OPINION

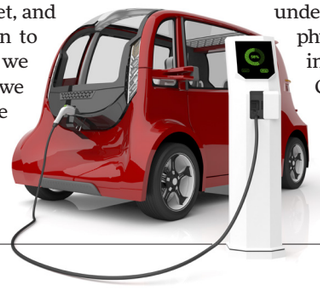
RUNNING ON EMPTY

From hydro dams to household fuses, New Zealand has nowhere near the capacity needed to move to an all-electric vehicle fleet, writes MICHAEL KELLY.

If, by 2050, we have a net-zero carbon emissions economy in New Zealand, there will be three major engineering projects successfully completed. We will have:

- Electrified ground transport.
- Electrified industrial and residential heat.
- Greatly expanded the electricity sector in terms of generation, transmission and distribution so that the first two projects can work.

These projects are specific to meeting the 2050 target, and are mostly in addition to business as usual. If we fail in any one of these we will certainly miss the target, as the scope for carbon offsets is relatively small.



As with US President John F Kennedy's 1961 commitment to go to the Moon by 1970, these three engineering projects will require strong leadership from the very top, the hard work of a cadre of dedicated engineers, secured finance, the supply of requisite materials and a comprehensive buy-in from the public.

In the absence of a clear blueprint for each of these projects, including a detailed road map of who does what, by when, and to what level of output performance, the public debate will continue as it has for two decades now, as just a lot of hot air underpinned neither by sound physics nor robust engineering. It is my hope that our Climate Change Commission steps up to take ownership of the preparation of these blueprints as a matter of national urgency. Its January 31 report used the word "engineering" only twice, and both in the context of genetic engineering of plants and animals. The commission should own, rather than ignore, the engineering response as described here.

MOTORING AS USUAL

Here are just a few hard numbers to start with. When a car is being refilled with petrol, energy is entering the petrol tank at the equivalent of 17 million watts. From that fact, and knowing how many cars, SUVs, trucks and vans there are in New Zealand, you come up with startling conclusions.

In the absence of a clear blueprint, debate will continue as before: just a lot of hot air.

Taking the three million cars and SUVs on the roads, the present hydroelectricity system in New Zealand generates enough electricity that, if all those vehicles were electric, car batteries could be charged every eight days. The one million trucks and vans are bigger vehicles and are on the road a greater proportion of their time. The eight-day return for battery charging nearly doubles.

Indeed, to continue with motoring as usual in New Zealand, we will need to install extra capacity equal to 120% of total hydroelectricity usage today just to power transport. We will need another 50% to cover commercial and domestic heating. The expansion of the electricity supply sector to achieve this level of consumption is precisely the third engineering project.

At the point where the grid electricity enters most New Zealand homes, there is a 60-amp fuse. This standard is decades old and reflects the range of appliances typically then used. For example, a single electric kettle draws 8A.

In the new era, fast (slow) chargers for cars are equivalent to four (two) kettles; an induction hob when initially heating up is equivalent to more than four kettles; an all-electric shower is equivalent to five kettles; and even an air-source heat pump when starting is equivalent to seven kettles. We will need to treble the capacity of the mains fuse in an all-electric house unless we are prepared to be crippled by frequent tripped fuses as we do two or more things simultaneously.

This in turn will require larger capacity copper wiring from the house to the substation, and the substation transformers will typically have to be more than doubled in size. The transmission for the enhanced electricity usage will need building. The whole grid needs upgrading.

This is an especially costly exercise if we are going to insist on electric cars in rural communities: just how many public charging points will we need in the countryside for the occasional drivers?

The expansion of the grid will have to predate the extensive introduction of electric vehicles. There are already places in Auckland where there is no local capacity for more than a few electric charging points without a major strengthening of the electricity distribution capacity.

FLAT BATTERIES

The idea that we might allow the grid to take energy from our batteries is fanciful; we would go to start a journey and find not enough charge in the battery, and no one who has critical work or family responsibilities will want to be delayed. The number of exceptions (key workers, travelling salesmen, rural dwellers, ordinary people with special commitments) is sufficiently large that the required infrastructure for two-way electricity from each house would not be commercially viable.

How much will these three projects cost? My initial estimate is about $100,000 per person. Spread over 30 years this is feasible, but at about $15 billion a year it is comparable with our current spend on education.

If the UK is a guide, the investment in the generation, transmission and distribution of electricity will need to be eightfold greater in each of the next 30 years than the average level of investment in the grid over the past 30 years. Who will pay, and who will finance? Where will all the extra professional and skilled trade engineers come from? The current engineers are all busy doing their day jobs, and these three engineering projects are on top of all else.

TIME TO GET REAL

What we need in New Zealand this year is a clear public debate on the scale and integrity of these big engineering projects, which are an essential precondition to meeting the Government's 2050 target for a net-zero emissions economy. And these are not sufficient on their own to achieve the target, as I have not mentioned agriculture, horticulture, forestry, shipping or aviation.

Officials in the Ministry for the Environment have just pointed out the impossibility of the public sector going carbon neutral by 2025. They realise that the engineering challenges for the public sector cannot be decoupled and solved first, and do not want to be blamed for an inevitable failure of policy that ignores engineering reality.

Dreams and reality: John F Kennedy.

GETTY IMAGES

Similarly, a 50% reduction in emissions by 2030 is off the cards in terms of engineering reality. Given that three billion people are still striving to join the global middle class, we know that energy demand will go up by 40% between 2015 and 2035, and that 80% of that increase will be fossil fuels. The unpalatable alternative is to leave the poor in poverty.

Let us begin to get real about what a net-zero economy for 2050 involves over the intervening 30 years. Let's work with robust data and banish ill-informed hot air and wishful thinking from the national debate. Let's examine the opportunity costs and undertake a cost-benefit analysis, as we would with any other major project. ▮

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