Before the Selwyn District Council

under: the Resource Management Act 1991

in the matter of: Proposed Private Plan Change 69 to the Operative District Plan: Lincoln South

and: **Rolleston Industrial Developments Limited**
Applicant

Statement of Evidence of Paul Farrelly (Greenhouse gas emissions)

Dated: 4 November 2021

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STATEMENT OF EVIDENCE OF PAUL FARRELLY

INTRODUCTION

1 My full name is Paul Michael Farrelly.

2 I have a BE Civil Engineering (Hons) from University of Canterbury. I started my career as a traffic and road safety engineer, and have subsequently had over 25 years commercial experience working across a number of industries. Over the past 10 years I have worked in the energy and carbon field.

3 In the past 2 years I have worked for Lumen, an engineering consultancy, as a Principal Consultant in their dedicated energy and carbon team. In this capacity I have developed greenhouse gas (*GHG*) inventories for a significant number of organisations, in a broad range of sectors. This includes infrastructure companies, an airport, several electricity distribution businesses (EDBs), manufacturers, consulting firms and retail businesses. Through this work I am well versed in calculating GHG emissions.

4 I am familiar with the plan change application by Rolleston Industrial Developments Limited (*the Applicant*) to rezone approximately 190 hectares of land on Springs Road, Lincoln to enable approximately 2000 residential sites and three small commercial zones.

CODE OF CONDUCT

5 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in Part 7 of the Environment Court Practice Note 2014. I have complied with it in preparing my evidence. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

6 My evidence will deal with the following:

6.1 Greenhouse gas (*GHG*) emissions from existing land use; and

6.2 Future anticipated GHG emissions arising from the proposed plan change.

EVIDENCE

INTRODUCTION TO GREENHOUSE GASES

7 There are several gases that contribute to the problem of global warming, the most prevalent of these being carbon dioxide (CO_2), methane and nitrous oxide.

8 Each of these gases have differing abilities to trap extra heat in the atmosphere, and it is the trapping of this heat that leads to global warming.

9 When evaluating GHG emissions, it is useful to have a common measure in order to allow comparisons between gases.

10 As CO_2 is by far the most prevalent of the GHGs, it is standard practice when measuring emissions to determine the level of each gas emitted, and then convert these emissions into their carbon dioxide equivalent, or CO_2-e.

11 The global warming potential (GWP) of a gas is a measure of its ability to trap extra heat in the atmosphere over time relative to CO_2. This is most often calculated over a 100 year period, and is known as the 100 year GWP.

12 By definition, the GWP of CO_2 is 1.

13 Methane is a short-lived GHG and has a GWP that is 28-36 times that of carbon dioxide over a 100 year time frame. Over a shorter year time frame its impact is much more significant, with its impact estimated at 84 times that of carbon dioxide over a 20 year period.

14 New Zealand has committed to reducing it's GHG emissions substantially. We need to reach net zero long-lived greenhouse gases by 2050, and to reduce biogenic methane emissions 24-47% by 2050, including 10% below 2017 levels by 2030.

15 The government is currently developing it's plan for how these emissions reduction targets will be achieved, and has recently released[1] (in October 2021) an Emissions reduction plan discussion document.

16 This has been heavily guided by advice provided by the climate change commission, in *it's Ināia tonu nei: a low emissions future for Aotearoa* report (June 2021).

[1] Ministry for the Environment. 2021. Te hau mārohi ki anamata | Transitioning to a low-emissions and climate-resilient future: Have your say and shape the emissions reduction plan. Wellington: Ministry for the Environment

17 Key strategies for achieving these targets include increasing the mix of renewables in our electricity generation network, electrification of our vehicle fleet, increasing the proportion of travel undertaken using active travel modes and public transport, and reducing agricultural emissions through a mix of lower herd numbers and technological innovations.

NATIONAL POLICY ON URBAN DEVELOPMENT

18 The National Policy Statement on Urban Development 2020 requires decision makers to consider whether proposals "support reductions in greenhouse gas emissions".

19 When considering the GHG emissions of a proposed development or land change it is appropriate to consider the life-cycle emissions of the proposed development, and the net change in emissions compared to the emissions arising from the current land use.

20 It is notable that the NPS does not specify a geographical boundary in which the effect of greenhouse gas emissions should be considered.

21 Therefore, I consider that supporting reductions in greenhouse gas emissions could be considered at a number of different levels – local, regional, national or global.

22 The ultimate purpose of reducing GHG emissions is to limit global warming. In the context of this purpose, it should not matter where or how emissions reductions are supported.

23 New Zealand has a growing population and a critical need to build more affordable housing.

24 There are many potential ways that this growing population can be accommodated. For instance, dwellings can be built in different locations, different types of housing can be constructed and different construction materials can be used.

25 Due to the materials required to build new housing, and the energy used in the operation of houses, some emissions arising from new developments are unavoidable.

26 Therefore, it is important that decisions on where to build new houses in New Zealand are made in respect of their overall net impact on GHG emissions, compared to other potential locations.

27 In the context of GHG emissions arising from housing related developments, I believe that GHG assessments should be based primarily on the basis of how the development's net life cycle emissions (that is an evaluation of emissions before and after the

development) compares to alternative development options within New Zealand, as opposed to whether the development, in of itself actually reduces GHG emissions.

EMISSIONS FROM EXISTING LAND USE

28 When considering a proposed development's impact on greenhouse gas emissions, it is first important to establish the level of emissions arising from the existing use of the land.

29 I visited the area of PC69 on 25 October 2021. It is largely flat land, with limited tree coverage. Much of the site is an operational dairy farm, and I observed a large number of cows present on the property when I visited the area.

30 The low tree coverage across the site means that there is limited carbon sequestration currently occurring on the land.

31 GHG emissions from the current farming operation have been measured and assessed through Overseer.

32 Overseer is a software package designed for NZ farming operations, that contains a GHG reporting module.

33 I consider that the Overseer model accurately represents the current GHG emissions arising from the farm.

34 Emissions from a dairy farm operation include the following:

34.1 Enteric fermentation – the process by which ruminant animals produce methane by digesting feed;

34.2 Manure management – the storage and treatment of manure produces emissions;

34.3 Agricultural soils – soils emit nitrous oxide due to the addition of nitrogen to soils through manure, dung and urine;

34.4 Fertiliser use – applying nitrogen (urea-sourced or synthetic) fertiliser onto land produces nitrous oxide and carbon dioxide emissions. Applying lime and dolomite fertilisers results in carbon dioxide emissions; and

34.5 The use of energy in operating the farm – fossil fuels used in vehicles and electricity to power cow sheds/irrigators/pumps.

35 The total emissions reported for the farm were 2,194 tonnes CO2-e for the year ended 2020. This excludes any emissions associated with the transportation and processing of milk that occurs once it is collected.

36 To put this into perspective, 2,194 tonnes CO2-e is equivalent to the following:

36.1 8.3 million vehicle kilometres travelled in a typical NZ vehicle (using the MFE's default private car emission factor (2020) per km of 0.265)

36.2 The average annual electricity usage emissions of approximately 2,570[2] Canterbury households.

37 Of the 2,194 tonnes of emissions reported from the farming operation, 1,460 tonnes (67%) of this is methane, which warrants specific attention due to it's greater impact on global warming in the short-term.

38 There is an increasing level of awareness in the scientific community of the need to reduce methane emissions as soon as possible. The recent Intergovernmental Panel on Climate Change (*IPCC*)[3], sixth assessment report makes this clear:

> *"Stabilizing the climate will require strong, rapid, and sustained reductions in greenhouse gas emissions, and reaching net zero CO2 emissions. Limiting other greenhouse gases and air pollutants, especially methane, could have benefits both for health and the climate"*

39 48% of New Zealand's emissions come from agriculture, with the dairy sector a major contributor to this.

40 New Zealand's emissions reduction targets require methane emissions to reduce by at least 10% by 2030 (against 2017 levels), and by 24-47% by 2050.

41 The Climate Change Commission's advice to government identifies three key ways in which methane emissions can be reduced, as follows: land-use change from agriculture to horticulture/forestry; a reduction in dairy cow numbers; ongoing improvements in the emissions efficiency of agricultural production.

42 The proposed plan change would result in a reduction in dairy cow numbers and therefore supports the climate change commission's advice and helps New Zealand towards achieving our required methane reductions.

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[2] The average residential home in Canterbury uses 8,550kWh per annum – per Electricity In New Zealand, 2018. The Electricity Authority.

[3] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group 1 to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

43 This should be taken into account when comparing this proposed development against others, particularly where a development would convert land with currently low or negative emissions (e.g. a golf course, or tree covered area), to housing.

EMISSIONS FROM PROPOSED LAND USE

44 Like any new residential development, GHG emissions will be emitted during three different stages of the project:

44.1 Construction of the infrastructure required to support the development;

44.2 Construction of the dwellings and commercial buildings; and

44.3 Emissions arising from the occupation of the dwellings and businesses operating out of the commercial buildings – primarily these emissions relate to energy use.

45 Emissions will also arise from travel related activities of residents who live within the blocks.

46 In terms of GHG emissions from infrastructure work (i.e. prior to the construction of the houses):

46.1 The site is relatively flat which limits the amount of earthworks required and therefore the amount of fossil fuels that will be used in preparing the site for development.

46.2 Some soil may need to be removed from the sites, however given the cost of disposing soil, I expect there will not be unnecessary removal of soil from the site.

46.3 In terms of materials for infrastructure, there is currently limited scope to avoid the use of greenhouse gas producing construction materials, however lower emissions materials are being developed all the time, and it is likely that by the time development commences some lower emissions materials could be specified by the developer.

46.4 The bulk of materials required in the development are anticipated to be roading related (concrete/asphalt) and piping.

46.5 The amount of infrastructure related materials required for a new housing development is primarily a function of the hectares to be developed rather than the number of dwellings.

46.6 In other words, the amount of roading, streetlighting, piping, fibre etc required does not depend so much on the number of houses, but rather the area that is to be developed.

46.7 From an infrastructure emissions intensity perspective (that is the emissions per resident), there is a real benefit in increasing the density of housing in a development, and with the PC69 development having a housing density of 12 houses/hectare I consider it's infrastructure will be relatively emissions efficient. However this could be further improved were the density increased to 15 houses/hectare.

47 The second major component of GHG emissions is the emissions associated with construction of the dwellings. The major contributing factor is the emissions that are "embodied" in materials that are used in the build.

47.1 Embodied carbon relates primarily to the energy used to create the building materials. Examples of materials with high embodied carbon are concrete and steel, compared to timber which has comparatively low embodied emissions.

47.2 There are two main ways of reducing embodied carbon in a dwelling: 1) build dwellings using lower-carbon materials, 2) reduce the size of a dwelling.

47.3 A recent (2020) study undertaken by Massey University and BRANZ[4] assessed the expected life cycle emissions for 3 different types of residential dwellings: detached housing, medium-density housing and an apartment.

47.4 A lifecycle analysis takes into account the emissions expected to be emitted across the various life stages of the development – this includes construction, operation and end of life treatment.

47.5 The study considers that a New Zealand home is expected to last for 90 years and the analysis should therefore consider emissions across this timeframe.

47.6 Key conclusions from the study were that the product stage (embodied carbon) is responsible for 16% of the life cycle emissions, with operational energy use responsible for 59%.

[4] Application of Absolute Sustainability Assessment to New Zealand Residential Dwellings - S J McLaren *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* 588 022064

47.7 Embodied carbon was relatively more significant for apartments, due to the greater use of high emissions materials such as concrete and steel in construction.

47.8 On a per m2 basis, across a 90 year period, the lifetime emissions are highest for apartments (21 kg CO2-e/m2/yr) compared to lifetime emissions for detached housing and medium density housing (13 kg CO2-e/m2/yr)

47.9 As multi-story apartments are unlikely to be built in the proposed plan change sites, I consider that the embodied emissions resulting from the type of dwellings envisaged on the plan sites to be relatively efficient from a GHG perspective.

48 Noting that emissions are also largely a function of dwelling size, it is important to consider the size of dwellings that would likely be built if the plan change is approved.

49 The plan provides for variable lot sizes, with the majority of the plan change area to be zoned Living Z. This zone provides for variable lot sizes, including Low Density (average allotment of 600m2 and minimum 500m2), Medium Density Small-lot (average of 500m2 and minimum 400m2), and Medium Density Comprehensive (maximum 350m2 with no minimum)

50 It is reasonable to expect that, on average, smaller houses would be developed in the medium density zones. It is also reasonable to assume that significantly larger houses, such as those built in low density zones, would not necessarily accommodate more people.

51 As such, the emissions per resident can be reduced by ensuring a higher density of dwellings is allowed for, with smaller section sizes.

52 When it comes to emissions from operational energy use, the main factors that influence this are 1) how energy efficient a dwelling is, 2) the type of energy that is used in the dwelling (electricity, LPG), 3) the size of the dwelling and 4) the use of on-site renewables (e.g. solar PV).

53 Emissions in PC69 can be minimised by encouraging[5] energy efficient homes to be built, ensuring that natural gas/LPG infrastructure is not provided as part of the development and encouraging the uptake of solar PV panels.

54 New homes offer the potential to be much more energy efficient than traditional NZ houses, due to better building materials, higher

[5] Rules mandating such requirements are not proposed, however they can be readily encouraged or promoted by the land developer and or home builders

levels of insulation and the ability to design homes to maximise thermal (or solar) gain.

55 There is growing awareness of the value of passive houses and I expect to see an increased uptake of these type of homes in the coming years. A passive home is one that is primarily heated passively (via the sun and heat recovery), oriented to optimise solar gains in winter and to prevent overheating in summer. Passive houses target energy use of around 25 kWh/m^2. For an average sized (180 m^2) passive house, energy use would be expected to be just 4,500kWh per annum, which equates to approximately 450 kg CO2-e per annum at current grid emissions factors. As NZ's electricity grid becomes increasingly renewable these emissions can be expected to reduce to around 250 kg CO2-e per annum[6] in 2030. Note that emissions from energy use are largely carbon dioxide, with little methane emitted in electricity generation.

56 An ideal site for passive design is a flat site, that is free of obstructions to the north and unlikely to be built out in future.

57 As such I consider the sites in PC69 to be ideal for passive house construction.

58 I also consider that the site is well suited for solar PV due to the flat nature of the land and the relative lack of existing trees within the area.

59 Furthermore, as apartments are unlikely to be built in the proposed plan change sites given the applicable Living Z rules, most houses are expected to be detached or semi-detached, and I would expect there could be a relatively high uptake of solar.

60 Taking these factors into account, I expect that dwellings built in PC69 sites would be relatively energy efficient compared to other developments and consequently would have relatively low emissions per resident.

EMISSIONS FROM TRANSPORTATION

61 Emissions from transportation are a function of mode of transport (i.e. vehicle type), distance travelled, and frequency of travel.

62 Emissions from transportation primarily arise from trips undertaken in vehicles that use fossil fuels, and in New Zealand this primarily means passenger vehicles.

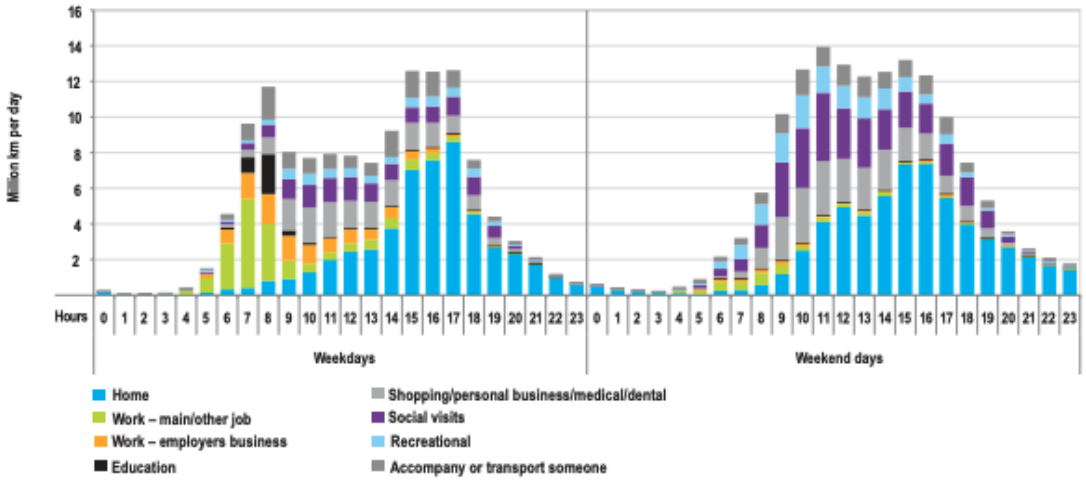
[6] Modelling recently released by The Climate Change Commission and used in *Inaia tonue nei: a low emissions future for Aoterora*, estimates a grid emissions factor of 55.1g CO2-e/kWh in 2030. The 2018 grid emissions factor is 101 g CO2-e/kWh.

63 It is extremely difficult to accurately model or predict the level of travel related emissions that may occur from residents of any proposed development, and indeed how these may compare to the travel related emissions of an equivalent group of residents in any other location.

64 The most comprehensive data for the types of trips that people undertake in New Zealand is provided by the Ministry of Transport.[7]

65 The following chart from that study shows the average distances travelled per day for different purposes:

Figure 12: Average distance per day by purpose and time of day (2010–2014)



66 This shows that on average, people travel further on weekend days (per day) than they do on weekday days, so the relative influence of commuting on overall travel emissions may be less than is commonly assumed.

67 It is reasonable to assume that many "high frequency" trips are made to the most conveniently located destination for the purpose of the trip (e.g. nearest dairy/takeaway outlet/café) whereas trips to "destination" locations – such as heading to a larger supermarket for a weekly shop occur relatively less frequently.

68 The proposed plan change development is on the fringe of Lincoln, however it is located approximately as close, if not closer to, the centre of Lincoln as other greenfield land in the area such as Flemington and Rosemerryn.

[7] Ministry of Transport. (2015). 25 Years of New Zealand Travel: New Zealand Household Travel 1989-2014.

69 I consider that Lincoln's commercial centre is currently the area centred around the large New World supermarket. This area also includes cafes, a pharmacy, a petrol station as well as a number of takeaway outlets and a liquor store. This is likely to be the area within Lincoln that currently attracts the most local 'day-to day' type trips.

70 This area is located approximately 2.5km from the centre of the PC69 area, which although relatively close, is likely too far away for residents to travel to it using active modes. However, this is no different to how the vast majority of trips to supermarkets (and the like) currently occur within the Christchurch urban area, so I don't see this as a key issue.

71 From an emissions perspective, it is encouraging that commercial areas have been incorporated into the ODP. This would allow residents to use active travel modes to access some key day-to-day services such as a cafe.

72 I note that the PC69 proposal has been amended to include two additional small commercial areas on top of the one initially proposed. This is encouraging as they are likely to meet the convenience needs of a greater number of residents, which would reduce the need for them to travel using non-active modes.

73 The proposed locations of the additional commercial areas will service both the west and east ends of the proposed development. In my view, this will ensure good connectivity with the Te Whariki and Verdeco Park subdivisions, would also potentially result in reduced convenience travel emissions from residents in these subdivisions.

74 The tenancies in the commercial areas will likely be self-selected, accounting for their likely desirability and convenience to nearby residents. For example, tenancies such as a day care centre, a café, a convenience store and potentially takeaways would likely be well utilised by the residents of the development and mitigate the need for travel further to other destinations.

75 Active travel to the commercial areas can be encouraged by ensuring strong pedestrian and cycleway connectivity and secure facilities for bikes (e.g. somewhere to lock a bike). I note the proposal now includes additional cycle connections east-west to join the two new proposed centres.

76 Overall transport emissions from PC69 could also be mitigated to an extent by ensuring that the highest density zones within the development are located as close to the commercial area as possible. This would ensure that as many residents as possible live within close proximity to the commercial area. In my view, the

proposed amendment adding two additional smaller commercial centres addresses this.

77 An issue of the proposed development, in terms of travel related emissions, is the distance to schooling, and especially to the nearest high school, with Lincoln High school located on the North side of town.

78 I understand that Lincoln high school is already at or near capacity and therefore were Lincoln to grow substantially, as envisaged by this plan change then a second high school would likely be required within Lincoln.

79 Travel related emissions could be mitigated significantly were the high school to be located within, or close to, the PC69 development, with active travel modes to the school well developed.

80 In terms of commuting trips:

80.1 The Christchurch City Council submission mentions that 39% of residents in Lincoln East travel into Christchurch for work or school. Other submissions note that people in Lincoln typically work in either Rolleston or Christchurch.

80.2 At the present time I understand there to be relatively limited employment opportunities within Lincoln, however I would expect that in time, as Lincoln grows, that more businesses will choose to base themselves within Lincoln.

80.3 This trend would be accelerated were the development to go ahead.

80.4 However, even if more employment opportunities in Lincoln were available, it is still likely that Christchurch and Rolleston will remain the major employment centres for Lincoln residents.

80.5 The road distance from 1491 Springs Road to the centre of Rolleston is approximately 11.5km, while the distance to central Christchurch is approximately 23km.

80.6 I agree with those submitters who have suggested that this distance is too far for people to cycle, and therefore commuting will be undertaken by either private vehicle or public transport.

80.7 It is worth noting that future commuting emissions are likely to be mitigated somewhat by an increase in working from home, which will substantially reduce the frequency of commuting.

80.8 The experience of Covid-19 has shown that a significant proportion of workers are able to perform their duties from a home office. I note that many large employers now offer employees significant autonomy and flexibility when it comes to where and when they choose to complete their work duties.

80.9 I expect that working from home, on one or more days a week will become standard practice for a large number of NZ employees.

80.10 I expect that Lincoln would have a higher proportion of working from home than average, due to the following factors

(a) The incentive to work from home is greater for employees who live further from their place of employment, due to the time and cost savings.

(b) Working from home will likely be even more attractive to those who live in a new, well-built warm home.

(c) It is therefore highly likely that residents of the PC69 development who work in a Christchurch office will be strong adopters of working from home.

(d) Working from home can be supported by ensuring that there is robust broadband conectivity provided to the developments, which I expect will be provided.

81 When it comes to commuting transport mode, it has been mentioned by many submitters that the bus network is currently relatively limited.

82 There have been a number of suggestions from submitters that the bus network needs to be improved if the development is to go ahead, and I support these sentiments.

83 Given the relative scale of the proposed development and it's impact on the population of Lincoln (an expected 69% increase in population), the development should be the catalyst for discussions about an improved bus service.

84 This might include extending bus routes to access more of Lincoln, provision of bike storage facilities in the centre of Lincoln to encourage "bike and ride", and allowing commuters to easily travel with a bike or scooter such that they can more easily access destinations within Christchurch City or Rolleston.

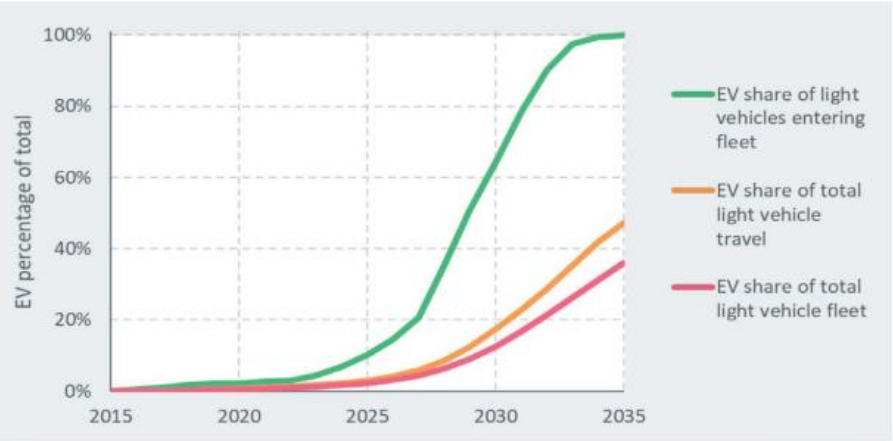
85 However, even with an improved bus network, it is likely that a majority of trips that occur between Lincoln and

Christchurch/Rolleston will continue to be undertaken in passenger vehicles.

86 Efforts could be made to encourage car-pooling wherever possible, and ride-share technology is likely to more easily enable this in future.

87 Over the life-time of the development, an increasing proportion of trips will be undertaken in electric vehicles, which have around 90% lower emissions (per km) than equivalent internal combustion engine vehicles

88 The climate change commission anticipates that by 2030 (when the PC69 site is likely to have been fully developed), 20% of all light passenger vehicle travel will be in electric vehicles, and by 2035 this will have increased to 46%. The following chart from *Ināia tonu nei* (page 123) illustrates this.



89 The government's emission reduction plan consultation document is slightly less bullish on EV uptake, but still anticipates that 30% of vehicles in the fleet will be electric by 2035 (vs 37% of vehicles in the climate change commission's advice).

90 I would expect the uptake of EVs to be much faster in a location like Lincoln than in other locations within New Zealand.

90.1 My rationale is that the round-trip commuting distance between Lincoln and central Christchurch, at approx. 45km, is close to the ideal distance to maximise EV uptake.

90.2 Research[8] indicates that two of the biggest barriers to EV adoption in NZ are the cost of EVs and range anxiety.

[8] Ministry for the Environment. 2018. *Reducing barriers to Electric Vehicle uptake: Behavioural insights analysis and review*

90.3 With regards to the cost of EVs:

(a) On average, a second hand EV costs between $5-10k more than a comparable Internal Combustion Engine (ICE) vehicle.

(b) Countering this, the annual running cost of an EV is much lower than a petrol/diesel equivalent, due to the lower cost of electricity. Furthermore the recently introduced clean car discount makes the up-front cost of EVs relatively lower.

(c) The Energy Efficiency and Conservation Authority (*EECA*) calculates that for an average NZ vehicle (that travels 11,000km per annum) the annual fuel savings of an EV are $1,460.

(d) The level of savings increase as a vehicle travels further. Therefore, it stands to reason that the economic incentive for purchasing an EV is much greater for drivers who have a greater travel need, such as commuters between Rolleston and Christchurch.

91 A second major barrier to EV uptake is range:

91.1 Due to its more affordable price (compared to other EVs) and availability, the most commonly purchased 2nd hand EV in NZ is currently a Nissan Leaf (2011-2016 models).

91.2 Leafs make up 50% of current EVs in NZ, and most of these have a 24 or 30kWh battery.

91.3 I consider that Leafs will continue to be the most commonly purchased 2nd hand vehicles for at least the next 3-5 years.

91.4 I expect that in the near-term employers will not be providing EV charging facilities (at work) for employees.

91.5 Therefore in the next 3-5 years, an EV owner will primarily need to charge their vehicle at home, or at public charging stations.

91.6 The anticipated range for a 2011-2016 Nissan Leaf is between 120-170km (using the EPA measure). The average range across these models is 145km - assuming travel on flat terrain.

91.7 Assuming a level of battery deterioration of 80% after 5 years - a 2nd hand leaf can be expected to have a "safe range" of 145*.8 = 116km.

91.8 Ideally batteries should only be charged to 80% in order to maximise their lifetime.

91.9 80% *116km = 93km, so this gives a maximum daily range of 93km for a 2nd hand leaf.

91.10 Given that commuters may need, at times, to undertake errands on the way to (or more likely) from work, an additional distance of 10km into the commute should be factored in.

91.11 In my view, the maximum 2-way commuting distance for a Leaf would be 83km (93-10) before a purchaser would need to upgrade to a vehicle with a larger battery, which would have a much higher purchase price.

91.12 A higher purchase price is likely to act as a significant deterrent and would be expected to put off many potential be EV buyers.

91.13 Therefore I consider that the optimal daily commute distance (one-way) for maximum EV uptake is between 20-40km.

With a distance of approx. 23km from the PC69 site to the centre of Christchurch, assessed as the location of the Riverside market (daily round trip 46km), it is reasonable to expect that there will be a high uptake of EVs in the proposed development area.

92 Passenger vehicle emissions arising from PC69 can be minimised by encouraging[9] electric vehicle uptake, through measures such as ensuring that new houses are electric-vehicle ready (for instance through ensuing adequate provision of electrical capacity to allow for time efficient at-home charging).

93 EV charging infrastructure can also be provided for in the proposed commercial areas.

94 Early engagement with Orion, to ensure that adequate electrical capacity is provided for each stage of the development to allow for vehicle charging, is encouraged.

RESPONSE TO SUBMISSIONS

RESPONSE TO SECTION 42A REPORT

95 I have reviewed the report produced by Mr Boyes and I make the following comments:

[9] Rules mandating such requirements are not proposed, however they can be readily encouraged or promoted by the land developer and or home builders

95.1 If it is determined that the eastern end of the PC69 site is not suitable for residential development, then I would advocate for the housing density of the remaining land to be increased, such that approximately the same number of properties as envisaged in the submission (2,100) can be developed as part of PC69. This will ensure the most efficient outcomes from an emissions/resident perspective. The Eastern side of the development should ideally also be planted in native trees to foster long-term carbon sequestration.

95.2 I concur with Mr Boyes that the proposed commercial area appears to be small, and note that the revised ODP includes provision for two additional commercial centres. In my view, this adequately addresses Mr Boyes' concerns.

95.3 Mr Boyes' highlights the concerns of several submitters and the Ministry of Education about the additional pressures that PC69 will place on existing schools. I understand from discussions with the submitter that some engagement with the MoE has already occurred. Locating a school within or near to the area of PC69, with good active mode connectivity, would have a positive effect on transport related emissions.

RESPONSE TO SUBMITTERS

96 I have reviewed those submissions where mention of GHG emissions has been made. As many of the comments made by submitters are similar, I have not referred to any specific submissions in this evidence, however I believe I have considered all points of significance that have been raised.

CONCLUSIONS

97 The proposed plan change supports greenhouse gas emissions reductions as it will result in a reduction in emissions from the existing dairy farm. These emissions are primarily methane, which has a substantially greater impact on global warming in the short-term than Carbon dioxide.

98 The form of housing and related infrastructure envisaged to be developed on the site is relatively efficient from a GHG emissions perspective, particularly on an emissions per resident basis.

99 Travel distances to key facilities are likely to be similar (or less) compared to alternative residential development sites within the Selwyn District.

100 Commuting related emissions are expected to be similar compared to alternative residential development sites within the Selwyn District. These emissions will reduce over time as people more

regularly work from home, and as electric vehicle travel becomes the predominant form of light vehicle travel in New Zealand.

101 Commuting related emissions (to Christchurch and Rolleston) could be further reduced by way of an improved bus network – likely enabled through the plan change by way of a resultant larger population in Lincoln, or through ride-sharing initiatives.

Dated: 4 November 2021

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Paul Farrelly