EECA “Grid Connected Domestic And Small Scale Renewables In New Zealand Business As Usual Uptake Projections To 2030” – April 2007

¹² Moxie Design Group (2007). *Understanding the market for sustainable living: The growth in the New Zealand solution seekers demographic; new market research*, Feb 2006

2.5 Predicted numbers of renewable electricity installers

The Australian experience provides an indication of an upper bound for the number of renewable electricity installers requiring training. Demand in Australia was artificially boosted by attractive grid tariff incentives unlikely to be introduced in New Zealand. However, as grid price parity is approached and exceeded under the New Zealand business as usual model, economics alone will incent consumers to have renewable electricity systems installed. It seems reasonable to then expect the number of installations per capita to follow the Australian trend with several years lag.

In Australia,¹⁵ the Electrotechnology Training Package administered by the ElectroComms and Energy Utilities Industry Skills Council (EE-OZ) has a total of ten qualifications in

sustainable/renewable energy ranging from level 2 certificates to advanced diplomas. There are three certificates at level 4 which is the first level where entry is restricted to registered electrical workers. Of these, the course mostly taken by electricians is UEE42009: –Certificate IV in Electrical – Photovoltaic Systems. This course which includes grid connect, is 1 year long and requires 300 hours of off-job study. Currently there are around 200 trainees on this course in Queensland and approximately 1000 across the continent. This represents around 5 percent of the 20,000 electrical trainees in Australia. Translating this proportion to New Zealand with around 3000 electrical trainees at any time, there is potential to have up to 150 trainees per cohort on a similar qualification

¹⁵ From John Shearston, Programme Manager, Electrotechnology, EE-Oz Industry Skills Council – November 2009

2.6 Current supply and qualifications of renewable electricity installers

Currently only a small number of businesses specialise in the design and installation of small scale renewable electricity systems. SEANZ lists ten members as designers and installers for PV systems. Of these, seven also design and install wind and micro-hydro systems. Most are solo operators. One company mentions having 22 installers throughout New Zealand.

The level of formal training of renewable electricity installers in New Zealand is low. Some are trained by equipment suppliers but many installers are self taught.

Renewable electricity standards that apply in New Zealand and Australia define the minimum requirements to meet desired levels of quality, performance and safety. Currently there is no way of verifying that practitioners are referring to, or are even aware of the standards, listed on the SEANZ website.¹⁶

Prior to 2011 the only formal renewable electricity trades training available in New Zealand was the Certificate in Applied Technology (Renewable Energy) offered by the Southern Institute of Technology (SIT). This and a subset course for SEANZ accreditation, draws on several Australian competency units. However it only covers work on stand-alone extra low voltage (ELV, <50Vac, <120Vdc) systems that unregistered (electrical) people can carry out. It does not cover prescribed electrical work (PEW), like grid connection and low voltage (LV, 50-1000Vac, 120-1500Vdc).

The full SIT course has not run for two years due to lack of demand. The shorter SEANZ accreditation course is attended by both electrically registered and non-registered participants. Non-registered students can obtain provisional SEANZ accreditation which commutes to full accreditation after a period of on-job experience and submission of case studies. This course typically has 15 starters but few completions.

¹⁶ <http://www.seanz.org.nz/standards>

2.7 Future supply (shortfall) requirements of renewable electricity Installers

From previous sections, it is apparent that with the approach of grid parity and beyond, supply of competent renewable electricity workers will significantly fall short of demand. This shortfall is likely to be around 150 people per year.

As public demand for renewable electricity systems increases, and awareness of the need for competent workers in the industry

grows, a system for training and recognised certification of competency will be needed. Although an estimated timing for grid price parity of 2013 is considered optimistic by some, installations have been occurring over several years and the early adopter effect experienced in Australia with uptake of GreenPower (see Section 2.4) is likely to lead to demand for competent installers increasing from 2012.

2.8 Decision drivers on potential students

For reasons discussed below, there are currently no drivers for potential students to study the National Certificate in Renewable Energy (Level 4).

New Zealand is at the early adopter stage of the life cycle for small scale renewable energy systems. Typical to this stage, installations are often performed by self-taught installers who have limited design knowledge and construction skills. Alternatively, workers skilled in their underpinning trade such as electricians become involved through PEW associated with renewable electricity installations and carry out the whole installation without any training in renewable electricity systems. Both situations result in problems caused by poor system design and installation; giving the industry a bad name and deterring potential customers.

There will be no incentive to change this scenario until:

- some form of certification of competency is in place for renewable electricity workers
- there are reasons why holding a certificate of competency is considered essential by renewable electricity workers
- there is public awareness of the certification of renewable electricity competence.

In comparison, the Clean Energy Council, Australia's nearest equivalent to SEANZ

operates a highly successful programme with over 4500 accredited installers.¹⁷ This is because "To be eligible for government incentives such as RECs, solar credits and feed-in tariffs the installer must be accredited by the Clean Energy Council". Similar motivation for accreditation is not available in New Zealand because there are no government backed incentives for installation of small scale renewable electricity systems.

For renewable electricity systems there are currently two schemes that give some recognition of competency, neither of which is well known to the public.

The first way is to apply for registration with the Electrical Workers Registration Board (EWRB) as an Electrical Installer – renewable energy systems of electrical supply.¹⁸ However, this registration category is not considered effective as a method of certification of renewable electricity competency for the following reasons.

1. Electrical Installer – renewable energy systems of electrical supply is a limited registration class designed to allow workers to do limited PEW associated only with renewable electricity systems. The class is only concerned about electrical safety and does not certify competency in the renewable energy technology.

¹⁷ <http://www.solaraccreditation.com.au/acccec/home.html>

¹⁸ <http://www.ewrb.govt.nz/content/public-register.html>

2. EWRB's jurisdiction covers the electrical safety and not renewable electricity system knowledge.
3. Other electrical registration classes of Inspector, Electrician and Electrical Engineer can perform all types of PEW and can effectively install renewable electricity systems without any training in the technologies.
4. Renewable electricity workers do not need to be registered if they use a registered electrical worker to perform the PEW associated with the renewable electricity installation.
5. Renewable electricity workers do not need to be registered if PEW is not involved in the installation.

The other method of recognition is an accreditation scheme operated by SEANZ. This is modeled along the lines of the Australian Clean Energy Council accreditation but does not carry the weight of a government authority scheme and is not sought after by renewable electricity installers.

Discussions to establish and publicise a reputable certification scheme are underway with EECA, EWRB and SEANZ.

3 Existing Courses, Qualifications, Registrations and Accreditations

3.1 Current renewable/sustainable energy trades training in New Zealand

Table 2 lists the results of a survey of available training related to trade knowledge and skills required for design, installation, commissioning and servicing sustainable energy techniques and technologies in the built environment. In addition, some suppliers occasionally offer product specific workshops.

Table 2 Current trade training courses in renewable energy

Topic area	Course provider	Course title	Training provided
Electrical efficiency	Electrical Contractors Association of New Zealand (ECANZ)	Ecosmart	Upskills electricians to assess client's energy requirements and recommend the most appropriate and efficient technology solution. Duration: Several 4-hour sessions led by product suppliers.
Electricity generation from renewable energy	Southern Institute of Technology (SIT)	Certificate in Applied Technology (Renewable Energy) (Level 4)	Training in the renewable electricity field for a range of mid level management, system design and installation (extra low voltage only), or promotional and marketing roles. No employment or work experience is required to complete the programme. Duration: 1 year full time
Electricity generation from renewable energy	ETITO & ESITO	Certificate in Renewable Energy (Level 4)	Training in design, installation, commissioning and servicing small scale stand alone and grid connected renewable electricity generation systems. Elective strands for PV, wind, mini-hydro and design. Includes on-job and off-job training. Duration: 1 year full time
Solar water heating	Southern Institute of Technology (SIT)	National Certificate in Solar Water Heating Installation (Management, Selection and Specification) (Level 5)	For licensed plumbers, and non-plumbers employed in sales, contract management roles, or technical positions wishing to gain experience in the field of installation, design and management of solar water heating installations (plumbing components only). The full National Certificate is restricted to Licensed Plumbers. Components of the National Certificate can be attained by non licensed plumbers. Duration: Distance learning theory and assessment, plus a 5-day block course covering theory and practical elements.

Table continues next page.

Solar water heating	Wellington Institute of Technology (Weltec)	Short course certificate in solar hot water installation (Level 4)	For licensed plumbers and gasfitters. Install, test, commission and maintain solar hot water heating systems Duration: Self directed study and 3 days practical.
Solar water heating	Waikato Institute of Technology (Wintec)	Short course certificate in solar hot water installation (Level 5)	Provides a recognised industry installation certificate for solar water heating systems. Duration: 60 hours in total composed of 40 hours self directed study and 20 hours practical.
Sustainable energy knowledge	Wairariki Institute of Technology	Diploma in Sustainable Energy, Level 5	Creates the awareness of the social, cultural, global and environmental impacts of renewable energy technology and the principles of sustainable development. Provides knowledge and skills required for employment within the operational areas of renewable energy producers, retailers and users. Duration: 1 year full time or part-time equivalent
Water efficiency	Master Plumbers, Gasfitters & Drainlayers NZ	GreenPlumbers®	Topics: Efficient Use of Water — general background, Energy Efficiency and the Environment, Hot Water from the Sun, Water Conservation—Technology and Solutions, Heat Pump Water Heating Duration: Five 4-hour workshops for accreditation as an EcoPlumber.

3.2 Other renewable/sustainable energy courses in New Zealand

Table 3 is a representative list of energy management training available in New Zealand.

Table 3 Energy management courses available in New Zealand

Provider	Topic	Course type	Target Market	Associated Qualifications
Canterbury University	Energy engineering	Part of 3 or 4-year full time course	Mechanical engineering students	Part of B.Sc.
EECA	General energy management	1-day or less	Target industries	N/A
Energy Link	Introduction to the electricity market, gas market; nodal pricing, hedging	1-day courses Flyer (2010)	Energy supply industry	N/A

Table continues next page.

Energy Management Association of New Zealand (EMANZ)	Commercial Building Energy Specialist	Short course	Engineers and technicians who specialise in improving energy efficiency in commercial buildings	NA Accreditation available Level 5-7
Energy Management Association of New Zealand (EMANZ)	Facilities Management Energy Efficiency	Short course	Facilities Managers, Building Managers	NA Accreditation available Level 5-6
Otago University	Energy management and energy studies	Part of 3 or 4-year course	Science students	Part of B.Sc. or B.App.Sc.
Schneider Electric — "Energy University"	General introduction to energy efficiency	Online education resource	From introductory to advanced	N/A
Southland Institute of Technology	Energy auditing, energy efficient building design, sustainability	Part of 1-year full-time course	Secondary school leavers	Certificate in Applied Technology in Renewable Energy
Waikato University	Compressed Air Systems — Education course for prospective auditors	Short course	Compressed Air Auditors	CAS Auditor accreditation for the Electricity Commission's Compressed Air Systems Auditor Accreditation Scheme

3.3 Accreditations for recognition of sustainability energy competency

3.3.1 Electricity generation

As previously discussed, (SEANZ)¹⁹ operates a competency based accreditation programme for design and installation of small scale PV, wind and micro-hydro schemes in stand-alone and grid connected configurations. SIT offers all of the required modules for stand-alone or grid connect accreditation through a programme of distance learning plus a 3-day practical workshop in Invercargill. The course is adopted from an early version of requirements for accreditation by the Australian Clean Energy Council and incorporates several Australian competency units.

Elective strands for accreditation are as follows.

Standalone Power Systems— Install
 Standalone Power Systems — Design
 Standalone Power Systems — Design and Install
 Grid Connect Systems — Install*
 Grid Connect Systems — Design
 Grid Connect Systems — Design and Install*

**Grid-connection options involve PEW and are only available to registered electrical workers.*

When introduced, the National Certificate in Renewable Energy (Level 4) will be recognised for SEANZ accreditation.

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<http://www.seanz.org.nz/>

3.3.2 Solar water heating

The Solar Industries Association operates an “accredited solar water heating retailer”²⁰ register of its members that meet the association’s standards.

An accredited solar water heating retailer will:

- describe to the consumer the different models of solar water heating that are available
 - outline the risks of overheating or freezing of different models
 - help the consumer choose the model that is best suited to their specific application
 - obtain from the consumer their hot water requirements
- specify the system design characteristics (storage tank design, supplementary heating controller, freeze protection, handling any hot water discharge)
 - discuss alternative locations for installation (some roofs may require an elevated frame to improve orientation and inclination)
 - provide information on indicative energy performance
 - enter into an agreement to supply the system, obtain the building consent on the consumer’s behalf, arrange for the system to be installed according to the consent conditions and commission the system for optimal energy performance.

²⁰ <http://www.solarindustries.org.nz/>

3.3.3 Energy management and auditing

Detailed information relating to achieving the following accreditations offered by EMANZ can be found on its website.²¹

- Energy Specialist (Lighting)
- Energy Specialist (HVAC)
- Commercial Buildings Energy Specialist
- Energy Manager (Facilities)
- Energy Auditors
- Compressed Air Systems Auditor

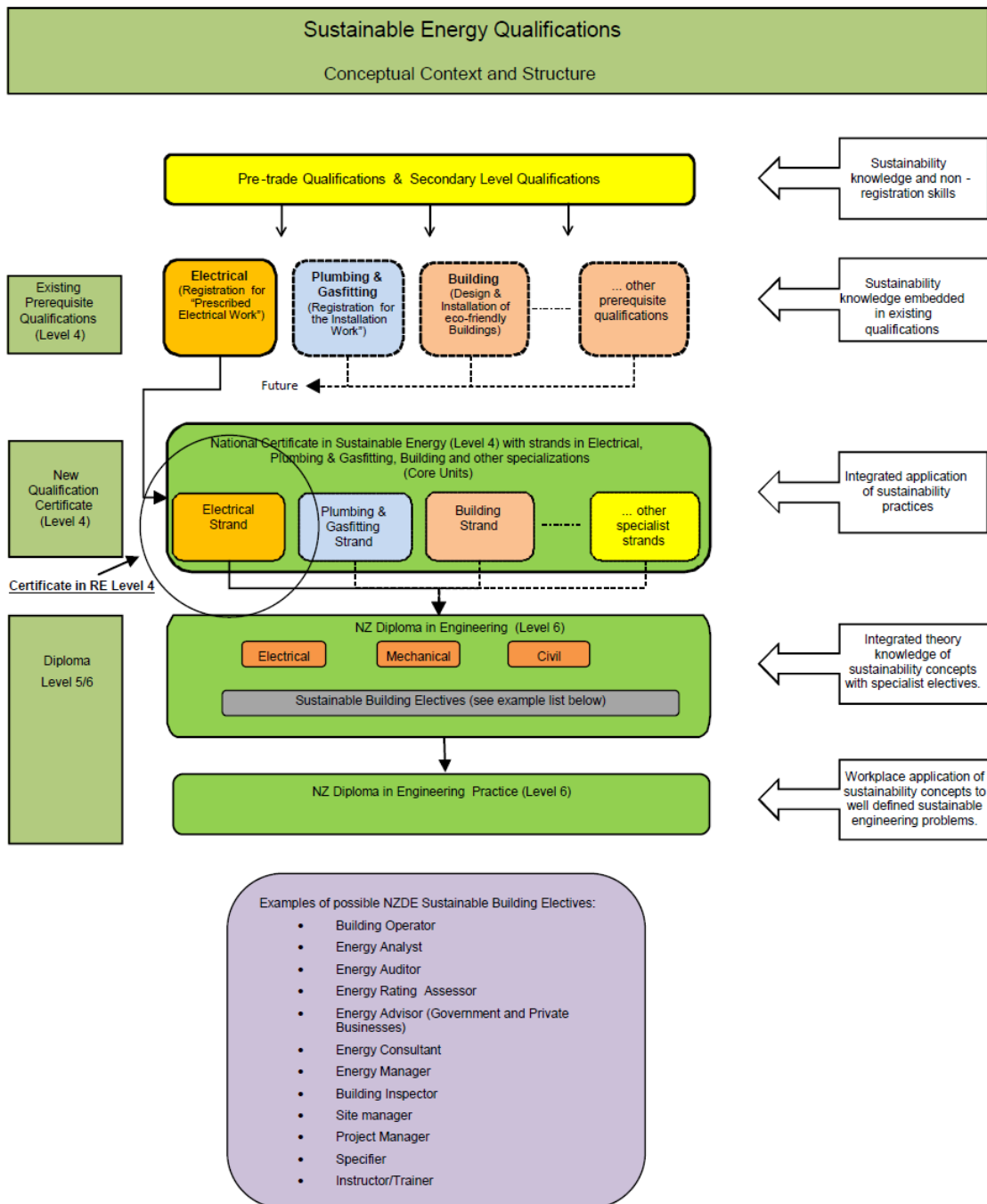
²¹ <http://www.emanz.org.nz/>

4 Proposed Sustainable Energy Trades Training Structure

Figure 1 is a conceptual framework around sustainable energy trades training. Salient points are:

- sustainable energy trades training is positioned as an extension of skills at the same level (4) as their base trade qualifications
- entry to sustainable energy courses will normally be from a specific trade background although others may enter if they meet prerequisite knowledge requirements
- the structure allows for cross-trade training if necessary at level 4
- potential progression to the National Diploma in Engineering and other sustainable energy career options.

Figure 1 Proposed structuring of sustainable energy qualifications



5 National Certificate in Renewable Energy (Level 4)

5.1 Certificate structure

The National Certificate in Renewable Energy (Level 4) augments existing trade skills with the practical skills and knowledge required to design, install, commission and maintain small scale renewable electricity generation systems in residential and commercial settings. For those wishing to increase career options, it also provides a pathway into higher qualifications such as the NZDE or into other specialist renewable energy roles.

The certificate's structure, depicted in Figure 2, with units listed in Table 4 is composed of common core subjects and four elective strands covering respectively: PV, wind energy conversion, micro-hydro generation and design. The three technology specific strands of the National Certificate in Renewable Energy (Level 4) include on-job elements. Credits by strand are shown below

Strand	PV	Wind	Mini-hydro	Design
Credits	129	106	97	137

Figure 2 Structure of the National Certificate in Renewable Energy (Level 4)

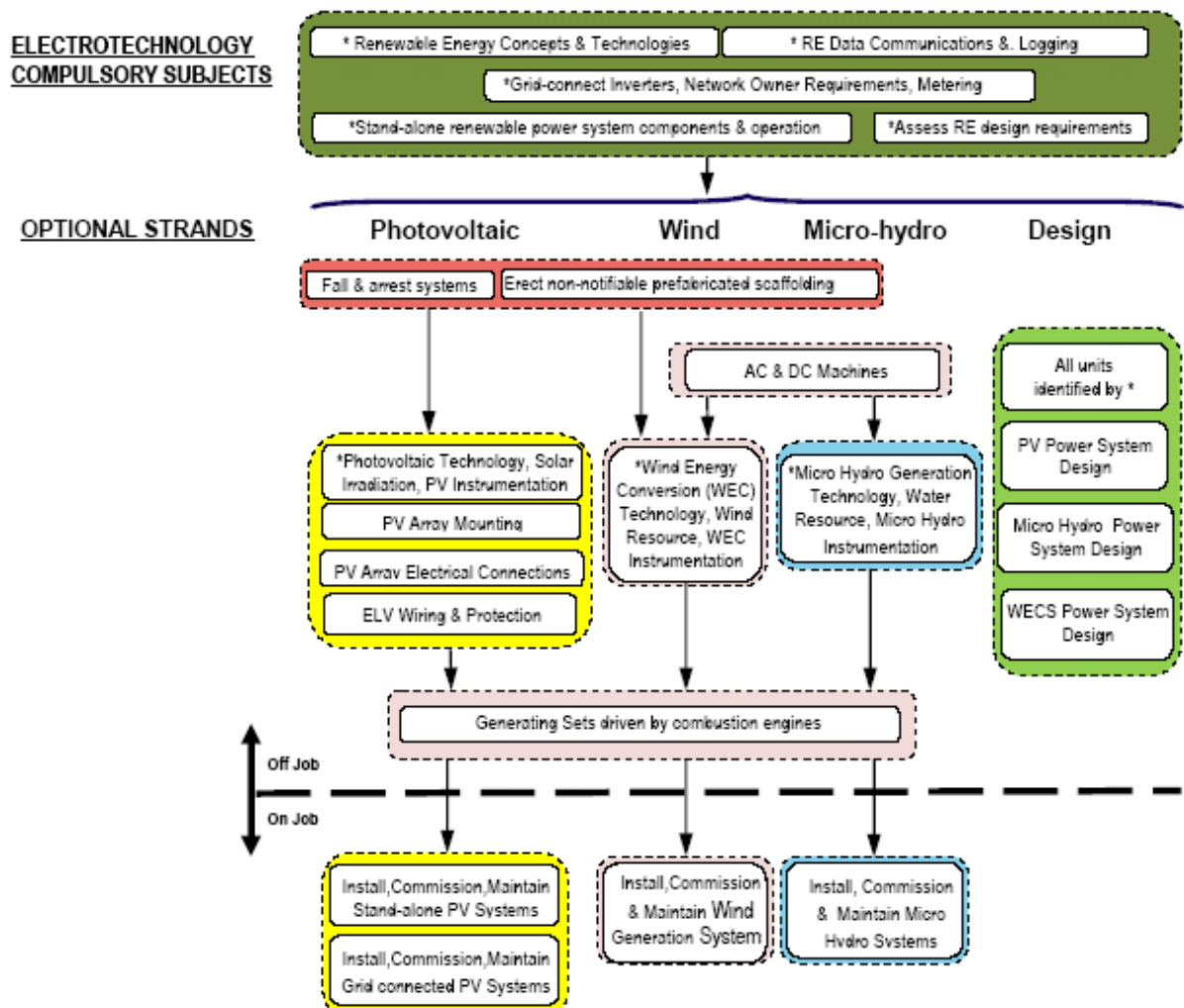


Table 4 Unit standards in the National Certificate in Renewable Energy (Level 4)

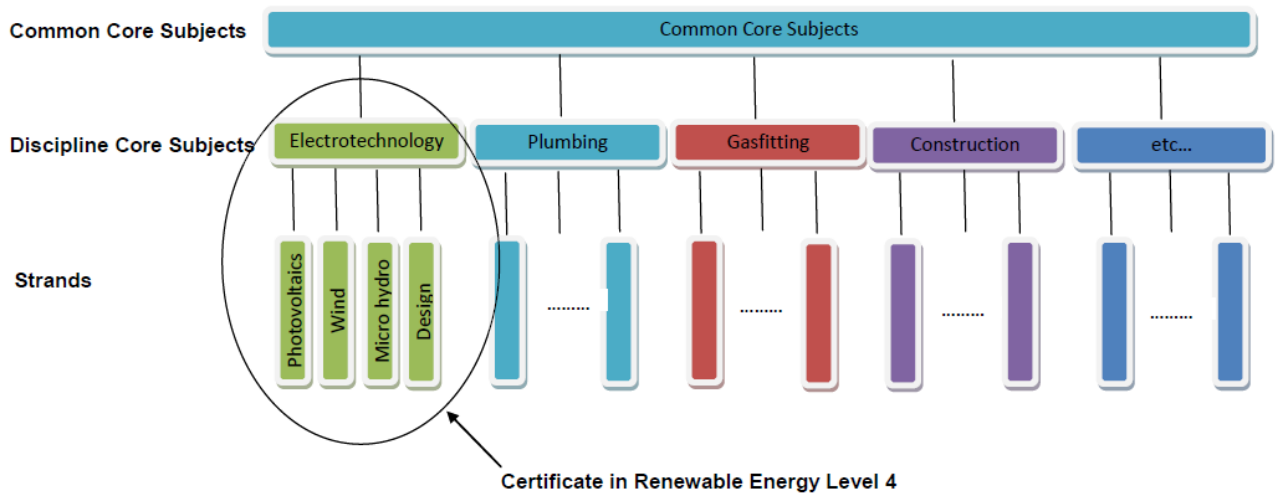
COMPULSORY CORE SUBJECTS		Credits
27428	Demonstrate knowledge of grid-connect Renewable Energy System components, owner requirements and metering	5
27433	Demonstrate knowledge renewable energy concepts and technologies	10
27434	Demonstrate and apply knowledge of Renewable Energy design requirement assessment	7
27435	Demonstrate and apply knowledge of Data Communications and Logging for Renewable Energy Systems	5
27436	Demonstrate and apply knowledge of stand-alone Renewable Energy System components and operation	15
		42
PHOTOVOLTAIC ELECTIVE STRAND		
9184	Erect non-notifiable prefabricated scaffolding,	5
10783	Install, commission, and maintain generating sets driven by combustion engines	10
15757	Employ fall arrest systems on building and construction sites	4
27427	Demonstrate and apply knowledge of Extra-Low Voltage requirements and testing for small scale Renewable Energy Systems	15
27432	Demonstrate knowledge of Photovoltaic arrays mounting requirements	5
27439	Demonstrate knowledge of photovoltaic technology	10
27440	Install, commission and maintain grid connected PV power systems	15
27442	Install, commission and maintain stand-alone PV power systems	20
27444	Demonstrate knowledge of requirements for connecting photovoltaic arrays	3
		87
WIND GENERATION ELECTIVE STRAND		
9184	Erect non-notifiable prefabricated scaffolding,	5
10783	Install, commission, and maintain generating sets driven by combustion engines	10
15757	Employ fall arrest systems on building and construction sites	4
27426	Demonstrate knowledge of d.c. and a.c. machines used for small scale Renewable Energy Systems	5
27441	Install, commission and maintain wind energy conversion systems	25
27443	Demonstrate knowledge of wind energy conversion systems	15
		64
MICRO HYDRO GENERATION ELECTIVE STRAND		
10783	Install, commission, and maintain generating sets driven by combustion engines	10
27426	Demonstrate knowledge of d.c. and a.c. machines used for small scale Renewable Energy Systems	5
27429	Demonstrate knowledge of micro hydro systems	15
27437	Install, commission and maintain micro hydro systems	25
		55
DESIGN ELECTIVE STRAND		
27439	Demonstrate knowledge of photovoltaic technology	10
27443	Demonstrate knowledge of wind energy conversion systems	15
27429	Demonstrate knowledge of micro hydro systems	15
27431	Design Photovoltaic Power Systems	20
27430	Design Wind Energy Conversion Systems	20
27438	Design Micro Hydro Systems	15
		95

5.2 Scope for additional strands in other trades

The structure of the level 4 certificate has the flexibility to be expanded if required to accommodate further subject areas. For example, Figure 3 indicates a possible expansion following the model of the NZDE which has common core subjects, discipline core subjects and optional strands within disciplines. Potentially there might also be strands across more than one discipline.

The suggested expanded framework also aligns with the government's aim of amalgamating similar qualifications. If other strands for other technologies are added to this qualification it would be better named "National Certificate in Sustainable Energy" because "renewable energy" tends to point only to energy generation.

Figure 3 Expansion of the National Certificate in Renewable (Sustainable) Energy (Level 4)



5.3 Registration implications for some strands

Some units of the National Certificate in Renewable Energy (Level 4) include the performance of PEW requiring electrical registration. Electrical registration is not required for the design strand which is suitable for people working as designers, specifiers, and in sales.

Classes of electrical registration permitted to carry out PEW are: electrical inspector, electrician, and electrical engineer. In addition, there is a category of registered Electrical Installer of renewable energy systems of electrical supply. This category is limited to work that is no more than 10kVA

capacity and connected to a standard low voltage installation.²²

Other trades such as plumbing and gasfitting also require registration. Given this, it is likely that any qualifications developed in these disciplines will also require registration or training towards registration in their conditions of study.

²² http://www.ewrb.govt.nz/content/board-rules/ROB_%20Classes%20of%20Reg.pdf

5.4 Career progression

Section 4, Figure 1 includes examples of career possibilities in sustainable energy roles. For example: building operator, energy analyst, energy auditor, energy rating assessor, energy advisor (government and private businesses), energy consultant, energy manager, building inspector, site manager, project manager, specifier, instructor/trainer. These roles will require additional training, experience, and in some cases, accreditation or registration to perform. Training for some of these roles is covered by courses listed in Tables 2 and 3.

People who want to pursue a higher level qualification and become technicians after completing the Diploma in Renewable Energy (Level 4) will normally progress to the Electrical Discipline — Power Specialisation programme in the NZDE.²³ This 2-year full time equivalent programme currently has one elective unit specifically addressing sustainable energy generation.²⁴ However sustainability is a theme throughout the course, and the project²⁵ carried out in the final year provides an opportunity to focus on renewable energy. The possibility of adding other renewable energy options to the programme is under investigation.

The National Engineering Education Plan (NEEP)²⁶ that informed development of the NZDE contained two career progression models²⁷ relevant to this discussion. Both models depict technical deepening on the vertical axis and managerial/leadership development on the horizontal axis. The National Certificate in Renewable Energy (Level 4) would sit at level 4 in both models.

Figure 4 depicts the Trades Model of progression for those who elect to continue operating within their trade environment. It indicates the main opportunities for progression would be in increasing leadership, management and business roles as experience is gained.

Figure 5 depicts the Career Model to describe progression possibilities for those who elect to advance to higher qualifications. As for the Trades Model, the horizontal axis indicates increasing leadership, management and business roles with experience. The vertical axis indicates technical deepening as higher level qualifications are gained. The first step following the National Certificate in Renewable Energy (Level 4) would be the NZDE as referred to above.

²³ <http://www.engineer.org.nz/nzde-home-page>

²⁴ DE6410 Generation and sustainable energy

²⁵ DE6499 Engineering Project (Electrical) Level 6

²⁶ http://www.ipenz.org.nz/ipenz/education_career/neep.cfm

²⁷ Courtesy of the Institute of Professional Engineers on New Zealand (IPENZ)

Figure 4 Trades model of career progression

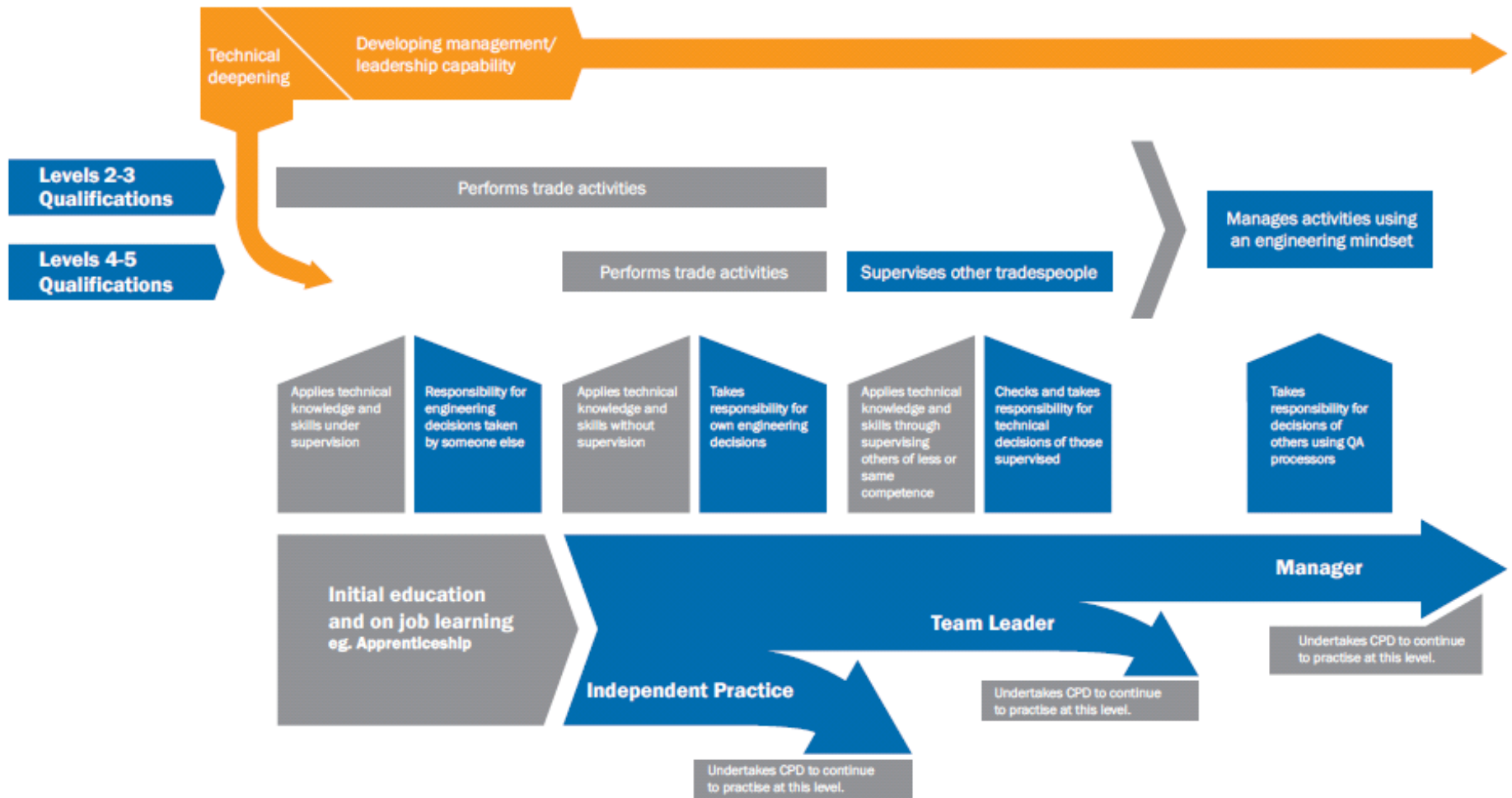
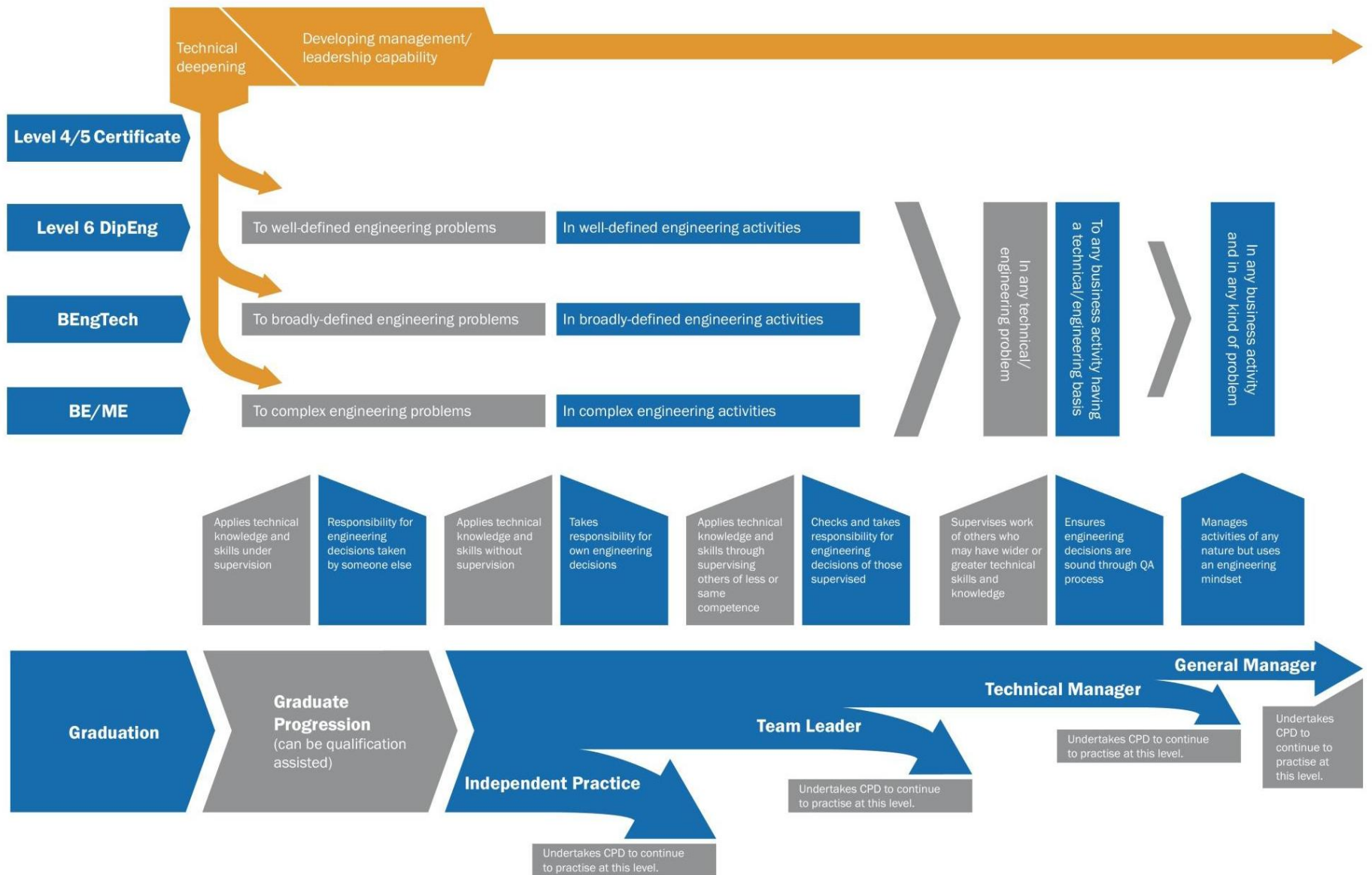


Figure 5 Career model to higher qualifications



6 Compatibility analysis against international best practice

6.1 Global trade training in sustainable energy

Most developed countries provide trades training in sustainable energy subjects. However it would not serve a useful purpose to compare them with New Zealand due to the disparity between so many variables

such as technical standards, building codes, electricity systems, work practices, and training methods. The one exception is Australia where there is a high degree of commonality with New Zealand.

6.2 Compatibility with Australian qualifications and accreditation

The transferability of occupations between New Zealand and Australia is legislated by New Zealand and Australian trans-Tasman mutual recognition acts which mirror each other.²⁸

Clause 16 (1) of the Australian Act states: “16 Entitlement to carry on occupation

(1) The Trans-Tasman mutual recognition principle is that, subject to this Part, a person who is registered in New Zealand for an occupation is, by virtue of this Act, entitled after notifying the local registration authority of an Australian jurisdiction for the equivalent occupation:

- (a) to be registered in the jurisdiction for the equivalent occupation; and
- (b) pending such registration, to carry on the equivalent occupation in the jurisdiction.”

This is mirrored by Clause 15 of the New Zealand Act.

There is almost 100 percent compatibility between Australian and New Zealand standards for work in electrical and renewable energy industries. It is therefore important that competencies attained from a New Zealand qualification are compatible with Australian requirements.

Compatibility was analysed between the National Certificate in Renewable Energy

(Level 4) and three categories of recognition in Australia.:

1. Similar qualifications in the Australian Electrotechnology Training Package²⁹
2. Grid connected PV skill sets identified in the Australian Electrotechnology Training Package.
3. Requirements for the Australian Clean Energy Council accreditation.³⁰

Details of the mapping method used and supporting tables are contained in Appendix B. Results are summarized in Table 5.

A high degree of compatibility was expected because, as a starting point, initial drafts of the New Zealand units were based on Australian essential knowledge and skills (EKAS) requirements. Some units were then modified or augmented with additional evidence requirements on recommendations from New Zealand industry representatives consulted during course development. The New Zealand units therefore tend to carry more rather than less requirements than in EKAS.

As indicated in Table 5, there is almost complete compatibility with the Australian

²⁸ Trans-Tasman Mutual Recognition 1997 (New Zealand) — http://www.legislation.govt.nz/act/public/1997/0060/latest/whole.html?search=qs_act_crimes_resel#d1m411289

Trans-Tasman Mutual Recognition 1997 (Australia) - <http://www.comlaw.gov.au/Details/C2004A05284>

²⁹ Electrotechnology Training Package UEE07, Volume 2 Part 2.1K, Section K – Renewable and Sustainable Energy. http://elt.ee-oz.com.au/files/UUEE07%20V3.1/K_Re%20Sus%20En%20Units.pdf

³⁰ http://www.solaraccreditation.com.au/dms/cec/accreditation/Pathways-091021/CleanEnergyCouncilAcceidiationPathway_v3.pdf

recognitions. However four subjects are not covered to the same depth in the National Certificate in Renewable Energy (Level 4).

These are:

- there is no strand for hybrid energy systems in the initial version
- there is no strand for biofuels in the initial version although biofuels are introduced
- lamp properties, luminaire design, and lamp selection are not specifically identified but would be addressed to some degree when assessing energy requirements.
- vegetation control for PV arrays.

Table 5 Compatibility of the National Certificate in Renewable Energy (Level 4) with Australian recognitions

Australian Recognitions	New Zealand renewable electricity qualification (initial version) compatibility
Qualifications	
UEE41907 Certificate IV in Electrical – Renewable Energy <i>Select, install, set up, test, fault find, repair and maintain electrical systems and equipment in buildings and premises. It includes ERAC requirements for an ‘Electrician’s license’ and competencies to select, install, set up, test, fault find, repair and maintain renewable electricity equipment and systems.</i>	Completely matched with the following exceptions: 1. Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate. 2. Lamp properties, luminaire design, and lamp selection are not specifically identified.
UEE42009 Certificate IV in Electrical — Photovoltaic Systems <i>Select, install, set up, test, fault find, repair and maintain electrical systems and equipment in buildings and premises. It includes ERAC requirements for an ‘Electrician’s license’ and competencies to select, install, set up, test, fault find, repair and maintain photovoltaic systems and associated equipment.</i>	Completely matched with the following exceptions: 1. Gas metering 2. Vegetation control for PV arrays
UEE41607 Certificate IV in Renewable Energy <i>This qualification provides competencies to select, install, commission, fault find and maintain multiple renewable energy sources and equipment for control of energy use.</i>	Completely matched with the following exception: 1. Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate.
Skill Sets	
PV grid connect designer	Completely matched
PV grid connect installer	Completely matched with the following exception: 1. Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate. 2. Vegetation control for PV arrays
PV grid connect designer and installer	

Table continues next page.

Clean Energy Council Accreditations	
Stand-alone Power System Design	Completely matched with the following exceptions: <ol style="list-style-type: none"> 1. Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate. 2. Lamp properties, luminaire design, and lamp selection are not specifically identified. 3. Vegetation control for PV arrays
Stand-alone Power System Install	
Stand-alone Power System Design & Install	
Grid Connect Design	Completely matched
Grid Connect Install	Completely matched with the following exception: <ol style="list-style-type: none"> 1. Vegetation control for PV arrays
Grid Connect Design & Install	
Hybrid	Not completely matched because Hybrid energy systems are not currently included in the National Certificate in Renewable Energy (Level 4)
Micro-Hydro	Completely matched
Small Wind	Completely matched

7 Qualification Provisioning Structure

7.1 New Zealand Qualifications Authority

All national qualifications and assessment units are registered on the NZQF³¹ administered by NZQA. Units are indexed in a hierarchical structure composed of fields, subfields and domains. A new subfield and domains were created to accommodate new renewable energy assessment units. The NZQF hierarchy for the National Certificate in Renewable Energy (Level 4) is as follows.

³¹ <http://www.nzqa.govt.nz/framework/explore/index.do>

Field: Engineering and Technology
Subfield: Renewable Energy Systems
Domains: Renewable Energy Systems — Design
Renewable Energy Systems — Generic
Renewable Energy Systems — Installation and Maintenance

Other domains can be added in future if needed.

7.2 Tertiary Education Commission

The TEC is responsible for funding tertiary education in New Zealand. For renewable energy trades training performed under an agreement with an ITO, the TEC will contribute to course costs through Standard Training Measure (STM) funding.

For renewable energy training not under an agreement with an ITO, the TEC will contribute to course costs through Effective Full Time Student (EFTS) funding.

7.3 Industry Training Organisations

ITOs are the standard setting bodies for trades training. The National Certificate in Renewable Energy (Level 4) was developed in collaboration with ETITO,³² ESITO³³ and a renewable electricity industry advisory

³² <http://www.etito.co.nz/>

³³ <http://www.esito.org.nz/>

group. ETITO has primary coverage of the qualification and both ETITO and ESITO are approved to assess units in the Renewable Energy Systems subfield.

Other ITOs may become involved if renewable energy units are developed for other technologies and trades

7.4 Industry training providers

ITPs deliver the off-job components of trades training qualifications. The number of ITPs offering any particular course is dependent on demand from students.

ITP arrangements and preparations for delivering the National Certificate in Renewable Energy (Level 4) will not be confirmed until there is confirmed demand

for the qualification (see section 2.8). Four potential providers identified to date are: SIT in Invercargill, CPIT in Christchurch, Wintec in Hamilton, and Waiariki in Rotorua. There may be others. This will replace the Certificate in Applied Technology (Renewable Energy) (Level 4) SIT currently offers.

7.5 Private training establishments

PTEs are also potential providers of courses. However, these organisations which are typically smaller than ITPs could have

difficulty developing the training resources required to achieve accreditation to offer the course.

7.6 Trade associations

Trade associations and peak bodies represent their industry sectors. They determine training needs within their sectors

and contribute expertise to course developments and reviews. Some assist with funding of training programmes.

7.7 Industry employers

Employers are responsible for ensuring trainees achieve the on-job training requirements of the qualification.

7.8 Fulfillment requirements

To gain accreditation to offer a course, a training provider must meet certain conditions around its ability to provide the course. These include such factors as relevant tutor qualifications, course materials and teaching aids, practical workshop facilities, assessment and moderation plans and financial viability to ensure the course runs to completion.

The three ITPs (SIT, CPIT, Wintec) that participated in development of the National Certificate in Renewable Energy (Level 4) have experience in teaching similar material and are expected to meet most requirements with minimal effort. Other ITPs may well have similar capabilities but this has not been investigated in any detail. In all cases, course materials will need to be developed specifically for the National Certificate in Renewable Energy (Level 4).

The estimated lead time for an ITP to produce course resources is between six and nine months depending on whether there is a need to “start from scratch” or existing resources are available to adapt. The latter is a possibility because early indications are that renewable electricity teaching resources already developed by EE-Oz may be made available for adaption for the New Zealand certificate.

8 Career Advice

8.1 Profile of qualifications in relation to career paths target

People studying qualifications covered by this education plan will typically be from one of the following groups.

1. Qualified in their underpinning trade and extending their competencies into renewable energy technologies.
2. Training concurrently for their underpinning trade qualification and the renewable energy certificate.
3. Have no trade qualification but have experience in installing renewable energy technologies.
4. Have no trade qualification but have sufficient prerequisite theory to undertake the course, and access to work experience requirements.

The qualifications serve to provide:

- applied knowledge and skills required to design, install and service renewable energy systems
- a platform for staircasing to higher level qualifications for those wishing to do so.

Practice license requirements, particularly in the electrical and plumbing sectors, mean there may be limitations on the work that can be performed after completion of the course

8.2 Recommended secondary school subjects in years 11, 12 and 13

For school leavers, the pathway to the National Certificate in Renewable Energy (Level 4) is via an existing underpinning trade. Therefore, the suggested school subjects are those that are recommended for students intending to enter apprenticeships in the underpinning trade category.

For electrical qualifications, students should have an interest in technology and study English, mathematics, and science or physics in years 11 and 12. ETITO³⁴ recommends that year 11 students study the following NCEA level 1 units:

English

- AS90053 Produce formal writing
- AS90054 Read, study and show understanding of extended written text(s)
- AS90055 Read, study and show an understanding of a number of short written texts
- AS90056 View/listen to, study and show understanding of a visual or oral text
- AS90060 Research, organize and present information

Mathematics

- AS90147 Use straightforward algebraic methods and solve equations
- AS90148 Sketch and interpret linear or quadratic graphs
- AS90149 Solve problems involving measurement of everyday objects
- AS90151 Solve straightforward number problems in context
- AS90152 Solve right-angled triangle problems

³⁴ Refer to "Study the right subjects" at <http://www.switchedoncareers.co.nz/im:2514/>

Science	<u>Or</u>	Physics
AS90186 Carry out practical science investigation with direction		AS90180 Carry out a practical physics investigation with direction
AS90187 Research, with direction, how science and technology are related		AS90181 Research, with direction, how physics and technology are related
AS90189 Describe properties and reactions of groups of related substances		AS 90183 Demonstrate understanding of motion in one dimension
AS90191 Demonstrate an understanding of physical systems		AS90185 Demonstrate understanding of electricity and magnetism

8.3 Pathways to renewable energy trade training from secondary school

Using the electrical trade as an example, there are several combinations for pathways from secondary school to the National Certificate in Renewable Energy (Level 4). Similar pathways with minor variations are available for other trades related to renewable energy technologies such as plumbing and gas fitting.

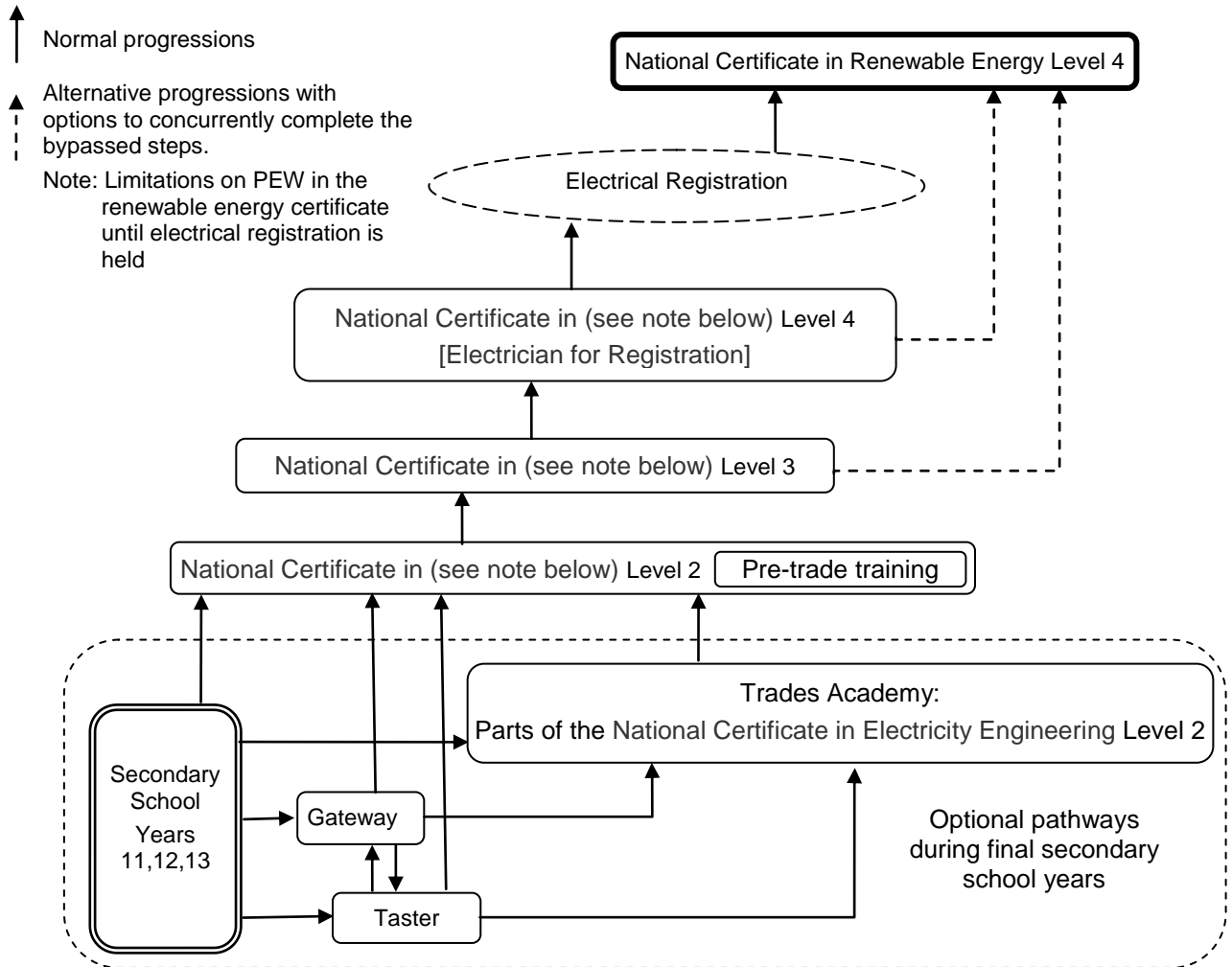
Three ways year 11-13 students can learn about the trade and gain experience are:

- ESITO Taster courses
- ESITO, ETITO, PGDRITO Gateway programmes
- trades academies

As depicted by the arrows in Figure 6, students can elect to attend any combination or none of these programmes depending on local accessibility, and their knowledge and certainty about progressing into the industry.

A brief description of each possibility follows. Details for individual trades are available from respective ITOs.

Figure 6 Pathways to the National Certificate in Renewable Energy (Level 4) from secondary school (electrical trade as example)



Note: Two national certificate streams are available for electrical qualifications. These are the:

1. National Certificate in Electricity Supply
2. National Certificate in Electricity Engineering

8.3.1 Taster courses

Free taster courses are provided throughout the country by ESITO³⁵ for school pupils and others 16 years old and over considering entry to the electricity supply industry. These

courses are typically five days long and held during school holidays. They provide an introduction to the electricity supply industry and offer the chance to gain skills, experience and knowledge of the industry.

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http://www.esito.org.nz/career_centre/industry/taster_courses.aspx

8.3.2 Gateway

Gateway programmes are available for year 11 to 13 students to gain workplace experience before entering an apprenticeship or enrolling in a pre-trade course on leaving school. They offer practical, on-the-job experience at a local workplace while the student is still at school. Students usually spend up to one day a week during the school year at a local workplace, or sometimes this workplace learning may take place in week-long blocks.

ITOs involved in renewable energy that currently offer Gateway programmes are: ETITO,³⁶ and ESITO³⁷ and PGDRITO.³⁸

³⁶ <http://www.switchedoncareers.co.nz/im:2526/>

³⁷ http://www.esito.org.nz/career_centre/career_advisors/gateway.aspx

³⁸ <http://ito.co.nz/apprenticeships/gateway-programme.aspx>

8.3.3 Trade academies

Trades academies focus on delivering trades and technology programmes to secondary school students based on partnerships between schools, tertiary institutions, ITOs and employers. Students in years 11 to 13, who are interested in a trades or technology focused career, are able to combine study towards their National Certificate of Educational Achievement (NCEA) with study towards a nationally transferable tertiary qualification at a trade academy. For example, the Wintec academy (Hamilton)³⁹ offers the National Certificate in Electrical Engineering Level 2.

Students therefore leave school having completed both NCEA and the National Certificate in Electrical Engineering Level 2. The latter qualification provides them with direct entry into the National Certificate in Electrical Engineering Level 3 as depicted in Figure 6

A full description of the role and objectives of trade academies is available from the Ministry of Education.⁴⁰

³⁹ <http://www.wintec.ac.nz/news/students-get-best-of-both-worlds.aspx>

⁴⁰ <http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/Initiatives/TradesAcademies/TradesAcademies.aspx>

8.4 Pre-trade training

Pre-trade training⁴¹ is available for school leavers and others who are not on an apprenticeship. This training route can help develop knowledge and practical skills in a particular area of work and can prepare for an apprenticeship or workplace training. It is provided through PTEs and ITPs.

Electrical pre-trade courses achieve all or part of the relative level 2 national certificates. Details of courses available can be found by searching the CareersNZ website (for electrical, search for “pre-trade electrical”).⁴²

⁴¹ <http://www2.careers.govt.nz/education-and-training/workplace-training-and-apprenticeships/pre-trade-training/>

⁴² http://www2.careers.govt.nz/education-and-training/?no_cache=1

8.5 Other articulation routes to the National Certificate in Renewable Energy (Level 4)

Conditional on meeting prerequisite requirements, people who have not followed the pathways described in Section 8.3. can also gain entry to the National Certificate in Renewable Energy (Level 4). Two categories of people who might wish to enter in this way are those:

- without a qualification, possibly self taught, who have experience in design, installation or servicing of renewable energy systems.
- with trade qualifications in a different field to the underpinning trade of the renewable energy strand they want to follow.

Electrical theory is not included in the course and therefore the main prerequisite is to have the required level of electrical knowledge (or underlying theory for other technologies if introduced). Candidates will also need to have access to on-job training. If they intend to perform PEW, which is inevitable if they intend to install or service grid-connected renewable electricity systems, they will also need to become registered electrical installers.⁴³

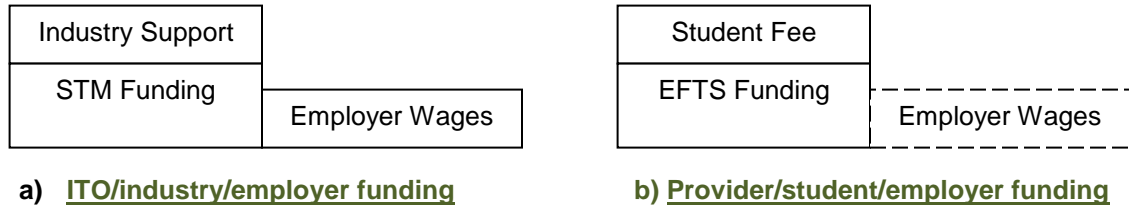
⁴³ <http://www.ewrb.govt.nz/content/public-register.html>

9 Funding

9.1 Funding model

Funding for renewable energy courses will follow established models for trade courses. These will be one of the arrangements depicted in Figure 7a) and b).

Figure 7 Funding models



9.1.1 ITO and industry funding model

This model applies to apprentices studying under an agreement with an ITO. Course costs are covered by STM funds determined and supplied by the TEC via the ITO and topped up by payments from industry. The apprentice receives wages from the employer.

9.1.2 Provider and student funding model

This model applies when providers offer courses for students who are not studying under an agreement with an ITO, such as pre-trade courses. The provider obtains EFTS funding from TEC and the student fee covers any shortfall which may be supported by a student loan or scholarship funding.

10 Implementation Plan

A series of short-term and longer term steps will be required to realise the objectives contained in this education plan. The timing of some activities will be triggered by demands yet to occur.

10.1 Current status (September 2011)

A new subfield for “Renewable Energy Systems” is in place within the Engineering and Technology field on the NZQF.⁴⁴ The subfield contains three new domains to accommodate the new and future renewable energy unit standards.

The subfield also contains the course description (NQF Ref: 1694) for the National Certificate in Renewable Energy (Level 4) with the initial four stands for PV, wind, micro hydro and design

⁴⁴ <http://www.nzqa.govt.nz/framework/explore/sub-field.do?frameworkId=1782666105>

10.2 Initial offering of the National Certificate in Renewable Energy (Level 4) course

The ITP to be first to offer the National Certificate in Renewable Energy (Level 4) is to be confirmed. SIT has indicated that if it offers the certificate, it will replace the currently offered Certificate in Applied Technology (Renewable Energy) (Level 4). Distance learning options would also be considered.

Timing of the introduction is uncertain and will be triggered by demand. As described in Section 2.8, the number of renewable electricity installations is expected to increase from 2012 but a corresponding demand for formal training is not expected to eventuate until there is a recognised certification of competency. Due to budget constraints, neither the provider nor ETITO will be committing resources to preparing course materials until demand is proven.

The following significant actions are required prior to commencement of the qualification.

<u>Action</u>	<u>Comment</u>
New subfield and domains on the NZQF	Complete
Qualification and new units on the NZQF	Complete
Confirm provider(s)	Depends on timing/demographics of demand
Introduce certification of competency	SEANZ and EECA are investigating.
Accreditation by ETITO of provider(s) to offer course	No difficulties expected due to experience of potential provider(s)
Research existing course material for adaption	Possibly from EE-Oz – to be confirmed.
Prepare course material	Six to nine months
Prepare promotional material	Three months concurrent with preparing course material
Commence course	Dependant on demand. Earliest practicable is second half of 2012.

10.3 Other developments

SEANZ has requested that a strand covering only grid-connected PV is included in the qualification. ETITO, ESITO and SEANZ have agreed to develop the new strand late in 2011 with the intention of including it in the initial offering of the course. Initial indications are that the new strand is expected to be composed of a remix of units already in the course.

A recommendation to add renewable energy options in the NZDE has been put to the New Zealand Board for Engineering Diplomas for consideration at its meeting late in 2011. The objective is to provide a more relevant pathway for people who wish to progress to a higher level qualification after completing the National Certificate in Renewable Energy (Level 4).

A recommendation will be put to the EWRB to have the National Certificate in Renewable Energy (Level 4) accepted as a qualification towards registration as an Electrical Installer – renewable energy systems of electrical supply.

The National Certificate in Renewable Energy (Level 4) is open for extension to cover other trades and technologies when respective industries consider there is a need. It is envisaged this would be achieved with additional strands as described in Section 5.2.

11 Conclusions and Recommendations

11.1 Early introduction of the National Certificate in Renewable Energy (Level 4)

Although the design, installation and servicing of renewable electricity systems is a fledgling industry in New Zealand, installations are occurring at an increasing rate. To ensure this work is competently carried out there is a need for early introduction of training towards the National

Certificate in Renewable Energy (Level 4). However without incentives to gain the qualification, preparations to offer the course will stall. It is therefore recommended that possible drivers such as student subsidies or a competency certification scheme, recommended below, are considered.

11.2 Certification of competency

The most significant conclusion from the development of this education plan is that there is a need for a recognised certification of competency in renewable electricity installation and servicing. All stakeholders consulted during development of the qualification and the Plan were enthusiastic about this concept. They also saw the development of the qualification as timely given the training vacuum that exists in this area. Accordingly many were motivated to make significant contributions to the developments. However, analysis of

drivers for potential students to take the qualification described in Section 2.8 indicates there will be little incentive to do so until a publicly recognised certification of competency is in place.

Certification of competency needs to be addressed by the industry and does not fall within the responsibility of the consortium ITOs. However, as a sector leadership initiative, the ITOs have drawn the issue to the attention of SEANZ and EECA for further consideration.

11.3 Expanded range of qualifications

The National Certificate in Renewable Energy (Level 4), additional renewable energy subfield on the NZQF, and this education plan are intended as cornerstones for future trades qualifications in the sustainable energy field.

The scope of the initial qualification is in small scale (less than 10kVA, residential, commercial) renewable electricity systems. Remaining in the trade qualification zone and the built environment, there is scope for future course developments to include:

- other renewable energy technologies such as : building-integrated photovoltaics (BIPV), solar water heating, biomass, geothermal
- larger scale electricity generation at industrial, local body and national levels
- sustainable energy systems and processes in building construction and associated trades.

12 Glossary

AC	Alternating current	PTE	Private training establishment
BCITO	Building & Construction Industry Training Organisation	PV	Photovoltaic production of electricity from light
BIPV	Building integrated photovoltaics	SE	Sustainable energy
CPIT	Christchurch Polytechnic Institute of Technology	SEANZ	Sustainable Electricity Association of New Zealand
DC	Direct current	SEDCE	Sustainable Energy in the Domestic & Commercial Environment
ECANZ	Electrical Contractors Association of New Zealand	SIT	Southern Institute of Technology
EE	Energy efficiency	STM	Standard training measures
EECA	Energy Efficiency and Conservation Authority	TEC	Tertiary Education Commission
EE-Oz	ElectroComms and Energy Utilities Industry Skills Council Ltd, Australia	TRoQ	Targeted review of qualifications
EFTS	Equivalent full time students	VAC	Voltage alternating current
ELV	Extra low voltage	VDC	Voltage direct current
EMANZ	Energy Management Association of New Zealand	WECS	Wind energy conversion system
ESITO	Electricity Supply Industry Training Organisation	Weltec	Wellington Institute of Technology
EST	Electrical service technician	Wintec	Waikato Institute of Technology
ETITO	Electrotechnology Industry Training Organisation		<i><u>End of Plan</u></i>
EWRB	Electrical Workers Registration Board		
IPENZ	Institute of Professional Engineers New Zealand		
ITO	Industry Training Organisation		
ITP	Industry training provider		
LV	Low voltage		
MED	Ministry of Economic Development		
NEEP	National Engineering Education Plan		
NZCTU	New Zealand Council of Trade Unions		
NZDE	New Zealand Diploma in Engineering		
NZQA	New Zealand Qualifications Authority		
NZQF	New Zealand Qualifications Framework		
PGDRITO	Plumbing, Gasfitting, Drainlaying & Roofing Industry Training Organisation		
PEW	Prescribed electrical work		
Provider	The ITP or PTE that delivers a course.		

Appendix A

Projected timing of demand for photovoltaic renewable energy systems

The following discussion primarily relates to grid-connected photovoltaic (PV) generation of electricity because this is increasingly the most dominant of the three common technologies for small scale renewable electricity production. Globally 90% of installed PV systems are grid connected. Though possibly more economic in some specialised situations, growth in the number of small scale wind and mini-hydro systems is limited by factors such as primary resource availability, higher maintenance costs of moving parts, and aesthetics such as noise and visual intrusion.

Figure A1 summarises the results of research of published material to seek information leading to the projected timing of grid parity in New Zealand. Historic projections included on the graph also indicate how uncertain forecasting of both electricity and PV prices can be with actual results significantly different to projections made in 2006, 2007 and 2009.

For grid pricing, in 2006 the Ministry of Economic Development (MED) projected wholesale and residential consumer retail electricity prices over the 25 years between 2005 and 2030.⁴⁵ Residential retail prices were projected to rise by 20.6% to 19.9 c/kWh in 2030. A 2010 update of predicted wholesale prices to 2030 did not vary significantly from the 2006 predictions. The 2010 update did not include residential retail price projections. Actual retail rates have increased faster than these projections with the low user rate in Auckland (Contact) in March 2011 being 26.17 c/kWh, significantly higher than the projected 2030 figure.

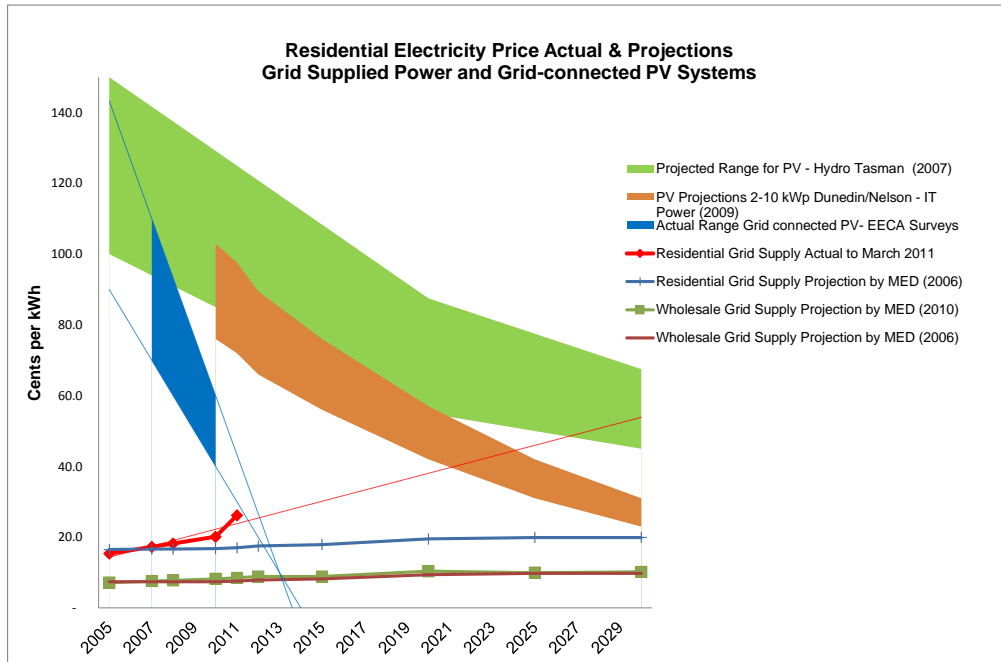
Grid-connected PV costs have dropped faster than historic forecasts. In a report to EECA in 2007¹, upper and lower bound costs for PV were projected to be in the range of 45 to 67.5 c/kWh in 2030. Another report to the MED in 2009,⁴⁶ projected electricity prices from PV systems in a range of New Zealand locations. Curves from the highest (Dunedin) and lowest (Nelson) are included on Figure A1.

Actual amortized prices for PV (30 year asset life, 5% discount rate, 15% utilization factor), recently reported by the Energy Efficiency and Conservation Authority (EECA) were in the range of 70 to 100 c/kWh in 2007 and 40 to 60 c/kWh 2010, figures well below those predicted in the above referenced reports.

⁴⁵ "Zealand Energy Outlook to 2030" – Ministry of Economic Development - 2006

⁴⁶ "Assessment of the Future Costs and Performance of Solar Photovoltaic Technologies in New Zealand" by IT Power Australia Pty Ltd for New Zealand MINISTRY OF ECONOMIC DEVELOPMENT – April 2009

Figure A 1 Projected electricity prices in New Zealand



	2005	2007	2008	2010	2011	2012	2015	2020	2025	2030
Residential Grid Supply Projection by MED (2006)	16.5	16.6	16.7	16.8	17.0	17.5	17.9	19.5	19.9	19.9
Wholesale Grid Supply Projection by MED (2006)	7.4	7.4	7.4	7.4	7.6	7.9	8.2	9.4	9.8	9.8
Wholesale Grid Supply Projection by MED (2010)	7.2	7.6	7.8	8.2	8.5	8.9	8.9	10.4	10.0	10.2
Residential Grid Supply Actual to March 2011	15.34	17.25	18.21	20.12	26.17					
PV Projections 2-10kWp Nelson (2009)				76	72.00	66	56	42	31	23
PV Projections 2-10kWp Dunedin (2009)				103	97.60	89.48	76	57	42	31
Grid connected PV-EECA Surveys		110	70	40						
Projected Range for PV — Hydro Tasman (2007)	150.0	141.7	137.5	129.2	125.0	120.8	108.3	87.5	77.5	67.5
	100	94	91	85	82	79	70	55	50	45

At first glance, straight line extrapolations of the actual increase in the grid supply price and decrease in PV cost suggest grid parity could occur in the 2012-2013 period. However the sharp decrease in PV costs (EECA figures) between 2007 and 2010 is generally thought to relate to several discrete events leading to global supply exceeding demand, and is unlikely to continue in the near future. Events dampening global demand over the period included the credit and global economic crisis

and the end of the Spanish feed-in tariff regime⁴⁷ (a method of subsidising grid-connected consumers). Meanwhile production volume increases of Chinese manufacturing plant led to economies of scale and lower prices. These factors were not related to technological or process improvements that will

⁴⁷ <http://www.nytimes.com/gwire/2009/08/18/18greenwire-spains-solar-market-crash-offers-a-cautionary-88308.html?pagewanted=1>

lead to long-term lower prices. Also some potential renewable electricity customers will not wish to wait for the 30 year system life used in the above PV calculations before they receive a positive return on their investment. They will delay installation until the relative electricity costs produce a break even within a period acceptable to them, possibly in the 3 to 5 year range.

Globally, Italy and Hawaii have reached grid parity and other countries with high sunshine hours and heavy reliance on fossil fuels for electricity generation are close to it. In Southern California there is now grid parity with peak electricity prices and many European countries and sunshine states in the USA expect to reach grid parity before 2015.^{48,49}

⁴⁸ <http://www.twst.com/yagoo/zaman15.html>

⁴⁹ <http://energybusinessdaily.com/renewables/solar-power/european-solar-subsidies-being-rolled-back/>

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Appendix B

National Certificate in Renewable Energy (Level 4): Compatibility analysis to Australian qualifications and accreditation

Compatibility was analysed between the National Certificate in Renewable Energy (Level 4) and three categories of recognition in Australia.

1. Similar qualifications in the Australian Electrotechnology Training Package⁵⁰
2. Grid connected photovoltaic skill sets identified in the Australian Electrotechnology Training Package.
3. Requirements for the Australian Clean Energy Council accreditation⁵¹

All of the Australian categories recognise different combinations from a cluster of 17 competency units from within the Electrotechnology Training Package administered by the ElectroComms and Energy Utilities Industry Skills Council (EE-Oz). Competency units in turn include Essential Knowledge and Skills (EKAS)⁵² (Essential Knowledge and Skills) which are the basic building blocks that define the competencies to be covered within respective units.

Outcomes and evidence requirements within units of the New Zealand certificate were mapped against EKAS elements contained within the three categories. Two of the Australian qualifications include training for an electrician license and all cover subjects such as health and safety which are also included during training for electrical licenses in New Zealand. Only renewable electricity related competency units and EKAS within the qualifications were compared with the National Certificate in Renewable Energy because in New Zealand, electrical training is covered separately, either as a prerequisite for, or concurrently with the certificate. A total of 23 EKAS are involved.

The following tables provide cross references from Australian qualifications, skill sets and the Clean Energy Council Accreditation to competency units and to EKAS. The total number of evidence requirements within EKAS are too numerous to include in this document and can be found in the Electrotechnology Training Package UEE07.⁵²

The first step in the matching process involved mapping evidence requirements in units of the New Zealand qualification against Australian EKAS requirements. Results are summarised in Table B 4 and Table B 5. Only New Zealand evidence requirements directly comparable to the Australian requirements are included.

Table B 2 indicates compatibility with Australian competency units by cumulating comments on compatibilities of EKAS nested in the units.

Table B 1 indicates compatibility with Australian recognitions by cumulating comments on compatibilities of competency units (and included EKAS) included in the recognitions.

⁵⁰ Electrotechnology Training Package UEE07, Volume 2 Part 2.1K, Section K – Renewable and Sustainable Energy. http://elt.ee-oz.com.au/files/UEE07%20V3.1/K_Re%20Sus%20En%20Units.pdf

⁵¹ http://www.solaraccreditation.com.au/dms/cec/accreditation/Pathways-091021/CleanEnergyCouncilAccreditationPathway_v3.pdf.

⁵² Electrotechnology Training Package UEE07, Part 2.2 of 3, Part 2.2 Essential Knowledge and Associated Skills (EKAS), Volume 2 of 2 <http://elt.ee-oz.com.au/files/UEE07%20V3.1/V2%20Pt%202.2%20EKAS.pdf>

Table B 1 Compatability with Australian recognitions and competency units contained in them

Qualifications	Competency units⁵³ <i>(Underlined are fully matched)</i>	Compatibility <i>(Refer Table B2)</i>
UEE41907 Certificate IV in Electrical – Renewable Energy	K23B, <u>K25C</u> , <u>K27B</u> , K28B, <u>K15B</u> , <u>K26B</u>	All matched except for the following. From EKAS 2.20.3 in K23B: Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate. From EKAS 2.20.91 in K28B: lamp properties, luminaire design, and lamp selection.
UEE42009 Certificate IV in Electrical — Photovoltaic Systems	<u>K25C</u> , <u>K35C</u> , <u>K48A</u> , G71C	All EKAS matched except for the following. From EKAS 2.6.2.3. in G71C: gas metering From EKAS 2.20.13: in K48A: required vegetation control to remove or reduce shading or soiling on a PV array
UEE41607 Certificate IV in Renewable Energy	K23B, <u>K25C</u>	Matched except for the following. From EKAS 2.20.3 in K23B: Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate.
Skill Sets		
PV grid connect designer	<u>K25C</u> , <u>K35C</u>	Completely matched
PV grid connect installer	<u>K25C</u> , <u>K48A</u> , G71C	All EKAS matched except for the following. From EKAS 2.6.2.3. in G71C: gas metering From EKAS 2.20.13: in K48A: required vegetation control to remove or reduce shading or soiling on a PV array
PV grid connect designer and installer	<u>K25C</u> , <u>K35C</u> , <u>K48A</u> , G71C	

Table continues next page

⁵³ Note: Following the practice in the training package, competency unit reference numbers are abbreviated from the full version which are in the form UEENEEK033B .i.e abbreviated to K33B

Clean Energy Council Accreditations		Note: Only electrician accreditations are included to compare with the New Zealand qualification
Stand-alone Power System Design	<u>K23B</u> , <u>K25C</u> , <u>K27B</u> , K28B, <u>K39B</u>	Matched except for the following. From EKAS 2.20.3 in K23B: Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate. From EKAS 2.20.91 in K28B: lamp properties, luminaire design, and lamp selection. From EKAS 2.20.13: in K34B: required vegetation control to remove or reduce shading or soiling on a PV array
Stand-alone Power System Install	<u>K23B</u> , <u>K25C</u> , <u>K27B</u> , K28B, <u>K34B</u>	
Stand-alone Power System Design & Install	<u>K23B</u> , <u>K25C</u> , <u>K27B</u> , K28B, <u>K34B</u> , <u>K39B</u>	
Grid Connect Design	<u>K25C</u> , <u>K35C</u>	Completely matched
Grid Connect Install	<u>K25C</u> , <u>K48A/K26B</u>	All EKAS matched except for the following. From EKAS 2.20.13: in K48A: required vegetation control to remove or reduce shading or soiling on a PV array
Grid Connect Design & Install	<u>K25C</u> , <u>K35C</u> , <u>K48A/K26B</u>	All EKAS matched except for the following. From EKAS 2.20.13: in K48A: required vegetation control to remove or reduce shading or soiling on a PV array
Hybrid	K33A	EKAS 2.20.10 in K33A is not fully covered because hybrid energy systems are not currently included in the National Certificate of Renewable Energy (Level 4).
Micro-hydro	<u>K37B</u> , <u>K38B</u>	Completely matched
Small Wind	<u>K30B</u> , <u>K31B</u> , <u>K43B</u>	Completely matched

Table B 2 Compatibility with Australian competency units and EKAS contained in them

Competency unit		EKAS <i>(Underlined are fully matched)</i>	Compatibility <i>(Refer Table B4)</i>
G71C	Install and set up interval metering	<u>2.5.12</u> , <u>2.6.2.2</u> , 2.6.2.3	All EKAS matched except for gas metering in 2.6.2.3.
K15B	Verify compliance and functionality of renewable energy installations	<u>2.20.25</u> , <u>2.18.1</u>	EKAS completely matched
K23B	Carry out basic repairs to renewable energy apparatus by replacement of components	<u>2.18.1</u> , <u>2.18.2</u> , 2.20.3	EKAS matched except for in 2.20.3: a. the following which is covered in electrical training: “calculation relating to energy, power and time with the appropriate number and time with the appropriate number of significant figures.” b. biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate.
K25C	Solve basic problems in PV energy apparatus	<u>2.20.14</u>	EKAS completely matched
K26B	Install and set up grid connected photovoltaic power systems	<u>2.18.1</u> , <u>2.18.2</u> , <u>2.20.19</u>	EKAS completely matched
K27B	Diagnose faults in renewable energy control systems	<u>2.2.3</u> , <u>2.18.1</u> , <u>2.18.2</u> , <u>2.20.15</u>	EKAS completely matched
K28B	Solve problems in stand-alone renewable energy systems	<u>2.18.1</u> , <u>2.18.2</u> , 2.20.9.1	EKAS matched except for lighting topics in EKAS 2.20.91 for: lamp properties, luminaire design, and lamp selection.
K30B	Solve problems in wind energy conversion systems	<u>2.18.1</u> , <u>2.18.2</u> , <u>2.20.16.1</u>	EKAS completely matched
K31B	Design wind energy conversion systems rated to 10 kW	<u>2.18.1</u> , <u>2.20.16.2</u>	EKAS completely matched
K33A	Design set up hybrid power systems	<u>2.18.1</u> , <u>2.18.2</u> , 2.20.10	2.20.10 not covered because hybrid energy systems are not currently included in the National Certificate of Renewable Energy (Level 4).
K34B	Install stand-alone PV systems	<u>2.5.5</u> , <u>2.18.1</u> , <u>2.18.2</u> , 2.20.9.1 , <u>2.20.13</u> , <u>2.20.14</u>	EKAS completely matched except for the following. From 2.20.9.1: Lamp properties, luminaire design, lamp selection. From 2.20.13: ” required vegetation control to remove or reduce shading or soiling on a PV array”
K35C	Design grid-connected power supply systems	<u>2.5.2.1</u> , <u>2.5.12</u> , <u>2.6.2.2</u> , <u>2.20.14.1</u> , <u>2.20.19</u>	EKAS completely matched
K37B	Install and set up micro-hydro systems	<u>2.18.1</u> , <u>2.18.2</u> , <u>2.20.17.1</u>	EKAS completely matched
K38B	Design micro-hydro systems	<u>2.18.1</u> , <u>2.20.17.1</u> , <u>2.20.17.2</u>	EKAS completely matched

Table continues next page

K39B	Design stand-alone renewable energy systems	<u>2.18.1, 2.20.9.2</u>	EKAS completely matched
K43B	Install small wind energy conversion systems for stand-alone	<u>2.5.5, 2.18.1, 2.18.2, 2.20.16.1, 2.20.16.2, 2.20.16.3</u>	EKAS completely matched
K48A	Configure grid-connected PV power systems	<u>2.20.13, 2.20.19</u>	EKAS completely matched except for: From 2.20.13: " required vegetation control to remove or reduce shading or soiling on a PV array"

Table B 3 Unit standards in the National Certificate in Renewable Energy (Level 4)

No.	Title
9184	Erect non-notifiable prefabricated scaffolding,
10783	Install, commission, and maintain generating sets driven by combustion engines
15757	Employ fall arrest systems on building and construction sites
27426	Demonstrate knowledge of d.c. and a.c. machines used for small scale Renewable Energy Systems
27427	Demonstrate and apply knowledge of Extra-Low Voltage requirements and testing for small scale Renewable Energy Systems
27428	Demonstrate knowledge of grid-connect Renewable Energy System components, owner requirements and metering
27429	Demonstrate knowledge of micro hydro systems
27430	Design WECS Power Systems
27431	Design Photovoltaic Power Systems
27432	Demonstrate knowledge of Photovoltaic arrays mounting requirements
27433	Demonstrate knowledge renewable energy concepts and technologies
27434	Demonstrate and apply knowledge of Renewable Energy design requirement assessment
27435	Demonstrate and apply knowledge of Data Communications and Logging for Renewable Energy Systems
27436	Demonstrate and apply knowledge of stand-alone Renewable Energy System components and operation
27437	Install, commission and maintain micro hydro systems
27438	Design Micro Hydro Systems
27439	Demonstrate knowledge of photovoltaic technology
27440	Install, commission and maintain grid connected PV power systems
27441	Install, commission and maintain wind energy conversion systems
27442	Install, commission and maintain stand-alone PV power systems
27443	Demonstrate knowledge of wind energy conversion systems
27444	Demonstrate knowledge of requirements for connecting photovoltaic arrays

Table B 4 Summary of New Zealand units and evidence requirements mapped to EKAS

EKAS		Unit: Evidence requirements	Compatibility
2.18.1	Occupational health and safety principles	15757, 9184	Working at heights covered in course. Remainder of EKAS covered during electrical training.
2.18.2	Electrical safe working practice		Covered during electrical training
2.2.3	Fault finding techniques		Covered during electrical training
2.20.10	Hybrid energy systems		Hybrid energy systems are not currently included in the National Certificate of Renewable Energy (Level 4).
2.20.13	Photovoltaic installations	27432: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 27442: 1.1, 3.6, 4.5 27444: 1.1, 1.2, 1.4, 1.5, 1.6	EKAS completely matched except for one item: "required vegetation control to remove or reduce shading or soiling on a PV array"
2.20.14	Photovoltaic power systems	27439: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.12, 3.13,	EKAS completely matched
2.20.14.1	Photovoltaic power systems (design)	27431: 2.1, 2.3, 2.4, 2.5, 2.6, 2.2, 3.6, 5.4, 5.5, 5.6, 4.7, 5.9, 5.13, 5.12, 4.15, 5.17 27433: 1.1, 1.2 27434: 4.1, 4.2, 5.2, 5.3 27440: 2.6	EKAS completely matched. One item included in electrical training: "assessing the occupational health and safety (OHS) risks when working on that particular site."
2.20.15	Renewable energy system electronics	27443: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11	EKAS completely matched
2.20.16.1	Types, construction and operating features of small WECS	27443: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11	EKAS completely matched
2.20.16.2	Installation and maintenance of small WECS	27441: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.1, 2.2, 2.3, 1.10, 1.11	EKAS completely matched
2.20.16.3	WECS siting and performance assessment	27430: 1.1, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 5.1, 5.2, 5.3, 5.4, 5.5 27443: 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 4.1, 4.2, 4.3, 4.4, 4.5	EKAS completely matched
2.20.17.1	Micro-hydro systems installation and maintenance process	27437: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9	EKAS completely matched
2.20.17.2	Micro-hydro systems	27429: 1.1, 2.2, 2.4, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8 27438: 2.1, 2.2, 2.3, 2.5, 2.6, 2.7, 2.8, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8	EKAS completely matched

Table continues next page.

2.20.19	Grid connected inverters	27428: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4 27436: 3.2 27440: 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 3.5, 3.9, 3.10, 3.11, 4.5	EKAS completely matched
2.20.25	renewable energy installations, ELV installation requirements	27427: 2.1, 2.2, 2.3, 4.1, 4.2, 4.3	EKAS completely matched
2.20.3	Introduction to renewable energy technologies	27429: 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 3.5 27430: 3.2, 5.3 27431: 3.6, 3.8, 4.6, 4.8, 5.4, 5.8 27433: 1.1, 2.3, 2.4, 2.10, 2.11, 3.1, 3.2, 3.3 27434: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.7, 2.8, 3.1, 3.2 27436: 2.1, 2.2, 2.7, 3.1, 3.5 27439: 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.8, 2.9, 3.1, 3.3, 3.6 27443: 1.1, 1.3, 1.6, 2.2, 2.3, 3.3, 3.7, 3.8, 3.9, 3.10, 3.1, 4.6	EKAS matched except for: a) the following which is covered in electrical training: “Calculation relating to energy, power and time with the appropriate number and time with the appropriate number of significant figures.” b) Biofuels are not covered to the same detail because there is no biofuel strand in the initial version of the New Zealand certificate.
2.20.9.1	Stand-alone renewable energy system components	27427: 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3 27436: 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9 27439: 3.11 US10783	EKAS matched except for lighting topics for: lamp properties, luminaire design, and lamp selection.
2.20.9.2	Stand-alone renewable energy system design consideration	27431: 1.2, 1.4, 1.6 Plus ERs in respective technology design units	EKAS completely matched
2.5.12	Electricity distributors, supply requirements	27428: 3.1, 3.2, 3.4, 3.5, 4.2	EKAS completely matched
2.5.2.1	Technical standards, regulations and codes for general electrical installations		Covered during electrical training
2.5.5	Technical standards, regulations and codes for extra-low voltage work	27427: 1.2, 2.1 Plus electrical training	EKAS completely matched
2.6.2.2	Electrical metering arrangements	27428: 3.3, 4.1	EKAS completely matched
2.6.2.3	Interval metering concepts and applications	27428: 4.1, 4.2, 4.3	EKAS matched except for gas metering.

Figure B 1 Clean Energy Council accreditations⁵⁴

Clean Energy Council – Accreditation Pathway UEE07 (ver 3) May 2011

Accreditation Type	Electrical Knowledge – Required Units of Competency*	PV System Knowledge – Required Units of Competency
Stand-alone Power System Accreditation		
SPS Design	Must complete all units	K023B, K025C, K027B, K028B, K039B
SPS Install	Must complete all units	K023B, K025C, K027B, K028B, K034B
SPS Design & Install	Must complete all units	K023B, K025C, K027B, K028B, K034B, K039B
Grid-connect PV System Accreditation		
GC Design	Must complete all units	K025C, K035C
GC Install	Must be a licensed electrician – no exemptions	K025C, K048A/K026B
GC Design & Install	Must be a licensed electrician – no exemptions	K025C, K035C, K048A/K026B

**If you are a licensed electrician or have an electronics/electrical engineering degree, you do not need to complete the Electrical Knowledge units*

Electrical Knowledge – Units of Competency*		PV System Knowledge – Units of Competency	
E001B	Apply OHS practices in the work place	K023B	Carry out basic repairs to renewable energy apparatus by replacement of components
E002B	Dismantle, assemble and fabricate electrotechnology components	K025C	Solve basic problems in photovoltaic energy apparatus
E003B	Solve problems in extra-low voltage single path circuits	K027B	Diagnose faults in renewable energy control systems
E004B	Solve problems in multiple path d.c. circuits	K028B	Solve problems in stand-alone renewable energy systems
E005B	Fix and secure equipment	K034B	Install standalone photovoltaic power systems
E007B	Use drawings, diagrams, schedules and manuals	K035C	Design grid connected power supply systems
E008B	Lay wiring/cablling and terminate accessories for ELV circuits	K039B	Design stand-alone renewable energy systems
G001B	Solve problems in electromagnetic circuits	K048A/ K026B	Install, configure and commission grid connected photovoltaic power systems

Endorsements – Required Units of Competency		
Hybrid	K033A	Design set up hybrid power systems
Micro-Hydro	K037B,	Install and set up micro-hydro systems
	K038B	Design micro-hydro systems
Small Wind	K030B,	Solve problems in wind energy conversion systems
	K031B	Design wind energy conversion systems rated to 10 kW.
	K043B	Install small wind energy conversion systems for stand-alone applications

Certificate for Working in South Australia (Mandatory)
Roof Safety – AIBS SA Chapter Tel: 08 8410 7522

⁵⁴ http://www.solaraccreditation.com.au/dms/cec/accreditation/Pathways-091021/CleanEnergyCouncilAcrcdiattionPathway_v3.pdf.