Solar Action Bulletin

Energy policy's importance to New Zealand

SAB94 JUNE 2013

solaraction
The New Zealand Renewable Energy Society

solaraction

Contents

Cover Photo: Scott Willis

Editorial

Lee White

Quite some time has passed since the last issue of Solar Action Bulletin was released. In the intervening time, technologies used to generate electricity from renewable energy sources have been steadily maturing. Solar energy capacity installed in some parts of Europe has increased dramatically, along with other types of renewable generation, due to generous policies designed to encourage exactly such an increase in renewable generation capacity. Countries around the globe have begun designing and implementing policies designed to promote renewable energy generation and reap the associated benefits to climate change mitigation, fuel security, and growth in related industries.

Now, in 2013, New Zealand remains one of few high income countries to have no policies specifically encouraging generation of electricity from renewable sources. Many other countries have now been using for some time policies designed to promote renewable energy. It is possible to see the strengths and weaknesses of each of these policies, and consider which New Zealand could benefit most from. It is possible, too, to consider the difficulties imposed by an absence of such policies, and how these might be addressed through policy measures. This issue of Solar Action Bulletin considers these policies and problems, through a wide variety of articles contributed by experts in the field and also by those affected by such policies.

Renewable energy investment in NZ

Geoff Kelly, Program Director at the University of Wollongong, Australia, in the Sydney Business School

At first glance NZ looks to be in an enviable position in terms of its renewable energy development. As often noted for example in government publications, over 70% of total electricity was generated from renewables in recent years, and new sources such as wind and geothermal energy have rapidly become significant in the generation mix. That picture however is less reassuring when examined more closely. International Energy Agency data shows that the percentage of electricity from renewables actually fell between 1990 and 2011, having been consistently lower through the 2010s; coal consumption increased by 20% between 1990 and 2011; and oil consumption (largely for transport) rose by more than 60% between 1990 and 2011. In capacity terms, while wind and geothermal saw significant growth (albeit from a low base) over the same period, most - almost 90% - of NZ's hydro capacity was installed in or before 1990.

It is evident that not only has the use of renewable potential failed to keep pace with energy demand growth over the last several decades, but that the resultant gap has been filled by fuels of much greater environmental, energy security and energy cost risk. An inevitable question then arises as to what are the current barriers to maintaining the achievements of the past, achievements which were not insignificant in terms of national investment and which underpin the current renewable contribution.

Clearly a range of factors may pose barriers to desired outcomes. National economic conditions may limit the financial resources available for investment, or technical issues may mount insuperable problems in technology deployment. These however, and other factors, don't appear markedly different to those of the past. A third aspect however will be explored a little further here - and that is the role of government in shaping and sustaining a national environment which fosters the environmental investments necessary to keep pace with a growing economy.

In modern economies government plays a significant role: in even the most 'market-based' economies such as the US, government has a formative role in defining and supporting national goals. In developing and setting in place common objectives, governments specify policy; but it is in the deployment of the means to achieve those policy goals - the policy instruments - that governments interact with society broadly and demonstrate commitment to their stated policies. The scale and effectiveness of policy instruments may indeed be a measure of that commitment. What then are the policy instruments in place to foster renewable energy development in New Zealand?

The centrepiece policy instrument for renewables, and other means of reducing greenhouse gas emissions, is the NZ Emissions Trading Scheme. Early advocates of trading systems saw such a system as a single solution to greenhouse gas abatement, functioning by introducing a carbon price which would effectively flow through all related markets, prompting actions to reduce emissions in the most cost effective manner. Later more nuanced views see ETS systems as a necessary but not sufficient means towards required levels of abatement. This reflects the fact that the markets through which those price signals were to flow were far from perfect markets, and those imperfections might influence outcomes as much as might the ETS price signal. In other words, it is accepted that in a real world situation, recognition must be taken of the real barriers which might exist to the abatement effectiveness of the ETS price signal – and other means devised and provided to address those barriers.

Many potential barriers exist. They include among others imperfect information in markets, principal- agent problems, consumer behavioural failures, market power and market structures (e.g. vertical integration in some energy markets). There is also the failure of markets to embed in current prices the potential for future gains such as those arising from industry development, and scale achievement in equipment supply. Each of these requires specific consideration: as the International Energy Agency put it "carbon pricing needs to be flanked by supplementary policies to fully realise its least cost potential in light of the known market barriers and imperfections". The ETS however has but little to support it, with the 2012 Budget confirming the scheduled demise of the last significant renewables incentive measure, the biofuels subsidy, in 2013. Other than a modest range of advisory and information activities, there are no substantive incentives or other measures in place to address those factors currently inhibiting renewables and other investments addressing emissions reduction and energy cost and security. NZ is unusual among developed countries in not having such measures in place.

But that is not the only issue: the ETS has its incentive levels determined by the interaction of supply and demand in the market for emission credits. If market factors shift as they are prone to do, the credit unit price, the incentive for emission reduction actions, may vary. This has been the case in the EU ETS, where unit prices have fallen dramatically through reduced demand arising from recession in the EU. This has led to emergency emission permit reduction measures by the EU, which has somewhat stabilised unit prices there. The NZ ETS has been similarly affected, to the point where unit prices have fallen recently to levels around $1.70/tonne, compared to the original $25/tonne. In monetary terms, the incentive for abatement action is now less than 7% of the starting value. Not surprisingly, potential alternative energy investments are unlikely to be greatly encouraged by either the absolute value of the incentive, or the demonstration of its propensity to shift radically with external conditions.

Both the separate but related issues noted here are matters which can only be addressed by government, and appropriate action could well see NZ move back to a position of some leadership in this important area. Failure to do so will see NZ lag further behind other developed countries (and some major developing countries) in the pursuit of robust low-carbon economic development.

REN21: Renewable energy support policies

● national-level policy

○ state/provincial policy

HIGH INCOME COUNTRIES $$$$	REGULATORY POLICIES						FISCAL INCENTIVES				PUBLIC FINANCING	
	Feed-in tariff (incl. premium payment)	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competitive bidding
Australia	○			○		●	●				●	
Austria	●			●		●	●	●			●	
Belgium		○	●	●		●	○	●	●			●
Canada	○	○	○	●			●	●	●		●	●
Croatia	●						●				●	
Cyprus	●			●			●					
Czech Republic	●			●		●	●	●	●		●	
Denmark	●		●	●		●	●	●	●		●	●
Estonia	●			●			●		●	●		
Finland	●			●		●	●		●	●		
France	●			●		●	●	●	●		●	●
Germany	●			●	●		●	●	●		●	
Greece	●			●			●	●	●		●	
Hungary	●			●			●		●		●	
Ireland	●			●	○	●						●
Israel	●	●			●				●		●	●
Italy	●	●	●	●	●	●	●	●	●		●	●
Japan	●	●	●			●	●				●	
Luxembourg	●						●					
Malta	●		●				●		●			
Netherlands	●			●		●	●	●	●	●	●	
New Zealand							●					
Norway				●		●	●		●		●	
Poland		●		●		●	●		●		●	●
Portugal	●	●	●	●	●		●	●	●		●	●
Singapore			●								●	
Slovakia	●						●		●			
Slovenia	●					●	●	●	●		●	●
South Korea[1]		●	●	●		●	●	●	●		●	
Spain[2]	●			●	●		●	●	●		●	
Sweden		●		●		●	●	●	●		●	
Switzerland	●						●		●			
Trinidad and Tobago							●	●	●			
United Arab Emirates		○			○					○	○	○
United Kingdom	●	●		●	●	●	●		●	●	●	
United States[3]	○	○	○	●	○	○	●	●	●	○	●	○

Note: Countries are organized according to GNI per capita levels as follows: "high" is USD 12,276 or more, "upper-middle" is USD 3,976 to USD 12,275, "lower-middle" is USD 1,006 to USD 3,975, and "low" is USD 1,005 or less. Per capita income levels and group classifications from World Bank, 2010. Only enacted policies are included in the table; however, for some policies shown, implementing regulations may not yet be developed or effective, leading to lack of implementation or impacts. Policies known to be discontinued have been omitted. Many feed-in policies are limited in scope of technology.

1 The South Korea feed-in tariff that was operational throughout 2011 has been replaced by an RPS policy for 2012.

2 In Spain, the feed-in tariff (FIT) was temporarily suspended in January 2012 by Royal Decree for new renewable energy projects; this does not affect

REN21. 2012. Renewables 2012 Global Status Report (Paris: REN21 Secretariat). Pages 70-73.

	REGULATORY POLICIES						FISCAL INCENTIVES				PUBLIC FINANCING	
	Feed-in tariff (incl. premium payment)	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competitive bidding
UPPER-MIDDLE INCOME COUNTRIES												$$$
Algeria	●											
Argentina	●			●			●	●	●	●	●	●
Belarus									●			
Bosnia & Herzegovina	●						●					●
Botswana							●		●			
Brazil				●	○			●	●		●	●
Bulgaria	●			●			●		●		●	
Chile		●			●		●		●		●	
China	●	●		●	●		●			●	●	●
Colombia				●					●			
Costa Rica	●											
Dominican Republic	●		●		●		●	●	●			●
Ecuador	●								●		●	
Grenada									●			
Iran	●							●		●		
Jamaica				●				●	●			
Jordan			●	●					●		●	●
Kazakhstan	●					●						
Latvia	●			●					●		●	●
Lebanon			●						●			
Lithuania	●										●	
Macedonia	●										●	
Malaysia	●	●		●					●		●	●
Mauritius							●					
Mexico			●		●			●			●	●
Palau		●										
Panama	●		●					●	●	●		●
Peru	●			●					●			●
Romania		●		●		●			●		●	
Russia							●					
Serbia	●						●					
South Africa							●					●
Thailand	●			●					●		●	
Tunisia			●				●		●		●	
Turkey	●						●					
Uruguay	●		●	●	●		●		●		●	●

● national-level policy

○ state/provincial policy

projects that had already secured FIT funding. The Value-Added Tax (VAT) reduction is for the period of 2010–12 as part of a stimulus package.

3 The United States temporarily allowed new facilities that qualified for the federal Production Tax Credit (PTC) to opt instead for an equivalent cash grant. This provision, under the American Recovery and Reinvestment Act of 2009, was available only to systems that began construction prior to 31 December 2011, and is not included here.

4 The area of the Palestinian Territories is included in the World Bank country classification as "West Bank and Gaza." They have been placed in the table using the 2009 "Occupied Palestinian Territory" GNI per capita provided by the United Nations (USD 1,483).

REN21. 2012. Renewables 2012 Global Status Report (Paris: REN21 Secretariat). Pages 70-73.

● national-level policy

○ state/provincial policy

	REGULATORY POLICIES						FISCAL INCENTIVES				PUBLIC FINANCIN	
	Feed-in tariff (incl. premium payment)	Electric utility quota obligation/ RPS	Net metering	Biofuels obligation/ mandate	Heat obligation/ mandate	Tradable REC	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competitive bidding
LOWER-MIDDLE INCOME COUNTRIES												$$
Armenia	●											
Cape Verde	●							●	●		●	
Egypt							●		●			●
El Salvador								●	●	●	●	●
Ghana	●				●	●			●			
Guatemala			●	●				●	●			●
Honduras	●							●	●			●
India	●	●		●	○	●	●	●			●	●
Indonesia	●	●		●			●	●	●		●	●
Marshall Islands									●			
Moldova	●								●		●	
Mongolia	●											●
Morocco											●	●
Nicaragua	●								●			
Pakistan	●		●				○				●	
Palestinian Territories[4]	●								●			
Paraguay				●					●			
Philippines	●	●	●	●			●	●	●	●	●	●
Senegal	●								●			
Sri Lanka	●	●	●	●			●		●	●	●	
Syria	●		●					●				●
Ukraine	●							●	●			
Vietnam							●	●	●			
Zambia				●			●		●			
LOW INCOME COUNTRIES												$
Bangladesh							●		●		●	
Ethiopia				●					●		●	
Gambia									●			
Haiti											●	
Kenya	●								●			
Kyrgyzstan		●					●		●			
Malawi				●					●			
Mali									●			
Mozambique				●							●	
Nepal							●	●	●		●	●
Rwanda									●		●	
Tanzania	●						●		●			
Uganda	●						●		●		●	

REN21. 2012. Renewables 2012 Global Status Report (Paris: REN21 Secretariat). Pages 70-73.

The way to go? American or German solar incentive models

Ralph Chapman, Director, Graduate Programme in Environmental Studies, Victoria University of Wellington[1]

Recently, I was in San Francisco, where a new emission trading scheme has come into effect, and there is a vigorous debate on net metering[2] (Montgomery 2013 (14 February)). Policy advisers, the utilities commission and the big energy companies in California are contesting the rules on net metering, including limits on rewarding sellers of solar PV power back to the grid. Essentially, the utilities are calling for the end of the current tariff which has rewarded sellers with the retail price of power. The California utility commission delayed the end-date for this subsidy recently; the utilities are seeking an early end to what they see as an unreasonable subsidy. They argue that those who supply solar electricity into the grid are being paid too much, given the costs such electricity imposes in grid and lines management.

The utilities' view has some merit, but seems to be driven by fear of disruptive competition (Roberts 2013) and to be too narrow an 'efficiency-based' view, a position similar to that taken by New Zealand's economic ministry. Such a view privileges a focus on costs and benefits to utilities, while wider social and systemic ramifications are given short shrift. More attention should in my view be paid to the dynamics of a changing electricity market and industry, the ability to avoid costly generation and transmission capacity investments, the climate change mitigation benefits of expanding renewable energy, and the value of a more reliable and resilient electricity system, including less reliance on imported fuels.

By contrast, the German approach is to consider a wider dynamic and societal view, including the advantages of reducing the need for nuclear and fossil fuel-based generating capacity (with their large negative externalities), the strategic development of a solar PV industry, and the benefits of diversity and resilience. The German system uses a different system to net metering, i.e. feed-in tariffs[3], but their effect of incentivising renewables, especially solar PV, is very similar.

The German system is not perfect – the feed-in tariffs per kWh of delivered solar and other renewable electricity are generous and thus costly – but their strategy has major merits.

These include greater certainty for renewables investors, a rapid growth of renewable generation in Germany, now on track to reach 35% renewable power by 2020 (Carrington 2012 (30 May)), more energy security arising from system diversity, and a degree of democratisation of energy generation through community and individual ownership of decentralised power generation systems. Greenhouse gas emissions in Germany (where the energy sector's share of emissions is 67%) have fallen 26% since 1990 (EEA 2012).

Consider further two main issues. Firstly, externalities: are the carbon advantages of solar PV really significant? Yes, absolutely: the current market in carbon is failing badly, so carbon and fossil electricity is under-priced. The reward for generating carbon-free electricity is much too low, especially in New Zealand, with its undiscriminating openness to foreign carbon units (Fallow 2013 (7 March)). There are two linked arguments here: (a) the international targets and regulation that determine the price of carbon are too weak, by an order of magnitude; and (b) there are huge risks around climate change that warrant a very precautionary (i.e. high) price on carbon emissions, of the order of at least \$100 per tonne (Ackerman and Stanton 2011). If the world proceeds on its current emissions path, catastrophic climate change, likely to involve, among other things, average surface warming of the order of 3 to 4°C, is projected for 2100 (Vieweg, Hare et al. 2012; Stewart and Eliot 2013), with profound and devastating social, economic and ecological consequences. In these circumstances, a carbon price that strongly incentivises renewables is necessary and urgent[4].

Second, what of the dynamic arguments about industry development? It helps to think about solar PV in the historic context of how energy subsidies and energy systems have evolved over time. Sound policy principles suggest that we would limit subsidies to only those activities which the market underprovided, such as widely useful knowledge and technology development, and activities offering clear environmental and other external benefits. But in the real world, the low prices of incumbent technologies are partly the result of past subsidies. Energy sector subsidies have been heavily skewed over time towards fossil fuel and nuclear forms of energy.

A dramatic picture of these is available in two recent documents (Pfund and Healey 2011; IMF 2013). The former finds that cumulative energy subsidies to renewables in the USA have amounted to US$6 billion, while those to nuclear were US$185 billion, and to fossil fuels $447 billion. What these sources suggest is that it is naive to take a one-moment-in-time view of efficiency; rather, a dynamic view of how the energy economy evolves over time, the advantages of incumbent technology, and the systemic need to support renewables in the face of those embedded advantages, should be considered. The game will change as solar PV costs converge more closely on grid parity (unfortunately being pushed down temporarily by cheap fracked gas). Utilities need to be thinking well beyond this. An approach akin to the German one of supporting solar in the light of dynamic considerations is wiser than the static, short-term emphasis generally espoused in the U.S. and New Zealand.

What are the implications for New Zealand? The carbon market context in New Zealand, and the accompanying incentive to constrain carbon emissions, is now weaker than in California, where a cap-and-trade scheme recently came into play (C2ES 2013) with a US$10/tonne price floor. There is a strong case to fix the carbon market urgently in New Zealand, or else subsidise renewables to reflect the real value of carbon reduction (as well as factors such as system diversity and security).

Fixing the market is not on the government's horizon at present. Some may also argue that New Zealand already has about 70% renewable electricity. But this level could desirably be increased. In a better functioning market, a higher price of carbon would support increased renewables investment, not just solar PV but other renewable technologies too, and renewables generating close to 100% of power needs would be attainable, with greater diversity of generation sources as well.

We can also learn from Germany's industry development experience, that there are benefits from supporting solar PV in New Zealand. A German-style feed-in tariff, or alternatively net metering – as exists in 43 US states – would provide such support, or support could be provided explicitly in other ways. New Zealand is unlikely to have a comparative advantage in manufacturing of solar panels, but there are opportunities for (and benefits from) the development of a 'balance of system' industry, involving sales, assembly, installation, and management. The sooner this part of the solar PV technological innovation system develops, the lower costs will be, and the more viable solar PV will become (Dangerman and Schellnhuber 2013). For decades, New Zealand, like other countries, has subsidised other electricity technologies; in the absence of a meaningful carbon market, there is a strong case for actively levelling the playing field, so that solar PV, and indeed other renewables, can make a significant contribution to lifting renewables penetration in New Zealand, contributing to a more sustainable and resilient energy system.

Endnotes

1 Thanks for the contribution of Andrew Boyles, Master of Environmental Studies candidate, VUW.

2 http://apps3.eere.energy.gov/greenpower/markets/netmetering.shtml

3 http://en.wikipedia.org/wiki/Feed-in_tariffs_in_Germany

4 Deloitte's cost estimates for renewables suggests that even $30 per tonne of CO2 makes a big difference to the viability of wind: see New Zealand Wind Energy Association (2012). Wind Energy: the growing role for wind energy in New Zealand's electricity system. Wellington, NZWEA. p.23.

References

Ackerman, F. and E. A. Stanton (2011). "Climate risks and carbon prices: Revising the social cost of carbon." Economics Discussion Papers.

C2ES (2013). California Cap-and-Trade Program Summary, Centre for Climate and Energy Solutions.

Carrington, D. (30 May, 2012) "Germany's renewable energy revolution leaves UK in the shade." Guardian.co.uk.

Dangerman, A. J. and H. J. Schellnhuber (2013). "Energy systems transformation." Proceedings of the National Academy of Sciences 110(7): E549-E558.

EEA (2012). Greenhouse gas emission trends and projections in Europe 2012: EEA Report No 6/2012. Copenhagen, European Environment Agency.

Fallow, B. (2013 (7 March)) "Govt in bind over emissions target." New Zealand Herald.

IMF (2013). Energy Subsidy Reform: Lessons and Implications. Washington, D.C., International Monetary Fund.

Montgomery, J. (2013 (14 February)) "Net Metering Debate Rages On Despite Calls For Calm." RenewableEnergyWorld.com

New Zealand Wind Energy Association (2012). Wind Energy: the growing role for wind energy in New Zealand's electricity system. Wellington, NZWEA.

Pfund, N. and B. Healey (2011). "What Would Jefferson Do?" DBL Investors, September.

Roberts, D. (2013). "Solar panels could destroy U.S. utilities, according to U.S. utilities." Grist (10 April).

Stewart, H. and L. Eliot (2013) "Nicholas Stern: 'I got it wrong on climate change – it's far, far worse'." Guardian.co.uk.

Vieweg, M., B. Hare, et al. (2012). 2° be or not 2° be: Climate Action Tracker Update, 30 November 2012, Climate Analytics, Ecofys, and the Potsdam Institute (PIK).

Renewable electricity support: how and why?

Aviel Verbruggen, Professor at the University of Antwerp, Belgium, in the Department of Engineering Management (www.avielverbruggen.be)

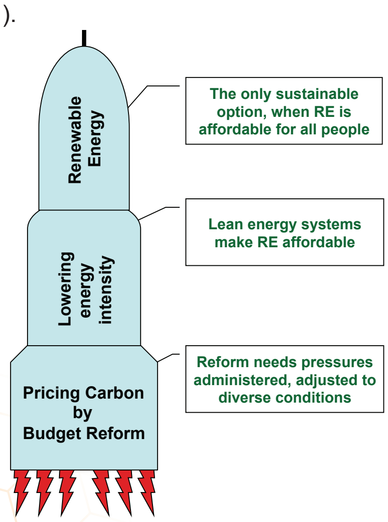
All energy policy of the last decades is affected and directed by concerns about climate change. Its profound irreversible impacts alarm many people all over the globe. So, politicians agreed in Copenhagen (2009) on a +2°C limit for global ambient temperature rise. Hovering around +2°C implies the concentration of greenhouse gases in our common atmosphere should not exceed 400 ppm $CO_{2\text{-eq}}$. Drastic action is urgent because in 2012 the concentration surpassed 440 $CO_{2\text{-eq}}$, and every year has increased more than 2 ppm, irreversibly for more than a century. The addition is proportional to yearly emissions of greenhouse gases, now 50 billion tons with energy-related CO_2 emissions counting for about 70% or 35 billion tons.

Why specific support for renewable energy?

Since Kyoto (1997) policy has been fighting the billion tons head-on, in vain because global emissions continue to rise. Indeed, a good doctor doesn't tackle symptoms but addresses causes, identified by an accurate diagnosis. An instructive start is the first-degree decomposition of energy-related emissions per person: $kgCO_2$ emitted/person = [$kgCO_2$/kWh energy] x [kWh energy/$GDP] x [$GDP/person].

Or in words: carbon intensity of used energy x energy intensity of GDP x wealth is equal to the CO_2 emitted by an individual. Three remedies for the emissions disease appear: substitute renewable energy for fossil fuels (and for nuclear which is also a non-sustainable supply); 2) lower irrevocably energy intensity of human activities; 3) restructure wealth by re-pricing goods & services and overhauling activities and practices. The remedies fit as 3-staged rockets for blasting climate policy gridlocks (figure 1).

Figure 1: Blast climate gridlocks by 3-staged rockets



The rocket metaphor tells us that we cannot get renewable energy in orbit for serving all people on earth without inventing and deploying much leaner, highly efficient, energy uses and practices. For the latter all consumers on earth must take responsibility for their share of emissions. Fortunately, the overwhelming majority of uses and practices are economically rational to optimize, with money attributing an incredible steering power to prices. This power is recognized by most scholars and politicians, but ill conceived by the high priests of neoclassical economics. The latter believe and preach that for cutting carbon emissions, it suffices to imagine a giant scythe (like the global market for emissions trading, or the globally uniform carbon tax). They forget that reality is not a flat wheat field, but an amalgamation of diverse ecosystems. Remodeling societal activities and practices requires a toolbox of hundreds of different cutting (knives, saws, scissors, axes, etc.) and pasting (welding, nailing, gluing, etc.) instruments and techniques. That toolbox is labeled "budget reform", because indeed consumers are incited to reallocate budgets from climate harmful to climate friendly goods & services. Budget reform is a task for national and local authorities, because they know best the specific socio-economic structures and textures in place and the ways of proper transformation. They can administer the pressures, necessary and sufficient, to activate sustainable changes. National budget reform is annually monitored, verified, and reported by noting four money flows from the national accounts (table 1).

Table 1: National Budget Reform, measured by 4 money flows available in every country's national accounts

	"Climate Goods"	"Climate Bads"
Levies, charges, taxes, excise duties	B1-	B2+
Subsidies, support, feed-in tariffs for renewable electricity	B3+	B4-

Monetary Variable = (B2 + B3) – (B1+B4)

Reduced to a single monetary variable, divided by either GDP or total public budget, one obtains an – internationally comparable – indicator of a country's performance in igniting the first stage of effective mitigation policy.

Table 1 shows that specific support for renewable energy is an integral part of budget reform and of mitigating CO_2 emissions. Such approach for addressing the major global policy challenge of this century is effective, efficient, fair, and workable. Why is it not substituted for the messy mirages of global emission permits trading or of uniform carbon taxing?

How is it best for a country to support its renewable electricity (RE)?

Every place and region owns a variety of RE opportunities, possibly classified in market, economic, technical, and sustainable development RE potentials. Identification and quantitative assessment of RE potentials is a hell of a job. Daily the sun sends to earth enough free energy to meet all human needs. But harvesting the free energy to meet the huge variety and quantity of human needs is tedious and costly in new technology and institutions. RE potentials are unlocked with a broad policy mix (figure 2). Technological innovation and proper energy pricing are crucial, and do interact a lot.

Energy as a commodity is simply a means to an end, not wanted for its own sake (who likes dirty coal, stinking oil, exploding gas, or dangerous electrons?). People buy and use energy as necessary for performing activities or obtaining goods & services. The use of energy is a mostly rational process, with prices signaling the best ways and steering the ultimate outcomes. Prices do not fall from heaven.

Prices are human constructs with private expenses as basic material but generally neglecting most of the public costs (for example nuclear risks, climate change impacts of fossil fuel use), shrugged off as externalities. Prices are augmented by private and public rents, and inscrutably rearranged by direct and indirect levies and subsidies (table 1). Our question here is: how do we set up the best system of financial support for renewable electricity?

Economists distinguish price driven from quantity driven instruments to pull and push people on uphill roads to results they do not pursue spontaneously. In supporting renewable electricity generation, both have been tried. Feed-in tariffs (FIT) are above market prices mandating purchases of renewable electricity by incumbent power systems, and are a price driven instrument. FIT expenses are charged to all consumers of grid power. An alternative method to support RE development is a tradable green certificate (TGC) assigned to qualified producers per MWh renewable electricity generated, a quantity driven instrument. Suppliers of grid electricity to end-users must annually submit to the regulator a quota of certificates equal to an announced percentage of their MWh sales. Table 2 shows three main attributes of the opposite approaches.

Figure 2: Unlocking Renewable Energy Potentials

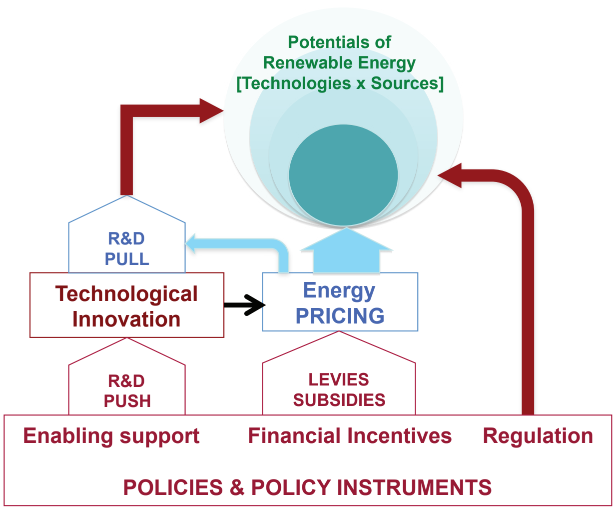


Table 2: Opposite attributes of main renewable energy (RE) support instruments

Main attributes of support systems	Feed-in tariffs - FIT	Tradable Green Certificates - TGC
Fixed RE supplies targets?	NO	YES
RE source & technology specific?	YES	NO
Mingled with electricity exchange prices?	NO	YES

FIT pays a set price for every RE MWh, resulting in less or more RE supply than the indicative targets announced. In TGC the set quota are fixed: shortfalls are heavily penalized, and overshoots are worthless if certificate banking is precluded, with banking eroding future efforts.

FIT systems catalogue the many various types of RE supplies, by qualifying sources and technologies with the help of several characteristics. FIT rates equal the levelized cost prices of the various supply types.

By design TGC strives for the opposite by creating a leveled playing field for all types of RE supplies to be rewarded by a single market price. Not policy, but the market must pick the winners. In practice, the “market” consists mainly of incumbent power generators that prefer mature technologies (e.g. co-firing biomass in obsolete, low-efficiency coal power plants), waste-to-energy plants, etc.

FIT is a transparent system, by distinguishing various RE categories each with a fixed purchase price per MWh over a fixed future period. The risks on financial loss for RE installers/investors are minimal, and the would-be investor does not need a specialized degree in complicated technical and administrative power supply systems. TGC intends to create a paper certificate market on top of the actual electricity exchange systems, assuming both levels are examples of competitive performance.

Simplistic market jargon was pushed in the years that the EU Commission saw the rising star of the carbon emissions trading scheme, constructed and inaugurated as flagship of EU climate policy.

The performance of support policies and instruments is assessed for the criteria efficacy (effective growth in RE supplies in a robust way), efficiency (static by minimizing costs of RE supplies; dynamic by inducing inventions and innovation; macroeconomic by a sensible restructuring of the activities in the energy sector and beyond), equity (apply the polluter pays principle; avoid rent skimming and excess profits; offer RE options for the less well-to-do people and countries), and institutional feasibility (transparent regulations with predictable results; no illusory prerequisites and conditions for letting the policies function). The practical experience in Europe is that FIT is by far the best instrument for unlocking the renewable electricity potentials. TGC mostly failed in functioning properly, failed in bringing more innovation to the renewable energy sector, and failed in impeding huge excess profits, which were subsequently mostly cashed by incumbent power companies.

Effect of Energy Policy on Small Scale Renewable Socio-technical Development

Bill Currie, Director of Powerhouse Wind

We are living in a world where a long period of easy access to cheap concentrated energy is reaching its limits. As humanity explores the margins of hydrocarbon bearing geologies to maintain existing rates of extraction of oil, gas and coal, energy return on energy invested (EROI) is declining and consequently the carbon intensity of the net energy produced is rocketing, just as our civilisation comes under increasing pressure to limit carbon emissions as our awareness of the impact of human induced climate change develops.

A tantalising but challenging contribution to the solutions we must find to these problems lies in technologies that fit within the scopes of local energy, distributed generation, and smart grid systems. These technologies in many ways point the electricity industry back to its roots, where energy was usually generated close to where it was going to be consumed.

An important feature of these approaches is the need for interconnections, sharing of resources, good flows of information, end-user involvement and novel commercial models to create smart and resilient systems. As well, these technologies need to grow and function alongside the traditional and well developed central electricity system we have today. Arguably, the greatest challenge in working with locally generated sustainable energy is not the development of the technical systems, but the development of the dimensions of 'energy culture' or how individuals, families and communities learn to use these technologies and develop their lifestyles accordingly. (See Energy Cultures: breaking out of business as usual Dr Janet Stephenson, Centre for Sustainability, University of Otago. Keynote address at The Energy Conference, NERI)

An ideal energy policy environment from the point of view of a small business aiming to make a contribution to the renewable distributed generation industry (www.powerhousewind.co.nz) would be one that recognises the urgent need for an experimental orientation as well as the 'business as usual' environment that supports the industry as it is now known.

Rather than focusing almost solely on honing an industry that has 127 years of history behind it, an ideal policy environment would be forward looking, and aiming to foster a range of experimental situations where new technical systems can have the opportunity to be developed, refined and improved (or rejected) in the context where they would be used. These local systems are not apart, like nuclear power stations with razor wire fences, but embedded in society, and cannot be developed in isolation.

There are some positive things happening. The National Policy Statement for Renewable Electricity Generation 2011 is a useful and succinct guide to regional authorities in terms of building the needs of all forms of renewable generation into new planning documents.

Our own experience is that the Dunedin City Council is responding well to this statement, and gathering input from all stakeholders for rules to be incorporated in the next revision of the District Plan which will be implemented sometime in 2014.

I would still like to see more support for, and commitment to experimental and pilot projects and demonstrations where solutions could be tested and refined, questions asked and answered and results prepared for revisions of plans based on seeing systems working and impacts identified and tested.

If we are not prepared to develop and demonstrate small scale renewable technologies in a socio-technical context, there is a very good chance that a good opportunity to make a difference will be lost.

Image: Thinair turbine installed near Brighton, Dunedin.

Removing barriers to future installers of small scale wind turbines

Study by Lee White, Applied Science student at the University of Otago, supervised by Sarah Wakes

Many rural land owners view the resource consent process as a significant barrier to installation of small scale wind turbines [1-2].

District Plans by city councils often do not provide guidelines specific to small scale wind turbines, further complicating consenting processes for those wishing to install the turbines [3].

City councils revising District Plans to better accommodate small scale wind turbines, and turbine manufacturers and distributors wishing to offer advice to clients, need to know which heights are likely to be suitable for small scale wind turbines.

Results from simulations run using Computational Fluid Dynamics software suggest heights in the range of 12 - 19 m are necessary even if no obstructions are present nearby. If a house is present nearby then, depending on roof shape, heights in the 19 - 23 m range may be necessary. “Suitable” heights are those found to generate 90-100% of electricity output achievable at any given site, even when wind flow is disrupted by nearby obstructions.

To remove barriers to potential installers of small scale wind turbines, councils should expect to permit for turbines with towers in the 15-20 m range.

1. Barry, M. and R. Chapman, Distributed small-scale wind in New Zealand: Advantages, barriers and policy support instruments. Energy Policy, 2009; 37(9): 3358-3369 DOI: 10.1016/j.enpol.2009.01.006.
2. Schaefer, M.S., B. Lloyd, and J.R. Stephenson, The suitability of a feed-in tariff for wind energy in New Zealand—A study based on stake holders' perspectives. Energy Policy, 2012; 43(0): 80-91 DOI: 10.1016/j.enpol.2011.12.032.
3. EECA. Domestic scale distributed generation: guidance for local government. 2010 [cited 2012 24 April]; Available from: http://www.energywise.govt.nz/resource/domestic-scale-distributed-generation-guidance-local-government.

Can New Zealand encourage homeowners to contribute to renewable electricity generation?

Lee V. White, graduate of Energy Management at the University of Otago, New Zealand

New Zealand at present does not have any policies specifically designed to encourage the installation of renewable generation capacity. There is further no policy guidance from the government as to how much a homeowner or a small community group wishing to generate renewable energy, and sell it to grid, should be paid for each unit of electricity (kWh). Anyone with a solar panel wishing to sell electricity back to the grid must negotiate rates with a retailer, and these rates are not always published for easy comparison. There is no guarantee that the negotiated rate will be offered far into the future, either. A homeowner or community group trying to assess the financial benefits (or potential losses) of installing a solar panel is left in a position where if the rate electricity retailers were willing to pay for power dropped, it might never be possible to pay back the capital cost of the system. Yet allowing homeowners and other non-traditional generators to enter the electricity generation market has many advantages, such as reducing transmission losses by using power close to point of generation. Further, encouraging all forms of renewable energy generation mitigates climate change and increases energy security by removing reliance on fossil fuels.

Other countries, particularly Germany, have successfully encouraged homeowners to install renewable generation capacity using policy mechanisms such as Feed-in Tariffs (FITs). Countries which use FITs, notably Germany, excel in installations of forms of energy such as solar photovoltaic (PV) panels which are needed for a diverse energy portfolio but are still relatively expensive to install due to not being fully mature technologies. Per capita PV installations are not linked to solar resource availability, but show a more convincing link with presence of supporting policies (Figure 1 and Table 1).

While a wide variety of schemes have been called FIT policies by the countries that implemented them, common to all FIT policies is that a fixed price will be offered over a fixed time for each unit of electricity generated by a renewable source covered by the FIT. In this way, installations of renewable energy can be promoted by providing a reasonably predictable stream of income to a wide variety of investors, including homeowners.

In general, the most effective FITs will pay the owner/installer of e.g. a solar PV panel slightly more for each kWh of electricity than it costs to generate, and this will be sustained over the expected life of the PV panel to allow producers of renewable energy to make a slight profit. The stable investment environment created by this allows those who would not traditionally produce electricity, such as homeowners, to enter the market with less fear of making a loss. As the capital cost of renewable technologies, such as PV systems, drops as the technologies mature the rate paid by the FIT - to new systems connecting to the grid - can be lowered to account for this. For a well designed FIT system it is important to have these revisions built in and completely transparent to ensure the environment remains predictable for investors. FIT rates are not adjusted in retrospect, but for any given PV owner would remain the same as the year in which they entered the scheme (and expended capital on the system).

As the cost of technology drops, then, so does the cost supporting each additional kW of generating capacity under a FIT policy which provides a stable environment for investors. For New Zealand cities, a FIT for solar PV following the cost of generation method could be set at around 17 c/kWh and still allow owners of PV panels to make a small 5% return on investment if the panel is optimally oriented. This is the case if the capital investment is around \$3300 per kW, if real interest remains low (2.2% accounting for inflation), and if a steady return can be made throughout the system's whole lifetime.

This is still higher than the wholesale cost of electricity (around 10 c/kWh), and a FIT funded by cost-sharing would cause electricity prices across the country to rise slightly. However, implementing a policy of this type would allow homeowners and communities to enter the generation market without fear of making losses.

This would allow them to act on desires to move away from fossil fuels and towards cleaner energy solutions, while at present most electricity users have no choice as to how the electricity they consume is generated. At present it is extremely difficult for homeowners and community groups to enter the generation market, and by doing so they carry a significant risk of financial loss since returns on investment lack long-term security.

Considering the benefits of having a diverse generation portfolio and of encouraging homeowners to enter the electricity generation process, a slight increase in electricity wholesale prices from an across-board scheme such as a FIT may be a good investment for future energy security.

Ranking	Country	Feed-in Tariff	Renewable Portfolio Standard	Net metering	Tradable Renewable Energy Certificate
1	Germany	Y			
2	Italy	Y	Y	Y	
3	Czech Republic	Y			Y
4	Belgium			Y	Y
5	Spain	Y			

Table 1: Highest ranked countries for most PV installations/ capita (from the REN21 Global Status Report 2012)

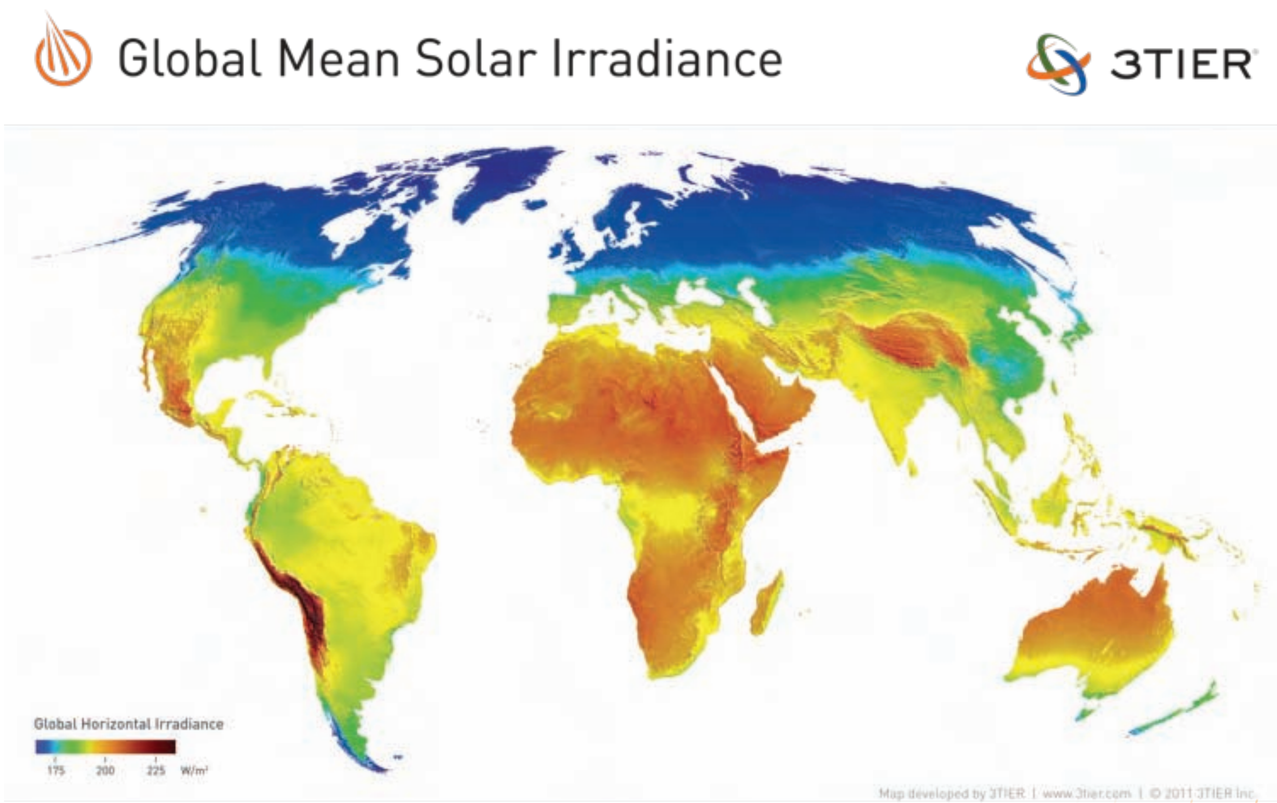


Figure 1: Global Mean Solar Irradiance

Family and the Fossil Carbon Safety Margin

Susan Krumdieck, Associate Professor at the University of Canterbury, New Zealand, in the Department of Mechanical Engineering

Past policies have been ineffective at curbing the growth of fossil fuel emissions – here is an analysis of the changes of energy consumption past present and future, along with CO_2 atmospheric level and global climate change risk from the latest models. However, let's make it more interesting by also looking at 7 generations of my family.

I wanted to look at the atmospheric CO_2 loading safety margin. There is an atmospheric CO_2 level that the models say will cause 2 °C temperature rise which will guarantee the end of our prosperous civilization, basically because it will melt the global ice and raise the sea level enough to destroy 80-90% of the investment that humanity has made to date. It will also mean a mass extinction and complete climate chaos. So – safety margin is a good name for it. If we get to a safety margin of zero, then the worst will happen, there is no chance it won't. Right now the safety margin is 565 Gt of CO_2. If we put that much more CO_2 in the air, the safety margin will be zero. This year our emissions are about 31 Gt per year. If we did not increase our emissions any further, then we would have 16 years until we have lost our safety margin. The amount of proven reserves (oil, gas, coal) that the energy companies plan to extract and bring to the market is 2795 Gt.

Here is my Family:

Great Grandmother Agnes
Grandmother Ruth
Mother Sue
Me
Daughter Kierra
Granddaughter
Great Grand-daughter

When Agnes was born, there was a global warming safety margin of CO_2 atmospheric loading of 1362 Gt, and the world emissions were about 0.3 Gt/yr. So, my Great Grandmother Agnes would have not been worried about the way that her society's energy use might affect her great grand daughter (me). She would have been much more worried about if I would be able to vote, have legal protection, survive wars and depression and even famine. She and her husband lost their farm in the Dust Bowl environmental disaster in the 1930's when my Grandmother Ruth was 4 years old.

When I was born, the CO_2 emission rate was up to a happy 4.6 Gt/yr, and the safety margin was still 1257 Gt. By this time, climate scientists had already been measuring the atmospheric CO_2 level at Mono Loa and could see it rising exponentially. If the fossil fuel production rate had been frozen at 1963 levels back then, due to alarm over exponential growth of emissions, then the safety margin would not have been exceeded for another 273 years, in 2236! No wonder nobody was worrying about climate change when I was a baby.

When Kierra was born in 1989, CO_2 emissions were up to 13.2 Gt per year and the safety margin had shrunk to 1042 Gt. This is the era where the Kyoto Protocol was established. It was understood that continued growth of CO_2 emissions was presenting a risk. The idea was to get the emissions into this 1990 range of 13.2 Gt from 2012 onward. In 1990 the safety margin would run out in 80 years at this rate of emissions. That's still just one lifetime, but it was thought that within that time some new technologies could develop to reduce the emissions further. Needless to say, this didn't happen.

Today, when Kierra is 24 years old and starting to think about a family, the emissions level is 31 Gt per year. If the nations of the world woke up and agreed to limit fossil fuel extraction and use to the rate it is today – no more growth – then when my granddaughter is 16 years old, the safety margin will be gone. I will live to see which side of the great climate debate was right.

By my calculations if the world agreed on a radical reduction of 15% in fossil fuel consumption per year for the next 10 years, leaving emission levels a bit less than 20% of current emissions and energy use equal to that in the 1960's, the safety margin will run out when my great grand-daughter is 67 years old.

At my age now, I can face the impossible prospect of the world reducing fossil fuel production and use drastically. I can think about how difficult that would be, how much hardship people would endure using only 15% as much fossil fuel. And still when my great-grand daughter is my age, she will have to face the impossible prospect of abandoning costal cities, mass extinction of species, unbelievably severe droughts, floods, temperature extremes and storms. And my sacrificing some of my conveniences is the best I can do for her now?

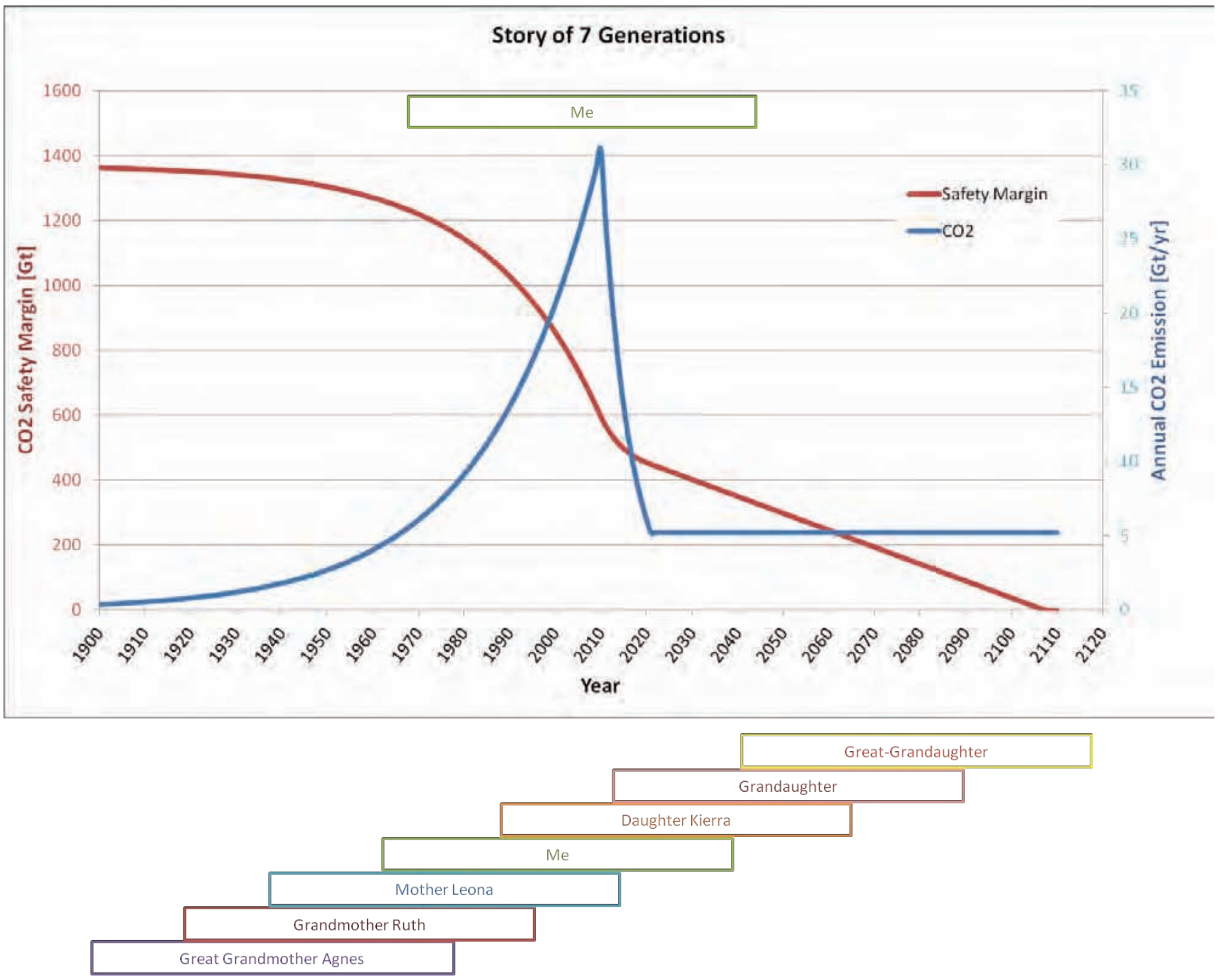


Figure 1: The aggressive reduction scenario which extends the safety margin through most of my great-granddaughter's life time

Blueskin and the changing electricity system: a time for community and a return to service?

By Scott Willis, Project Manager at the Blueskin Resilient Communities Trust

Introduction

NZ is blessed with an electricity backbone (the National Grid) running the length of the country between the two main islands, a circulatory system of local networks and abundant real and potential renewable energy. Far sighted engineers and natural assets were responsible for this heritage, however all is not perfect in the land of the long white cloud. When Blueskin residents in 2006 first expressed a desire for the community to build and control its own electricity generation, it seemed like a simple expression of civic responsibility. To be honest, it was also a signal of resistance to the ideology of market rules, which, since the reregulation of the electricity sector in the 1980's patently have not delivered better service to residents. Back in the 1980's our centrally run system providing generation, transmission, distribution and retail supply (essentially a 'service' based system) was replaced with a new system based on profit[1]. By 2009, for example, $4.3 billion had been extracted from the New Zealand market[2].

Blueskin residents, back in 2006, weren't primarily thinking about price however. The 2006 visioning workshop looked to the challenges ahead, and residents began thinking about how we might, as a community, build greater resilience, including resilience in our energy systems. A wind cluster was only part of a wider picture of actions, albeit an attractive goal. A simple goal too, surely, after all, energy assets have been built by entrepreneurial communities in past[3]. Ah! If only things were that simple! Now, 7 years on, we've made much progress towards our goal of community energy and have confronted many challenges. This is an insight into our local efforts to build community renewable electricity generation in a challenging policy environment.

Service to Profit

The transformation of the NZ electricity sector that began in 1986 can be summarised as one from service to profit, or "the implementation of light-handed regulation"[4]. Since the eighties, our electricity system, developed over 100 years, has been progressively broken up from a natural monopoly into competing electricity 'silos' under general government oversight and with increasingly complex regulation with often contradictory effects.

What the transformation hasn't done in any significant way, is challenge the 'Think Big'[5] approach that was a defining feature of the Muldoon years (1975-1984) and which established a mould for virtually all generation projects from that point on. The current electricity market is shaped by that Think Big heritage.

The Electricity Market

Any grid connected generation must participate in the national electricity market, however generators under 10 MW don't have to make offers to the market (the Blueskin wind cluster proposal is under 10MW). The NZ electricity market is a 'spot market' with 'hedge' contracts. Such a market structure presents significant challenges of unpredictability and volatility and is essentially an exclusive club for the largest gentailers (generation-retailers)[6]. Small scale, or community scale generation really isn't even thought about so effectively what we have is a situation where "small generators contract their output to others who are already in the market, who then look after offering and reconciliation"[7]. This situation is far from ideal for small generation projects as effectively it means selling to your competitors, i.e. other generators. That is the big challenge for community generation under current regulations.

Small scale generation?

Transpower's 'Glide Path' strategy (essentially a managed run down of the national grid in the assumption that distributed generation would naturally come into being) was transformed in 2011 into an 'Enduring Grid' strategy, (in which the main trunk line will be bolstered, reinforced and made stronger). At the same time, the 'Green Grid' project[8], a 6 year research project, is looking at how to devise a grid in which our electricity system is supplied with 90% renewable electricity[9]. Distributed Renewable Generation[10] (DRG) will be considered as part of that research.

At the 2013 New Zealand Wind Energy Association conference (20-22 March), we learnt of a number of small wind projects in the pipeline, despite the industry bias in favour of big projects, at a time when 'Think Big' seems to be losing its ideological shine. Might this be the moment when small scale renewable generation comes into its own?

We think so. The regulatory situation is still inappropriate for DRG and smaller scale developments but there is a growing appreciation of the need to secure local electricity supply, build renewable generation before oil supply contracts even further, and secure some of the 'green growth' benefits of DRG. When we began this journey back in 2006, we had no idea of the complexity of the market. We worked on energy literacy and energy demand reduction first. In 2009 we began working on generation not with an assessment of the NZ electricity market, but with wind testing. By 2010 we had completed a feasibility study, and had been briefed by Greg Sise of EnergyLink[11] on the market challenges. We were confronted with the hard truths. Nevertheless, lack of good regulation was not going to stop a powerful community momentum! By early 2011 we had worked out a way to deal with those market challenges – enlist some allies.

The trick is to 'de-risk' DRG under current regulations. The approach we began working on in late 2011 was something that had been successfully trialled in Canterbury already – a 'hedging' contract for the sale-purchase of a limited quantity of electricity between a small generator and the local council[12]. The Dunedin City Council (DCC) is currently working on an Energy Plan and has its sights on low carbon innovation.

The Council has expressed its interest in providing a long term hedging contract for the Blueskin wind cluster project[13]– effectively signalling it may guarantee purchasing the electricity at a set price over a similar period in a way that is cost-neutral or cost-positive. With the final wind analysis being worked on at present, Resource Consent application in process, it is time that we begin the process of getting a hedge contract in place.

Summary

One hundred years ago it was community entrepreneurs who helped build up a resilient national electricity system. Today, we can't wait around for central government to enact sensible regulation. Industry, business, community, local government – all seem to be aware of the need to be creative and find solutions to the economic, resource and climate challenges we all face. Our centrally controlled, heavily regulated electricity system is no longer, and a paradigm change is underway. The Blueskin wind cluster proposal is a Distributed Renewable Generation project, but it is also a social business in the making, aiming to deliver benefit to the community and build further energy resilience. We can't at a community level hope to become a gentailer and compete with the big boys and girls. But neither should we. Through collaboration and partnerships we can work within current regulations while working to ensure that we illustrate where modifications need to be made when the architects of regulatory change come calling.

Pete of Pioneer Generation surveys the Blueskin wind cluster site prior to the installation of the 30 metre wind measuring tower, 2013.

Basil Ireland, landowner, lends his shoulder to raise a 10 metre tower in 2011.

Basil Ireland, Gerry Thompson and Scott Willis begin raising a 10 metre tower on Porteous Hill, with Blueskin Bay in the background (2011).

Teams from Pioneer Generation and Energy3 work together to install a 30 metre tower on Porteous Hill, 2013. Silverpeaks in the background.

Blueskin and the changing electricity system: a time for community and a return to service?

Notes and References

End Notes:

1 Farnworth, S., 2011. "Competition Law and Electricity Regulation in New Zealand; A Law and Economics Analysis of the Electricity Authority's Undesirable Tradition Situation Regime". Presentation at the 2011 Otago Energy Research Centre conference [http://www.otago.ac.nz/oerc/past_events.html]. Farnworth described how language through reregulation changed to support profit pursuit (i.e. 'Dynamic Efficiency' vs. 'Static Efficiency').

2 Ibid.

3 In 1902, a group of Dunedin businessmen formed the Waipori Electric Power Company and started building a hydroelectric station on the Waipori River, 45 kilometres by transmission line from Dunedin. Pioneer Generation was begun by community entrepreneurs in 1920 (see http://www.pioneergen.co.nz/about-us/our-history/).

4 See: http://www.iscr.org.nz/f310,14092/Chapter_5_New_Zealand_s_Electricity_Reform_History.pdf

5 'Think Big' refers to an interventionist state policy to boost economic growth and buffer New Zealand against the energy crisis that first emerging in 1973 by through engaging in big industrial projects, such as a dam to provide energy for an aluminium smelter, an oil refinery, etc.

6 The 5 major electricity generators in New Zealand also own retailing arms, and as a consequence demonstrate 'vertical integration' – management control of a supply chain. Companies expressing this form of vertical integration are known as 'Gentailers' (or Generators/Retailers)

7 Greg Simes, EnergyLink (personal communication).

8 Janet Stephenson, personal communication.

9 And why such a mediocre goal as part of the national energy strategy? Why not 100%, when we're so close already?

10 Distributed renewable generation (or DRG) is generation that feeds not directly into the national network (owned and managed by Transpower) but into the local network (owned by many different local network companies) and is typically used within the local network.

11 EnergyLink is a national independent energy advisory company based in Dunedin. See: http://www.energylink.co.nz/

12 The Christchurch City Council entered into a 10 year contract with WindFlow Technology Limited to purchase electricity produced from the Gebbes Pass WindFlow 500 turbine in 2001 at a set price. This provided certainty to a start up company and very cost effective electricity for the council over the 10 year period.

13 At the time of writing a memorandum of understanding to begin work on developing a hedge contract between BRCT and the DCC has been agreed upon and is in the final stages of being signed into being.

Recommended reading

Electricity Market Reform: An International Perspective
edited by Fereidoon P. Sioshansi, Wolfgang Pfaffenberger,
particularly chapter 7: *Restructuring the New Zealand Electricity Sector 1984 – 2005*
by Geoff Bertram

Global Status Report (2012) by REN21,
www.ren21.net

The Carbon Challenge: New Zealand's Emissions Trading Scheme
by Geoff Bertram and Simon Terry

Powering the Green Economy: The feed-in tariff handbook
by Miguel Mendonca, David Jacobs and Benjamin Sovacool

A Policymaker's guide to Feed-in Tariff Policy Design
by the National Renewable Energy Laboratory,
www.nrel.gov/docs/fy10osti/44849.pdf

We welcome new members

To sign up

Fill out this form and send it to:
The Treasurer, Solar Action, PO Box 6457, Dunedin.
OR
Email your details to:
membership@solaraction.org.nz

Fees

Individual	**$80**
Student / Superannuitant / Unwaged	**$45**
Small corporate / Institition	**$650**
Corporate (per annum)	**$1250**

Payment optons

Send a cheque to the Treasurer. Please make cheques payable to "Solar Action"
OR
Make your payment by Internet banking to:
12-3008-0244150-000 (ASB)

Please quote your name and membership number (if known) in the 'reference boxes when paying by internet banking, and send an email with the transaction details to **membership@solaraction.org.nz**

Solar Action is not registered for GST.

Your details

Name ____________________

Organisation ____________________

Email ____________________

Address ____________________

____

City ____________________

Phone no# (   ) ____________________

Fax (   ) ____________________

Receipt required? YES / NO

Join our email list

Send an email to timb@solaraction.org.nz to join our email list at **no charge!**

solaraction
The New Zealand Renewable Energy Society

solaraction

The New Zealand Renewable Energy Society