

# “Beasts”—New Zealand’s utility vehicles: their climate change emissions and macho marketing

John Horrocks, Nick Wilson

## ABSTRACT

Vehicle emissions are an important contributor to the growth of greenhouse gas emissions in New Zealand. Here we explore the role of sports utility vehicles (SUVs) and light utility vehicles (utes) in this problem. Marketed as macho symbols of toughness and dominance, often through comparisons with savage predators, these vehicles are promoted largely to male consumers. Eight out of 10 of the highest-selling new light vehicles in 2018 were SUVs or diesel-powered utes, with the latter standing out as the heaviest emitters of CO<sub>2</sub>, as well as posing health hazards through their emissions of fine particulates and NO<sub>x</sub>. The current popularity of these vehicles may create resistance to some of the substantive regulatory steps which will be needed if New Zealand is to meet its climate change commitments under the 2015 Paris Agreement. An example of such an initiative is the current government proposal for a Clean Car Standard and Clean Car Discount—a ‘feebate’ scheme which confers a price advantage on new electric vehicles and smaller cars.

“You’re Going to Need a Bigger Garage” reads an advertisement for the 2019 Ford Ranger Raptor in *New Zealand Autocar* magazine.<sup>1</sup> Despite the need for urgent action to reduce carbon dioxide (CO<sub>2</sub>) emissions, which was signalled by the most recent report from the International Panel on Climate Change,<sup>2</sup> there is no sign of slackening in consumer demand in New Zealand for large diesel-powered utility vehicles like the Raptor, which are heavy emitters of CO<sub>2</sub>.

A number of countries now plan to ban future sales of all *new* fossil-fuel powered vehicles: by 2025 (Norway); by 2030 (Denmark, India, Ireland, Israel and The Netherlands); by 2032 (Scotland); and by 2040 (China, England, France, Wales and Northern Ireland). New Zealand, by contrast, remains one of the three countries in the OECD, together with Australia and Chile, which have been slow to adopt a regulated fuel efficiency standard for vehicles. Such a policy was explicitly rejected in 2009, when Transport Minister Steven Joyce said that it could cost up to \$1,500 more to

buy a larger car.<sup>3</sup> Ten years later, a similar scheme has once again been proposed.<sup>4</sup> The aim is to facilitate a progressive switch to a low-emissions fleet by requiring importers to bring in more fuel-efficient and electric vehicles. Consumer discounts for buying such vehicles would be funded by increased registration costs for vehicles entering the fleet like large sports utility vehicles (SUVs) and light utility vehicles (utes). A measure of how much ground New Zealand has to make up is that by 2014 the average emissions of new light vehicles manufactured in Japan were already at 105 grams of CO<sub>2</sub> per kilometre—the proposed target for New Zealand to reach by 2025.<sup>4</sup> Progress up to now in New Zealand has also been limited by the slow increase in the number of electric vehicles (EVs). In Norway, a country with a population of similar size, and which also has access to abundant hydroelectricity, 58% of passenger cars sold in March 2019 were fully electric.<sup>5</sup> In New Zealand, on the other hand, only 768 new electric vehicles (EVs) were registered during 2018. This represented less than 1% of new passenger

vehicles.<sup>6</sup> The New Zealand Government's goal, set in 2016, of 64,000 EVs by 2021,<sup>7</sup> is unlikely to be realised.

Apart from the delay in adopting a fuel efficiency standard, New Zealand has been out of line with moves in other countries to reduce the number of vehicles running on diesel, including restrictions or bans on such vehicles in inner city areas.<sup>8</sup> Manufacturers are following suit; Swedish carmaker Volvo has already ceased to introduce new diesel models from 2019.<sup>9</sup> In the UK, in March 2018, a month when car sales were usually high, sales of new diesels fell by more than a third,<sup>10</sup> and this trend was maintained throughout the year.<sup>11</sup>

A leading reason for these decisions has been the pollution from diesel cars, vans, trucks and buses of fine particulates equal to or smaller than 2.5 microns in diameter ( $PM_{2.5}$ ), as well as nitrogen oxides ( $NO_x$ ).<sup>12</sup> The health risks of exposure to fine particulates are well-recognised.<sup>13,14</sup> In New Zealand, the collection of data about such emissions is still discretionary, as there is no national environmental standard for fine particulates. This contrasts with the European Union, in which an ambient air quality limit for  $PM_{2.5}$  in urban areas has been in place since 2015.<sup>15</sup> Information in New Zealand about exposure to the larger  $PM_{10}$  particulates is also haphazard, as the regional councils and unitary authorities that collect the data use different techniques for measuring them.<sup>16</sup> There is, however, a major national database on air pollution from  $NO_2$ , the National Air Quality ( $NO_2$ ) Monitoring Network.<sup>17</sup>

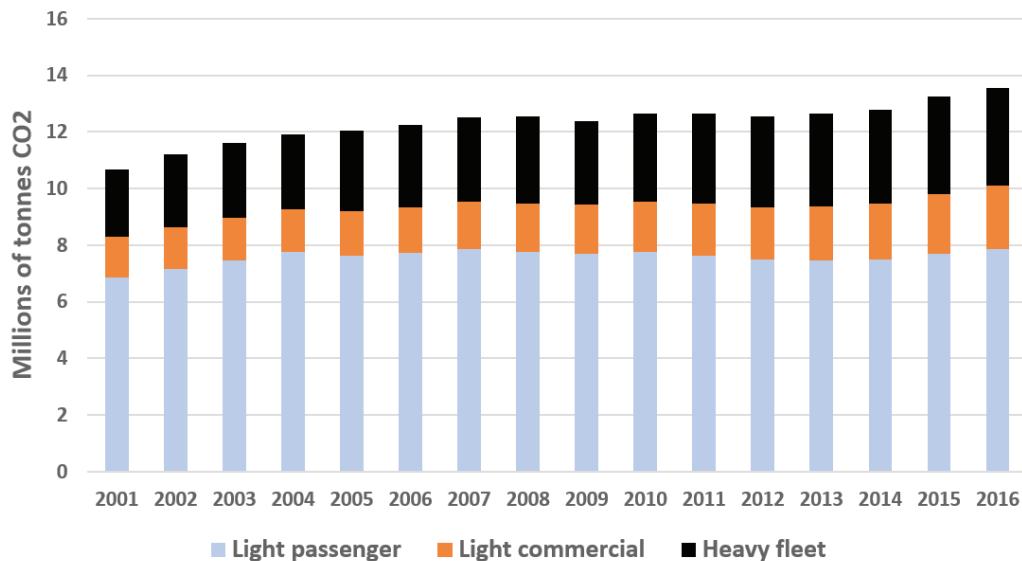
Despite the very limited data on vehicle emissions in New Zealand, a major study in 2012 (the HAPINZ Study), estimated that pollution from  $PM_{10}$  particles from vehicle emissions caused 256 premature deaths annually, as well as social costs of \$934 million.<sup>18</sup> This figure is similar to the 267 deaths from accidents on the roads in the same year.<sup>19</sup> Follow-up research using the same model suggests that by 2016 there was a small (8%) improvement in the attributable mortality estimates,<sup>14</sup> but it has to be remembered that additional health impacts of other pollutants, especially  $NO_x$ , were not assessed by these studies. By 1993 in Auckland 79.9% of  $NO_x$  emissions already came from vehicles.<sup>20</sup>

New Zealand's strong consumer preference for utes and SUVs was demonstrated in 2018 by the fact that buyers could choose between a staggering 92 brands, with 286 versions of these vehicles.<sup>21</sup> With their distinctive boxy shape, their extra ride height and, for the larger models, sheer size, SUVs and utes appear to be designed to satisfy a need for an assertive appearance, over and above their capacity to handle roles such as towing and off-road driving conditions. The Nissan Patrol, with its massive 5.6 litre V8 engine and 4x4 facility that can be customised to surfaces such as rock, snow and sand, represents the luxury end of the SUV market, but there are now several small SUVs as well, such as the Audi Q2 AWD and the two-door Honda HR-V AWD. These are described in the 2019 *New Zealand Four Wheel Drive Annual* as blurring "the lines that used to exist between the various car and light commercial sectors".<sup>22</sup> Considerations such as fuel efficiency and the vehicle's emissions have historically been less important than other attributes of SUVs. The Nissan Patrol has a claimed fuel consumption of 14.4 litres/100km.<sup>23</sup>

Utes have also changed character in recent years. Once the preferred choice for tradespeople, farmers and contractors, their enhanced comfort, the incorporation of the tray into the body of the vehicle and the option to have a twin cab model have meant that they can serve a dual purpose as a workhorse and a family vehicle. This means that the classification of utes by the Ministry of Transport as light commercial vehicles is probably no longer accurate. The trend for utes to become popular town cars is typified by the Ford Ranger ute, which has been the highest-selling new passenger vehicle in New Zealand since 2015, with 9,904 sold in 2018.<sup>24</sup> This demonstration of consumer preference may present barriers to a rapid decline in vehicle emissions, especially given the durability of these vehicles and the number that are already in the vehicle fleet.

Given this background, in this viewpoint article we explore further the issue of vehicle emissions in New Zealand, with the aim of determining the contribution of different categories of new light passenger vehicles and utes. The focus is on the highest-selling new SUVs and utes, and whether they run on diesel or petrol, as these are the

**Figure 1:** Vehicle CO<sub>2</sub> emissions from the Ministry of Transport’s “Vehicle Fleet Emission Model” from 2001 to 2016<sup>25</sup> (excluding the relatively minor contribution of motorcycles).



Note: “Light commercial” is defined by the Ministry of Transport by vehicle type (ie, truck under 3.5 tonnes, van, ute) rather than by usage.

prototypical new vehicles favoured by New Zealand consumers. The marketing of the dominant brands of these vehicles and how they are characterised is also described, in order to discover whether any particular themes in this material may create difficulties for future initiatives to reduce vehicle emissions. More detailed methods for this work are in the Appendix.

### Patterns for vehicle emissions

The overall pattern from the New Zealand data clearly shows increasing CO<sub>2</sub> emissions since 2001 for the vehicle fleet (Figure 1). There have been increases in emissions for all three categories: light passenger, light commercial and heavy transport. At least for the light vehicle fleet as a whole, this pattern is being driven by an increase in the overall number of vehicles and not by the emissions per vehicle—which have been slowly declining between 2005 and 2017.<sup>25</sup> The Ministry for the Environment has attributed this decline to improvements in fuel specifications and stricter emissions limits for new and used vehicles entering the fleet.<sup>26</sup>

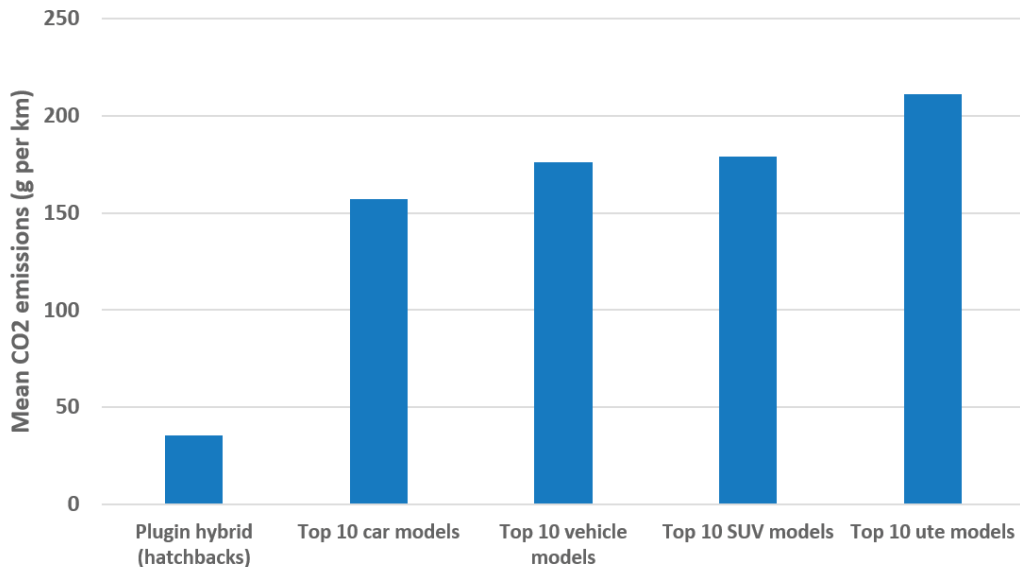
Among the new light passenger vehicles sold in New Zealand in 2018, the highest average CO<sub>2</sub> emissions were from utes, followed by SUVs and then cars (Figure 2, Table A1 in the Appendix). Given that 5 of the 10 highest-selling new light passenger

vehicles in New Zealand during 2018 were large utes, while three were SUVs and two were cars, this indicated that these utes made a disproportionate contribution to the overall load of CO<sub>2</sub> emissions. By contrast, an analysis for the top selling vehicles in 2011 indicates that the ratio of cars to SUVs was eight to two at this time.<sup>27</sup>

The average emissions for the five utes in the 2018 top-selling list (Ford Ranger, Toyota Hilux, Mitsubishi Triton, Holden Colorado and Nissan Navara), all powered by diesel, were 211g/km. This contrasted with the emissions for versions of the highest-selling car in 2018, the Toyota Corolla (eg, the ZR Hatchback, which runs on petrol, had claimed CO<sub>2</sub> emissions of 96g/km). CO<sub>2</sub> emissions per km for utes in general were also six times those of plugin hybrid hatchbacks (Figure 2, Table A1). The best performing plugin hybrid had only a tenth the emissions per km of the poorest performing ute (23 vs 219 g/km, Table A1).

The patterns for fuel efficiency ratings were similar: utes were worst, then SUVs, then cars (Table A1). Diesel was the dominant fuel in all categories of highest-selling new passenger vehicles except cars (ie, 80% of the top 10 new vehicle models and 100% of the top 10 new utes). The starred pollution ratings on the

**Figure 2:** Average CO<sub>2</sub> emissions (g/km) for new vehicles sold in New Zealand in 2018 (see Table A1 for further details).



*Rightcar* website were, however, little help in assessing the relative contribution of pollutants such as NO<sub>x</sub>, eg, there were no ratings at all for 50% of the top 10-selling vehicle models. Apart from this information gap, tests of NO<sub>x</sub> emissions under real-world driving conditions indicate that actual emissions from passenger vehicles running on diesel may be as much as seven times higher than the figures provided by manufacturers, which are drawn from laboratory certification testing.<sup>28</sup>

### How SUVs and utes are described and promoted

Female models in bathing suits were once a favoured way to promote vehicles at motor shows, but we found that the 2018 generation of SUVs and utes were no longer presented as ‘babe magnets’. They were characterised, instead, as outright symbols of potency and aggressive dominance (Table 1). Prestige and appearance were also given as important reasons for buying them. Motoring journalist Steve Cardno described the Ford Everest SUV as “...the big hitter of the bunch”,<sup>29</sup> while another writer, David Linklater, enthused that the Holden Acadia is “... a big fella... you want a large SUV that has a really masculine character. Because you like the growly V6 engine”.<sup>30</sup> This macho aspect was highlighted by the slogan Holden used to promote this 3.6 litre petrol SUV—“Built to Rule the Road”.<sup>31</sup> Appeals to potential female buyers of SUVs and utes

were conspicuously absent from the 2018 issues of *NZ Autocar*.

Advertisements by Ford, a sponsor of the All Blacks, were used during the period of the 2019 Bledisloe cup to establish a connection between rugged sportiness and the Ranger Wildtrak Bi-Turbo. Prominent players like Kieran Reid were seen endorsing this vehicle, including an appearance on Ford’s own website, where they are featured together with the Ranger Wildtrak in the middle of a rugby stadium.<sup>32</sup> Another player, Jordie Barrett, appears in a promotional photo by a Ford dealer in Taranaki, where he is being congratulated as he takes possession of his own “All Black” Ford Ranger.<sup>33</sup>

An association with adventure was prominent in the visual images of these vehicles on distributors’ websites, as well as in advertisements and motoring articles (Table 1). Vehicles like the Ford Ranger Raptor were frequently pictured in mid-air as they burst through difficult terrain.<sup>34</sup> The focus on adventure was summed up in *Stuff’s Top Cars 2018*, which suggested that the Ford Raptor is “...an enormous toy”, which has an “...appeal to the big kid in us”.<sup>35</sup> Though the possibility of escape to exotic locations was often featured, urbanites were not forgotten, with a selling-point being the capacity of these vehicles to sail over those “annoying” features of city streets, speed bumps (Table 1).

**Table 1:** Themes with illustrative examples in the presentation of SUVs and utes in *New Zealand Autocar*, 2018.

Theme	Details: article headings (H); magazine cover (C); advertisement (A); text (T)	Vehicle/s	Ute/SUV	Date
Animal imagery (typically aggressive)	...all paw wagons (T)	Holden Commodore Tower & Subaru Outback 3.6	SUVs	8/18
	Ranger Raptor The Talons are Out! (C)	Ford Ranger Raptor	Ute	3/18
	It rages and bellows, pops and bangs (T)	Range Rover Sport	SUV	10/18
	...'tiger nose' grille (T)	Kia Sportage	SUV	12/18
	YEE HAW! We Go Flying in the Raptor (C)	Ford Ranger Raptor	Ute	9/18
	Beast Wars (H)	VW AmarokV6 versus Mercedes Benz X350	Utes	3/18
Appeal to urbanites	These are made for cross-country adventures, but many city folk like 'em too. Maybe they need to tow something a cross-over can't... or they live on a street with annoying speed bumps, as these things sail straight over them (T).	Ford Everest and Holden Trailblazer	SUVs	12/18
	Urbanites will love Raptor's ride quality. Nothing with a full chassis rides quite like this, or devours speed bumps so effectively (T)	Ford Ranger Raptor	Ute	12/18
	...it's still fun to use when accelerating from a motorway on-ramp (T)	Toyota Hilux SR5 Cruiser	Ute	7/18
Macho	...no longer a dowdy MPV...a spunky seven-seater SUV (T)	Peugot 5008	SUV	4/18
	A muscular presence perfect for the current gung-ho mood of the market (T). Mighty Whitey 2500 (H).	Chevrolet Silverado 2500	Ute	9/18
	Butch Cruiser (H)...has one critic going so far as to describe it as a 'hammerhead shark', but the rejuvenated cruiser has a more butch appearance, thanks to a hexagonal grille and a squarer bumper design than lesser models (T)	Toyota Hilux SR5 Cruiser	Ute	7/18
	AMG's Middleweight brawler (H)	Mercedes AMG	Ute	7/11
Adventure	Democratic Power (H)... fun and responsive to drive—on road and off (T)	VUW Amarok 6	Ute	8/18
	Adventure Meets Smarts. The Nissan X Trail (A)	Nissan X Trail	SUV	7/18
	Beach Bush and Beyond (A)	Nissan Navara ST X	Ute	11/18
Prestige	It just looks like a million bucks (A)	Range Rover Velar P250	SUV	10/18
	Part of the appeal for the buyers is the look; these look ready to scale mountains (T)	Ford Everest and Holden Trailblazer	SUVs	12/18
	...power and torque literally sloshing out of its 4.0 litre capacity. Handles and rides like a boss (T)	Lamborghini Urus	Ute	9/18
	...the truck to be seen in this summer (T)	Ford Ranger Raptor	Ute	12/18

The names and attributes of several brands of SUVs and utes implied that buyers would be like the owners of dangerous beasts, or even adopt this character themselves once they were behind the wheel (Table 1). There is not only the Ford Ranger Raptor, but also the Holden Colorado Sportcat, the Volkswagen Amarok, named after a mythical giant wolf, and now in 2019, the Rhino, which replaces Ssangyong's popular Actyon ute.

## Discussion

The principal finding of this analysis was that New Zealand's growing light passenger vehicle fleet is dominated by classes of vehicle that are adding disproportionately to the country's increasing emissions of CO<sub>2</sub>, as well as emitting other pollutants that pose risks to health. The popularity of these SUVs and utes appears to be reinforced by the way they are described in the motoring press and by the distributors' own promotional websites. Nevertheless, the focus of the qualitative part of our analysis was limited to images and text in the print media and so further research is warranted. A study of video presentations on the distributors' websites, as well as sources such as YouTube and television advertisements, could be additional steps to complement the current research.

A comprehensive analysis of SUVs and utes would also consider their impact on patterns of road crash injuries. But briefly here we note that the size incompatibility between SUVs and smaller vehicles results in a higher risk of death in crashes for those in the smaller vehicle.<sup>36</sup> While this incompatibility trend may be declining in the US, this problem is not declining for crashes between pickups and cars.<sup>36</sup> Vehicles classified as being light trucks or vans (LTVs) (including compact sport utility vehicles (SUV), full-size SUVs, minivans, full-size vans, compact pickups and full-size pickups) have also been reported to contribute to an excess total risk of death in crashes with other LTVs.<sup>37</sup> Furthermore, there are concerns about SUVs having a disproportionate role in fatal single-vehicle pedestrian crashes<sup>38</sup> and in terms of having a higher rollover risk than other vehicles.<sup>39</sup> While our qualitative analysis was also brief, it did also identify themes around aggressive animals and driving behaviour (Table 1) that could be problematic in terms of how safely people drive both SUVs and utes.

In order to meet New Zealand's greenhouse gas emissions targets, such as the obligations under the 2015 Paris Climate Agreement to reduce emissions by 30% by 2030 (from 2005 levels),<sup>40</sup> substantive regulatory steps will be needed to produce a rapid reduction in emissions from the transport sector. One of the most positive aspects of the Government's current Clean Car proposal is that it includes the adoption of the stringent emissions testing procedure required in Europe since September 2018, the Worldwide Harmonised Light Vehicles Test Procedure (WLTP).<sup>41</sup> At present, New Zealand requires that new imported vehicles meet only the outdated Euro 5 emission standard (or Euro 4 for used imported vehicles).<sup>42</sup> Apart from a rapid increase of funding for public transport, other policy initiatives that would help to reduce vehicle emissions include support for urban intensification (rather than continued urban sprawl), expansion of cycling infrastructure, expansion of pedestrian zones that are car-free, and an accelerated programme of scrappage for older vehicles (as in past New Zealand scrappage trials<sup>43</sup> and the US Federal 'cash for clunkers' programme). All of these steps, either at central government or local level, have the potential to improve environmental health as well.

## Conclusions

Sales of new light passenger vehicles in New Zealand are dominated by large SUVs and utes, many of which run on diesel. Their popularity and the way they are marketed create potential roadblocks to the many actions that will be needed to meet the country's emissions targets. In terms of vehicle emissions and their health effects, New Zealand has typically been a 'follower' rather than a leader, and was notoriously slow to adopt lead-free petrol.<sup>44</sup> A shift in policy is signalled, however, by the proposed Clean Car scheme, the introduction of the recent Zero Carbon Act (which sets a target of zero emissions by 2050), and the establishment of a Climate Commission to advise and report on progress towards this goal. If this legislation proves to be more than an aspirational gesture towards reducing emissions, it will provide more context for a reevaluation of this country's obsession with large and polluting passenger vehicles, as well as making it less acceptable to market them as symbols of predatory power and aggression.

## Appendix

### Methods for the quantitative and qualitative analyses

#### Emissions data

Trend data relating to CO<sub>2</sub> emissions for the vehicle fleet were abstracted from a New Zealand Ministry of Transport website<sup>45</sup> and graphed. To provide a more in-depth picture for 2018, we then examined new vehicle sales data for the 2018 year from the Motor Industry Association.<sup>46,47</sup> From the monthly data, we generated top-10 lists for all vehicle models sold in the categories of: all vehicles, cars, SUVs and utes.

#### Data on vehicle performance (2018 models)

The New Zealand Government's *Rightcar* website<sup>48</sup> was used for estimating typical performance of models in each of the above named categories. The first step was to select the vehicle model categories that encompassed 2018 models and which had the largest number of model variants. The next step was to select within these groupings the most commonly named specific model. If further options existed, a random number in Excel was used to determine selection (eg, automatic vs manual; or diesel vs petrol). Finally, for comparison purposes, we selected all 2018 models of plugin hybrid hatchbacks that were listed on the *Rightcar* website. The full dataset (Excel file) is available on request from the authors.

#### How SUVs and utes were described and promoted in 2018

We examined how these classes of vehicles were described in the 2018 edition of *New Zealand Autocar*, the leading specialist car magazine in New Zealand, with an estimated readership of 20,000.<sup>49</sup> A qualitative content analysis was made of advertisements, headings of articles, text and covers for all 12 issues in 2018, in order to isolate particular themes in this material, together with exemplars of them. Further thematic material was drawn from articles by motoring journalists in other publications, including *New Zealand Four Wheel Drive* and the Fairfax Group's New Zealand outlets *Stuff* and the *Dominion*, as well as the New Zealand websites for each vehicle brand.

#### Additional results

**Table A1:** Emissions-related characteristics of new vehicles sold in New Zealand in 2018 (our analysis of car specific data from the *Rightcar* website).

Vehicle characteristic	All top 10 vehicle models (including utes and SUVs)*	All top 10 car models	All top 10 SUV models	All top 10 ute models	Plugin hybrid (hatchbacks) (n=6 models)**
CO <sub>2</sub> emissions – average (g per km) (SD)	176 (27.1)	157 (26.2)	179 (24.2)	211 (27.8)	35.5 (13.0)
– range (g per km)	140–219	129–209	149–221	164–261	23–53
“CO <sub>2</sub> emissions” average stars (more stars represent lower emissions, maximum is 6 stars)	4.35	4.25	3.60	4.10	6.00
Fuel efficiency (L / 100 km) (SD) (lower is better for the environment)	7.01 (1.05)	6.84 (1.14)	7.25 (1.19)	8.23 (1.11)	1.55 (0.56)
Fuel type: % diesel	80%	0%	60%	100%	Not relevant
Engine capacity (average) (litres)	2.31 (0.53)	2.01 (0.71)	2.29 (0.44)	2.66 (0.42)	Not relevant

**Notes:** SD: standard deviation.

\*Comprised of five utes (50%), three SUVs (30%) and two cars (20%).

\*\*These values from the manufacturer represent estimates of the mix of driving patterns involving electric-only and petrol only and so may over- or under-estimate emissions depending on how they are used in New Zealand settings.

## Further specific research needs and consumer information on the vehicle fleet

### More research into the health and other social costs of anthropogenic air pollution in New Zealand

While valuable research has been conducted as per the HAPINZ study of 2012 and a report in 2002 to the Ministry of Transport,<sup>50</sup> more is required. That is, the health and social cost externalities are not recognised in the funding model of the Land Transport Authority. This is the model which currently applies virtually all its revenue from fuel excise duty, road user charges, heavy road user charges, and vehicle registration and licensing fees to the expenditure on the land transport network, excluding rail (ie, to roads).

### Better consumer information about pollutants other than CO<sub>2</sub>

This could start with improvements to the Government's *Rightcar* site, eg, consistent reporting of NO<sub>x</sub> data. In 2008, Wilson et al reported on the minimal information provided to New Zealand consumers about the fuel efficiency and CO<sub>2</sub> emissions of the vehicles they were buying.<sup>51</sup> Though some of this information is now provided at point of sale, it should ideally be complemented by information about other exhaust emissions.

---

#### Competing interests:

Nil.

#### Author information:

John Horrocks, Independent Researcher, Eastbourne, Lower Hutt;  
Nick Wilson, Department of Public Health, University of Otago, Wellington.

#### Corresponding author:

Prof Nick Wilson, Department of Public Health, University of Otago, Wellington.  
nick.wilson@otago.ac.nz

#### URL:

<http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2019/vol-132-no-1507-13-dec-2019/8080>

---

#### REFERENCES:

1. Ford New Zealand. You're Going to Need a Bigger Garage. New Zealand Auto-car (2018, December), p2.
2. Intergovernmental Panel on Climate Change (IPCC). Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments [Media release]. IPCC 2018;(8 October) [http://www.ipcc.ch/pdf/session48/pr\\_181008\\_P48\\_spm\\_en.pdf](http://www.ipcc.ch/pdf/session48/pr_181008_P48_spm_en.pdf)
3. Joyce S. Govt won't proceed with fuel economy standard [Media release]. Wellington: NZ Government, Media Release (2009, 28 August).
4. Ministry of Transport. Moving the light vehicle fleet to low-emissions: discussion paper on a Clean Car Standard and Clean Car Discount (9 July, 2019). <http://www.transport.govt.nz/assets/Import/Uploads/Our-Work/Documents/11de862c28/LEV-consultation-document-final.pdf>
5. Karagiannopoulos L, Solsvik T. Tesla boom lifts Norway's electric car sales to record market share. Reuters (2 April, 2019). <http://www.reuters.com/article/us-norway-autos/tesla-boom-lifts-norways-electric-car-sales-to-58-percent-market-share-idUSKCN1RD2BB>
6. Motor Industry Association. Vehicle sales. (Accessed 25 June 2019). <http://www.mia.org.nz/Sales-Data/Vehicle-Sales#hybrid>
7. Ministry of Transport. Electric vehicles [last updated on: 30/04/2019]. Ministry of Transport. <http://www.transport.govt.nz/multi-modal/climatechange/electric-vehicles/>
8. McGrath M. Four cities move to ban diesel vehicles by 2025. BBC News (2016, 2 December). <http://www.bbc.com/news/technology-36484444>



- bbc.com/news/science-environment-38170794
9. Campbell P. Volvo ditches diesel from all new models. *Financial Times* (2018, 15 May). <http://www.ft.com/content/6bf0ce8a-5786-11e8-b8b2-d6ceb45fa9d0>
  10. West K. Dieselgate leaves UK 's car industry in crisis. *Guardian* (2018, 21 April). <http://www.theguardian.com/business/2018/apr/21/dieselgate-uk-car-industry-sales-slump>
  11. Sunday Times Driving. The UK's Top Ten Selling New Cars in 2018 (Updated). Sunday Times Driving. (7 January, 2019). <http://www.driving.co.uk/news/uks-top-10-best-selling-cars-2018/>
  12. Anenberg SC, Miller J, Minjares R, Du L, Henze DK, Lacey F, Malley CS, Emberson L, Franco V, Klimont Z, Heyes C. Impacts and mitigation of excess diesel-related NO<sub>x</sub> emissions in 11 major vehicle markets. *Nature* 2017; 545:467–71.
  13. Di Q, Wang Y, Zanobetti A, Wang Y, Koutrakis P, Choirat C, Dominici F, Schwartz JD. Air pollution and mortality in the Medicare population. *N Engl J Med* 2017; 376:2513–22.
  14. Ministry for the Environment; Statistics NZ. Our Air 2018, Data to 2017. Ministry for the Environment, Statistics NZ. <http://www.mfe.govt.nz/sites/default/files/media/Air/our-air-2018.pdf>
  15. European Environment Agency. Air quality in Europe – 2018. EEA Report No. 12/2018. ENN\_Air\_quality\_in\_europe\_report\_2016%20(1).pdf
  16. Land Air Water Aotearoa. Factsheet: Monitoring air quality in New Zealand (14 June 2016). <http://www.lawa.org.nz/learn/factsheets/monitoring-air-quality-in-new-zealand/>
  17. New Zealand Land Transport Authority. National Air Quality Monitoring Network. New Zealand Land Transport Authority, 2016 (October). <http://www.nzta.govt.nz/resources/air-quality-monitoring/>
  18. Health Research Council of NZ. Updated health and air pollution in New Zealand study. Wellington: Health Research Council of NZ, Ministry of Transport, Ministry for the Environment, Land Transport Authority, 2012. [http://www.hapinz.org.nz/HAPINZ%20Update\\_Vol%201%20Summary%20Report.pdf](http://www.hapinz.org.nz/HAPINZ%20Update_Vol%201%20Summary%20Report.pdf)
  19. Ministry of Transport. Motor vehicles crashes in New Zealand 2012. Ministry of Transport, 2012. <http://www.transport.govt.nz/mot-resources/road-safety-resources/roadcrashstatistics/motorvehiclecrashesinnewzealand/motor-vehicle-crashes-in-new-zealand-2012/>
  20. Ministry for the Environment. Nitrogen oxide (NO<sub>x</sub>) emissions. Retrieved 16 June 2019 from: <http://www.mfe.govt.nz/publications/air/emission-inventories-co-nox-so2-ozone-benzene-and-benzoapyrene-new-zealand/4>
  21. New Zealand Four Wheel Drive Annual. Buyer's guide. Auckland: Adrenalin Publishing, 2018, pp.62–86.
  22. New Zealand Four Wheel Drive Annual 2019. Buyers Guide Small SUV. Auckland: Adrenalin Publishing, p.52.
  23. Nissan NZ. Nissan Patrol. (2018). <http://nissan.co.nz/cars-vehicles/patrol/overview>
  24. Automobile Association. Top 10 NZ new vehicles sold in 2018. (4 February 2019). <http://www.aa.co.nz/cars/motoring-blog/top-ten-nz-new-vehicles-sold-in-2018/>
  25. Ministry of Transport. Vehicle fleet statistics (Updated 3 May 2019). <http://www.transport.govt.nz/mot-resources/vehicle-fleet-statistics/>
  26. Ministry for the Environment. Environment Aotearoa 2015. Wellington: Ministry for the Environment, 2015. <http://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2015>
  27. Patel V, Wilson N. Top selling new cars in New Zealand: recent trends in air pollution and greenhouse gas ratings. *N Z Med J* 2012; 125:113–4.
  28. Franko V, Sánchez A, German J, Mock P. Real-world exhaust emissions from modern diesel cars. A meta-analysis of PEMS emissions data from EU (Euro 6) and US (Tier 2 Bin/ULEV II) diesel passenger cars. Beijing, Berlin Brussels, San Francisco, Washington: International Council on Clean Transportation, 2014. (Accessed 23 June, 2019). [http://www.theicct.org/sites/default/files/publications/ICCT\\_PEMS-study\\_diesel-cars\\_20141013.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_PEMS-study_diesel-cars_20141013.pdf)
  29. Cardno S. Three's company. New Zealand Four Wheel Drive Annual. Auckland: Adrenalin Publishing, 2018, pp. 16–24.

30. Linklater D. Acadia: the new Commodore. *Dominion Post* (3 November, 2018), pF1.
31. Holden NZ. Holden Acadia 2018 Range. Holden New Zealand Limited [NZ]. Retrieved 29 November 2018 from: <http://www.holden.co.nz/cars/acadia>
32. Ford New Zealand. Celebrate a great deal at Ford. [http://www.ford.co.nz/offers/?&searchid=aw\\_1050463592\\_60398168135\\_362411861968\\_b\\_g\\_%2B-ford%20%2BBranger%20%2Bwildtrak&gclid=C-j0KCQjw2K3rBRDiARISAOFSW\\_4Wr\\_Mp9P60H-AdP6jYZM1ts7qMC1w-PhBqCg-TIRbNxBfcCtA7SotO4aAo-wEALw\\_wcB&gclsrc=aw.ds](http://www.ford.co.nz/offers/?&searchid=aw_1050463592_60398168135_362411861968_b_g_%2B-ford%20%2BBranger%20%2Bwildtrak&gclid=C-j0KCQjw2K3rBRDiARISAOFSW_4Wr_Mp9P60H-AdP6jYZM1ts7qMC1w-PhBqCg-TIRbNxBfcCtA7SotO4aAo-wEALw_wcB&gclsrc=aw.ds)
33. Ford New Zealand. Energy City Ford Sponsorship. <http://www.energyford.co.nz/Page/121/sponsorship-energy-city-ford-new-plymouth>
34. New Zealand Autocar. YEE-HAW We Go Flying in the Raptor [Cover]. *New Zealand Autocar*, 2018 (September).
35. Stuff. Raptor is brilliant on and off the road. *Stuff Top Cars* (2018, November) p6.
36. Monfort SS, Nolan JM. Trends in aggressivity and driver risk for cars, SUVs, and pickups: Vehicle incompatibility from 1989 to 2016. *Traffic Inj Prev* 2019; 20:S92–S96.
37. Ossiander EM, Koepsell TD, McKnight B. Crash fatality and vehicle incompatibility in collisions between cars and light trucks or vans. *Inj Prev* 2014; 20:373–9.
38. Hu W, Cicchino JB. An examination of the increases in pedestrian motor-vehicle crash fatalities during 2009-2016. *J Safety Res* 2018; 67:37–44.
39. Keall M, Newstead S. Induced exposure estimates of rollover risk for different types of passenger vehicles. *Traffic Inj Prev* 2009; 10:30–6.
40. Ministry for the Environment. About New Zealand's emission reduction targets. (Accessed 11 June 2019). <http://www.mfe.govt.nz/climate-change/climate-change-and-government/emissions-reduction-targets/about-our-emissions>
41. Vehicle Certification Agency. The Worldwide Harmonised Light Vehicle Test Procedure (WLTP). (Accessed 10 June 2019). <http://www.vehicle-certification-agency.gov.uk/fcb/wltp.asp>
42. New Zealand Transport Agency. Exhaust Emissions. 2016. <http://vehicleinspection.nzta.govt.nz/virms/entry-certification/i-and-c/exhaust/exhaust-emissions#up>
43. Ministry of Transport. Vehicle scrappage schemes [Updated 14/2/2019]. Ministry of Transport, <http://www.transport.govt.nz/land/vehiclescrappageschemes/>
44. Wilson N, Horrocks J. Lessons from the removal of lead from gasoline for controlling other environmental pollutants: a case study from New Zealand. *Environ Health* 2008; 7:1.
45. Ministry of Transport. Vehicle fleet statistics (Updated 3 May 2019). <http://www.transport.govt.nz/mot-resources/vehicle-fleet-statistics/>
46. NZ Motor Industry Association. Sales data: Vehicle sales (2018 data). NZ Motor Industry Association, <http://www.mia.org.nz/Sales-Data/Vehicle-Sales>
47. NZ Motor Industry Association. Sales 2018. NZ Motor Industry Association. <http://www.mia.org.nz/Sales-Data/Vehicle-Sales>
48. New Zealand Government. Rightcar. New Zealand Government (Accessed 17 May 2019). <http://rightcar.govt.nz/>
49. Roy Morgan. Readership in New Zealand, 12 Months to December 2018. Roy Morgan (Accessed 25 June 2019). <http://www.roymorgan.com/industries/media/readership/readership-new-zealand>
50. Fisher G, Rolfe K, Kjellstrom T, Woodward A, Hales S, Sturman A, Kingham S, Petersen J, Shrestha R, King D. Health effects due to motor vehicle air pollution in New Zealand [Report to the Ministry of Transport]. Wellington: Ministry of Transport, 2002. [http://www.researchgate.net/profile/Rupendra\\_Shrestha/publication/229139401\\_Health\\_effects\\_due\\_to\\_motor\\_vehicle\\_air\\_pollution\\_in\\_New\\_Zealand/links/09e415122cdf1d-4fae000000/Health-effects-due-to-motor-vehicle-air-pollution-in-New-Zealand.pdf](http://www.researchgate.net/profile/Rupendra_Shrestha/publication/229139401_Health_effects_due_to_motor_vehicle_air_pollution_in_New_Zealand/links/09e415122cdf1d-4fae000000/Health-effects-due-to-motor-vehicle-air-pollution-in-New-Zealand.pdf)
51. Wilson N, Maher A, Thomson G, Keall M. Vehicle emissions and consumer information in car advertisements. *Environ Health* 2008; 7:14.