



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato



Electric Vehicle Policy: New Zealand in a Comparative Context

Barry Barton and Peter Schütte

November 2015

Research Report

Centre for Environmental, Resources and Energy Law
University of Waikato

Research Report

Electric Vehicle Policy: New Zealand in a Comparative Context

Barry Barton and Peter Schütte

November 2015

ISBN 978-0-473-34402-3 (softcover)

ISBN 978-0-473-34403-0 (PDF)

This research is part of the multi-disciplinary study *Energy Cultures*, www.energycultures.org, which is funded by the Ministry of Business, Innovation and Employment.

CENTRE FOR ENVIRONMENTAL, RESOURCES AND ENERGY LAW / TE PUTAHI O TE TURE TAIĀO

CEREL is a research centre in Te Piringa / Faculty of Law at the University of Waikato. Its objective is to promote and facilitate high-quality research and teaching in the fields of Environmental Law, Natural Resources Law and Energy Law.

Its address is:

The Centre for Environmental, Resources and Energy Law
Te Piringa / Faculty of Law
University of Waikato
Private Bag 3105
Hamilton 3240
New Zealand

Telephone: (07) 838 4466 ext 6727

Email: cerel@waikato.ac.nz

Internet: www.waikato.ac.nz/cerel



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato



Electric Vehicle Policy: New Zealand in a Comparative Context

Barry Barton and Peter Schütte

November 2015

Research Report

Centre for Environmental, Resources and Energy Law
University of Waikato

EXECUTIVE SUMMARY

Electric vehicles are presently attracting a great deal of attention worldwide. In comparison with internal combustion engine vehicles, they offer public benefits in respect of:

- greenhouse gas emissions,
- energy efficiency,
- energy security,
- air pollution and noise.

This is particularly so in New Zealand where approximately 80 per cent of electricity is generated from renewable resources. Transport is a large and rapidly-growing contributor to New Zealand's greenhouse gas (GHG) emissions. Nonetheless, electric vehicles (EVs) are motor vehicles, and their promotion does not solve problems of highway congestion and travel time.

This study analyzes laws and policy measures that can be put in place in order to encourage the uptake of EVs in the light vehicle fleet. The EV policies of California, Norway, and Germany receive particular attention. The investigation draws on major recent studies under the auspices of the International Energy Agency, the International Council on Clean Transportation, the United States National Research Council, and the British Climate Change Committee. From them and much other research emerges a consistent story about the barriers to the uptake of EVs and the success of policy measures to overcome the barriers.

Barriers to EVs. The main barriers to the uptake of EVs, as identified in analysis internationally, are:

- (i) The substantially higher capital cost of EVs in comparison with internal combustion vehicles (ICVs), even allowing for reductions in EV prices that are likely to occur.
- (ii) The shorter driving range of EVs in combination with recharge times, especially in terms of public perception.
- (iii) The need for a better-developed charging infrastructure.
- (iv) The need for policy measures for ICVs that put proper price or regulatory pressure on their adverse effects, so that the advantages of EVs in comparison with ICVs are not masked.

Character of EV Policy. The international research and experience lead to the following conclusions about the character of EV policy.

- (i) There are clear public policy rationales for action to encourage EVs in New Zealand.
- (ii) Policy for EVs needs to be part of an overall mobility strategy that takes an 'avoid, shift, improve' approach to transport, for example in producing improvements in the whole vehicle fleet.
- (iii) Public policy is the main driver for the uptake of EVs. Non-fiscal policy measures such as parking and lane privileges, and the encouragement of charging infrastructure, are likely to be useful, but their real effect in the face of the problem of high EV prices, and in the absence of fuel efficiency measures, is doubtful. On the other hand, the development of a charging infrastructure does not appear to need major government involvement.
- (iv) An uptake of EVs is rare in jurisdictions that do not have significant fiscal incentives for the price support of EV purchases.
- (v) New Zealand is distinctive internationally (with Australia) in not regulating vehicle fuel efficiency in any way beyond a labelling requirement. Very few countries, if any, are trying to promote EVs without fuel efficiency measures. It may not be possible to promote them without fuel efficiency requirements. EV policy should not labour against a head wind produced by a lack of policy pressure on the adverse effects of ICVs.
- (vi) There is ample evidence that a general price on carbon, such as through an effective Emissions Trading Scheme (ETS), gives a price signal for using hydrocarbon fuel that is necessary, but not sufficient on its own, to induce significant change.

Policy Measures for New Zealand. From the comparative analysis, a suite of EV policy measures is identified that have credibility and a proven record of success internationally, and that are suitable to New Zealand conditions.

- (i) A feebate scheme, applying to the whole of the light motor vehicle fleet, on the occasion of the initial registration of a vehicle in New Zealand, providing a price benefit or charge on the basis of the CO₂ emissions of the vehicle. The size of benefit or charge per unit of emissions would be set so as to provide a real influence on the selection of vehicles in the New Zealand market, and the pivot point would be re-set regularly to produce revenue neutrality. An effective feebate system would avoid the need to introduce price subsidies for EVs. It would operate as a form of fuel efficiency standard for the benefit of the entire light vehicle fleet.

- (ii) Awareness measures to improve public awareness, perceptions, and knowledge of EVs as an option. The measures need to be carefully directed at different audiences, and designed in the light of research on perceptions and behaviour.
- (iii) Measures to encourage the growth of a public charging infrastructure; standard-setting for charger plugs and communication protocols, and powers for road controlling authorities to manage street activity.
- (iv) Legislation to provide clarity and permanence of policy intention, improving the investment climate, removing barriers, and clarifying points of uncertainty.
- (v) Price pressure on the use of hydrocarbon fuels through the ETS, at a level high enough to bring about changes in vehicle use.

Other barriers have also been identified, such as in the fringe benefit tax, and further research is likely to identify more. When EV numbers become substantial, other questions will need to be resolved, such as a method for EV users to contribute to the maintenance and development of the road network.

CONTENTS

Executive Summary	ii
Table of Abbreviations	vi
The Authors	vi
1 Introduction	1
2 Electric Vehicles and Public Policy	3
2.1 The Policy Rationale for Encouraging Electric Vehicles	3
2.2 Improving the Uptake of Electric Vehicles	10
2.3 The Different Policy Options for Electric Vehicles	13
3 International Comparisons	15
3.1 California	15
3.2 Germany	18
3.3 Norway	20
3.4 Insights from Comparisons	22
4 The Main Options	23
4.1 Price Support to Address the Cost of Electric Vehicles	24
4.2 Efficiency Standards: Fuel Efficiency or GHG Emissions Regulation	27
4.3 Feebates	30
4.4 Charging Facilities	33
4.5 Public Awareness and Ancillary Regulation	34
4.6 Statute, Mandate, and Institutions	36
5 Policy for New Zealand	37
5.1 Characteristics of Desirable EV Policy	38
5.2 Policy Measures	40
6 Implications for EV Law and Policy Generally	42

TABLE OF ABBREVIATIONS

CAFE	Corporate average fuel efficiency
CO₂	Carbon dioxide
CO₂-e	Carbon dioxide equivalent
ETS	Emissions Trading Scheme
EU	European Union
EV	Electric vehicle
GHG	Greenhouse gas
ICCT	International Council on Clean Transportation
ICV	Internal combustion vehicle
IEA	International Energy Agency
kW	Kilowatt
kWh	Kilowatt hour
MEPS	Minimum energy performance standard
NOX	Nitrogen oxides
NPE	National Platform for Electromobility
OECD	Organisation for Economic Cooperation and Development
VAT	Value-added tax
ZEV	Zero emissions vehicle

THE AUTHORS

Barry Barton is a Professor of Law and the Director of the Centre for Environmental, Resources and Energy Law in Te Piringa, the Faculty of Law of the University of Waikato, Hamilton, New Zealand.

Peter Schütte is a lawyer in BBG und Partner, Rechtsanwälte, Germany, and Lecturer in Law at Bremen University. He was a Visiting Fellow at the University of Waikato in 2013–2014.



1 INTRODUCTION

Mobility is vital for human wellbeing; people put a high value on being able to move around, whether for work or play, and put a high value on being able to move the goods that they need for sustenance, trade, or whatever other reason. An efficient transport system is essential for any country. But transport is expensive, and it imposes adverse effects on social wellbeing, in particular, greenhouse gases, air pollution, and noise. In this respect, electric vehicles (EVs) have attracted enormous interest as a desirable alternative to conventional internal combustion vehicles (ICVs). This study analyzes laws and policy measures that can be put in place in order to encourage the uptake of EVs in the light vehicle fleet. Initially we consider the adverse effects of ICVs, which provide a policy rationale for supporting EVs, and then turn to consider EV policies from around the globe, with a particular focus on California, Norway, and Germany. The main options that require consideration are subsidies and other value support, fuel efficiency and carbon dioxide regulation, feebates (schemes that combine fees for poorly-performing vehicles with rebates for high-performing ones), electric charging facilities, public awareness measures, and legislation. It becomes clear that EV policy cannot be made in isolation from policy concerning ICVs; EV policy measures should not labour against a head wind produced by a lack of policy pressure on the adverse effects of conventional vehicles.

Fortunately, there is a growing base of knowledge about how EV policy measures work. In particular, major studies have recently been produced under the auspices of the International Energy Agency, the International Council on Clean Transportation, the United States National Research Council, and the British Climate Change Committee. These separate detailed studies from around the globe tell a strong and consistent story about the barriers to the uptake of EVs and the success of policy measures to overcome them.

On the basis of this research and comparative analysis, we make recommendations for EV policy for New Zealand. We emphasize the need for action that is part of general mobility strategy and addresses the adverse effects of the motor vehicle fleet as a whole, and confirm the importance of an effective, realistic, equitable form of price support or incentive for an uptake of EVs in the foreseeable future. The central measure is a feebate scheme applied to the carbon dioxide emissions of vehicles being brought into New Zealand. A feebate scheme is very suitable for New Zealand conditions. It would impose fees and provide rebates on a revenue-neutral basis. It would be supported by awareness measures to improve the public's understanding and acceptance of EVs, and measures to encourage the growth of charging

infrastructure, and improvements in the price signal sent by the Emissions Trading Scheme.

The interest in EVs has gone through different phases. They were invented in Scotland and in the United States as early as in the first half of the nineteenth century. EVs in their 'first age', the late nineteenth century, became a serious competitor to ICVs. In 1900, 28 per cent of the passenger cars sold in the United States were electric, and about one-third of the cars on the road in New York City, Boston, and Chicago were electric. Mass production of an inexpensive ICV (the Model T), the invention of the electric starter for the ICV (which eliminated the necessity of the hand-crank), a supply of readily affordable petrol, and the development of the national American highway system (which allowed long-distance travel), however, led to a decline in EVs.¹ Their 'second age' began in the 1960s with increasing oil prices as well as emerging environmental and energy-security concerns. However, their numbers did not rise significantly, because oil prices came back down, and electric battery technology did not advance fast enough.

The current 'third age' is characterized by concerns about the emission of greenhouse gases and the other pollutants that affect air quality in many metropolitan areas. Stricter emission thresholds values for ICVs have been introduced in a great number of countries. At the same time, technical advances, especially with batteries, have made EVs more attractive. They are attractive because of lower fuel costs, lower maintenance costs, less interior noise and vibration from the power train, often better low-speed acceleration, the ability to fuel up at home, and zero exhaust emissions if the vehicle is operating on its battery.² Nevertheless, even with the rapid technical advances, they are more expensive than ICVs, their range before recharging is less than for ICV refuelling, charging is slower and charging networks are not as ubiquitous as service stations selling petrol. Understandably, the first movers into EV ownership are still generally described as well-educated, urban, environmentally conscious, tech savvy, trendsetting, and politically active; EVs have not become a frequent choice for 'average' vehicle purchasers.³

1 National Research Council, Committee on Overcoming Barriers to Electric-Vehicle Deployment, *Overcoming Barriers to Deployment of Plug-In Electric Vehicles* (2015) p 8. Unless noted otherwise, in this report EVs refer to passenger on-road cars that derive all (pure or battery EV) or some (plug-in hybrid EV) of their power from the electricity grid. E-bikes or electrically-assisted bicycles represent a whole other transport story to explore; there are 230 million of them in China, and they are becoming very popular elsewhere.

2 National Research Council, above n 1, p. 12.

3 Deloitte Touche Tohmatsu Ltd, *Unplugged: Electric Vehicle Realities Versus Consumer Expectations* (2011) available www.deloitte.com.

2 ELECTRIC VEHICLES AND PUBLIC POLICY

2.1 The Policy Rationale for Encouraging Electric Vehicles

What is the rationale for government action, new laws, and new policies, for the purpose of encouraging EVs? It is desirable not only to have a clear justification for policy measures but also to make sure that they are well suited to the objectives in question.

Climate change and energy efficiency. The first rationale is the climate change and energy efficiency aspects of motor vehicle transport. Transport emissions are a major source of anthropogenic greenhouse gases (GHGs), 23 per cent of global CO₂ emissions.⁴ In New Zealand, transport is one of the fastest-growing sectors for contributions to GHGs, and road transport in particular. In 2013, road transport produced 12,688 kt CO₂-e, an increase of 69.4 per cent from the 1990 quantity, compared to the increase in total emissions over that time of 21.4 per cent.⁵ (Road transport produces 90.1 per cent of all transport emissions.) Transport emissions account for 44 per cent of the emissions from the energy sector, more than electricity, manufacturing and fugitive emissions combined.⁶ Only the agricultural methane emissions are greater. Transport is therefore a large problem in climate policy, and getting bigger.

However, New Zealand does not have an effective price on GHG emissions produced by using transport fuels. For each litre of fuel sold, the Emissions Trading Scheme (ETS) charge is about 0.6 cents per litre.⁷ This is remarkably little. It probably exerts no price pressure at all on fuel choices or vehicle choices. The problem is not specific to transport; it is the result of allowing unreliable emission reduction units to be used in the New Zealand ETS,

4 J D Miller and C Façanha, *The State of Clean Transport Policy: A 2014 Synthesis of Vehicle and Fuel Policy Developments* (International Council on Clean Transportation [ICCT], 2014) p 6.

5 Ministry for the Environment, *New Zealand's Greenhouse Gas Inventory 1990–2013* (2015) p 70. In addition to these emissions directly from transport are the further emissions produced in the course of the production, refining and transportation of petroleum products. It may also be noted that the place of energy emissions is smaller than in many countries because 48% of New Zealand GHG emissions are from the agricultural sector.

6 Ministry for Business, Innovation and Employment, *New Zealand Energy Greenhouse Gas Emissions Report 2013*, p 2.

7 Ministry of Business, Innovation and Employment, Importer Margins up to the week ending 11 September 2015, diesel ETS charge 0.5775 cents per litre, regular petrol ETS charge 0.6675 cents per litre; see www.med.govt.nz/sectors-industries/energy/liquid-fuel-market/weekly-oil-price-monitoring.

and requiring emitters to surrender only one unit for every two tonnes of emissions.⁸

Greenhouse gas emissions are directly linked to energy efficiency which has numerous advantages of its own in reducing energy costs and reducing the adverse effects of energy supply activities and infrastructure.⁹ EVs are about four times as efficient as conventional ICVs at using the energy delivered to the vehicle to overcome vehicle road load.¹⁰ But EVs also generally improve energy security, because they shift from petroleum to electricity, which – in New Zealand and most other developed countries – is produced more locally and is more stable in price. Petroleum is New Zealand's largest import,¹¹ and is notorious for its price volatility. From a national economic point of view it is advantageous to reduce risk and sensitivity to fluctuations in currencies and commodity prices. From the viewpoint of individuals and firms, there is a lot to be said for protecting oneself against the combination of a plummeting New Zealand dollar and an escalating oil price – an entirely foreseeable combination.

Air pollution and noise. Air pollution from motor vehicles is another reason why EVs offer advantages. According to a 2012 study, pollution from on-road vehicles in New Zealand causes premature mortality, extra hospital admissions, and restricted activity, with an estimated total social cost of \$942 million.¹² Road vehicles are the main source of nitrogen oxides and carbon monoxides, and diesel engines produce particulate matter. The evidence of a substantial negative externality from ICVs is clear, although in most places domestic fires are a worse source of pollution, and all pollutants from road transport declined between 2001 and 2013 even as vehicle kilometres travelled increased by 12 per cent.¹³ Along with pollution, traffic noise is harmful; exposure can lead

8 Generally see A Cameron, ed, *Climate Change Law and Policy in New Zealand* (Wellington: LexisNexis 2011.) Oil companies are participants in the ETS under the Climate Change Response Act 2002, owning 'obligation fuel' at the point of importation or production: schedule 3 part 2. These participants are obliged to surrender one emissions unit for each 2 tonnes of emissions from their activities each year: ss 63 and 63A.

9 GHG emissions and energy efficiency are connected because vehicles produce CO₂ in direct proportion to the amount of fuel used: Ministry of Transport, *Annual Fleet Statistics 2014* p 11.

10 N Lutsey, *Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments* (ICCT, 2015) p 7.

11 Statistics New Zealand, *Overseas Merchandise Trade: January 2015 – Tables*. (Petroleum and related products slipped to position 3 in the year ending January 2015 if one subtracts New Zealand's petroleum exports.)

12 G Kuschel et al., *Updated Health and Air Pollution in New Zealand Study*, Vol 1: Summary Report (2012) pp iv-v. The study probably underestimates motor vehicle effects because of the difficulty of assessing NO₂ exposure. Car drivers are exposed to the highest average levels of CO: 60% higher than cyclists, 40–100% higher than bus passengers and over 100% higher than train passengers. S Kingham et al., *Determination of Personal Exposure to Traffic Pollution while Travelling by Different Modes* (NZ Transport Agency Research Report 457, 2011) p. 84.

13 Ministry for the Environment, *Environment Aotearoa 2015*, p 30.

to subconscious physical reactions (e.g. high blood pressure and various types of heart diseases), effects on sleeping behaviour, disturbed cognitive functioning, and long-term effects on well-being and health, producing significant social costs.¹⁴

The New Zealand regulatory response to the air pollution problem is the Land Transport Rule: Vehicle Exhaust Emissions 2007, which is made under the Land Transport Act 1988. The Rule regulates emissions of substances directly harmful to human health; carbon monoxide, particulates, nitrogen oxides and hydrocarbons. It does not regulate carbon dioxide emissions. Emissions standards were first introduced only in 2003. Major changes were made in 2007, and other changes subsequently. The present policy is to follow the Australian Design Rules, which allow different standards but mainly the European Union's regulations. Australia has had vehicle air pollution rules in place since the 1970s.¹⁵ There is a lag behind Europe of four or five years in bringing the standards into force; for example, New Zealand is in the course of introducing the Euro 5 standard 2013–2016, while in Europe that occurred in 2009–2011.¹⁶ On the whole, Australia and New Zealand's vehicle exhaust emission rules are aligned with other OECD countries,¹⁷ and can be credited with the reduction in pollution since 2001.

In New Zealand there are few legal requirements for the testing of the exhaust emissions of vehicles. The Land Transport Rule: Vehicle Exhaust Emissions¹⁸ says that in order to obtain a warrant of fitness a vehicle must 'not emit clearly visible smoke' unless the driver can show that the engine is original equipment and its design does not allow the vehicle reasonably to comply. Most other countries regularly test vehicles for emissions, at least in urban areas.¹⁹ It is tempting to say that general testing should be introduced in New Zealand and would put proper pressure on ICVs that would make EVs look more attractive. It is certainly true that enforcement of the existing Rules could be stronger, but it is less clear that new testing requirements

14 L den Boer and A Schrotten, *Traffic Noise Reduction in Europe: Health Effects, Social Costs and Technical and Policy Options to Reduce Road and Rail Traffic Noise* (CE Delft, Delft, 2007). They estimate the social costs of traffic noise in the EU to be at least €40 billion per year, about 90% of which are caused by passenger cars and lorries.

15 Motor Vehicle Standards Act 1989 (Cth) and Vehicle Standard (Australian Design Rule 79/04 – Emission Control for Light Vehicles) 2011. See Climate Change Authority, 'Light Vehicle Emissions Standards for Australia' 2014, p 26.

16 The New Zealand Government policy is to implement new standards at the same time as Australia or 2 years after Japan or Europe, as appropriate: *Regulatory Impact Statement: 2012 Amendment to the Land Transport Rule: Vehicle Exhaust Emissions 2007*, p 3. Motor vehicle importers tried to delay amendments of the Rule: *Imported Motor Vehicle Industry Association v Minister of Transport*, High Court Wellington CIV-2011-485-1972, 1 December 2011.

17 Miller and Façanha, above n 4, pp 14–17, 38–40, 56.

18 Land Transport Rule: Vehicle Exhaust Emissions 2007, s 4. Section 2 requires classes of used or modified vehicles to be tested on entry into New Zealand.

19 For the United States see www.dmv.org.

would make much difference. Modern petrol engines with electronic engine management do not go out of tune the way that their predecessors did, and contribute little to air pollution, especially because ozone formation is uncommon in the New Zealand climate. Heavy diesel vehicles produce most of the air pollution, and diesel vehicles are difficult to test accurately. They form only a small part of the light vehicle fleet, and the introduction of an EV has only a small probability of displacing a diesel.

EVs would certainly help reduce vehicular air pollution, and there are important special niches such as electric buses that call for attention. However ICVs as a whole in the light vehicle fleet are already facing regulatory pressure in New Zealand that is similar to that imposed in many other countries (if not as up to date as it could be), and that is producing results. The likely path for further improvement may be in better enforcement.

Electricity as a fuel. Most of the advantages of EVs, especially in low emissions and efficiency, depend on the merits of electricity as a fuel rather than oil. From a private EV owner's point of view, the price of this fuel is important.²⁰ But the public benefits depend on how the electricity is generated. Renewable energy sources, especially hydro, have always dominated New Zealand's electricity supply, and their place is growing at the present at the expense of coal and natural gas. The proportion of renewables in the generation mix is approaching 80 per cent, although it varies with rainfall.²¹ Geothermal and wind energy account for most recent additions to generation capacity, and a further 10,500 GWh of renewable production has been consented in anticipation of demand.²² This makes a switch of transport fuel from petroleum to electricity an attractive one in New Zealand. The picture is less attractive in many other countries. For the OECD as a whole, the proportion of renewables is 22 per cent; Australia 14.9, Germany 26.2, Norway 97.7, the United States 12.9, and California 24; but in Germany and California the proportion is increasing.²³

20 'Fuel cost changes from ICE to EV are a result of two factors: the price differential between electricity and gasoline, and the efficiency differential between ICE and EV engines.' IEA, *Energy Efficiency Market Report 2014*, p 73. In New Zealand and some other countries household electricity prices are higher than gasoline on a per-joule basis, and this price differential is subtracted from the efficiency differential to produce a reduction in fuel costs of approximately 45%.

21 Renewables contributed 79.9% in the 2014 calendar year: Ministry of Business, Innovation and Employment, 'New Zealand Energy Quarterly' March 2015.

22 Cf current market of about 43,000 GWh. F Whineray, address to Mighty River Power Ltd AGM, 6 November 2014, available www.mightyriver.co.nz.

23 IEA, *Renewables Information* (2015), Table 3, OECD: Share of electricity production from renewable sources (%), 2014 provisional figures.

New Zealand electricity companies are interested in EVs as a new market, because demand for electricity is not growing fast. More than 90 per cent of light vehicles in New Zealand are parked at home overnight, many of them in a garage or carport with a single-phase outlet that allows 2 kW charging.²⁴ The electricity supply system will not be stressed. Even under an optimistic EV uptake scenario of 80 per cent of the vehicles entering the fleet by 2040, EV charging is likely to be no more than 8 per cent of total electricity demand.²⁵ There would be some effect on distribution systems that would require investment, and management by minimizing EV charging in peak demand periods. Home-based EV charging times can be managed as interruptible load using smart chargers, smart meters, or ripple control. Fortunately most New Zealand electricity retailers are already offering time-of-use pricing plans (in contrast with many jurisdictions overseas) which may be enough to manage peak demand without regulation. One company offers a plug-in vehicle fuel package with a discount for night-time electricity use. One wonders whether companies will offer to finance the purchase of an EV in exchange for a long-term contract, just as telecommunication companies make it easy to buy a high-end mobile phone.

It therefore seems unlikely that electricity industry regulation will be required for EVs, but if it is it will need new legislation. The Electricity Industry Act 2010 gives the Electricity Authority no mandate over EVs, renewables, climate change, or energy efficiency, and in the Participation Code it can impose obligations only on industry participants and related parties not consumers.²⁶ It is unlikely that it could require retailers not to sell electricity except on condition that electric vehicles be subject to load control. The Electricity Act 1992 does not apply; it deals with safety, standards, and land access. Its general provisions for electrical codes of practice are to be read in that context. Nor does the Energy Efficiency and Conservation Act 2000; it does not give a general power to make regulations for the purposes of the Act.

Limits on the public benefits from EVs. At the same time we must accept that EVs do not solve all problems. EVs are still motor vehicles. They need highway infrastructure and cause congestion, and promoting them will not reduce travel times or solve problems of urban form. They may compete with

24 New Zealand Centre for Advanced Engineering, 'Electric Vehicles: Impacts on New Zealand's Electricity System' (Technical Report 2010) p 21.

25 New Zealand Centre for Advanced Engineering (2010) above n 24. The Report concludes that the use of fossil fuel generation would actually decline because additional non-schedulable renewables (especially wind but also run-of-river hydro) would become economic. Also see M Duke, D Andrews, T Anderson, 'The Feasibility of Long Range Battery Electric Cars in New Zealand' (2009) 37 Energy Policy 3455–3462. A similar view that EVs are manageable but raise a question about time of charging is expressed in Electricity Authority, 'Implications of Evolving Technologies for Pricing of Distribution Services' (Consultation paper, 2015), p 50.

26 Electricity Industry Act 2010 s 32. On the narrowing of the objectives of the Electricity Authority, see B Barton, 'Electricity Regulation in New Zealand: the Early Stages of a New Regime' (2008) 26 Journal of Energy and Natural Resources Law 207.

public transport for policy effort and public funds, and they may perpetuate old transport policies and practices.²⁷ A commonly-accepted broad framework for transport policy is 'avoid, shift, and improve' putting an emphasis first on 'avoid' policy to slow travel growth, such as through city planning, 'shift' which moves travel to more energy efficient modes such as public transit, walking or cycling, and 'improve' is effort to reduce the energy consumption and emissions of all travel modes.²⁸ EVs only address 'improve.' Electricity as a fuel has adverse effects on the environment in its transmission and distribution. It has adverse effects in its generation, even from renewable energy sources such as from hydro, geothermal, and wind power, although those sources certainly have less serious effects than do non-renewable sources.

There may be a regional dimension to the best use of EVs. In cities, the cleaner air and lower noise of EVs are attractive, although public transport and active transport (cycling and walking) will often be better options there. EVs may not be suitable in remote areas where range is an issue, so perhaps is an optimum niche for them in areas of medium density where the travel distances are not high but where public transport is difficult.

It must also be noted that policy measures to encourage EVs may be slow in taking effect. The turnover of cars in New Zealand is remarkably slow; the country has a relatively old vehicle fleet at an average vehicle age of 14 years.²⁹ A Delphi study shows experts thinking that it will take 15–20 years for EVs to reach 20 per cent of the private and commercial fleet, with many respondents thinking it will take even longer.³⁰ With a New Zealand fleet of about 3,300,000 light vehicles and an annual entry of about 250,000 vehicles, that would require EVs to capture something like 10 or 15 per cent of all new vehicle registrations in that time. A more gradual change in the composition of the vehicle fleet seems more likely.

The transport sector. Nonetheless, the transport sector is a substantial one and any opportunity for improvement is to be welcomed. Transport is the largest consumer of New Zealand's total final consumption of energy. In 2013, transport was responsible for 17.2 per cent of New Zealand's total GHG

27 D Rees, 'Could Electric Cars be Bad for the Environment?' blog post 5 November 2014, www.energycultures.org.nz.

28 IEA, *Energy Efficiency Market Report 2014*, p 60, citing Deutsche Gesellschaft für Internationale Zusammenarbeit, 'Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)' (Eschborn, 2004).

29 Ministry of Transport, *Annual Fleet Statistics 2014* p 13.

30 J Stephenson, D Hopkins, and A McCarthy, *New Zealand's Future Transport System: Drivers of Change* (2014). Centre for Sustainability, University of Otago, Dunedin, New Zealand, p 31.

emissions, and 43.6 per cent of all energy emissions.³¹ (More than 90 per cent of transport emissions are from road transport.) It is one of the fastest-growing emissions sectors, and as we have noted road transport emissions have grown three times as fast as overall national emissions.³² The country's population density is low and the use of public transport in major cities is low by international standards. New Zealand has the fourth highest rate of passenger car ownership per capita in the OECD, and actually the highest rate of all of overall motor vehicle ownership.³³

There are strong public policy reasons to favour EVs in a country like New Zealand where little of the electricity is generated from fossil fuels.³⁴

The *Energy Efficiency and Conservation Strategy 2011–2016*³⁵ declares a target that by 2016 'The efficiency of light vehicles entering the fleet has further improved from 2010 levels.' Without dwelling on the extreme modesty of this target,³⁶ we can note that the *Strategy* then says that the Government will encourage the entry of alternative transport fuels and electric vehicles in the New Zealand market. However virtually nothing has been done to this effect, and the policy regime is virtually undeveloped. The only specific policy instrument in action at the present is an exemption from road user charges, described below.

31 *New Zealand's Greenhouse Gas Inventory 1990–2013* above n 5 p 70. 90.1% of transport emissions are from road transport. The place of energy emissions is smaller than in many countries because 48% of New Zealand GHG emissions are from the agricultural sector.

32 *New Zealand's Greenhouse Gas Inventory 1990–2013*, above n 5.

33 OECD, *Environment at a Glance 2013: OECD Indicators*, p 68.

34 EVs are seen as beneficial in many other countries as well: eg, National Research Council, above n 1. EVs have been considered in New Zealand by: Energy Efficiency and Conservation Authority, *Deploying Electric Vehicles in New Zealand: A Guide to the Regulatory and Market Environment* [2012]; S Lemon and A Miller, 'Electric Vehicles in New Zealand: From Passenger to Driver?' (Electric Power Engineering Centre, 2013); and S Lemon and A Miller, 'Electric Vehicles in New Zealand: Technologically Challenged?' (Electric Power Engineering Centre, 2013)

35 Ministry of Economic Development, *New Zealand Energy Efficiency and Conservation Strategy 2011–2016*, p. 19.

36 M Eusterfeldhaus and B Barton, 'Energy Efficiency: A Comparative Analysis of the New Zealand Legal Framework' (2011) 29 JERL 431 note that the target of 'improved', like other targets in the Strategy that do not state any extent of improvement, is very easily met – even the slightest improvement would qualify, and that for a measure that sees year-on-year improvement as a matter of routine.

2.2 Improving the Uptake of Electric Vehicles

In spite of their advantages, not many EVs are being bought in New Zealand or internationally. It is true that the EV sales are growing, but the numbers are still minute. In New Zealand, at the end of 2013, there were only 108 light electric vehicles on New Zealand roads, out of a total fleet of 3,364,948.³⁷ The picture improved over the following months, so that by August 2015 the light electric fleet had reached 773 vehicles;³⁸ but that is still an almost imperceptible share of the vehicle fleet – one car in four and a half thousand. The picture is similar globally. The total global EV stock at the end of 2014 was estimated at 665,000 light vehicles, with growth in many markets, but showing something of a slowdown recently, and still being only 0.08 per cent of total passenger cars.³⁹ A target of 20 million EVs by 2020 set by the Electric Vehicles Initiative looks unreachable.⁴⁰ The market share of EVs in sales has reached one per cent only in Netherlands, Norway, Sweden, and the United States. Norway stands out as over 20 per cent, and, in the US, California at 4 per cent.⁴¹

We can therefore identify a policy problem of how to lift the uptake of EVs in order to reap their advantages to society in reduced GHGs, pollution, noise, and a fuel that is nationally-sourced and stable in its pricing, without adversely affecting efforts to promote public transport, cycling, and suitable urban form. EVs are likely to become common gradually without policy action, as technology and prices improve, but there is a distinct public benefit in making the transition more rapidly, especially where barriers to change can be identified and where there is real urgency about reducing GHG emissions.

Why is the uptake of EVs slow? In general the main barriers for the introduction of EVs as a mass market product today are as follows.

- (i) The higher capital cost of EVs in comparison with ICVs.⁴² This is an obstacle even though costs are coming down, and even though the total cost of ownership over the lifetime of the vehicle is often less than that of

37 Ministry of Transport, *Quarterly Vehicle Fleet Statistics, July–September Quarter of 2014*, p 8.

38 Ministry of Transport, *Monthly Light Vehicle Registrations, August 2015*.

39 IEA, *Energy Technology Perspectives 2015*, p. 102.

40 IEA, *Global EV Outlook 2015*.

41 Miller and Façanha, above n 4 p 26; 'Norway to Review Electric Car Subsidies as Sales Soar' Reuters, 20 April 2015.

42 Lutsey above n 10, p 9 cites a cost differential of US \$8,000–\$16,000. This is consistent with the National Research Council's findings (above n 1, p 112) that without tax credits or other subsidies, retail prices and cumulative ownership costs over 5 years are unfavourable to EVs, even, it may be noted, at generally lower US gasoline prices. A European study showed that in net terms mid-sized EVs cost €18,000 more than ICV vehicles: F Kley, M Wietschel, and D Dallinger, 'Evaluation of European Electric Vehicle Support Schemes' p 75 in M Nilsson, K Hillman, A Rickne and T Magnusson, eds, *Paving the Road to Sustainable Transport* (2012).

an ICV.⁴³ Prices must drop further if EVs are to obtain a significant market share.⁴⁴ In addition, it is a paradox that advances in the fuel efficiency of ICVs reduce relative attractiveness of EVs.⁴⁵

- (ii) The shorter driving range of an EV in combination with times required to charge the vehicle.⁴⁶ In fact the great majority of daily car trips are well within EV driving ranges.⁴⁷
- (iii) The need for a better-developed charging infrastructure.⁴⁸
- (iv) The need for policy measures to internalize the negative external effects of ICVs. Without effective action on the GHG emissions and air pollution caused by ICVs, in the form of price measures or regulatory requirements, the benefits of EVs are insufficiently valued. The price signal of an ETS has been noted above, and the significance of fuel efficiency standards for EV uptake is examined below.

Other reasons may be minor in their impact but they may accumulate in public thinking; concerns about safety, standardization of charging systems, maintenance, retention of value, and the range of models available. But a recent study of public perceptions in New Zealand shows that the chief barriers in the minds of potential purchasers are the first two above, the upfront costs and the range and charging time of EVs.⁴⁹ However, the study also shows

43 Battery costs, which can be half of an EV's cost, have dropped from US \$900/kWh in 2007 to \$380, and still dropping: S Nyquist, 'Peering into Energy's Crystal Ball' McKinsey Quarterly July 2015. However few purchasers keep their car long enough to profit from the lower lifetime costs; early surveys of purchasers in China, Europe, and the United States showed that most expected to recoup the initial price premium of an EV within three years: IEA / Electric Vehicles Initiative, *Global EV Outlook* (2013) p. 30. The National Research Council (above n 1, p 113) concludes that the decline in EV production costs is likely to occur gradually, and may not be sufficient by itself to ensure widespread adoption of EVs.

44 Lemon and Miller, *From Passenger to Driver*, above n 34, p. 5; IEA, *Tracking Clean Energy Progress* (2012), p. 49.

45 Deloitte, above n 3, p. 16.

46 An international survey shows that the vast majority of consumers expect EVs to recharge in less than two hours. 37% of the Japanese consumers saw a maximum of 30 minutes charging time as acceptable: Deloitte, above n 3 p 8. However such responses are likely to be strongly affected by the framing of the question.

47 'Nearly 70% of average daily travel in the US is less than 40 miles and more than 90% is less than 80 miles, while BEVs can routinely travel 40–80 miles on one charge' see IEA, *Global EV Outlook* (2013) p 26. See also National Research Council (2013) above n 1 p 2. Similar expectations were found by Deloitte, above n 3 p 6. Vehicles in the U.S. in general are parked more than 90% of the time, usually at home or work: IEA, *Global EV Outlook* (2013) p 29.

48 IEA, *Global EV Outlook* (2013) p. 25; J Perdiguero and J L Jiménez, 'Policy Options for the Promotion of Electric Vehicles: a Review' (Institut de Recerca en Economia Aplicada Regional i Pública, 2012) p 7 et seq.; Lemon and Miller, *From Passenger to Driver*, above n 34 p 5.

49 R. Ford, J. Stephenson, M. Scott, J. Williams, D. Rees and B Wooliscroft, *Keen on EVs: Kiwi Perspectives on Electric Vehicles, and Opportunities to Stimulate Uptake* (2015, Centre for Sustainability, University of Otago).

2.3 The Different Policy Options for Electric Vehicles

In this situation, there is a great deal of interest in understanding the measures that a government can take to encourage the uptake of EVs. Over the last twenty years countries have introduced many such measures, and although they appear in great variety it is possible to classify them systematically. Some measures are aimed at EVs only (subsidies in particular), while other measures affect the entire vehicle fleet and EVs as part of it. Some of the reported policy studies are confined to EV policies alone, but recognize that they do not cover the full suite of possible measures.⁵¹ Other studies, such as Kley, Wietschel and Dallinger, go wider.⁵² As for measures that address the entire vehicle fleet, they can be divided into those that address local air pollution and those that are aimed at energy consumption and GHGs, but there are significant co-benefits between the two kinds.⁵³

Table 1: A general taxonomy of EV measures

Type of measure	Examples	Characteristics
Unregulated market forces	Improving EV technology, with cheaper vehicles and longer range. Lower and steadier electricity prices than petrol prices. Electricity utility company incentives.	Market pressure may or may not have a positive influence, or bring about positive change fast enough.
Conventional regulation	Vehicle fuel efficiency standards (MEPS, CAFE); affecting the whole fleet, aimed at fuel efficiency and/or GHG emissions. Zero Emission Vehicle programs favouring EVs. Low-carbon fuel laws. Air pollution controls. Emissions testing exemption. Building code for chargers. Electric utility regulation to facilitate charging. Removal of barriers in existing law.	The strongest action the state can take. Little dependent on market and consumer behaviour. More general law reform.

51 L Jin, S Searle and N Lutsey, *Evaluation of State-Level U.S. Electric Vehicle Incentives* (International Council on Clean Transportation (ICCT), 2014); P Mock and Z Yang, *Driving Electrification: A Global Comparison of Fiscal Incentive Policy for Electric Vehicles* (ICCT, 2014); Lutsey, above n 10.

52 Kley, Wietschel, and Dallinger, above n 42.

53 Miller and Façanha, above n 4, p 22.

Type of measure	Examples	Characteristics
Fiscal measures	<p>Taxes, rebates, subsidies, whether one-time on vehicle purchase or annual. Measures focussed on vehicle purchase and retention, or on usage. Measures general in character or focussed on EVs or other technology specifically.</p> <p>One-time subsidies on purchase; reduced purchase and/or annual tax for EVs; subsidies for EV supply equipment; free electricity at public charging stations; scrappage; feebates (ie bonus/malus), tax deductions or credits. Exemptions from road user charges; reduced congestion charges & parking fees. R&D funding.</p> <p>Increased taxes on harms from non-EV vehicles eg carbon taxes, fossil fuel taxes (ie Pigouvian taxes on externalities).</p>	<p>Dependent on consumer behaviour for uptake. Often give strong support to conventional regulation.</p>
Decentred regulation	<p>Energy information and education; labelling measures; benefits and public awareness through special access to carpool lanes, free parking, charging facilities, etc.</p> <p>Public purchasing.</p>	<p>Flexible and fast. But depend on consumer and organizational behaviour.</p>
Organization	<p>Agency given statutory function of promoting low carbon transport/EVs.</p>	<p>A champion with legal right and duty to act.</p>
Market mechanisms	<p>Tradable certificates for energy savings (white certificates); ETS affecting the price of fossil fuels.</p>	<p>Dependent on consumer behaviour for uptake. Risk of complexity.</p>

Table 1 draws on thinking from energy regulatory theory to classify the most significant measures by type.⁵⁴ It provides a roadmap of the main issues that need to be explored first in a selected range of comparator countries and then in relation to New Zealand. One of the key features that it shows is that some policy measures are directed specifically and only at EVs, while others are aimed at bringing about change in the vehicle fleet or light vehicle fleet as a whole. As the comparative analysis proceeds, it becomes clear that both are sure to be important for New Zealand policymaking.

⁵⁴ Eusterfeldhaus and Barton, above n 36.

3 INTERNATIONAL COMPARISONS

We will evaluate the EV policies of California, Germany, and Norway. California is a good comparison for its long history of effective policies to abate traffic and pollution problems and then climate change. Germany is a country that has set a strong policy direction to decarbonize its use of energy but at the same time is a major car manufacturer. On the other hand, Norway currently has the highest rate of EVs per capita in the world and, like New Zealand, has a high percentage of renewable production of electricity. In each jurisdiction, we will particularly ask whether it pursues a systematic approach to promote electric vehicles, whether it has conventional regulation, fiscal measures and other measures in place, and how EV policy sits in relation to non-EV-specific laws and policies.

3.1 California

California has long exercised leadership in the United States on air pollution and GHG emissions from motor vehicles, and on energy policy generally. EVs are no exception, generally under the rubric of zero emissions vehicles (ZEVs) which refrains from making choices between different technologies. The Air Resources Board has worked on ZEV since 1990, and in 2010 it made regulations requiring manufacturers to sell an increasing percentage of ZEVs in California, 14 per cent for model years 2015 to 2017, and another regulation for 2018 and subsequent years.⁵⁵ The 'Transit Fleet Rule' requires bus operators to reduce fleetwide particulate and NOX emissions with alternative fuels, advanced technologies, or retrofits, in order to reduce local air pollution and GHG emissions. Under direction from the State Governor, the *2013 ZEV Action Plan* identified actions that different agencies would take to complete necessary infrastructure, improve consumer awareness and demand, and increase fleet uptake, in order to reach a target of 1,500,000 ZEVs by 2025.⁵⁶

What is striking about these California ZEV initiatives, apart from their ambition, is how they fit within a very comprehensive and detailed energy policy framework; they do not stand alone. The centrepiece is the *Integrated Energy Policy Report*, a statutory responsibility of the California Energy Commission since 2002. Its 2014 version focuses on transportation and its

⁵⁵ 13 CCR §1962.1 and §1962.2.

⁵⁶ Available www.opr.ca.gov. See Miller and Façanha, above n 4, p 27. Nine other states have also adopted ZEV programs; Jin, Searle and Lutsey, above n 51.

role in meeting state climate, air quality and energy goals.⁵⁷ An important part of the policy work that it coordinates is the Alternative and Renewable Fuel and Vehicle Technology Program, funded with up to \$100 million annually. The Low Carbon Fuel Standard began in 2011. For decades, the Air Resources Board has exerted strong pressure on motor vehicle pollution, and from 2004 its standards have controlled GHG emissions as well. Most recently medium and heavy duty vehicles have come under scrutiny for regulation. The Board is responsible for the Cap-and-Trade Program under the California Global Warming Solutions Act of 2006,⁵⁸ which was launched in 2013, and under which transportation fuels were brought in 2015, so that the Program now covers 85 per cent of the state's GHG emissions. The 2006 Act sets an ambitious target of limiting California's GHG emissions at 1990 levels by 2020, and requires continuing reductions beyond then. Again, what EVs must be compared with is a continuing and substantial restriction of the negative impacts of ICVs.

The vehicle fleet of California is also affected by federal laws and policies. One of the most prominent national policy initiatives is the *EV Everywhere Grand Challenge* launched in 2012.⁵⁹ It focuses on technical efforts to cut battery costs (from their current \$500/kWh to \$125/kWh), reducing vehicle weight and reducing the cost of electric drive systems. It includes work on charging infrastructure, education and policy. The Department of Energy has made substantial grants to subsidize charging infrastructure. The EV Everywhere goal is by 2022 to produce EVs that are as affordable as today's gasoline-powered vehicles. The most significant federal measure for EVs is a federal income tax credit for purchasers of EVs, ranging between \$2,500 and \$7,500 depending on battery size, and restricted to the first 200,000 vehicles sold by each manufacturer in the United States.⁶⁰ The credit is not refundable, so it is little benefit to people who have low tax liabilities. The American Recovery and Reinvestment Act of 2009, which put the credit in place in lieu of one that also benefited hybrid vehicles, also authorises substantial loans and grants to the EV industry.

Just as in California state law and policy, these federal policies and provisions that address EVs directly must be seen in the broader policy context of transport, climate, and pollution. The most important feature is fuel and GHG efficiency standards. The corporate average fleet efficiency (CAFE) standards have improved energy efficiency to reduce dependence on foreign

57 California Energy Commission, *Integrated Energy Policy Report: 2014 IEPR Update* (Publication CEC-100-2014-001-CMF, 2015).

58 California Health and Safety Code § 38500 et al (AB 32, 2006), 17 CCR § 95801.

59 US Department of Energy, *EV Everywhere: Grand Challenge Blueprint* (2013).

60 26 USC § 30D; Congressional Budget Office, *Effects of Federal Tax Credits for the Purchase of Electric Vehicles* (Washington, September 2012) p 3.

oil, and have mitigated local air pollution since the 1970s.⁶¹ The standards are imposed on manufacturers and importers, in respect of the average performance of all the regulated vehicles that they manufacture for sale in the United States in a year. That gives them flexibility and the ability to sell inefficient vehicles as well as efficient ones. The standards under the Energy Policy Conservation Act initially covered passenger cars but not minivans, pickup trucks and sports utility vehicles, sales of which boomed in the 1980s; those vehicles were only brought under the regulations under an 'attribute based' system in 2009. The agencies set average fuel economy standards for different classes of vehicle for each model year eighteen months in advance. In addition, the Clean Air Act directs the Environmental Protection Agency to set standards for any air pollutants from a motor vehicle which may reasonably be anticipated to endanger public health or welfare.

After much struggle, including the court case *Massachusetts v Environmental Protection Agency*,⁶² the system was extended to GHG emissions. California, which has always been ahead in reducing air pollution, and which has had the benefit of federal waivers for that purpose, was also ahead on GHG emissions. In 2012 a national standard was agreed to simplify the carmakers' duties under the Clean Air Act emissions controls, the CAFE standards, and California's GHG controls, but with progressively more ambitious targets that will force improvements in vehicle technology.⁶³ The heavy-duty vehicle fleet is also attracting regulatory scrutiny.

The chief point that can be made out of this complex field of American policy is that it applies a great deal of regulatory pressure to the adverse externalities and efficiency concerns arising out of ICVs. The pressure reduces the attractiveness of ICVs in relation to EVs. The general motor vehicle regulation and the EV-specific regulation are related. Equally, and surprisingly, the Congressional Budget Office concludes that the federal tax credits for the purchase of EVs may have zero effect because of the pressure that CAFE standards put on vehicle suppliers, who can match the greater EV sales numbers with greater numbers of low-economy vehicles.⁶⁴ The conclusion seems very relevant to New Zealand in underscoring the central role of fuel efficiency standards and their direct effect on EVs.

61 42 USC § 32902 et seq, 49 CFR § 501 et seq; J S Martel and K K White, 'Motor Vehicles and Transportation' ch 14 p 325 in M B Gerrard, ed, *Law of Clean Energy* (American Bar Association, 2011).

62 549 US 497 (2007); J Freeman, 'The Obama Administration's National Auto Policy: Lessons from the "Car Deal"' (2011) 35 *Harvard Env L Rev* 343. Fuel efficiency and GHG emissions are directly related because CO₂ is a product of burning hydrocarbon fuel.

63 OECD, *Climate Change Mitigation Policies and Progress* (2015) p 76.

64 Congressional Budget Office, above n 60, p 12.

3.2 Germany

In 2009, Germany adopted the *National Electromobility Development Plan* which set a goal of becoming a lead market and lead manufacturer, with the goal of 1,000,000 electric vehicles on the road by 2020.⁶⁵ The important *Energy Concept* policy statement of 2010 added a goal of 6,000,000 vehicles by 2030.⁶⁶ The Electromobility Plan established the National Platform for Electromobility (NPE) with experts from industry, science and society in seven working groups, on drive technologies and vehicle integration, battery technology, charging infrastructure and power grid integration, regulation, standardization and certification, materials and recycling, training and qualifications, and general framework.⁶⁷ The results from these working groups were brought together in a 'systemic approach'. It addresses Vehicle Technology, Energy and Environment, Charging Infrastructure and Urban Planning as well as Intermodality. In addition, education, standards and information and communication technology (ICT) are seen as crucial preconditions for the system. The NPE's specific vision is formulated as to create a robust 'electric mobility system' until 2020 that enjoys widespread public acceptance, guarantees high availability, reliably meets individual mobility needs (private and commercial transport) and facilitates the marketing of technologically sophisticated and profitable products.⁶⁸

Since April 2012 the 'systemic approach' on the federal level has been accompanied by four testing regions as showcases for electric mobility within the federal states of Baden-Württemberg, Berlin/Brandenburg, Lower Saxony, and Bavaria.⁶⁹ In 2014, 90 projects combining a total of 334 individual initiatives were funded in the showcase regions. The Federal Government's financial contribution amounts to approximately €157 million.⁷⁰ The emphasis is on testing and demonstrating electric mobility in everyday life, with a special focus on linking EVs and the electricity system by using information and communication technology in the transport system.⁷¹

65 'Nationaler Entwicklungsplan Elektromobilität der Bundesregierung' (1.8.2009) available in English www.bmub.bund.de/.

66 Federal Ministry of Economics and Technology (BMWi), *Energy Concept* (2010 with amendment in 2011) available in English www.germany.info p 24.

67 'Nationale Plattform Elektromobilität' available www.bmub.bund.de (retrieved 17.4.2015) and 'Vision and Roadmap of the National Electric Mobility Platform' September 2012, available www.bmwi.de (retrieved 17.4.2015).

68 Nationale Plattform Elektromobilität, *Progress Report 2014 – Review of Pre-Market Phase*, available in English: www.nationale-plattform-elektromobilitaet.de/fileadmin/user_upload/Redaktion/NPE_Progressreport_2014_engl.pdf (retrieved on 8.11.2015), p. 16.

69 See www.schaufenster-elektromobilitaet.org/programm/ (retrieved on 17.4.2015).

70 See NPE, *Progress Report 2014*, above n 68 p. 39.

71 IEA, *Hybrid and Electric Vehicles: The Electric Drive Gains Traction* (May 2013) available www.ieahev.org, p. 120.

Currently the following legal incentives for EVs are in force in Germany.

- EVs are exempted from the motor vehicle tax for ten years when licensed before the end of 2015 and for five years when licensed from 2016 until the end of 2020.⁷²
- This exemption is accompanied by a fifty percent tax reduction on the purchase price for all EVs.⁷³
- The Federal Ordinance on the licensing of motor vehicles allows interchangeable licence plates for ICVs and EVs, among other vehicles. This instrument is supposed to facilitate the ownership of an EV as second vehicle.⁷⁴
- Electricity used in public transport is subject to an electricity tax reduction.⁷⁵

A new Electromobility Act was enacted in June 2015.⁷⁶ It authorizes municipalities to grant privileges to EVs (and hybrid and fuel-cell vehicles) for parking and bus lanes, and for those vehicles to be specially identified in their registration numbers. In addition, a draft Ordinance on Charging Infrastructure was presented in October 2015.⁷⁷ It is supposed to harmonize charging infrastructure standards in Germany to grant national and European interoperability according to recent European legislation.⁷⁸ The operators of public charging infrastructure will be obliged to report the start and finish of infrastructure operations to the Federal Network Agency.

Effective regulation of GHG emissions is another important part of the picture of policy in Germany. It takes the form of the European Union CO₂ emission standards for motor vehicles. These standards which were introduced in 2007 have become steadily more stringent, and are credited with putting

72 Section 3b of the federal motor vehicle tax law (Kraftfahrzeugsteuergesetz).

73 Section 9 para. 2 of the federal motor vehicle tax law (Kraftfahrzeugsteuergesetz).

74 Annex 4 section 2a of the federal ordinance on the licensing of motor vehicles (Fahrzeugszulassungsverordnung), see Mayer and Warnecke, 'Legal questions on individual electric mobility in road traffic' (Rechtsfragen individueller Elektromobilität im Straßenverkehr), *Kommjur* (Journal for the Communal Lawyer) 2013, 361, 365.

75 Section 9 para. 2 of the federal electricity tax law (Stromsteuergesetz).

76 Elektromobilitätsgesetz, dated June 5th, 2015 (BGBl. – Federal Gazette – I p. 898).

77 See www.bmwi.de/BMWi/Redaktion/PDF/V/verordnung-ladeeinrichtungen-elektromobile-kabinettschluss,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf (retrieved on 8.11.2015).

78 Directive 2014/94/EU on the deployment of alternative fuels infrastructure, [2014] OJ L307/1.

significant pressure on the ICV fleet.⁷⁹ (CO₂ emissions are, as we have noted, directly related to fuel efficiency.) Further strengthening of the standards has been decided on, coming into effect in 2020. The Volkswagen scandal, which concerned nitrogen oxides emissions from diesels, is likely to result in tighter testing to reduce non-compliance and to reduce the more general gap between results under controlled test conditions and under actual on-road conditions. Relatively high fuel prices also play their part.⁸⁰

However the recent legislation and policy measures do not foresee subsidies or direct aid for EV purchasers, and that is thought to be the reason for the small uptake of EVs – only 24,000 vehicles reported at the end of 2014.⁸¹ The lack of progress without subsidies is relevant to New Zealand, where subsidies are politically difficult. On the other hand, the steps being taken for public awareness and charging infrastructure are relevant for comparative purposes. Less useful is the German emphasis on industrial inventiveness in car manufacturing, because New Zealand has no equivalent industry to safeguard as a world leader.

3.3 Norway

Norway's EV history began in the 1970s when prototypes of EVs and propulsion systems were developed by private enterprise with financial support from the Research Council of Norway.⁸² In the 1990s the first vehicles were tested with enterprises and organizations as users. In this period the first EV incentives were introduced. From 1999 to 2009 EV car production in Norway ('Kewet') and a Norwegian EV industry cluster evolved. In 2009 the government organization Transnova was established to support testing and demonstration of new technologies that could reduce GHG emissions from the transport sector. Transnova made it possible to finance the establishment of charging stations on a wide scale and to start various test and demonstration facilities. Transnova also supports 'Gronn bil' an organization promoting EV usage in municipalities and fleets. After having reached 0.4 per cent of the total fleet of passenger

79 ICCT, *EU CO₂ Emission Standards for Passenger Cars and Light-Commercial Vehicles* (2014); OECD, above n 63 p 77. The current EU Regulations, including the tightening of the standards in 2020, are Regulation (EC) 443/2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO₂ emissions from light-duty vehicles, [2009] OJ L140/1, as amended by Regulation (EU) 333/2014 to define the modalities for reaching the 2020 target to reduce CO₂ emissions from new passenger cars, [2014] OJ L103/15.

80 Lutsey, above n 10 p 13.

81 B Parkin and D Tschampa, 'Merkel Backs Incentives in 1 Million Electric Cars Push' (2 December 2014) www.bloomberg.com. In CO₂ emissions Germany is also said to be performing poorly in EU terms: *CO₂ Emissions from New Cars in Europe: Country Ranking* (European Federation for Transport and Environment, 2014).

82 See E Figenbaum and E Kolbenstvedt, *Electromobility in Norway: Experiences and Opportunities with Electric Vehicles* (Oslo, Institute of Transport Economics, TØI Report 1281/2013, 2013) p I to III.

vehicles (approximately 10,000 vehicles) in 2012, the number of EVs passed 50,000 in April 2015, with EVs being one-fifth of all sales.⁸³

Norway's central government presently supports EVs with the following measures.⁸⁴

- 'EL' number plates for privileges like using bus lanes and for awareness generally.
- Exemption from the initial vehicle registration tax. EVs do not pay this initial fee anyway (unless they are heavy ones) because the computation of the tax takes account of weight, combustion engine power, and CO₂ and NO_x emissions.
- Exemption from VAT tax (usually 25 per cent) on the purchase of an EV.
- Lowest fee band for the annual licence.
- Fringe benefit tax (on employee benefits) half the usual rate.
- Slightly higher mileage allowance where one is payable by an employer.

While some of these measures, like the exemption from the initial vehicle registration tax, can be characterized as the absence of an environmental charge, others, especially the VAT and fringe benefit tax measures, are clearly subsidies for purchasers. In addition there is a range of local incentives, such as access to bus lanes, road toll exemption, free road ferry tickets, and free parking. The incentives that are thought to have been most effective are the VAT exemption, access to bus lanes, and free use of toll roads and ferries.⁸⁵ It may be useful to try such exemptions and favours in New Zealand.

Norway has made several efforts at setting policy objectives in the field of GHG emissions. The present objective is that the average CO₂ emissions from new passenger cars would be reduced to 85 g/km by 2020. This was advanced in a White Paper on Climate Policy and then ratified by a Parliamentary settlement in 2012.⁸⁶ EVs and hydrogen vehicles are identified for special attention, but some of the policy measures, such as the initial vehicle registration tax, and high petrol and diesel prices, benefit ultra-efficient ICVs as well as EVs. Most recently the government has been considering amendments to the car tax system to base it more on emissions levels rather

83 Lutsey, above n 10, p 12; 'Norway to Review Electric Car Subsidies as Sales Soar' Reuters, 20 April 2015.

84 Figenbaum and Kolbenstvedt, above n 82, p 24.

85 Figenbaum and Kolbenstvedt, above n 82 p. VII, Table S. 1.

86 Figenbaum and Kolbenstvedt, above n 82 p 23.

than engine power.⁸⁷ Again, we observe that a jurisdiction that is a world leader in the field has not tried to set up EV policy separately from climate and transport policy.

3.4 Insights from Comparisons

The international comparison shows these jurisdictions have pursued concerted systematic approaches to the task of increasing the numbers of EVs. The comparison suggests that, under current market conditions, EVs are unlikely to appear in New Zealand in large numbers without governmental support. The United States example is relevant to the possibility of EVs as a mass market product. The capital costs of EVs are still much higher than for ICVs and would need to be offset by tax reductions or other types of assistance in order to persuade consumers to purchase an EV. The larger question in New Zealand is therefore whether the government is willing to invest in a desirable emerging technology even though it does not pay off in the short term. We also see that in each of these jurisdictions there are policies aimed at promoting EVs, but always in a framework of general motor vehicle regulation that includes substantial pressure on GHG emissions. In California the state and federal EV policy actions stand alongside general ETS pressure on the price of carbon and general motor vehicle regulation. The importance of CAFE standards in relation to EV actions is particularly emphasized by the Congressional Budget Office. The pressure on the negative externalities of ICVs provides a platform, a level playing field, where the benefits of EVs can be fairly taken into account.

The United States and Germany have large motor vehicle industries, and they seek global leadership in EV manufacturing technology – vehicles, batteries, and charging systems – so they support the uptake of EVs for industry development reasons along with environmental ones. Those reasons do not apply to New Zealand. Germany is useful however as an example of systematic planning, and provision for municipal action, but the low numbers of EVs appear to show what can happen if price support is low or absent. Norway therefore seems to be a useful comparison for many purposes, showing for example how EVs can be introduced within metropolitan areas in particular. Many of the incentives used in Norway, such as access to bus lanes, free parking, and free toll roads, would not result in high costs for the New Zealand public, especially if they were applied only in selected metropolitan areas. Other aspects of the Norwegian incentives appear to show the successfulness of substantial price support.

87 H Stolen, 'Volkswagen Scandal may Lead to Rethink of Norway's New Car Tax' (Reuters, 29 September 2015).

4 THE MAIN OPTIONS

There is now a growing body of studies that assess the effectiveness of various government policies on EVs. A useful synthesis of them by Nic Lutsey of the ICCT shows that many different types of government action will be necessary over the next ten years to overcome barriers and grow the EV market. As for specific measures, he says:⁸⁸

Increasingly stringent efficiency standards, electric vehicle research and development support, and national electric vehicle planning appear to be necessary but insufficient actions to grow the electric vehicle market. Consumer incentives that reduce the cost of ownership are important to improve the consumer proposition on the new advanced electric technologies. Increasing availability of home, workplace, and public electric charging infrastructure is also of high importance... It is becoming increasingly clear that a comprehensive portfolio of national, state, and local actions is critical for the increased deployment and use of electric vehicles.

Element Energy Ltd, in a significant study for the United Kingdom's Committee on Climate Change, had come to very similar conclusions, finding that the following key action targets would have to be pursued to achieve a high uptake of EVs:⁸⁹

- Continuing and sustained improvements are required in the supply of EV models. GHG legislation in the form of emissions standards and mandates provides a significant market driver for supply, so tightening CO₂ emissions standards are likely to be 'decisive' in determining the level of electrification of the fleet and the rate of EV adoption.⁹⁰
- Consumer awareness and acceptance of EVs must be increased significantly from current levels, so that the mass market actively considers them as a viable vehicle choice.
- Charging infrastructure should be provided initially by increasing the awareness of car buyers of the process of installing household off-street charging units, and, in the longer term, stimulating a national network of publically-accessible charging points.

⁸⁸ Lutsey, above n 10 pp v, 12.

⁸⁹ Element Energy, above n 50 p 124–127.

⁹⁰ Car and light commercial vehicle sales in the UK are subject to the EU emissions performance standards described above at note 79.

- A level of equivalent value support (financial or otherwise) is expected to be required, of the order of £2,500 per EV, for 2020–2030. This is required even if targets for vehicle supply, consumer awareness, and charging infrastructure are met. However the modelling shows that this figure is highly dependent on vehicle cost inputs and should be kept under review. Feebates are identified as likely to be an important and affordable driver of market change.

In similar vein, the International Energy Agency (IEA) considers that the keys to global EV growth are:

- lowering the initial vehicle cost,
- developing electricity storage and fuelling technologies, and
- co-ordinating infrastructure investment.⁹¹

This international research and experience shows consistency about the policy priorities. We can proceed to consider the main policy options in greater depth, with particular reference to New Zealand conditions.

4.1 Price Support to Address the Cost of Electric Vehicles

Price support, fiscal incentives, or subsidies are generally regarded as important or essential to produce any significant uptake of EVs. As Lutsey and others point out, best-practice principles show that they need to be big enough to make a difference, available immediately at the time of sale, and put in place for long enough to send a clear signal to automakers and importers.⁹² Mock and Yang make an international analysis of responses to fiscal incentives for EVs.⁹³ In some countries large fiscal incentives have been offered. Norway offered €11,500 per battery EV (about 55 per cent of the vehicle base price), and the Netherlands €38,000 per plug-in hybrid EV (about 75 per cent). Unsurprisingly those massive incentives led to rapid growth in the EV share in vehicle sales, nearly 6 per cent and nearly 5 per cent respectively. California shows a major response too. More surprisingly, in Sweden and the United Kingdom, with incentives of 35 per cent and 50 per cent of vehicle base price respectively, EV sales barely budged from zero. Germany, as we have seen, has few fiscal incentives and is also seeing much

91 IEA, *Energy Efficiency Market Report 2014*, p 73.

92 Lutsey, above n 10 p 23. The National Research Council (above n 1 p 119) makes similar findings, emphasizing the superiority of immediate rebates at the point of sale over tax credits or deductions, but noting the need for further research about which incentives are most effective.

93 Peter Mock and Zifei Yang, *Driving Electrification: A Global Comparison of Fiscal Incentive Policy for Electric Vehicles* (ICCT, 2014).

less EV growth than other leading countries. Mock and Yang conclude that fiscal incentives are powerful mechanisms, but are not the only factor that influence EV market growth. The Element Energy study showed that the capital cost premium is the most significant restraint on mass EV adoption, so that financial incentives or value support are effective and essential.⁹⁴ It emphasizes that consumers have a short pay-back outlook on investments, and that awareness and acceptance is vital.

Another study finds that direct and indirect incentives available in different American states are correlated with higher EV sales, and that the most effective incentives are subsidies, carpool lane access, and emissions testing exemptions.⁹⁵ But the study does not explore the causative links that lie behind the correlations, and leaves out non-EV measures such as vehicle regulation and low-carbon fuel requirements. A different comparison of American states finds that both the generosity and size of tax incentives affect consumer behaviour, and that consumers are much more motivated by sales tax waivers than income tax credits, because of their ease, immediacy, and transparency.⁹⁶ Overall, policymakers have a good deal of evidence that the question of vehicle price cannot be ignored, and that price support measures are essential and effective.

In New Zealand, a moderate subsidy or incentive for EVs exists in the form of an exemption from road user charges, which lasts until 30 June 2020.⁹⁷ Road user charges are normally paid by users of non-petrol vehicles such as diesel-engine vehicles in order to fund the National Land Transport Programme, which pays for roads and other transport infrastructure. For a typical car driver driving 14,000 km the charge is \$812 per annum. (For petrol-fuelled vehicles, the equivalent payments are made through the fuel excise duty which is part of the price of petrol at the pump.) The exemption may have its origins in a wish to avoid double-charging the users of plug-in hybrid EVs (PHEVs), who pay the fuel excise tax on the petrol that they buy. However with the exemption in place, the user of a PHEV is not contributing to the maintenance of the road network for the portion of his or her travel that is fuelled by electricity, and the user of a full EV (one that does not have a petrol engine to recharge the battery or as part of the power train) is not contributing either way.

94 Element Energy, above n 50 p 127. On the impact of public incentives, also see Brook Lyndhurst Ltd, *Uptake of Ultra Low Emissions Vehicles in the UK* (for the Department of Transport, 2015) p 31.

95 L Jin, S Searle and N Lutsey, *Evaluation of State-Level U.S. Electric Vehicle Incentives* (ICCT, 2014).

96 K Gallagher and E Muehlegger, 'Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Vehicle Technology' (2011) 61 *J Env Ecs & Management* 1.

97 Road User Charges (Exemption Period for Light Electric RUC Vehicles) Order 2012, made under s 37 of the Road User Charges Act 2012. Also see Road User Charges (Rates) Regulations 2014.

As a price incentive, this exemption from road user charges is out of step with the research conclusions that we have considered above, in being a very light price signal, failing to help with the up-front cost, and failing to send a long-term signal. More importantly, it exempts EV owners from something that they can reasonably be expected to pay for – the road system. Ideally, exemptions or incentives for EV owners would relate to the public benefits from their vehicles, as to GHGs, pollution, and noise. Thus, it appears that this exemption needs to be replaced by other policy measures that give stronger incentives for EVs, and ensure that when EV users reach significant numbers they contribute to the funding of the road network.⁹⁸

Taxation can also affect prices. The existence of tax credits or other mechanisms to favour EVs (such as in the United States) has been noted. However they can work the other way. In New Zealand, the fringe benefit tax payable on benefits received by an employee is calculated for a vehicle on its cost price or market value.⁹⁹ The tax will generally be higher for EVs; it does not take into account the lower operating cost of an EV. Reform seems desirable to eliminate the disincentive of over-taxation. Further research may find other tax issues that need attention.¹⁰⁰

Are EV purchase price incentives or subsidies justifiable? There is a justification on economic efficiency grounds, insofar as they correct for positive externalities.¹⁰¹ However a more efficient way to address negative externalities is to apply Pigouvian taxes, which would increase the price of petrol and make EVs more competitive in the market-place and also to promote other changes such as smaller vehicles and fewer travel kilometres. The equity or distributional aspects of a subsidy are also important; if it is clumsily designed it will only help the well-to-do buy EVs.

Even where an economic justification exists, and where there is evidence of their efficacy, the New Zealand policy environment is cool to subsidies. Since neoliberal reform began in 1984, subsidies have been viewed with great disfavour. In respect of EVs, it is likely to be said that the government does not have any primary role in addressing the price barrier. There is certainly evidence, such as that from Sweden and the United Kingdom, that small subsidies seem to have little effect, and that even large ones may not work. However the broader span of evidence internationally is that price is important and that policy measures to address price barriers are orthodox

98 See K Jordan, *The Legal Framework for Energy Efficiency in Road Transport: A Critique of Legislation, Regulation, and Policy in New Zealand*, unpublished LLM thesis, University of Waikato, 2013, p 97.

99 Income Tax Act 2007 Schedule 5.

100 A useful study is *CO₂ Emissions from New Cars in Europe*, above n 81.

101 S B Peterson and J Michalek, 'Cost-effectiveness of plug-in hybrid electric vehicle battery capacity and charging infrastructure investment for reducing US gasoline consumption' [2013] 52 *Energy Policy* 429 at 437.

and successful. The importance of vehicle price is an uncomfortable truth for New Zealand EV policymaking. If vehicle prices are not to be supported by subsidies and incentives, then perhaps all the more effort is needed with other policy measures. Otherwise there will be little change.

One of the most promising policies to address vehicle price while avoiding most of the difficulties of conventional incentives is a feebate or bonus/malus scheme. But before considering its merits we should put EVs into the overall context of motor vehicle fuel efficiency.

4.2 Efficiency Standards: Fuel Efficiency or GHG Emissions Regulation

Motor vehicle sales in most countries are now covered by efficiency standards, whether in the form of fuel efficiency, fuel economy, or GHG emissions.¹⁰² We have noted efficiency standards in the law of comparator jurisdictions and in international overviews of clean transportation policy. Efficiency standards address market failures in relation to energy efficiency, and in relation to climate change. Some of the oldest are the American 'CAFE' standards – corporate average fuel efficiency standards – introduced to tackle air pollution in California but now also part of the response to climate change. They are very cost-effective in putting pressure on ICVs, and they are regarded as important to the deployment of EVs.¹⁰³ In the European Union, the CO₂ standards that were put in place for cars in 2009 set an overall fleet average target for 2015 of 130 g/km, which accelerated reductions considerably; in 2006 the average was about 160 g/km.¹⁰⁴ It is expected that the standards taking effect in 2020 will produce a 25 per cent reduction in fuel consumption, and at a negative abatement cost for CO₂; that is, the fuel savings will actually be larger than the cost of compliance, resulting in net savings of between €80 and €295 per ton of CO₂ avoided.

102 We follow Miller and Façanha, above n 4, in their use of the term 'efficiency standards' to refer collectively to targets for fuel consumption, fuel economy, and CO₂ or GHG emissions: p 4. The standards are directly related in their effect.

103 D. Kodjak, *Policies to Reduce Fuel Consumption, Air Pollution, and Carbon Emissions from Vehicles in G20 Nations* (ICCT, 2015) p. 19; Lutsey, above n 10; National Research Council, above n 1 p 116.

104 ICCT, 'EU CO₂ Emission Standards for Passenger Cars and Light-Commercial Vehicles' (Policy Update January 2014). The EU 2020 target value for passenger cars, set in 2014, is 95 g/km CO₂, and for vans 147 g/km, although it can change with vehicle weight and other parameters: see the Regulation at note 79 above. Reforms are under way to close the gap between the existing laboratory-style tests for CO₂ emission levels and 'real world' on road levels. The existence of this substantial gap (about 25 per cent for passenger cars) has been known for some time. An update shows that manufacturers are well on track to meet the 2020 targets: ICCT, 'CO₂ Emissions from New Passenger Cars in the EU: Car Manufacturers' Performance in 2014' (Briefing, 2015).

Efficiency standards of this kind are usually directed at the average performance of the fleet of vehicles that a manufacturer or importer sells in a year in a jurisdiction. This is an important characteristic from a policymaking point of view. It gives a company and the purchasing public some valuable flexibility; the company can sell less efficient models as long as they are balanced with sales of the more efficient models in its range. It is practicable to carry out this averaging exercise where a company makes or imports thousands or millions of vehicles; but it may be more difficult if the market is made up of multiple small companies.

The most recent substantial study of efficiency standards, by the International Council on Clean Transportation (ICCT), surveyed vehicle markets representing 85 per cent of total vehicle sales in 2013. It found that efficiency standards, whether regulations or equivalent fiscal policies, covered over 80 per cent of passenger cars sold globally.¹⁰⁵ (The US, Canada, China and Japan also have standards for heavy duty vehicles.) Of the surveyed markets, only Australia and Russia did not have efficiency standards. These standards have proved to be a highly cost-effective means of cutting CO₂ emissions, and highly effective in producing fuel savings. The IEA says that the use of fuel economy standards has taken hold worldwide, and between 2000 and 2010 has improved new vehicle fuel efficiency by 20 per cent in OECD countries and 10 per cent in other countries.¹⁰⁶ The world is moving fast. The '50by50' campaign of the Global Fuel Economy Initiative intends to make all light duty vehicles 50 per cent more fuel efficient by 2050.¹⁰⁷

Australia and New Zealand are therefore outliers in the global trend towards vehicle efficiency standards, not only behind the EU and North America, but also behind Brazil, India, and China. Even Saudi Arabia is adopting a CAFE standard.¹⁰⁸

Australia has not implemented a recommendation to introduce a light vehicle emission standard, to reduce the emissions standards of those vehicles from an average of 192 g CO₂/km to 105 g CO₂/km by 2025.¹⁰⁹ It was estimated that its benefits would outweigh costs substantially both nationally and

105 Miller and Façanha, above n 4, p. 22–23, 50–52. The survey covered China, the US, the EU, Japan, Brazil, India, Russia, Canada, South Korea, Australia, and Mexico, but not New Zealand.

106 IEA, *Energy Efficiency Market Report 2014*, pp 70–71.

107 IEA, *Energy Efficiency Market Report 2014*, p 71.

108 'Proposed Saudi Arabia CAFE standard for new LDVs 2016–2020' www.theicct.org, 18 December 2014.

109 Climate Change Authority, *Light Vehicle Emissions Standards for Australia* (Canberra, 2014). A more recent study evaluates EVs along with natural gas vehicles: Energeia, *Review of Alternative Fuel Vehicle Policy Targets and Settings for Australia* (prepared for the Energy Supply Association of Australia, 2015). It shows at p 37 that Australia has a luxury car tax which gives fuel-efficient vehicles a moderate reduction, and an emissions reduction fund aimed at certain large vehicle fleets, but that neither of them has a large effect.

individually. The standard would increase the cost of a car by \$1,500 but with fuel savings of \$830 in the first year and \$8,500 over the life of the car. Australia has a voluntary scheme, but in the absence of regulation, the average CO₂ emissions of new Australian cars is 45 per cent worse than European requirements,¹¹⁰ and in light of the swift progress being made in Europe the gap is likely to be growing.

In New Zealand, a fuel economy standard was considered in 2008, but it was dropped after a change of government.¹¹¹ The reasons given were that the standard would be complex and that its costs would outweigh its benefits. The Minister's Cabinet paper noted that transport GHG emissions had been rising, and that virtually all developed countries had rules to regulate and improve the average fuel economy of vehicles entering their fleets, either by a purchase incentive programme or by an average fuel economy or CO₂ standard. But it argued that New Zealand had included vehicle fuels in its Emissions Trading Scheme; that there was a voluntary trend towards more efficient vehicles, and that the costs of a regulation would be substantial, especially because of the large number of small importers of used vehicles.¹¹²

Let us evaluate these arguments against fuel efficiency standards. Above we have noted evidence from Europe that the costs do not outweigh the benefits – that there is a negative abatement cost, meaning that the gain in fuel efficiency is economically worthwhile even without the GHG abatement. The existence of a general price on carbon alongside vehicle efficiency standards is common, for example in California, British Columbia and Quebec. The existence of both policy measures is not unnecessary duplication. There is firm evidence that carbon pricing as a policy on its own is not enough to overcome all barriers to cost-effective energy use actions.¹¹³ In any event the New Zealand ETS price pressure on ICVs of \$0.006 per litre, noted above, is unimpressive. As for complexity, we noted the ICCT conclusion that efficiency standards have proved to be highly cost-effective as a means of cutting CO₂ emissions and reducing fuel costs. The IEA comes to the same conclusions in its detailed analysis.¹¹⁴

110 M L James, *Vehicle Fuel Efficiency Standards* (Parliamentary Library, Canberra, 2013) p 5.

111 Press release, Minister of Transport S Joyce, 28 August 2009. There is a power to make regulations for minimum energy performance standards for vehicles under the Energy Efficiency and Conservation Act 2000 s 36(1)(a). Whether 'minimum' standards is wide enough to include minimum fleet average standards (which is the requirement usually imposed on manufacturers internationally) is an uncertainty that would need further analysis if fuel efficiency standards are pursued in New Zealand.

112 Office of the Minister of Transport, 'Vehicle Fuel Economy Standard – Report Back' Report to Cabinet Economic Growth and Infrastructure Committee, August 2009; Cabinet Economic Growth and Infrastructure Committee, Minute of Decision, 19 August 2009, EGI min (09) 17/13.

113 L. Ryan, S. Moarif, E. Levina, R. Baron, *Energy Efficiency Policy and Carbon Pricing* (IEA, 2011).

114 IEA, *Energy Efficiency Market Report 2014*, p 70.

The arguments against fuel economy standards could be extended by saying that New Zealand is different in not manufacturing cars; however the fact of the matter is that in other countries standards apply equally to manufacturer and importer companies.¹¹⁵ Nor can it be said that New Zealand can rely on other countries' standards, because in most countries it is fleet averages that are regulated. In most markets, if a car manufacturer or importer produces low-efficiency cars, it is obliged to sell high-efficiency ones as well in order to meet the average, or it is obliged to pay high registration charges for its low efficiency cars; but in New Zealand it can sell as many of its low-efficiency cars as it likes.

However, complexity may be greater in New Zealand than in other countries on account of the fact that many of the motor vehicles coming into the country are used imports, imported by large numbers of small importer companies.¹¹⁶ The averaging characteristic of fleet average fuel efficiency regulation may be impracticable if numerous companies have to average the fuel efficiency performance of the mere handfuls of vehicles that they import.

The fuel economy or efficiency standards that have taken hold worldwide put regulatory pressure on the ICV fleet, which will be reflected in marketing, vehicle price, and the range of models available. That makes EVs more a more attractive option for suppliers and for purchasers.¹¹⁷ GHG emissions legislation is thought to be 'decisive' and a 'key driver' for the uptake of EVs in Britain.¹¹⁸ Very few countries are trying to promote EVs without also using efficiency standards to shape the composition of the vehicle fleet. If Australia and New Zealand try to promote EVs without action on fuel efficiency, they will be doing something quite different from everyone else, and it may not work. EV policy-making cannot overlook efficiency standards without looking anomalous.

4.3 Feebates

The preceding two sections of this analysis bring together cogent and up-to-date international evidence firstly about the significance of the price barrier and the effectiveness in many circumstances of price incentives, while noting

115 For example in Canada the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, SOR/2010-201 s 8 apply equally to companies that manufacture and import vehicles. Those Regulations are also interesting in providing a system of emission credits that companies can bank or trade to meet their compliance obligations: s 20 et seq. A similar province-level example is Quebec's Regulation respecting greenhouse gas emissions from motor vehicles, CQLR c Q-2, r 17.

116 The figures for light vehicle registration (when a vehicle is first brought on road in New Zealand) show that slightly more than half of them are used vehicles, almost all imports. For light passenger vehicles (cars and SUVs) the used vehicles are about 60% of the total: Ministry of Transport, 'Monthly Light Vehicle Registrations August 2015' p 2.

117 Miller and Façanha, above n 4, pp 26 and 53.

118 Element Energy, above n 50, pp 81 124-27.

that subsidies are less common in New Zealand than elsewhere; and secondly about the importance of fuel efficiency standards, while noting the possible complexity of imposing fleet averages in New Zealand. In this section we turn to feebates, because they have the potential to address both of those issues. They are a very promising means of bringing about change in motor vehicle fleets, and in New Zealand's circumstances in particular.

Feebate systems are generally recognized in the literature of environmental economics and policy.¹¹⁹ German and Meszler explain that in a feebate or bonus / malus system, each model of vehicle is rated for its GHG emissions or efficiency performance, so that better vehicles get rebates and worse ones are assessed fees.¹²⁰ A feebate can be applied to the initial import or manufacture of a vehicle on a one-off basis, or can be part of an annual licence. The reward for a societally-beneficial choice is tangible and immediate. It provides a stable predictable price for future reductions in emissions, and does not target an individual technology. A true feebate is revenue-neutral and self-financing; fees received from above the 'pivot point' are balanced by the rebates paid below it. (The pivot must therefore be reset periodically as technology changes.) A feebate can therefore be distinguished from a subsidy. Furthermore, a feebate is technology-neutral; it influences the purchase of ICVs and EVs alike. It encourages hybrids, fuel cells, and hydrogen vehicles as well as EVs.

A feebate provides a continuous long-term incentive to improve the performance of cars bought or manufactured. It is therefore different from a performance-based standard, which provides no incentive after minimum compliance, but it can readily co-exist with standards and complement them. A feebate also works smoothly with usage-focussed measures such as an ETS that influences the consumption of fuel. In a feebate system, EVs can have ratings that estimate the emissions produced indirectly from the use of electricity; they would be at the extreme favourable end of the scale where, such as in New Zealand, renewable electricity generation predominates. German and Meszler conclude that the best practice for feebate design is as follows.

- A continuous and linear feebate line rate, without breaks or discontinuities.
- Balance of fees and rebates with adjustments to the pivot point over time as vehicle efficiency improves, to make the system self-funding. (But it is the gradient or steepness of the slope of the feebate line that determines the scheme's effectiveness.)

119 T T Tietenberg and L Lewis, *Environmental and Natural Resource Economics* (10th ed, 2015) p 437. For an early study as to EVs, see A Ford, 'Simulating the Controllability of Feebates' (1995) 11 *System Dynamics Review* 3.

120 J. German and D. Meszler, *Best Practices for Feebate Program Design and Implementation* (ICCT, 2010). The British study by Element Energy (2013) above n 50 p 97 also emphasizes feebates as an important policy option.

- A system that treats all vehicles equitably, without any adjustment for attributes such as size or weight.
- A linear metric such as CO₂ emissions or fuel consumption (litres/km), and not a non-linear performance metric such as miles per gallon.

The best example of a feebate scheme is the bonus-malus system that applies to initial vehicle registration in France from 2008. The fee side ranges from €150 to €8,000, and the rebate from €150 to €6,300.¹²¹ EVs qualify for the highest bonus. A motor vehicle dealer can advance the bonus to reduce the purchase price directly. The bonus-malus scheme produced an immediate reduction of 6 per cent in CO₂ emissions in new cars, almost twice that in the rest of the EU, and significant reductions have continued. The scheme is effective in promoting EVs; evidently, the slope or gradient of the feebate rate line is steep enough to affect behaviour. The parameters, especially the pivot point are periodically updated. Other jurisdictions including Ireland and Ontario have feebate or feebate-like systems. Germany has a graded scale in its annual vehicle registration (or licensing) tax that sends a larger price signal than the French one, but it may have less consumer impact because it is spread out over time.¹²²

For New Zealand, a feebate scheme for initial vehicle registration at the time of importation is attractive as a policy instrument because it would apply to all vehicles, and would incentivize performance at all levels, not simply above a basic standard. A feebate also copes well with complex and diverse vehicle fleets, and does not rely on precise forecasts of technology or market developments. The revenue-neutral character of a feebate is attractive in political terms, although to maintain the neutrality it will be necessary to re-set the pivot point from time to time, not only in response to changing technology but also in response to changes in the practices of vehicle importers and the choices of the purchasing public. The feebate provides price support or an incentive to reduce the capital cost price barrier of EVs. A feebate system is likely to be attractive in terms of social equity; it is less likely than most systems to put good quality vehicles out of the reach of poor families.

A feebate on initial vehicle registration would work better than a fleet average fuel efficiency requirement in addressing the large number of small importers bringing vehicles into New Zealand. There would be no need for

121 National Research Council, above n 1, p 136.

122 German and Meszler, above n 120 pp 18 and 28. The study *CO₂ Emissions from New Cars in Europe*, above n 81 p 11, concludes that the annual tax is so weakly graded according to CO₂ emissions (a linear €2/g/km above a given threshold) as to have little or no effect on consumer choice. The legal basis of the French feebate is the Code général des impôts, art 1010 bis and 1011 bis. There is evidence that the French feebate system is less vulnerable to gaming for tax purposes than an emissions standard system: P Mock, *Optimizing to the Last Digit: How Taxes Influence Vehicle CO₂ Emission Levels* (ICCT, 2015).

each importer to determine its average fleet performance for the year, which could be very constraining and administratively complex if there are many importers with 'fleets' of only a few vehicles. Rather, each vehicle would be assessed separately for its feebate rate at the time of import or first sale. The primary effect of a feebate on initial import or first sale is therefore on the decisions of importers about the all-up cost of bringing different kinds of cars into the country.

In addition, feebate principles could be applied to the periodical licensing of vehicles. That step would provide ongoing pressure over time on the decisions of owners about vehicle choice and retention. Such pressure would accelerate change in the existing vehicle fleet, which will otherwise occur only over a period of years as the oldest cars are decommissioned. However, an annual feebate charge would be more complex administratively than a one-time feebate on initial registration, with a different fee, and possible rebate, for every kind of vehicle. A further limitation is that it would affect vehicle ownership but not vehicle use. A substantial price signal on hydrocarbon fuel consumption, such as could be sent through an effective ETS, may therefore be better, but it would policy action to change the existing ETS.

It therefore seems that a feebate applied to the initial registration of light vehicles would be effective in promoting EVs and clean transportation generally. It solves many of the problems that have been identified in international research. It avoids some of the difficulties that arise in New Zealand specifically. It puts in place a form of fuel efficiency standard and price support that makes it unnecessary to pursue other less effective and less attraction regulatory and fiscal action.¹²³

A feebate on initial registration or on periodic licensing would be implemented by changes to the Land Transport (Motor Vehicle Registration and Licensing) Regulations 2011, with changes to the authorizing provisions of the Land Transport Act 1998 probably required as well.

4.4 Charging Facilities

California, Germany, Norway, and other countries are active with measures to support the development of EV charging facilities. There is a need

¹²³ France shows that a feebate system can co-exist effectively with fuel efficiency standards, but, if feebate parameters are carefully set, efficiency standards may not be necessary. An alternative is to use efficiency standards that are not averages but minima. They would then prevent substandard vehicles from being imported, which could be useful in eliminating the worst-performing vehicles from the market, but there may be a high cost in lost flexibility, such as may be necessary to deal with unusual vehicles. Further research would be required to determine the success of such standards if they are in use in any country.

for regulation or standard-setting of charger plug and communication protocols.¹²⁴ Publicly-accessible chargers can be installed in workplace and shopping centre parking, and as the numbers of EVs increase it is likely that service stations and other companies will find commercial niches to sell high-speed charging. If charging facilities are to be provided on the street, the city or district council will need to manage parking and signage. Some cities, cooperatives and companies may promote EV car-sharing schemes such as the one in Paris.¹²⁵ However many owners will be able to rely on their ordinary garage electrical outlets for overnight charging; more than 85 per cent of New Zealand dwellings have garages or carports that provide a safe place for vehicle charging.¹²⁶ The overall picture that is likely to unfold is one where there is certainly a need for some government action to enable the construction of an effective charging network, but where private enterprise is generally able to lead the introduction of the new technology, and meet the needs of vehicle owners if serious numbers of EVs start to appear. There is an agenda for law reform, not being explored in detail here, to authorize standard-setting for chargers, and to ensure that local government and other road controlling authorities have the necessary direction and powers to manage and promote EV charging facilities. The German statute of 2015 provides a comparative example.

Element Energy confirms this conclusion, citing robust evidence that shows that it is not necessary for the government to provide large-scale access to a national public charging infrastructure for early EV adoption.¹²⁷ The study concludes that a public network may provide some degree of psychological reassurance, and that it will need to grow in the future, but that the highly-preferred location for charging will be in off-street parking, to which 70 per cent of new car buyers have access. Government action in providing charging infrastructure does not seem to be the key to EV uptake.

The main role for government action in New Zealand seems to be regulation for standard-setting and for the promotion and control of on-street activity such as parking at charging points.

4.5 Public Awareness and Ancillary Regulation

Many of the measures required to improve public awareness are 'decentred regulation' in the meaning of our table, directed at improving the public profile of EVs and increasing a public climate of acceptance. Research shows that

124 National Research Council, above n 1, p 33.

125 IEA, *Energy Efficiency Market Report 2015*, p 169.

126 EECA, above n 34 p 4. Work-place charging facilities effectively double an EV's commuting range. However, in the United States charging at home is expected to predominate, although there are difficulties with apartments and other dwellings without dedicated parking: see National Research Council, above n 1, pp 82–87.

127 Element Energy, above n 50, p 126.

consumers and fleet managers are not well informed about EVs, and that a number of perceptual factors contribute to consumer uncertainty and doubt about them, particularly the total costs of ownership over time, and the effective driving range of EVs.¹²⁸ Educational and information measures are therefore essential. In fact, most travel by road is well within the range of a fully-charged EV, and plug-in hybrids do not have significant range limitations at all, but 'range anxiety' is a concern expressed by many potential purchasers.¹²⁹ The special number plates in Norway are a good example of an effort to improve public awareness, identifying EVs and giving them preferential rights as to bus lanes, parking, road charges and ferries. Benefits of this kind, mainly non-financial 'perks,' are likely to encourage EVs, and do not impose obvious fiscal costs. They are also measures that a municipality can implement.¹³⁰ In New Zealand the Energy Efficiency and Conservation Authority produced an online tool for fleet purchasers to compare the total cost of ownership of EVs and other vehicles. Corporate or government fleet procurement on a large scale can also spur EV sales, by leading public opinion and accelerating economies of scale. The German government intends to replace its existing vehicle fleet with EVs, and the French government is coordinating the purchase of 50,000 EVs.¹³¹ However, there may be an element of subsidy in such purchases if they are more expensive than ICVs, unless there is a commercial justification.

An existing public awareness measure applying to all vehicles in New Zealand is the Energy Efficiency (Vehicle Fuel Economy Labelling) Regulations 2007. Its references to litres per 100 km are unsuitable for EVs, but a variation has been introduced, giving purchasers an estimate of fuel economy based on electricity prices.¹³²

More expansive public awareness measures for EVs are clearly essential, and are widespread internationally. However it is unlikely that they are enough on their own to change the views of prospective purchasers so much as to outweigh the disadvantages of high EV purchase prices, limited driving range, and limited variety of models; all the more so where ICVs do not face significant regulation of fuel efficiency or GHG emissions.¹³³ Public awareness policies therefore have a role in supporting policies aimed at price and fuel efficiency.

128 Lutsey, above n 10, p 24; National Research Council, above n 1, p 51.

129 National Research Council, above n 1, p 47.

130 N Lutsey, S Searle, S Chambliss, and A Bandivadekar, *Assessment of Leading Electric Vehicle Promotion Activities in United States Cities* (ICCT 2015).

131 Bundesministerium für Umwelt, Naturschutz, Bau und Reaktürsicherheit, press release 'Bundesumweltministerium ist Vorreiter bei der Beschaffung von Elektrofahrzeugen' 14 February 2014; IEA, *Global EV Outlook* (2013) p 33.

132 EECA (2012) above n 34, p 7.

133 Element Energy Ltd, above n 50; Lutsey, above n 10, p 23.

4.6 Statute, Mandate, and Institutions

Finally, it should be pointed out that legislation – a statute – can play a vital part in encouraging EVs. Ever since Jeremy Bentham’s time, it has been realized that a statute crystallizes the law clearly, and in addition crystallizes social norms and expectations in ways that are important even if it does not greatly change the law in the sense of rights and duties. A statute is a formal and relatively permanent expression of the collective intent, that underscores that a matter is not purely one of individual initiative, and that creates a context for the crystallization of public opinion. It sends stronger signals about the duration and stability of policy than does a policy statement or a ministerial press release, and significantly improves investment certainty. A statute can also confer a mandate on an agency that is then clearly designated as the champion for the policy, and that has a claim on fiscal resources to carry out that statutory duty.

In New Zealand, an Act or Amendment of this kind could take care of points we have noted where changes to the law seem necessary to remove a barrier, or simply desirable in order to provide clarity and direction. Examples are the functions and powers of the Electricity Authority, the functions and powers of road controlling authorities, and the setting of standards for charging equipment. Fuel efficiency standards, as we have seen, are already possible under the Energy Efficiency and Conservation Act 2000. A feebate scheme probably requires an amendment of the Land Transport Act 1998.

5 POLICY FOR NEW ZEALAND

As we have seen, analysis internationally has identified the main barriers to the uptake of EVs as a mass market product as:

- (i) The higher capital cost of EVs in comparison with ICVs, even allowing for likely EV price reductions.
- (ii) The shorter driving range of EVs in combination with the length of recharge time, especially in terms of public perception.
- (iii) The need for a better-developed charging infrastructure.
- (iv) The need for policy measures for ICVs that internalize their negative external effects.

We have considered a range of policy options that can be grouped under the general headings of unregulated market forces, conventional regulation, fiscal measures, decentred regulation, organization, and market mechanisms. The policy efforts and results of California, Germany and Norway have been examined closely. So too have substantial international studies that have become available recently.

The main policy options in use in various combinations were identified as:

- (i) Increasingly stringent efficiency standards
- (ii) Improved range of models
- (iii) Consumer incentives or price support, to lower initial vehicle costs
- (iv) Research and development of technology
- (v) Improvement of public awareness
- (vi) Coordination of development of charging infrastructure.

Naturally these are not all of equal importance. Some, like the coordination of the development of charging infrastructure, are thought to require little government action except for standards and regulation. Others, such as research and development, will be more important for vehicle-manufacturing jurisdictions but not others. The significance of work on efficiency standards will depend on the quality of the existing standards. The supply of a range of models is largely a matter for the private sector in the market, but is also highly subject to policy settings that encourage or discourage EVs. In New Zealand's case, price, efficiency standards, and public awareness have particularly stood out.

5.1 Characteristics of Desirable EV Policy

The New Zealand Minister of Energy and Transport is enthusiastic about EVs, and says a policy package is on the way, with an emphasis on coordinating charging points and improving public awareness, and with a warning not to expect subsidies or government funding of charging points.¹³⁴ The comparative analysis that we have carried out puts us in a position to reach some conclusions about the character of EV policy for New Zealand.

- (i) There are clear public policy rationales for action to encourage EVs in New Zealand, in the directly-connected matters of GHG emissions, energy efficiency, and energy security, and in relation to air pollution and noise.
- (ii) Policy for EVs needs to be part of an overall mobility strategy that takes an 'avoid, shift, improve' approach that includes urban and rural settlement form, public transport, enhanced pedestrian and cycle access, and emerging forms of 'mobility services.' EVs have roles to play in a sustainable society, even though they are not the 'one big solution' to all transport issues.¹³⁵ It is not necessary to predict the niches that EVs will fill first. EVs may well provide personal mobility for commuting (especially where public transport is difficult to provide), but there may be less readily-foreseeable possibilities for heavier EVs on stop-and-start services on regular routes, such as mail delivery and rubbish collection.
- (iii) Public policy is identified as the main driver for the uptake of EVs.¹³⁶ Without public policy action, not only on capital cost but also infrastructure and on public awareness, the market settings of the present and the medium-term future are unlikely to produce the necessary momentum. Non-fiscal policy measures such as EV parking and lane privileges, and encouragement of charging infrastructure, are important, although their real effect in the face of the price problem and in the absence of fuel efficiency measures is doubtful. Multiple policy actions are required, rather than one single entire solution.
- (iv) An uptake of EVs is rare in jurisdictions that do not have significant fiscal incentives for price support. The price barrier, especially the upfront capital cost, is a significant barrier to EV purchases without some form of price support. There are other issues affecting purchase decisions,

134 S Bridges press release, 'Opportunities to Cut NZ's Road Transport Emissions' 21 October 2015; 'Electric Vehicles Must Make Own Way in NZ, says Government' 23 October 2015, www.stuff.co.nz.

135 IEA, *Global EV Outlook* (2013) p. 36.

136 Deloitte, above n 3, p. 20; Perdiguero and Jiménez, above n 48, see the role that the public sector will play as 'crucial'.

shown for example in the UK where incentives have not produced the expected uptake, but the literature is clear about the significance of price. Prices are coming down but the problem cannot be regarded as solved. If the price question is left to the market, on a 'do nothing' basis, then there is a likelihood that significant net public benefits will be lost.

- (v) New Zealand is distinctive internationally (with Australia) in not regulating vehicle fuel efficiency in any way beyond a labelling requirement. Very few countries, if any, are trying to promote EVs without fuel efficiency measures. It may not be possible to promote EVs without fuel efficiency requirements; it would be making EV policy with one hand tied behind our backs. New Zealand may not succeed with EVs if it tries.
- (vi) There is ample evidence that an effective ETS gives a general price signal for the burning of hydrocarbon fuel that is necessary, but not sufficient on its own, to induce significant change. The New Zealand ETS, of course, needs to be strengthened substantially in order to become effective.
- (vii) Excellent relevant policy guidance can be found in the analysis by He and Bandivadekar of the optimal design of fiscal policies associated with new passenger vehicle CO₂ emissions.¹³⁷ They found evidence to support the following design criteria:
 - The policy should be directly linked to vehicle CO₂ emissions.
 - The policy should apply to the entire vehicle fleet, not a subset thereof.
 - The policy should set fees that vary continuously across the spectrum of CO₂ emissions, as opposed to fees that apply to a limited CO₂ range or fees that are invariant across a covered range of CO₂ emissions, as is the case with stepwise or bin-based policy structures.
 - Policies that apply both at the time of purchase and throughout a vehicle's lifetime influence a consumer's vehicle replacement decision and, thus, can yield greater CO₂ reductions than a single time-of-purchase policy alone.
 - Targeted incentives promoting the use of alternative energy fuels or advanced vehicle technology should be linked to vehicle CO₂ performance.

¹³⁷ H He and A Bandivadekar, *A Review and Comparative Analysis of Fiscal Policies Associated with New Passenger CO₂ Emissions* (2011, ICCT) pp 8–9. Germany's policies came the closest to an ideal CO₂ incentive structure among the countries they reviewed: p. 10. The point about avoiding steps or bins is reinforced by evidence that EU manufacturers are building cars tailored to emissions taxes, likely to have an emissions figure of 89, 99, 109, etc g/km: Mock, above n 122.

EV policy for New Zealand can be formulated in relation to the linked grounds of GHG (CO₂) emissions and fuel efficiency. He and Bandivadekar say that the first of their criteria is the most important, the direct linkage to CO₂ emissions, and that seems a very relevant design principle. Their criteria also show that conventional ICVs cannot be put to one side; good policies apply to the entire vehicle fleet. (The IEA comes to the same conclusion.¹³⁸) They are particularly cogent in this respect where there are no existing vehicle fuel efficiency requirements. The criteria also suggest that the current New Zealand exemption from road user charges is not a well-designed EV policy.

What fits all of He and Bandivadekar's criteria is a feebate system, applying to the whole light vehicle fleet. Feebates would encourage EVs but also hybrids and ultra-efficient ICVs, without favouring any particular technology, and would promote GHG and fuel efficiency right across the vehicle fleet.

This listing of characteristics of EV policy-making does not pretend to be a full and complete description of the issues. Several matters noted in one part or the other of the analysis remain unexplored. One example is how EV owners should contribute to the construction and maintenance of the road network, if they are paying neither fuel excise tax nor road user charges. Such matters require further analysis.

5.2 Policy Measures

From this comparative analysis it becomes possible to identify a suite of mutually-supporting policy measures to promote EV that have credibility and a proven record of success internationally, and that are suitable to New Zealand conditions.

- (i) A feebate scheme, applying to the whole of the light motor vehicle fleet, on the occasion of the initial registration of a vehicle in New Zealand, providing a price benefit or charge on the basis of the CO₂ emissions of the vehicle. The size of benefit or charge per unit of emissions would be set so as to provide a real influence on the selection of vehicles in the New Zealand market, and the pivot point would be re-set regularly to produce revenue neutrality. An effective feebate system would avoid the need to introduce price subsidies for EVs. It would operate as a form of fuel efficiency standard for the benefit of the entire light vehicle fleet.

138 The IEA regards a combination of various instruments as necessary, most important of all an improved fuel efficiency of vehicles and vehicle fleets, but also new types of vehicles, such as battery electric vehicles, plug-in hybrid electric vehicles, and alternative fuels such as advanced biofuels capable of reaching very-low CO₂ emissions: see IEA, *Tracking Clean Energy Progress* (2012) p. 44.

- (ii) Awareness measures to improve public awareness, perceptions, and knowledge of EVs as an option. The measures need to be carefully directed at different audiences, and designed in the light of research on perceptions and behaviour.
- (iii) Measures to encourage the growth of a public charging infrastructure; standard-setting for charger plugs and communication protocols, and powers for road controlling authorities to manage street activity.
- (iv) Legislation to provide clarity and permanence of policy intention, improving the investment climate, removing barriers, and clarifying points of uncertainty.
- (v) Price pressure on the use of hydrocarbon fuels through the ETS, at a level high enough to bring about changes in vehicle use.

This is not an exhaustive list. Other barriers have been identified, such as the overtaxation of EVs through the fringe benefit tax. Further research is likely to identify more. When EV numbers become substantial, other questions will need to be resolved, such as a method for EV users to contribute to the maintenance and development of the road network.

6 IMPLICATIONS FOR EV LAW AND POLICY GENERALLY

Reflecting more generally on the wide range of policy measures coming into use to encourage the uptake of EVs, one is impelled to return to the reasons behind them; air pollution, noise, climate change, energy security, and energy efficiency generally. The rationale for encouraging EVs is to be found in the externalities and other market imperfections that lead us to use fossil fuels in harmful ways, and found in economies where little electricity is generated from fossil fuels. EVs are not the only ways we are tackling these problems; in any jurisdiction one finds a range of policy measures deployed or under consideration to address them. There is a range or spectrum of policy measures, from those tightly targeted on EVs to those that are very general, such as in putting an economy-wide price on carbon dioxide emissions. In between are measures for motor vehicles generally, addressing pollution, GHG emissions, and efficiency. For a proper picture of the policy context of EVs, it seems essential to take a broad and not a narrow view of the measures along this spectrum. The analyses above recognize the importance of other measures.¹³⁹ EV measures cannot be considered in isolation. Interest in EVs does not occur in a vacuum.

More specifically, policy interest in EVs arises in comparison with ICVs. It arises by asking how EVs are better for individuals and society in comparison with the alternative, ICVs. There would be no public policy interest in EVs if they were the only means of transport available apart from horses and bicycles. The EV policy exercise is necessarily one of comparison with ICVs. It therefore requires accurate comparisons that include a full range of social costs, and in particular the non-internalized costs of pollution, climate and inefficiency. Only then can the real expense of EVs be evaluated. At the core of our argument is that the analysis of EVs should compare like with like.

Another consequence is that an EV policy necessarily includes ICV policy. There is no way around the fact that the electric vehicle debate shines a light on our management of the adverse effects of conventional motor vehicles. This, as we have seen, is particularly relevant to Australia and New Zealand which do not have fuel efficiency standards.

¹³⁹ Mock and Yang above n 51, and Element Energy above n 50, particularly emphasize the point.

A broader view of EV policy also ensures that our policy mix is the best possible. There is no point formulating elaborate EV support mechanisms if they are undercut by shortcomings in dealing with ICV externalities. Further, a broader view avoids locking in on one technology in addressing general problems. General measures put a consistent signal through the economy and avoid picking winners,¹⁴⁰ while targeted measures can remove specific barriers. This is particularly important when technology is in flux; low emission internal combustion engines, advanced biofuels, plug-in hybrids, battery EVs, and fuel cells are all evolving rapidly.

140 M J Trebilcock and J S F Wilson, 'The Perils of Picking Technological Winners in Renewable Energy Policy' p 343 in G Kaiser and B Heggie, eds, *Energy Law and Policy* (Toronto: Carswell, 2011).

