ESR NEWSLETTER
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Contents

Webinar Notice: What is wrong with the New Zealand Electricity Market?

A review of the electricity reforms in New Zealand since 1986, by Dr George Bertram

ESR Zoom Webinar Wednesday 19 August 2020, 6.00pm.

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Geoff Bertram's broad research areas included climate change policy, environmental economics, income and wealth distribution, and small island economies. His current research areas include climate change policy, environmental economics, New Zealand macroeconomics and economic history, income and wealth distribution, regulatory economics (including analysis of excess profits and anti-competitive practices with particular reference to the electricity industry), and the development of small island economies.

1.The Building for Climate Change programme: MBIE press release extract

The Building for Climate Change programme has been set-up to get us building in a completely different way. Tackling the climate change challenge will require vision, commitment and perseverance as well as significant change. It won't be done overnight and it won't be easy.

We'll be setting targets around energy use and carbon emissions that focus on getting New Zealand where it needs to be. At the start, we should be able to reach the goals through good current practice, but over time, the goals will be increased to make greater carbon savings and emissions reductions. To meet the goals, we'll need to make some changes to current building laws – both the Building Act and the Building Code.

We'll also focus on starting to change people's behaviour, and the way they think about building. We'll do this through information incentives, and innovation.

At first, we'll be focussing on how we can build new buildings better. In the future, we'll also likely need to look at what changes need to be made to existing buildings.

Any changes we make will be thought through carefully, and we'll talk to the people who will be affected by the changes first. This means that we'll be working closely with the building and construction sector, other government agencies, iwi, key stakeholders, local government and communities across New Zealand to make sure we get this right.

THE FRAMEWORKS

Transforming operational efficiency

This framework will set upper limits for new buildings to obtain a consent under the Building Act 2004. The framework will set levels of efficiency for **energy use and water use**. They will also set defined comfort levels including temperature ranges and air quality that will need to be achieved for consent.

These targets will mean that everyone involved in the design, development and construction of a building will need to keep efficiency at the forefront of their thinking.

As well as direct benefits there will be co-benefits including improved health outcomes and reduced energy bills – both of these are likely to have greater impacts on parts of society that are most in need. This is an area where we will seek significant co-operation and partnership with both the Sector and other government agencies to ensure we deliver these co-benefits.

Reducing whole of life embodied carbon

This framework will set mandatory reporting requirements as well as targets that will need to be kept under to gain consent. The framework will consider the allowed level of greenhouse gas emissions from:

2. India's draft policy on Scientific Social Responsibility

The following item was forwarded to Thomas Neitzert by John Peet who then forwarded to me for inclusion in our newsletter but was lost in my spam folder. Dr Rajesh Tandon is an internationally acclaimed leader and practitioner of participatory research and development. He is Founder-President of Participatory Research in Asia (PRIA), since 1982, and UNESCO Chair in Community Based Research and Social Responsibility in Higher Education, since 2012.

In early January, at the 107th annual Indian Science Congress held in Bengaluru, the Department of Science & Technology (DST), Government of India shared its draft policy on Scientific Social Responsibility (SSR), inviting discussion. As a leading country with a strong base of modern science and its institutions, India's efforts to prepare a framework of social responsibility of science is really very meaningful and important.

In the draft, the purpose of the policy is described as utilisation of scientific knowledge towards achieving social goals, acknowledging that "building a strong connect between science and society is essential." SSR is explained as "the confluence of scientific knowledge with visionary leadership and social conscience." The 'responsibility' of science to connect with society is an 'ethical obligation, not a legal requirement' under the policy. It is viewed in the spirit of 'giving back' the benefits derived from science to society.

The policy explains how linkages between science and society can be bridged through a number of activities based on an annual SSR plan in each science institution of the central and state governments. Common activities include popularising science in schools and through mass communication channels for the general public. Using science for social entrepreneurship and development of applications based on science are also suggested activities under SSR.

How can this proposed framework for the social responsibility of science in India be made more robust and contemporary, building on India's own long history of scientific tradition? What lessons can be learnt from other countries?

Globally, Europe has long-standing policies to build conversations between institutions and leaders of science with citizenry. It was at the turn of the 21st century that Europe began experimenting with new paradigms of science and knowledge. What began as a connect between science and society, shifted to science for society. To make science, especially 'high' science, understandable to citizens, science communication centres and networks became active across Europe, partnerships between researchers and societal problems received support from the European Union, and 'science shops' became a regular part of many European universities. In the past five years, the European science establishment has begun to acknowledge that society itself may be a source of knowledge relevant to addressing some of the challenges the planet faces today. Therefore, the Horizon 2020 programme of the European Union focused on science with society. This new framework is called Responsible Research & Innovation (RRI).

At the heart of the global debate today are questions about what is science and what is knowledge. India's draft SSR policy acknowledges the nation's long tradition of science and knowledge, but then focuses exclusively on what is labelled as 'modern' science. Is local knowledge about health, agriculture, water and forestry available with communities not 'science'? With the world facing increasing impacts of climate change that affect our food supply, water availability and oxygen-for-breathing, scientists have begun to acknowledge the 'scientific' merit of traditional and Indigenous knowledge demonstrated in everyday practices of farmers, tribals, fisher-folks, women and others who have been innovating solutions from practice for generations. Traditional practices of organic agriculture are being promoted world-wide. Holistic approaches to health combine knowledge systems of Ayurveda, Unani, and Siddha with 'western' allopathic knowledge system. Yoga has become universally popular. Nutritionists acknowledge the benefits of traditional grains in diets.

Around the world, the chasm between 'modern' and 'traditional' science, as if they are in opposition to each other, is being bridged by many communities of scholars. India's Prime Minister too has called upon all citizens to address the growing challenge of water scarcity in the country through use of 'traditional' knowledge for water-harvesting, storage and distribution. The Government of India needs to continue to make special investments in supporting local, Indigenous practices. The Ministry of Science and Technology, along with other ministries (Agriculture, Health, Ayush, Environment Forest and Climate Change) and multiple societal stakeholders (industry, farmers' associations, tribals, women farmers' groups, etc), can co-create the new SSR policy incorporating features of science with society. In this sense, the SSR framework can aspire for mutually respectful and supportive relationships between scientists and science institutions on the one hand, and society and its various actors, on the other, making them authentic partners for societal progress. This will require a more holistic and inclusive meaning of knowledge – one that acknowledges multiple sources and forms of knowledge, which when synergised with 'modern', published knowledge will produce resilient solutions for societal benefit. Instead of focusing on a knowledge economy, a knowledge society can be encouraged through adopting a critical, open, questioning approach -- sometimes labelled 'scientific temper' in society -- 'liberating' people from superstitions and dogmas.

As a recent book from Canada's Indigenous community, Knowing Home: Braiding of Indigenous Science with Western Science, argues, "It is not about replacing one hegemonic knowledge system with another… it is about finding a way for multiple knowledge systems to work together in the interests of all life on the planet."

3. The next-generation, lower-cost, 'million-mile' electric-car battery

From an article on the CNBC website, Jun 30 2020 by Tim Mullaney

Lithium-ion batteries are expected to be replaced with lithium-iron phosphate and other chemistries over the next few years. This will cut costs and extend vehicle range and extend battery life.

As Tesla plans next-generation electric vehicle batteries, focus is turning to lithium iron, not the lithium ion that has been the fundamental chemical engineering science powering EVs to date. Elon Musk's car company and GM, among other auto companies, want much longer-range and more durable battery cells.

New battery technology is possible, allowing cars to go 400 miles or more between charges and lasting as long as 1 million miles. That could spur EV sales the same way the first 100,000-mile warranties on gas cars once did. Eliminating the rare, expensive and controversial element cobalt from batteries is among the biggest aims.

4. The Top 5 advancements needed to make Automated Vehicles an everyday reality

Extracted from TrafficTechnologyToday.com Web Team, dated July 10, 2020

Automated vehicles (AVs) have progressed to the point that some are puzzled as to why we don't see more of them in action. With personal vehicles and fleet trucks alike now able to navigate, manage roads, and even work in conjunction with one another, it certainly feels as if we're on the cusp of a transition to fully automated road traffic. And yet, we're not quite there.

A few more advancements are needed before we'll start to see more of these vehicles on the roads, whether in the trucking industry or otherwise. Here we take a look into what some of those advancements might be.

1. Positive changes to regulation
While some see strict and widespread regulation as being antithetical to AV progress, the truth is that AVs simply need the *right* regulations in place. In the best-case scenario, positive changes to regulation will accomplish two goals at once: They will better prepare modern environments to safely accommodate AVs, and they will spark ongoing innovation in design and functionality. In short, we need to see governments and regulatory bodies working *alongside* companies designing AVs, rather than just over them or in response to them.

2. Established parameters within which AVs can 'learn'
One lingering concern about autonomous vehicles is that they don't always have much opportunity to *learn* in safe environments. Typically, high-end smart tech is able to learn on the job, but when road safety is at hand, this sort of trial isn't much of an option. Efforts are being made to teach self-

driving vehicles how to recognize certain things — such as the habits or attitudes of other drivers. But even if certain vehicles and systems have "learned" safety (such as our platoon operations), regulators and other authorities are likely to seek extreme clarity regarding what vehicles can learn, and when and how they do it.

3. Ever-improving PCBs driving smart functions

It can be easy to take for granted the internal systems that help to drive the smart functions of autonomous vehicles. When you begin to think of such vehicles essentially as computers though, it's easy to gain more appreciation for the components – specifically, the printed circuit boards – that make everything work. Already to this point we've seen some impressive innovations in PCBs that bundle more power into smaller and more versatile packages; multi-board PCBs are among the next-gen designs that accomplish this, and rigid-flex and high-density interconnector designs can also be useful for certain smart vehicle functions. Even with these existing innovations in PCB design though, more will likely be needed. As we continue to improve other aspects of autonomous vehicles to make them even more road-ready, the demands on computing mechanisms will only grow greater.

4. Answers to the ethical questions

What we're talking about specifically are questions such as whether a car should protect its own driver or the greatest number of potentially affected people, given the choice – or whether a car should have the capability of breaking traffic laws in order to avoid a minor accident. These questions will need to be sorted out, in all likelihood, before we see the number of autonomous vehicles and fleets many hope to see on the roads.

5. Smarter environments

Finally, autonomous vehicle adoption on a broad scale is also going to require smarter environments. It's been said that smart cities need smart cars, such that people driving (or rather, riding) in cities will benefit from vehicles' ability to interact with one another. But in crowded environments, those vehicles will also need to communicate with their general surroundings. They'll need to recognize stoplights and crosswalks, respond to rapid changes in traffic, and so on. So, it might be more appropriate to say that smart cars need smart cities. This isn't of quite as much concern for connected platoons or shipping fleets, but it is one more hurdle to overcome in general.

5. Spreading rock dust on fields to remove CO_2 from the air

From an article by Damian Carrington Environment editor, Guardian website, Wed 8 Jul 2020

Spreading rock dust on farmland could suck billions of tonnes of carbon dioxide from the air every year, according to the first detailed global analysis of the technique. The chemical reactions that degrade the rock particles lock the greenhouse gas into carbonates within months, and some scientists say this approach may be the best near-term way of removing CO_2 from the atmosphere.

The researchers are clear that cutting the fossil fuel burning that releases CO_2 is the most important action needed to tackle the climate emergency. But climate scientists also agree that, in addition, massive amounts of CO_2 need to be removed from the air to meet the Paris agreement goals of keeping global temperature rise below 2C.

The rock dust approach, called enhanced rock weathering (ERW), has several advantages, the researchers say. First, many farmers already add limestone dust to soils to reduce acidification, and adding other rock dust improves fertility and crop yields, meaning application could be routine and desirable.

Basalt is the best rock for capturing CO_2, and many mines already produce dust as a by-product, so stockpiles already exist. The researchers also found that the world's biggest polluters, China, the US and India, have the greatest potential for ERW, as they have large areas of cropland and relatively warm weather, which speeds up the chemical reactions.

The analysis, published in the journal Nature, estimates that treating about half of farmland could capture 2bn tonnes of CO_2 each year, equivalent to the combined emissions of Germany and Japan. The cost depends on local labour rates and varies from $80 per tonne in India to $160 in the US, and is in line with the $100-150 carbon price forecast by the World Bank for 2050, the date by which emissions must reach net zero to avoid catastrophic climate breakdown.

"CO_2 drawdown strategies that can scale up and are compatible with existing land uses are urgently required to combat climate change, alongside deep emissions cuts," said Prof David Beerling, of the University of Sheffield, a lead author of the study. "ERW is a straightforward, practical approach."

Prof Jim Hansen, of Columbia University in the US and one of the research team, said: "Much of this carbonate will eventually [wash into] the ocean, ending up as limestone on the ocean floor. "Weathering provides a natural, permanent sink for the carbon." Hansen, who famously warned the US Senate about global warming in 1988, said improving soil could also underpin food security for billions of people.

Other proposed ways of pulling CO_2 from the atmosphere at similar rates include using chemical solvents to capture it directly from the air, or growing energy crops, burning them to produce electricity and then burying the CO_2 emissions. The new research suggests ERW will be less expensive than either and, unlike energy crops, does not compete with food for land. But the scientists said all approaches may be needed to beat the climate crisis.

Planting trees and adding charcoal to soil also remove CO_2 from the air, and these approaches could potentially be used in combination with ERW to maximise the impact. "Planting trees is an excellent option for CO_2 removal but is not sufficient on its own," said the scientists.

Basalt is preferred for ERW as it contains the calcium and magnesium needed to capture CO_2, as well as silica and nutrients such as potassium and iron, which are often deficient in intensively farmed soils. Some farmers in south-east Asia already use it to boost depleted silica in rice fields, while trials in the Netherlands are using it to boost tree planting. Most importantly, ERW reduces soil acidity, which already affects about 20% of arable fields around the world.

Basalt is one of the most common rocks on Earth, and waste dust from mining could be used for ERW, as could waste from cement and steel manufacturing. This would remove the need to grind the rocks into fine particles, which requires energy. But how big these waste stockpiles are is unknown.

Beerling said ERW did not require new technology, and farmers could get behind it, adding: "If you could demonstrate to farmers in China and India, for example, that they are going to get crop yield increases and get paid $100 a tonne for removing CO_2, then it becomes really attractive."

Prof Johannes Lehmann, of Cornell University, and Angela Possinger, of Virginia Tech, both in the US, who were not involved in the study, wrote in a commentary on the work in Nature: "Any carbon sequestration involving soils is a formidable challenge because the technologies must be used on vast areas of land that are operated by hundreds of millions of farmers. Farmers must be fully behind such a global effort or it will fail." They added: "Benefits to crop growth will need to be prioritised, as will financial incentives." But they concluded that using ERW to "support soil health and crop production could emerge as our best near-term solution to the problem of removing CO_2 from the atmosphere".

Beerling said that while the model used for the analysis was sophisticated, it would be important to compare its estimates with real-world experiments under way on 4ha plots in the UK, US, Australia and Malaysian Borneo, and that more research was needed on the detailed soil chemistry. "It is quite a young science," he said.

6. Solar Hot Water Heating in New Zealand

This item was prepared from information provided by ESR member Eric Jansseune (ericjansseune1957@gmail.com). Any questions on the assumptions made should be directed to Eric.

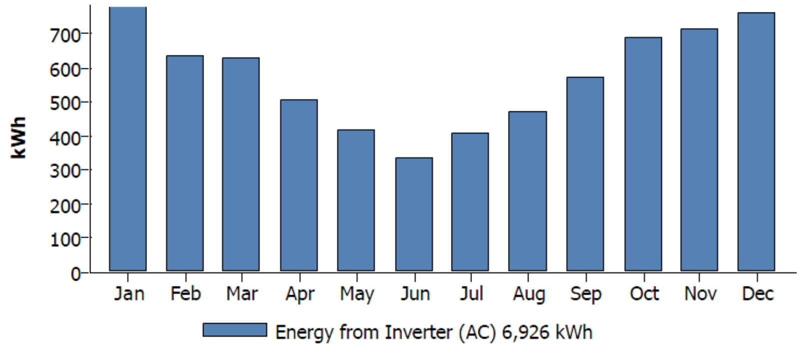
Unlike many developed countries worldwide, there is no compulsory feed-in tariff in New Zealand for solar power export to the grid. Energy providers in NZ are free to pay or not pay for export of electricity to the grid, resulting in rather long pay-back times.

More than 80 % of NZ domestic buildings use a lot of electricity for the basic needs of hot water, cooking and heating air-conditioning. The energy needs for hot water in an average NZ household can be estimated at minimum 4,500-5,000 kWh per year. The total average electricity needs for New Zealanders are reported at 10,000 kWh per year. This figure is rather high compared to the rest of the developed world. Hot water cylinders and electric heaters electricity losses are directly reflected in household energy bills. These losses average around 30-50 % in many households because of their inefficient appliances.

A solar hot water (SHW) state-of-the-art system can produce as much as 800 kWh per year per m^2 collector while an average solar power system produces 200-225 kWh per year per m^2 panel. To provide the electrical needs for hot water only, a household would theoretically need a solar power system of a minimum of 25 m^2 solar PV array. A simple and small SHW of only a 3 m^2 SHW collector, however, can easily cover 70% of the yearly hot water production costs for a 4-person family. The estimated cost of such a system is $6,000 including $600 for copper piping and a $600 installation cost.

At the feed-in tariff of 8 ct/kWh currently offered by only two energy providers in NZ, it becomes very hard to demonstrate a short pay-back time for solar power systems. Solar hot water systems on the other hand always save a dollar for a dollar at full electricity tariff. Advanced solar hot water systems have a proven life span of 30 years without drop of efficiency, unlike solar PV panels which yearly loose efficiency because of degradation of the solar cells.

An average household will need more than 13 kWh per day to produce enough hot water. For a solar power system which is not connected to the grid, called OFF-GRID, this will be hard to produce during many months of the year and in winter period specifically. A typical monthly energy production is shown below for a 5 kWpeak solar power system to demonstrate that it cannot produce enough electricity.



To maximise the energy produced by a solar power system, a typical NZ family would have to adapt some of their daily routines. Using appliances e.g. washing machines and dishwashers during daylight and taking showers on specific moments of the day are some of the actions that can increase the cost savings.

Regardless the size of the solar power system, it is the feed-in tariff and the self-consumption time during daylight hours that determines the pay-back time. The scenarios below set out the pay-back time based on the self-consumption rate of the solar power. They are based on *a 3* kWp, or 18 m^2 system, with a 3 % yearly increase of electricity price. If the 0.5 % yearly energy drop of the PV panels is taken into account, the pay-back times increase by 1-2 years.

Scenario energy use	Simple pay-back time
30/70 % = 30% self-consumption	14-16 years
50/50 % = 50 % self-consumption	12-14 years
70/30 % = 70 % self-consumption	10 years
100% self-consumption	8 years

In comparison, a SHW system covering 70% of the yearly hot water production costs would have a pay-back period of 7-9 years.

It is not a choice between solar hot water <u>or</u> solar power. The average household in NZ consumes 25 kWh/day. This electricity use should preferably be reduced <u>before</u> investing in a solar power system. In residential and commercial buildings, the priority should first be the choice of energy efficiency measures (LPG gas, double glazing, lighting, insulation etc.[i]) followed by an advanced SHW system. These investments will be more cost-effective with shorter pay-back times than any kind of solar power system.

[i] To overcome the standing losses of a hot water cylinder, the direct use of LPG for cooking, hot water and heating will be much more efficient and cheaper to run. The use of a gas califont for instantaneous hot water should be more promoted in NZ because it reduces the electricity bill without loss of comfort. The use of LPG gas is not only more efficient than electricity but is also much cheaper to run for the same kWh unit. Average in NZ is 19-20 ct/kWh (2019) for LPG compared to 30-35 ct/kWh for electricity.

Ross Rutherford ESR Newsletter Editor, 9 August 2020