He Pou a Rangi
Climate Change Commission

Official Information request reference: 2021-006

5 March 2021

Email: [redacted]

Dear [redacted]

Thank you for your Official Information Act 1982 request, received on 5 February 2021 for the following:

> *"…all models used by the Commission in preparing the consultation material published on 31st January 2021".*

In addition to the above, you asked a series of questions relating to the Commission's draft advice on emission budgets and evidence of 31 January 2021. You indicated that you were happy to receive responses to these questions once they were completed (i.e. outside the confines of the Act). Some of these questions were subsequently clarified and/or modified following conversations between you and [redacted] on Friday 19 February 2021 and in subsequent email correspondence.

Some questions were also addressed, or partially addressed, by the Chair, Chief Executive and Team Lead - HIP at the [redacted] meeting on the 24 February 2021.

The Table below lists these questions in their original form. The Table does not outline the supporting context you provided in your request. This is provided as Attachment 1.

Question	**Original request (5 February)**
1.1	*Please provide a list of all models used and the status as to if, and if so when, the Commission propose to publish them*
1.2	*Please provide in spreadsheets, or easy to use tables, all datapoints for the text tables, graphs, charts, and other material metrics and reported results in the draft advice and evidence published for consultation and subsequent zoom and other public presentations.*
1.3	*Can the Commission provide transcripts of all public zoom presentations including Q&A?*
1.4	*Can the Commission establish a webpage with questions from interested parties and the written response from the Commission?*
2.1a	*Has the Commission a tolerance on the accuracy of Figure 5.1 e.g., +/- 50% or +/- 100% etc that they are comfortable with and so consider that they have modelled the electricity price adequately provided they are within this unpublished tolerance?*
2.1b	*If the Current Policy Reference case and scenarios tested were adjusted so that the near-term price path reflected futures market prices, then how would that change the Commission's emissions budgets and recommendations?*

2.1c	*What carbon prices have been included in the electricity price modelling and specifically has the price trend from Figure 8.2 in Evidence Chapter 8 been applied?*
2.1d	*What is the effective C-price impact as a percentage of the wholesale costs illustrated in Figure 5.1? Alternatively, please provide the Carbon $/MWh impact across the 2021-2035 period.*
2.1e	*What is the assumed gas price with and without carbon costs across the time-period?*
2.2a	*Is the CCC suggesting another government agency become involved or are there gaps in the regulatory governance of electricity distributors by the Commerce Commission or Electricity Authority?*
2.2b	*Has the CCC identified any gaps or additional aspects not covered by decisions from the EPR?*
2.3a	(Refer necessary action 7, Reduce emissions from process heat: Recommendation a. "Urgently introducing regulation to ensure no new coal boilers are installed.") *We want to understand the CCC rationale for making this recommendation. For example, has the CCC identified a risk that parties may build new coal boilers and that there are no other policy levers that can be considered other than recommending a ban. If so, can we see that analysis. If there is no analysis, then is this recommendation virtue signalling?*
2.3b	*In either case can we have all the analysis the Commission has considered before making these recommendations?*
2.4	(Refer necessary action 9, Increase energy efficiency in buildings, recommendation c6:) *Please provide the analysis or reference supporting this statement* and *Please provide the analysis the Commission considered relating to this recommendation.*
3.1a	*Please provide the new and replacement capital investment and early retirement (i.e., earlier than the end of the economic life of existing assets) for each year to 2050 assumed for the Current Policy Reference scenario and every other scenario considered by the Commission for:* • *Electricity transmission.* • *Electricity distribution.* • *Gas transmission.* • *Gas distribution.*
3.1b	*For each of the above infrastructure sectors for year* and *each scenario, please provide:* • *The assumed operating and maintenance costs.* • *The assumed volumes transported, and relevant units used (flow and or peak).*
3.1c	*Please provide any material or consideration made to the treatment of regulated monopoly assets stranded by the Commission's recommendations.*
3.2	*Has there been any consideration of the impacts on profitability of EITE firms, emission budgets or wider economic impacts in the modelling?*
3.3	*Is there a report, or chapter in the Commissions reports, or model that tabulates the biomass pathway to 2035 by regional locality?*
3.4	*Has the Commission undertaken a probability analysis of sector pathways being met taking into account the uncertainty of human reactions or economic hardship decisions driving behaviour?*
4.1	*Please provide a reconciliation of the estimates of the effect on GDP in 2035 compared to the Current Policy Reference between the text in the draft advice (pe87) with table 12.2 of the Evidence Chapter 12.*

4.2	*Could you please provide a description by industry as modelled in C-Plan of the new technologies adopted and the switch in energy use preferably at 5-year intervals starting from 2020. If this cannot be supplied quickly, then at 2017, 2025, 2030, 2035 and 2050 – the years reported in "Table 12.2: GDP projections from the Commission's C-PLAN modelling ($ billion)" (Chapter 12 p7).*
4.3	*Could you please explain what modelling approach led to the different assumptions for the scenarios "Table 12.1: The key assumptions used in each of the scenarios run in C-PLAN." (Chapter 12 p5-6) delivering almost identical GDP growth paths in "Table 12.2: GDP projections from the Commission's C-PLAN modelling ($ billion)" and provide data on the share of GDP by industry as modelled in C-Plan.*

In terms of your request made under the Act for *…all models used by the Commission in preparing the consultation material published on 31st January 2021*, we can inform you that the following models were used: C-PLAN, DIM-E, ENZ and EMarket.

The Commission fully intends to make the C-PLAN, DIM-E and ENZ models publicly available. When contracting the development of these models, we specified a requirement for them to be open source with supporting documentation on how the models work. These contracts have not yet been concluded.

Given that the work on the open source versions and documentation has not been completed yet, we are refusing your request for these models under section 18 (d) of the Act as the information requested is or will soon be publicly available.

In releasing our draft advice for consultation, we are not consulting on our models. Our consultation is focused on the areas required under the Climate Change Response Act (2002). Acknowledging the interest in the models, we have made a range of information publicly available. The models have gone through internal quality assurance processes, had input and review from the Commission's modelling reference group, and been independently peer reviewed by international experts and Aotearoa specialists. They have been described as fit for purpose by the reviewers. These reviews and further information are available on the Commission's website here: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/

As part of responding your request, we have considered the public interest in whether the information could be made available before the completion of the contracted work. Unfortunately, C-Plan, DIM-E and ENZ currently include information that is commercially sensitive, proprietary, and/or provided to the Commission in confidence. As such, the Commission is withholding this information under the following sections of the Act:

- 9(2)(b)(2) - would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information
- 9(2)(ba)(i) protect information which is subject to an obligation of confidence or which any person has been or could be compelled to provide under the authority of any enactment, where the making available of the information— would be likely to prejudice the supply of similar information, or information from the same source, and it is in the public interest that such information should continue to be supplied.

EMarket is a propriety electricity market model owned by EnergyLink. As such, the Commission is withholding this information under the following sections of the Act:

- 9(2)(b)(2) - would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information
- 9(2)(ba)(i) protect information which is subject to an obligation of confidence or which any person has been or could be compelled to provide under the authority of any enactment, where the making available of the information— would be likely to prejudice the supply of similar information, or information from the same source, and it is in the public interest that such information should continue to be supplied

Whilst we are unable to release the C-PLAN, DIM-E and ENZ models at this stage, the Commission has made every effort to ensure relevant information is available on our website. In line with other government agencies, our

modelling assumptions, inputs and results are available and can be accessed here: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/

We have run a number of sessions with stakeholders on the models, the assumptions and the draft advice. We are also, on an ongoing basis, responding to specific questions on the modelling and the results raised by stakeholders as we have done in Attachment 1.

We believe there is sufficient information available to allow for informed submissions on the draft advice. We anticipate the open source versions of the models, with supporting documentation, will be ready for release between June and the end of July 2021. We will be in touch with you when this information is available.

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

In terms of your questions relating to the Climate Change Commission's (the Commission) draft advice on emission budgets and evidence of 31st January 2021, a full response has been attached to this response letter (Attachments 1 and 2).

Please note that the Commission has a policy to proactively release OIA responses to help others have access to more information. Consequently, this letter will be published on our website with your name and contact details redacted to protect your privacy.

Kind regards

Jo Hendy
Chief Executive
Climate Change Commission

Attachment 1 - Answers to 5 February 2021 Questions from the [redacted]

Please note, many of your questions refer to decisions and recommendations. The Commission is still in the process of making decisions on the final advice. Following feedback over consultation on the draft advice, we will be reassessing the draft recommendations. The Commission will only provide advice on the direction of the emissions reduction plan policy development and decisions sit with government.

1. Process questions

Question 1.1 - *Provide a list of all models used and the status as to if, and if so when, the Commission propose to publish them.*

Answer - Please refer to the answer provided in the response letter.

Question 1.2 - *Please provide in spreadsheets, or easy to use tables, all datapoints for the text tables, graphs, charts, and other material metrics and reported results in the draft advice and evidence published for consultation and subsequent zoom and other public presentations*. We acknowledge that the Commission announced yesterday a suite of material will be published that may in part of whole meet this request. *Could you please advise all interested parties when this material will be published so parties can effectively manage our time and resources?*

Answer - This request/question was addressed in conversations between [redacted] and the Climate Change Commission (the Commission - Team Lead, Heat, Industry and Power) on Friday 19 February 2021 and in subsequent emails.

In summary, the following was discussed and agreed to:

- data that underpins the charts created by the Commission in the advice report has been released and can be accessed here: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/
- [redacted] would ask [redacted] bers to identify any Commission-created charts in the Evidence report that they would like the data for, and the Commission will provide the information as soon as possible.
- The datasets published by the Commission should provide the underlying data for every figure and number in Evidence report chapters 7-9 and 12-13 (i.e. all the scenarios and impacts content).
- Numbers have been provided for each figure in chapters 12 and 13 in the C-PLAN and DIM-E results datasets. This was not done for chapters 7-9 because of the great number figures contained in these chapters, but everything there should be replicable from the ENZ scenarios dataset provided.
- The Commission is happy to provide help if members need assistance finding the information they want in the datasets.
- Finally, it was agreed that [redacted] would ask members to identify any Commission created charts members have seen in any public zooms, presentations or any other forum and they wanted data for - the commission is committed to provide this data.

Question 1.3 - *Can the Commission provide transcripts of all public zoom presentations including Q&A?*

Answer - This question/request was addressed in conversations on Friday 19 February 2021 and subsequent email correspondence between [redacted] and [redacted]. It was agreed that the Commission currently does not have capacity to do this (i.e. provide transcripts) but that further thought will be given to the desirability of this for future consultation events.

Question 1.4 - *Can the Commission establish a webpage with questions from interested parties and the written response from the Commission?*

Answer - The Commission has a Frequently Asked Questions (FAQ) page https://www.climatecommission.govt.nz/get-involved/faq/ and is happy to receive any feedback from [redacted] on any missing questions.

2. Electricity and gas sector questions

Question 2.1 - Refer Figure 5.1 "In our modelling path, wholesale electricity prices in Aotearoa decrease and then return to close to 2021 levels by 2035. The shaded area shows the range between the maximum and minimum price for different regions." Note:

- The Commission's modelled price range in 2021 to 2023 is more than 30% less than current observed futures prices. Put another way, observed market expectations from futures prices are more than 40% higher than the Commission's estimates.
- The Commission assume for the Current Policy Reference that the Tiwai Point Aluminium Smelter closes in 2023. Figure 5.1 shows wholesale prices falling before that date. Unless there is an assumed retirement of large generation plant and or significant new generation entering the market before that date, we would expect prices based on the current offer behaviour and market structure to remain at materially higher levels than in Figure 5.1. [redacted] view aligns with the above bullet point on observed futures market prices.

To understand the outputs in Figure 5.1 we need access to the models including demand forecasts and assumptions about the construction of generation capacity.

[redacted] questions are:

Question 2.1a - *Has the Commission a tolerance on the accuracy of Figure 5.1 e.g., +/- 50% or +/- 100% etc that they are comfortable with and so consider that they have modelled the electricity price adequately provided they are within this unpublished tolerance?*

Answer – Please refer to the cover letter in relation to the models.

The wholesale electricity price path shown in the referenced figure is from the complementary electricity market modelling that we undertook using Energy Link's E-market and I-Gen models. The purpose of this modelling was to gain insight into the market pricing and generation build that our electrification scenarios would entail and to validate the more simplified electricity market modelling approach undertaken in ENZ. The electricity demand paths for the Headwinds and Tailwinds scenarios (as of November 2020) from ENZ were used as inputs for the Energy Link modelling piece. These inputs are available on our website (see link below). This tailwinds scenario model result was used for the price commentary provided for the Central Pathway as the growth in demand was judged sufficiently similar so as to not warrant a unique model run.

The price modelling is not intended to be a short-term price forecast, but rather a projection of what could occur in a particular electrification scenario based on explicit assumptions around emissions, generation and fuel costs. If the assumptions around these costs are incorrect, or the market

operates in a manner not consistent with what has been modelled, then these costs will differ from those actually observed in the market. We undertook this modelling in November 2020. It is fair to say that the recent or current market conditions, which combine a tight gas situation and low hydro storage, have not been reflected in the model and therefore the modelled market prices are not accurate while this condition persists.

We have undertaken a sensitivity analysis around future gas prices for the projected electricity system in 2029, but for a scenario with a lower level of electrification than that shown in figure 5.1. We explored what we considered to be an upper bound on wholesale gas prices. The results of this sensitivity analysis are available in the Electricity Market Modelling Presentation available on our website. Data and modelling » Climate Change Commission (climatecommission.govt.nz)

Question 2.1b - *If the Current Policy Reference case and scenarios tested were adjusted so that the near-term price path reflected futures market prices, then how would that change the Commission's emissions budgets and recommendations?*

Answer - This has not been modelled.

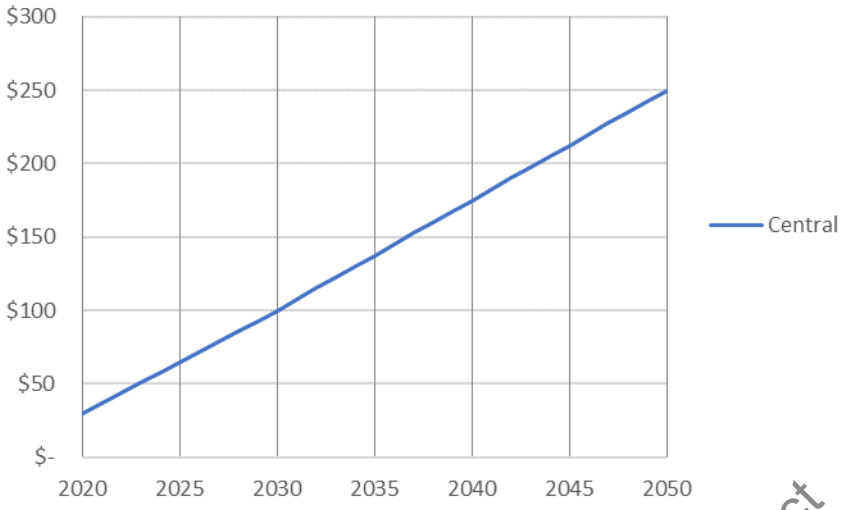
We note that the transition to a low carbon Aotearoa depends on the uptake of long-lived capital assets and expect that investment decisions will be made with an outlook beyond short-term price expectations. We have noted in the Advice to that is it critical there is affordable, abundant, low emissions and secure electricity to ensure that the transition to a low emissions economy takes place. Specifically 'Necessary Action 5' makes draft recommendations pertinent to this.

Question 2.1c - *What carbon prices have been included in the electricity price modelling and specifically has the price trend from Figure 8.2 in Evidence Chapter 8 been applied?*

Answer - The price path shown in figure 8.2 on page 8 of chapter 8 in the evidence report corresponds to an 'emissions value' - this is a modelling construct used in ENZ and is not intended to correspond directly to an ETS setting. The 'emissions value' does not equate to a forecast of the NZU price. The emission value rises within the ENZ model to trigger the uptake of abatement measures. These actions could however be encouraged through a mix of emissions pricing and other policies.

The emissions price path used as an input for the Energy Link electricity modelling is not exactly equivalent to the emissions value path in figure 8.2, although the starting and finishing points are the same. The path is shown in the figure below. This emissions price is the cost of emissions applied to gas, coal, diesel and geothermal generators within the model – i.e it is modelled as if it was an ETS within the Energy Link setting. However, it is likely that that the actual NZU price would be lower than this in the future, depending on the extent to which the Government adopts complementary policies as we have recommended. The more that complementary polices are driving actions to reduce emissions, the more likely it is that the NZU price will be lower. We do anticipate the NZU price would follow an overall upwards trajectory however we have not provided a forecast.

Model emissions value ($/TCO2)



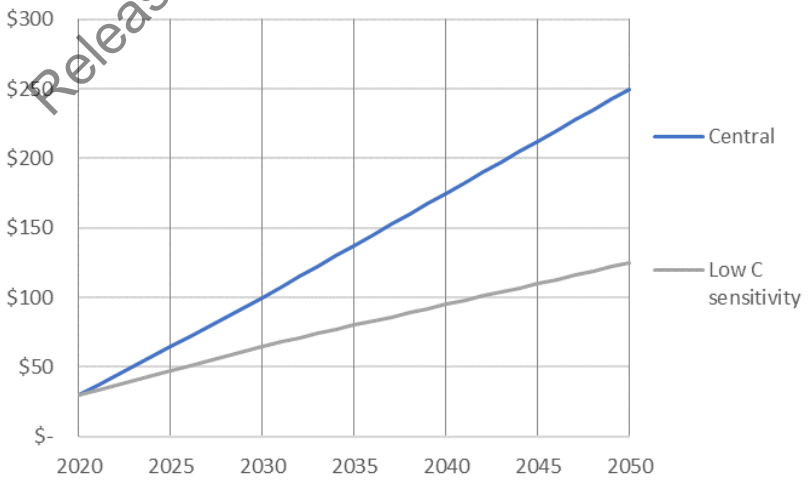
As part of the electricity market modelling done using the Energy Link modelling tools, a lower emissions pricing path was also tested as a sensitivity. This is included alongside the model inputs and summary result files on the Commission's website.

Question 2.1d - *What is the effective C-price impact as a percentage of the wholesale costs illustrated in Figure 5.1? Alternatively, please provide the Carbon $/MWh impact across the 2021-2035 period.*

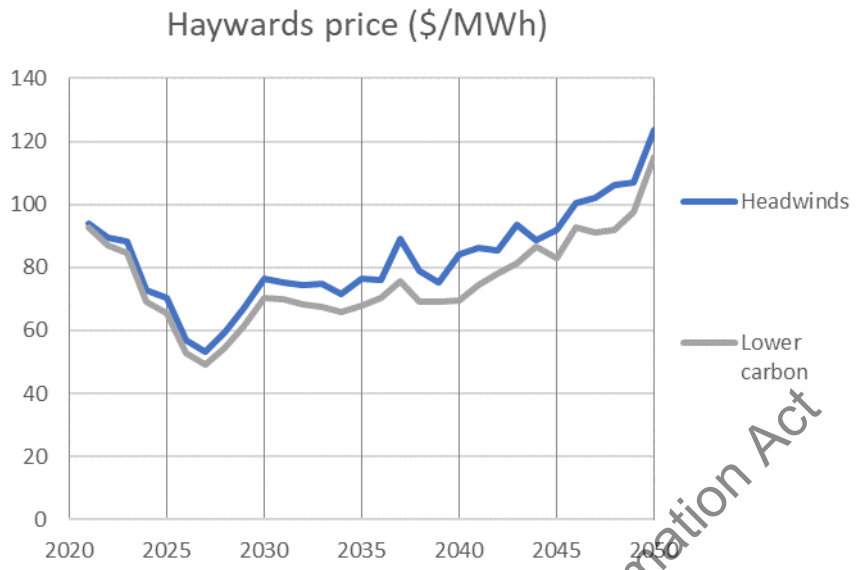
Answer - Please see previous answer on emissions price.

The emissions value impact was tested through sensitivity analysis of the modelled headwinds scenario using the Energy Market modelling tools. In this sensitivity the emissions value rises to 50% of the level of that used in the central model run. The paths are compared in the figure below.

Model emissions value ($/TCO2)



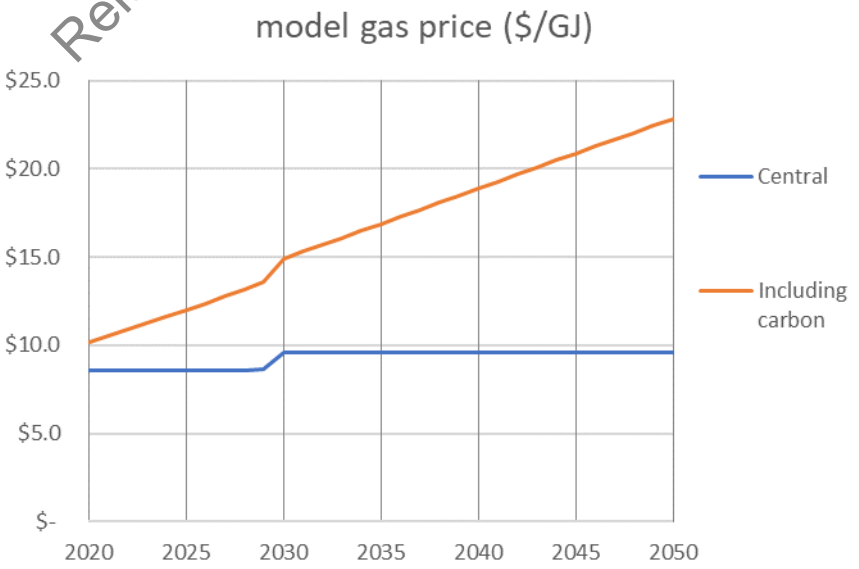
The results of the sensitivity test are shown on the plot below. The result shows that for a scenario with a similar amount of electrification a lower emissions price translates to a $7/MWh lower electricity price (averaged across record).



This data is available in the results file published on the CCC's website here: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/

Question 2.1e. - *What is the assumed gas price with and without carbon costs across the time-period?*

Answer - See the figure below which shows the modelled gas price for electricity generators with and without an emissions price incorporated in the total cost of gas. The price step at 2029 corresponds to the assumed departure of Methanex. This data is available in the results file published on the CCC's website: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/



Question 2.2a - Refer necessary action 5, Maximise the use of electricity as a low emissions fuel: Recommendation d. "Assess whether electricity distributors are equipped, resourced and incentivised to innovate and support the adoption on their networks of new technologies, platforms and business models, including the successful integration of EVs." The remits of the Commerce Commission and Electricity Authority cover this.

Is the CCC suggesting another government agency become involved or are there gaps in the regulatory governance of electricity distributors by the Commerce Commission or Electricity Authority?

Modified request - *What Board papers did the Commissioners receive from staff on the question whether there are gaps in the regulatory governance of electricity distributors by the Commerce Commission or Electricity Authority? and Can the staff please explain what the thought process was for arriving at the recommendation?*

Answer - A number of considerations informed recommendation *Necessary Action 5.* The pathway set out in the report is not prescriptive, it illustrates one way of meeting the emissions budgets. However, common to all of the sensitivities is a significant uptake of electric vehicles. This means an accompanying change in the load in homes as people charge and charging infrastructure nationally. Other changes which may affect EBDs include but are not limited to more distributed generation, localised storage, changing tariffs, more and different technology interacting with their networks and entities asking to use it differently. The Commission is aware that the Commerce Commission and EA have programmes of work in place to identify the necessary regulatory and price barriers and incentives. The Climate Commission sought to reinforce the importance of successful adoption of new technologies and business practices critical to enabling the transition. We welcome feedback through the submissions process.

A number of Board Papers were relevant to the discussions the Board had around the draft recommendation. Specifically, the draft versions of the Evidence report chapters (sent in November 2020), papers on draft recommendations for 2 Board meetings in early December, revised Evidence Report chapters sent to the Board in December, draft Advice report sent in mid-December, draft reports sent in January.

A complete set of Board minutes are due to be released soon.

Question 2.2b - Refer necessary action 5, Maximise the use of electricity as a low emissions fuel: Recommendation f. "Monitor and review to ensure electricity remains affordable and accessible, and measures are in place to keep system costs down, such as demand response management." This has been comprehensively considered in the Electricity Price Review (EPR) and subsequent decisions by government.

Has the CCC identified any gaps or additional aspects not covered by decisions from the EPR?

Modified request - *What Board papers did the Commissioners receive from staff referencing the Electricity Pricing Review or noting affordability of electricity issues?* and *Can the staff please explain what the thought process was for arriving at the recs?*

Answer - The Commission was conscious of the work done by the EPR and this (and previous reviews) was discussed in the context of arriving at the wording of this recommendation. Ensuring that electricity is affordable and accessible is critical to ensuring that the switch to electric vehicles takes place, that process heat users have viable alternatives fuels and that electricity remains a low emissions option that households and businesses can rely on. We appreciated the free and frank

discussion we had with [redacted] on 24 February 2021 regarding current market conditions and options to ensure that electricity remains affordable was informative. We would welcome continued engagement as we refine our modelling and revise our recommendations.

A number of Board Papers were relevant to the discussions the Board had around the draft recommendation. Specifically, the draft versions of the Evidence report chapters (sent in November 2020), papers on draft recommendations for 2 Board meetings in early December, revised Evidence Report chapters sent to the Board in December, draft Advice report sent in mid-December, draft reports sent in January.

A complete set of Board minutes are due to be released soon which will outline the Board's decision-making process.

Question 2.3a - Refer necessary action 7, Reduce emissions from process heat:

Recommendation a. "Urgently introducing regulation to ensure no new coal boilers are installed."

This is not discussed in the draft advice or evidence chapters. It simply appears in the list of necessary actions.

We want to understand the CCC rationale for making this recommendation. For example, has the CCC identified a risk that parties may build new coal boilers and that there are no other policy levers that can be considered other than recommending a ban. If so, can we see that analysis. If there is no analysis, then is this recommendation virtue signalling?

Modified request - *What Board paper did the Commissioners receive (from staff) around the recommendation to "Urgently introducing regulation to ensure no new coal boilers are installed."?* and *Can staff please explain what the thought process was for arriving at the recs?*

Answer - from a principles-led perspective, in section 2.2 of the Advice report, principles 1 (align with the 2050 target), 2 (decarbonise the economy) and 4 (avoid unnecessary cost) taken together inform this recommendation. It is worth reading the detail under each of these, which I won't repeat here. Installing a coal boiler today could commit to emissions for up to 40 years given the lifespan of the average boiler. That takes it beyond the 2050 target and commits to gross emissions that are incompatible with the objective to decarbonise the economy. Principal 2 focuses on reducing gross emissions within our borders rather than sequestering in forests. There are viable alternative lower emissions technologies to coal boilers today. The rising emissions price may make a coal boiler an asset that needs replacing ahead of its natural replacement cycle due to it becoming an uneconomic proposition. Avoiding scrapping assets will reduce overall costs to the economy.

A number of Board Papers were relevant to the discussions the Board had around the draft recommendation. Specifically, the draft versions of the Evidence report chapters (sent in November 2020), papers on draft recommendations for 2 Board meetings in early December, revised Evidence Report chapters sent to the Board in December, draft Advice report sent in mid-December, draft reports sent in January.

A complete set of board minutes are about to be released.

Question 2.3b - Refer necessary action 7, Reduce emissions from process heat:

Recommendation d. "Helping people to access capital to reduce barriers to the uptake of technology or infrastructure upgrades such as boiler conversions, energy efficiency technologies, and electricity network upgrades."

Alleged barriers to access to capital is a theme not just for companies considering process heat conversions. The Commission makes two other recommendations about access to capital:

- "Enable more independent generation and distributed generation, especially for remote rural and Māori communities, and ensure access to capital for this purpose" (Necessary action 5, Maximise the use of electricity as a low emissions fuel, recommendation 4).
- "As part of an equitable transition, evaluate and support interventions such as leasing, hire and sharing schemes to remove barriers and address some of the upfront capital costs of EVs" (Necessary action 3, Accelerate light electric vehicle uptake).

[redacted] is unsure if the alleged barriers are:

- circumstances that some parties find themselves in from time to time as part of fluctuating economic cycles; or
- true economic barriers reflecting some fundamental and material economic market failure.

If the latter, then we agree solutions need to be considered though relying on capital from taxpayers would have to a policy of last resort. If the former, then is the Commission in effect recommending a preference for cross-subsidisation between classes of households and corporate-welfare?

(in either case) Can we have all the analysis the Commission has considered before making these recommendations?

Modified request - *What Board papers did the Commissioners receive from staff mentioning access to capital as a barrier?*

Answer - For remote, rural and Māori communities, please refer to evidence report, chapter 6, pg. 24-26. This has been informed by interviews with Māori-collectives. Draft versions of the evidence report were seen by the board.

For HIP, it was discussed in 12-13 May 2020. Access to capital has been cited as a barrier in stakeholder engagement that took place throughout 2020 and through the heat, industry and power technical reference group meetings. Our analysis also drew on submissions from stakeholders to MBIE's Accelerating Energy Efficiency and Renewable Energy consultation, Productivity Commission's Low emissions economy inquiry, and the Process Heat in New Zealand work programme.

For transport, no Board paper specifically discussed access to capital as a barrier to the uptake of EVs or participation in car sharing schemes. Recommendation was informed by stakeholder engagement and mitigation options analysis.

Part of modified request - *Can the staff please explain what the thought process was for arriving at the recs?*

Staff can follow up with a conversation after materials have been sent.

Question 2.4 - Refer necessary action 9, Increase energy efficiency in buildings, recommendation c6:

"Setting a date by when no new natural gas connections are permitted, and where feasible, all new or replacement heating systems installed are electric or bioenergy. This should be no later than 2025 and earlier if possible."

This would be a large intervention in the gas sector with wide-spread ramifications for gas demand and supply side affecting households and businesses. There is little analysis of the pros and cons of

this recommendation apart from a statement that "Electricity is a more efficient and lower emissions source of energy for heating homes and businesses than gas."7 It's unclear if this refers to thermal or whole-of-asset-life economic efficiency. Please provide the analysis or reference supporting this statement.

There is no supporting economic analysis as to why the date of 2025 is recommended.

Please provide the analysis the Commission considered relating to this recommendation.

Modified request- *Please restrict the scope of this request to the modelling information and supporting analysis.*

Answer - The costs of heating appliances variabilised over the asset's entire lifetime in units of $/kWh are given in the table below. These values are based on the inputs of the Marginal Abatement Costs Curve analysis by MFE. These costs are also available in the detailed assumptions sheet which has been published in the 'Technical assumptions in ENZ' workbook on the Commission's website.

	Space heating		Water heating	
	Heat pump	Gas	Electric cylinder	Gas
Commercial and public	0.08	0.07	0.03	0.04
Residential	0.17	0.14	0.07	0.09

The heating cost is the sum of this capital cost and the delivered energy costs. The delivered energy costs are calculated endogenously in the ENZ model and are based on wholesale costs weighted by consumer use profiles (DWA/TWA), network costs and retail costs. The assumptions which build up these prices are outlined in the 'Technical assumptions in ENZ' workbook, as are the modelled output consumer energy costs.

As modelled, the cost of heating is generally similar for gas vs electric technologies, although rising emissions prices and gas network costs lead to the model favouring electricity. The 2025 ban and 2050 phase out are imposed in the model. They are not cost driven.

3. Cross-sector questions relevant to the electricity and gas sectors.

Question 3.1a - *Please provide the new and replacement capital investment and early retirement (i.e., earlier than the end of the economic life of existing assets) for each year to 2050 assumed for the Current Policy Reference scenario and every other scenario considered by the Commission for:*

- *Electricity transmission.*
- *Electricity distribution.*
- *Gas transmission.*
- *Gas distribution.*

Question 3.1b - *For each of the above infrastructure sectors for year and each scenario, please provide:*

• The assumed operating and maintenance costs.

• The assumed volumes transported, and relevant units used (flow and or peak).

Modified/clarified request - *please ask Simon for the numbers or the formulae used to calculate the incremental transmission and distribution costs or both. We will provide part 2 (assumed O&M and volumes) of this query too. Part 3 (regulated monopoly assets) – please narrow the scope from "any material or consideration" to "any reports to the Board".*

Answer - We have not modelled infrastructure or infrastructure costs at this level of detail. Infrastructure is not a constraint within the ENZ model.

We have made estimates of total infrastructure costs for electricity transmission and distribution which are intended to reflect capital and operating costs. For electricity the cost is driven by growth in generation and growth in demand with various assumptions around proportionalities for different user groups.

It is difficult to explain succinctly in text and we would prefer follow-up conversation to explain.

The total system network costs are allocated to different user groups in the model. Within the model logic, the only sectors which make fuel switching decisions based on these network costs are residential and commercial consumers in selection of heating system (although this is overruled by ban and phaseout settings). The variabilised and fixed network costs for consumers are reported in the published datasets.

Pipeline infrastructure costs are assumed to be constant at $260 million per year. These costs become allocated amongst a smaller base of gas users. Total gas use is reported in the published data outputs.

Question 3.1c - *Provide any material or consideration made to the treatment of regulated monopoly assets stranded by the Commission's recommendations.*

A presentation was provided to the chair of the Board in October 2020 to, in part, outlining how regulated monopoly assets operate under current electricity market regulatory settings. The material does not assume these assets are stranded by the Commission's recommendations.

Question 3.2 - Refer necessary action 19, Continued ETS improvements, recommendation b:

"… the Government make progress on … Undertaking a first principles review of industrial allocation policy."

We note that industrial allocation phase-out through the currently legislated reduced level of assistance has not been considered despite this being a material change by 2035 (high emissions intensity firms will reduce allocation from 90% to 70% and moderate intensity firms from 60% to 40%).

Evidence Chapter 7 p21 states," Changes in rates of industrial allocation in the NZ ETS are assumed to have no effect on industrial output, nor on uptake of mitigation options, where decisions are assumed to be made based on marginal costs."

Has there been any consideration of the impacts on profitability of EITE firms, emission budgets or wider economic impacts in the modelling?

Modified request - *Please substitute "any consideration" for "any material that went to the Board"*

Answer - To clarify, the quoted text (Evidence Chapter 7 p21) refers to the modelling approach in the ENZ model. This model does not assess the profitability of EITE firms. Firm profitability depends not only on domestic emission and energy prices, but also their ability to pass changes in operating costs on (through price increases in finished goods) and their competitiveness in an international market (which depends on many things beyond domestic climate policy). Although these are important considerations, we have not tried to address the impact of profitability within the ENZ model.

A document titled 'Summary of key HIP assumptions' was discussed in a workshop attended by members of the board on the 22nd of September 2020. The document which pertains only to the ENZ model assumptions summarised the production activity assumptions of industrial sectors and made that note that 'The model does not explore the viability of industries in response to a rising carbon price.'

In terms of other board papers with reference to the profitability of EITE firms, the board saw the draft versions of the advice and evidence reports which make reference to the free allocations for EITE firms.

Question 3.3 - A large increase in the use of biomass is an important part of the draft pathways, e.g.:

"In our path, fuel switching to biomass also occurs in some other energy-intensive industries such as pulp and paper production.

Overall, our path takes advantage of the country's currently under-used biomass resource, moving towards a more circular economy. Achieving this uptake will require the development of supply chains for gathering and processing biomass along with the establishment of local markets."

[redacted] agree with the Commission that use of biomass is constrained locally due to transport costs. That does leave energy-intensive businesses where conversion to biomass is not economic in a bind.

Is there a report, or chapter in the Commissions reports, or model that tabulates the biomass pathway to 2035 by regional locality?

Modified request – Following clarification conversations, it was agreed that *instead of the final sentence in this section, the CCC would provide a written explanation of how the model works out biomass availability and the regional figures for biomass availability for future years.*

Answer - In the ENZ model forestry residue and pulp logs are utilised as a fuel for process heat and as a feedstock for liquid biofuel production. The available supply of biomass is based on the forestry module of ENZ.

The National Exotic Forest Description and other data from MPI are used to estimate standing forest areas by region. Forest harvesting is modelled based on an average rotation length of 28 years. Total recoverable volume (TRV) and the proportion of pulp logs are calculated based on a reference yield table and regional multipliers provided by Scion. The volume of recoverable harvest residues is assumed to be 5% of the TRV.

Note that the wood yield tables and other forestry assumptions are available on our website in the worksheet titled 'Technical-assumptions-in-ENZ-land-and-waste.xlsx'

An adjustment to the available supply of pulp logs is made to remove the consumption of existing domestic users.

Regional matching of supply and demand occurs for biomass use as a boiler fuel in food processing. Scaling factors are also applied to restrict the available regional supply – the purpose of this is to prevent the food processing sector from consuming all the available supply within the region at the expense of other users and to ensure a balance between fuel switching to bioenergy and electrification. The latter is thought to reflect the practicalities of using biomass as a boiler fuel on a massive industrial scale which might limit the uptake. The scaling settings are varied between scenarios with settings of 25% of regional availability for CPR, Headwinds and Further Behaviour and 50% for other scenarios and pathways.

Wood, pulp and paper processors also utilise biomass to displace fossil fuels. We have not regionally matched supply and demand for these sectors as they are located in forestry regions.

A workbook (Attachment 2) is provided which details the biomass supply, regional consumption (for food processing) and other consumption.

Question 3.4 - *Has the Commission undertaken a probability analysis of sector pathways being met taking into account the uncertainty of human reactions or economic hardship decisions driving behaviour?*

Modified request - *The CCC to provide a written explanation of the question in the first sentence rather than conduct a search of Board papers etc.*

Answer - We have looked at alternative combinations of measures which would achieve the same overall budget levels to assure ourselves that the budgets could be met in a range of circumstances. We have not attempted to assign probabilities to the delivery of specific abatement measures. We intend to explore the sensitivity of our path to uncertainty through conducting sensitivity analysis prior to providing our final advice.

Question 4.1 - The modelled impact on GDP in 2035 is reported in the draft advice (pe87) as:

"Looking out to 2035, our modelling suggests that reducing emissions to meet our proposed emissions budgets would cost Aotearoa no more than $190 million each year over emissions budget 1, $2.3 billion each year over emissions budget 2, and $4.3 billion each year over emissions budget 3."

Taking the Commission's estimates of GDP in 2020 of $321b and the Current Policy Reference estimate of GDP in 2035 of $396b, and the using the above estimates of annual decreases for each emission budget period to 2035, we calculate GDP in 2035 of the proposed emission budgets as $362b. $362b is 8% less than $396b.

In contrast the lowest estimate of GDP in table 12.2 of any scenario in the Evidence Chapter 12 is $392b (Transition Pathway 4 (TP4): Faster reductions).10 $392b is 1% less than $396b. These estimates support the draft advice:

"The overall costs of meeting the country's targets and our proposed emissions budgets are likely to be less than 1% of projected GDP."

Please provide a reconciliation of the estimates of the effect on GDP in 2035 compared to the Current Policy Reference between the text in the draft advice (pe87) with table 12.2 of the Evidence Chapter 12.

Answer - The figures in the Advice Report for the reduction in GDP under Transition Pathway 4 (as modelled by CPLAN) compared to the CPR represent the average difference in GDP in each year

across each of the budget periods, not the annual difference in each of the periods. The figures are not the additional difference in GDP in each year.

The level of GDP projected under each scenario for each year are now published on our website. See https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/C-PLAN-results-dataset-for-2021-draft-advice.xlsx

Question 4.2 - The Commission's CGE model is described in the evidence report (Chapter 12 p 4) as having important differences from other CGE models used to analyse the effects of climate change policy:

"C-PLAN models emissions reducing in response to climate policy with little or no reduction in output, and so shows a smaller impact on gross domestic product (GDP) and abatement costs than other CGE models in Aotearoa.3 This occurs because C-PLAN explicitly includes key emissions-reducing technologies that allow emissions to be reduced without reducing output (e.g. a methane vaccine), and also allows industries to switch the energy sources they are using."

Please provide a description by industry as modelled in C-Plan of the new technologies adopted and the switch in energy use preferably at 5-year intervals starting from 2020. If this cannot be supplied quickly, then at 2017, 2025, 2030, 2035 and 2050 – the years reported in "Table 12.2: GDP projections from the Commission's C-PLAN modelling ($ billion)" (Chapter 12 p7).

Answer - We have not provided the switch in energy use by sector as this will require significant additional analysis, and only providing it for the specified years would not reduce the size of the task.

The modelled technologies in C-PLAN can be found in the spreadsheet we have published with C-PLAN outputs. This sets out the output in dollar terms for each year and scenarios is given in the OutputDetails sheet. See https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/C-PLAN-results-dataset-for-2021-draft-advice.xlsx
(found on our website at https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/C-PLAN-results-dataset-for-2021-draft-advice.xlsx).

The sheet EmissionsDetails in the same spreadsheet has the emissions quantities for both the new technology sectors and their existing counterparts, and so the change in emissions due to the new technologies can be determined from this data.

Explicit new technologies:

- Electric vehicles for household transportation - see sector hht1, and compare with sector hht which is the equivalent for internal combustion household transport
- Electric vehicles for commercial land transportation (including rail) - see sector rtp1, and compare with sector rtp which is the equivalent for internal combustion commercial land transport
- Methane-reducing technology for dairy farming - see sector rmk1, and compare with sector rmk which is the equivalent for dairy farming without this technology
- Methane-reducing technology for beef and sheep farming - see sector b_s1, and compare with sector b_s which is the equivalent for dairy farming without this technology
- Carbon capture and storage for geothermal electricity - see sector eoth_ccs, and compare with sector eoth which is the equivalent for geothermal electricity without CCS.
- Biomass for process heat is produced by the sectors bh_hor, bh_mil, bh_mtp, bh_ofd, bh_omf, bh_w_p, and used in the sectors hor, mil, mtp, ofd, omf, w_p respectively

(horticulture, dairy processing, meat processing, other food products, other manufacturing, wood & paper). This will be substituting for coal, gas, and other non-electricity energy sources in these sectors.

- Energy for electrification of process heat is in the sectors eh_hor, eh_mil, eh_mtp, eh_ofd, eh_omf, eh_w_p, and used in the sectors hor, mil, mtp, ofd, omf, w_p respectively (horticulture, dairy processing, meat processing, other food products, other manufacturing, wood & paper). This will be substituting for coal, gas, and other non-electricity energy sources in these sectors (as with biomass), and use electricity in their production.

Question 4.3 - *Could you please explain what modelling approach led to the different assumptions for the scenarios "Table 12.1: The key assumptions used in each of the scenarios run in C-PLAN." (Chapter 12 p5-6) delivering almost identical GDP growth paths in "Table 12.2: GDP projections from the Commission's C-PLAN modelling ($ billion)" and provide data on the share of GDP by industry as modelled in C-Plan.*

Answer – These assumptions came from staff assessment of the key material changes that could affect the economy. They deliver similar but not identical growth paths because the economy has many ways to decarbonise in the model including the new technologies in the model, as well as the low proportion of the economy that is emissions-intensive. The uptake of new technologies that are explicitly specified in the model, price-driven fuel switching, and price-driven energy efficiency (where the price is determined by an ETS-type scheme for each of the two net emissions caps) means that emissions can be reduced to meet the emissions caps without substantially reducing output from most sectors. It is also the case that large parts of the economy (such as the services sector) are not emissions-intensive and so are not heavily affected directly by the emissions caps.

The output of each sector is given in the OutputDetails sheet of our recently published spreadsheet https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/C-PLAN-results-dataset-for-2021-draft-advice.xlsx (found on our website at https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/C-PLAN-results-dataset-for-2021-draft-advice.xlsx). Note that the total output of all sectors does not add to GDP as it includes both intermediate and final production, whereas GDP is defined as solely final production.