



Official Information request reference: 2021-008

10 March 2021

Email: [REDACTED]

To whom it may concern,

Thank you for your Official Information Act 1982 (the Act) request, received on 9 February 2021 for the following:

"Under the official information act, could I please have a copy of:

- 1. Could I please have a list of all economic models used to estimate the economic impact of draft (or hypothetical) emissions budgets.*
- 2. Could I please have a copy of all economic results provided to the Commission by external contractors (including draft, interim, preliminary, etc results). For example, if an excel spreadsheet of economic model outputs was received by the Commission, could I please have a copy of this spreadsheet.*
- 3. Could I please have a copy of all feedback provided to external contractors on economic results (including draft, interim, preliminary, etc results) by the Climate Commission. For example, emails sent to third party contractors where changes are suggested or requested.*
- 4. Could I please have a copy of any correspondence between the Commission and Ministers officers on the results of economic modelling, including both correspondence sent and received.*
- 5. Could I please have a copy of any emails sent by Climate Change Commissioners in response to results produced from economic models (including draft, interim, preliminary, etc results).*
- 6. Could I please have a copy of the assumptions used by the Climate Commission in economic modelling, including final assumptions used in final model outputs and other assumptions tested in earlier model runs.*
- 7. Could I please have a copy of any emails (or letters) received by other government organisations or private sector organisations discussing the basis for these assumptions, and any replies sent by the Commission.*
- 8. A copy of any peer review of the assumptions and / or economic models, including draft peer reviews received by the Commission and any replies sent by the Commission."*

The table below lists the different parts of your query and the responses provided.

Item	Response
1.	A list of all the models used by the Commission to support the preparation of its draft advice, including a brief description of their purpose, has been attached to this response (see Attachment 1 – List of Models)



2.	<p>In line with the approach of other government agencies, our modelling assumptions, inputs and results for the draft advice are available and can be accessed here: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/</p> <p>In terms of draft, interim and preliminary results; we are withholding this material under the following sections of the Act:</p> <ul style="list-style-type: none"> - section 9(2)(g)(i) - to maintain the effective conduct of public affairs through the free and frank expression of opinions; and - section 9(2)(f)(iv) – to maintain the constitutional conventions for the time being which protect the confidentiality of advice tendered by Ministers of the Crown and officials.
3.	<p>The Commission has identified a large volume of correspondence between its staff and contractors on economic results. This material is being withheld under the following sections of the Act:</p> <ul style="list-style-type: none"> - section 9(2)(g)(i) - to maintain the effective conduct of public affairs through the free and frank expression of opinions; and - section 9(2)(f)(iv) – to maintain the constitutional conventions for the time being which protect the confidentiality of advice tendered by Ministers of the Crown and officials.
4.	<p>In relation to your request for correspondence between the Commission and Ministers' offices on the results of the economic modelling, we can inform you that there was no correspondence.</p> <p>Prior to the release of the Commission's draft advice for consultation, the Commission offered all parties an opportunity to be briefed on the contents of the draft advice for release.</p>
5.	<p>In relation to your request for emails sent by Commissioners in response to results produced from economic models, we can inform you that there are no emails relating to the economic results.</p>
6.	<p>The assumptions used by the Climate Commission in its modelling are publicly available and can be accessed here: https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/</p> <p>We are withholding assumptions used in earlier model runs under the following sections of the Act:</p> <ul style="list-style-type: none"> - section 9(2)(g)(i) - to maintain the effective conduct of public affairs through the free and frank expression of opinions; and - section 9(2)(f)(iv) – to maintain the constitutional conventions for the time being which protect the confidentiality of advice tendered by Ministers of the Crown and officials.
7.	<p>In relation to emails (or letters) received discussing the basis of the assumptions in the modelling, the Commission is currently consulting on the assumptions and evidence to inform our final advice.</p> <p>The Commission did not share these assumptions prior to publication of the draft advice and as a result there is no correspondence related to this question.</p>

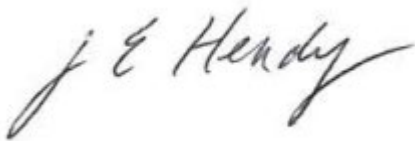
8.	<p>The final peer reviews have been published and can be accessed here: https://www.climatecommission.govt.nz/get-involved/our-advice-and-evidence/</p> <p>In terms of draft peer reviews in relation to this part of your request, please find attached a draft peer review of models and modelling provided by Infometrics (see Attachment 2 – Review of models and assumptions (draft)). Please note that this draft peer review does not materially differ from the one published on our website.</p> <p>Please note that some information contained in this attachment has been withheld under section 9(2)(a) of the Act – to protect the privacy of natural persons, including that of deceased natural persons.</p>
----	---

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.

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.

I trust that the information provided fulfils your information request.

Kind regards



Jo Hendy
Chief Executive
Climate Change Commission

Released under the Official Information Act

Attachment 1 - Models used by the Commission

Model	Purpose
Climate Policy Analysis (C-PLAN)	C-PLAN is an Applied Computable General Equilibrium (CGE) model. The model is/has been used to give the Commission a sense of the economic impacts and costs of emissions budgets and policies. This model is being developed by Motu Economic and Public Policy Research and Vivid Economics.
Distributional Impacts Model – Employment (DIM-E)	DIM-E is a distributional impacts model that takes output from C-PLAN and combines it with microdata to understand employment effects. The model is/has been used to give the Commission a sense of how the employment impacts of emissions budgets and policies might be distributed. As with C-PLAN, this model is being developed by Motu Economic and Public Policy Research and Vivid Economics.
Emission in New Zealand (ENZ)	<p>ENZ is a bottom-up sectoral model that covers all the main emitting sectors of the New Zealand economy – energy, industry, transport, land use, agriculture, forestry, and waste.</p> <p>This model is used to give the Commission a detailed sense of the emissions reductions that are feasible in each sector by factoring in specific technologies and mitigation options, and cost trajectories. The model also captures the major interactions between sectors. For example, if there is an increase in forestry, this will flow through into an increase in biomass availability for heat or biofuels.</p>
EMarket	<p>This is a proprietary model owned by EnergyLink. Information on the model can be accessed here: https://www.energylink.co.nz/resources</p> <p>The way in which the model is used by the Commission is described in the Interim Climate Change Commission's <i>Accelerated electrification</i> report¹.</p> <p>Specifically:</p> <ul style="list-style-type: none"> • The I-Gen model calculates what electricity generation capacity will be required in the future. It builds power plants progressively in order of those which are the cheapest to construct and operate, and which can also, collectively, deliver the required amount of electricity. • The EMarket model then takes the power plants built by the first model and calculates how these different power plants are used throughout the year. It does this by simulating market behaviour on a three-hourly basis, ensuring supply meets demand. • EMarket also simulates demand response, triggered by high electricity prices. It does this by specifying load that can be shed in response to price. Large grid-scale batteries are also included in the model to help meet peak demand. Both demand response, and batteries, are needed to keep non-supply³⁹ to very low levels.

¹ https://www.iccc.mfe.govt.nz/assets/PDF_Library/daed426432/FINAL-ICCC-Electricity-report.pdf

Released under the Official Information Act

4 December 2020

Dr Anita King
Principal Analyst
Climate Change Commission

Contact details withheld under section 9(2)(a) of the Act (to protect the privacy of natural persons, including that of deceased natural persons)

DRAFT

Review of Models and Modelling

Dear Anita

Thank you for the opportunity to review the modelling undertaken by the Commission.

To confirm our earlier discussions, I haven't seen anything so seriously suspect about the modelling that it would prevent the Commission from publishing the work done to date. To be even surer I requested a model comparison and an additional run of the C-PLAN model, notably:

1. An industry by industry comparison of results for the Reference scenario from C-PLAN with the Base Case scenario from ENZ. Eventually a similar comparison between TP1 and an analogous scenario from ENZ (Headwinds?) would be also be useful.
2. A re-run of TP1 with half the carbon price over the period to 2050 so that gross emissions are endogenous. No other changes to exogenous settings, including forestry removals. The aim here is to see how far off the 2050 target gross emissions would be, and also to understand the importance of different industries in the abatement equation, excluding changes in agricultural CH₄ which are largely exogenous.

I address the outcomes of these analyses below, but a few general matters first.

Modelling methodology

As one would expect there is no automatic link between the ENZ and C-PLAN models. Instead the link is described as a 'loose coupling'. The main use of ENZ is to provide inputs into C-PLAN in areas such as EV uptake and land use.

A good approach is to compare results at the industry level from the two models and reconcile any major differences. This is discussed further below. Of course differences are to be expected. For example general equilibrium effects are omitted from ENZ, and production

function elasticities in C-PLAN are unlikely to align perfectly with known production technologies in ENZ.

As the model coupling develops there may be opportunities for inputting some of the C-PLAN results back into ENZ – for example electricity prices.

CPLAN model

The C-PLAN model has the core requirements of an applied general equilibrium model. It has the standard mix of households who maximise utility, producers who maximise profit, international trade, and a government sector. Industry production functions are of a nested variety permitting various degrees of substitution between inputs. Similarly consumers can substitute between different goods and services.

A model audit is not warranted (nor requested) and in any case functional forms and parameter values can always be debated. To understand and have confidence in the model's results requires:

- Knowing how the model's closure rules are set.
- Observing how sensitive the results are to changes in some key inputs.

These aspects are discussed below.

Macroeconomic closure

The closure settings accord with standard GE modelling practice. Between scenarios there is no change in total hours worked, no change in the government's fiscal position and no change in the international current account balance (with the real exchange rate being endogenous).

Question 1: What happens to rates of return across the scenarios and does the capital stock change across scenarios?

GDP effects

In some scenarios the domestic carbon price diverges substantially from the world carbon price which rises to US\$250 by 2050. In the BAU scenario New Zealand EITE (emissions intensive, trade exposed) industries have a competitive advantage, but in some other scenarios that advantage flips. This has little effect on the output of EITE industries as they either exit New Zealand well before 2050 (aluminium and methanol production) or have output constrained to near BAU levels (cement and steel).

These exogenous assumptions are likely to be the main reason why real GDP exhibits such small changes between scenarios compared to past modelling by NZIER and Infometrics. Even scenarios TP3 and TP4 which have ETS1 carbon prices over \$800/tonne do not see reductions in GDP of more than 1% in 2050. Other exogenous changes such as emissions from waste, a higher uptake of EVs and the disappearance of gas-fired electricity generation (from ENZ) also play a significant part in enabling the economy to adjust to those very high carbon prices at little overall cost – not much of the economy is left exposed to such prices. Without these and other changes in technology the model would likely produce larger macroeconomic effects. In that connection:

Question 2: What happens to other macroeconomic variables such as private consumption, gross investment and the terms of trade in the various scenarios?

Question 3: Also what is the value of the lump sum transfer of revenue from the carbon charge back to households?

ENZ and C-PLAN output comparison

There are a number of ways to compare results from the ENZ and C-PLAN models.

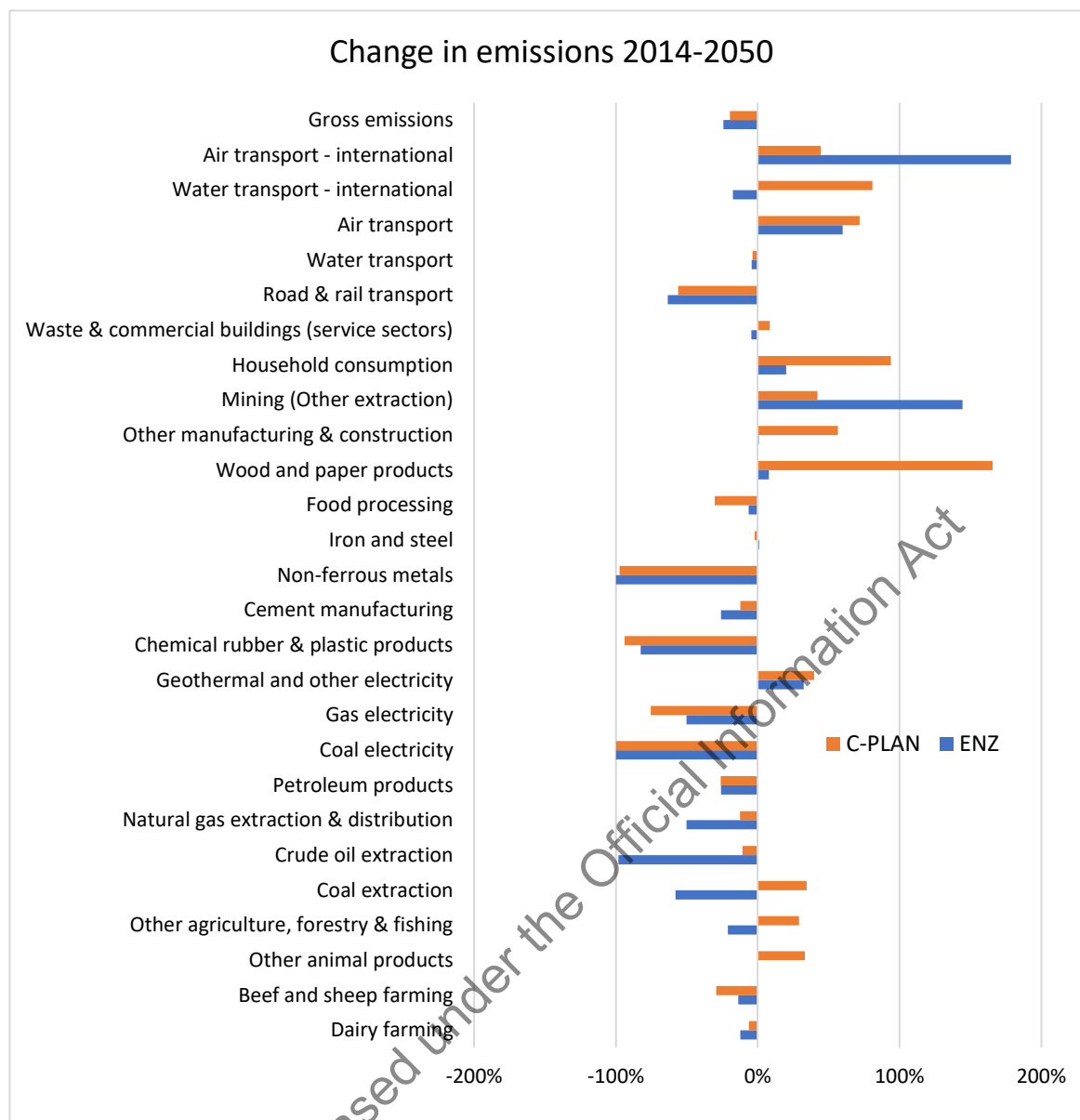
1. Base year calibration of emissions from each model.
2. The change in emissions from the base year to 2050 in the a BAU (Reference) scenario, in either absolute changes or proportionate changes.
3. The change in emissions in 2050 between alternative scenarios, in either absolute changes or proportionate changes.

Figure 1 shows the second option in terms of percentage changes. The changes in total emissions are very close; -20% in C-PLAN and -24% in ENZ. However, ignoring international transport, which is outside New Zealand's carbon budget, there are some significant differences:

Figure 1

Released under the Official Information Act





- household consumption
- other manufacturing and construction
- wood and paper products
- food processing
- all of the mining industries
- other agriculture, forestry and fishing
- other animal products

It is possible that C-PLAN is projecting higher economic growth which pulls up activity and emissions in the household sector, as well as in industries such as other manufacturing and construction, forestry products, and mining. Food processing is an exception as C-PLAN depicts a bigger emissions reduction than ENZ.

To some extent differences may also be attributable to variations in how industries are defined in the two models.

Question 4: As noted above identical results should not be expected, nor sought, but are there any other obvious reasons for the differences?

In absolute terms the models are consistent, with both projecting the largest emission reductions to occur in road transport, pastoral agriculture, and electricity generation – in descending order.

C-PLAN half price scenario

The price path to 2050 ending at \$338 in Scenario TP1 leads to gross emissions of 24.3Mt (30% lower than under BAU) which, with forestry removals of the same amount, meets the 2050 target of net zero emissions (excluding biogenic methane). This is by design. Halving the price leads to gross emissions of 27.8Mt, so net emissions are short of the target by 3.5Mt.

Looking at the scenarios in reverse order, a price of \$169 which is \$134 above the BAU price of \$35, reduces emissions by 7.0Mt. Doubling the price to \$338 reduces emissions by only a further 3.5Mt, so there is a clearly a rising marginal abatement cost curve – as expected.

Question 5: What is the change in GDP relative to BAU in the half price scenario?

The incremental change of 3.5Mt has the following components:

- 1.07Mt of CO₂ commercial road transport.
- Seven industries see a change in CO₂ emissions of more than 0.1Mt, for a combined total of 0.98Mt.
- Non-biogenic methane changes by 0.20Mt CO₂e.

These changes combined account for 64% of the total change.

In terms of proportionate changes, the average is 15% and highest is 100%, the latter being households abandoning fossil fuelled transport.

These results seem plausible in the context of production and consumption substitution elasticities that are estimated from historical data. They also underline the importance of being able to incorporate into GE models historically unprecedented changes such as a large scale shift from fossil fuelled vehicles to electric vehicles. Another example is new methane reduction technologies in agriculture (vaccines and modified grass varieties).

ENZ model

Bottom-up modelling with backstop technologies such as in ENZ is certainly a useful modelling approach, but it does depend on knowing what those technologies might be. In dairy processing for example there seems to be no ability in ENZ for substitution of energy-intensive evaporation or the transport of liquid milk over long distances, in favour of reverse osmosis, as was introduced at the Tuamarina dairy factory after a fire in 2004.

An energy efficiency parameter or fuel substitution elasticity in a standard GE model production function could capture the effects of such a change without knowledge of that particular technology.

The point is that one should not necessarily expect a GE model to always understate the possibilities for input substitution in production (or consumption).

EBIT

In ENZ land use change in agriculture and forestry is exogenous, encapsulating policies such as the proposed essential freshwater standards, with on-farm responses such as changes in output per hectare and changes in EBIT/ha.

The price of biogenic CH₄ emissions is endogenous (to meet the target), which can also lead to changes in EBIT/ha.

Question 6: Are changes in EBIT/ha in C-PLAN ever large enough to have potential feedback effects to land use assumptions in ENZ?

Harvested wood products

The carbon stored in harvested wood products is simulated by changing the factor for averaging emissions from 17 years to 22 years, but there is no feedback to this number from changing the product mix, for example as could occur if more forestry is used to produce biofuels.

Question 7: Are changes in the forestry product mix in C-PLAN ever large enough to potentially affect the assumed forestry removals of CO₂ in ENZ?

DIM model

The Distribution model seems appropriate for what it is intended to do.

There is, however, one potentially important issue that it does not address, notably the effect of recycling revenue from the carbon charge back to households. My understanding is that this is not possible to simulate with the model at its current stage of development.

This is actually quite a tricky modelling extension. The industry results that are distributed by DIM (across dimensions such as employment by gender or region) already capture the effects of recycling revenue back to the household sector in aggregate – via the lump sum transfer. That aggregate picture can be theoretically consistent with many ways of distributing the revenue amongst different income groups and household types.

However, It can also be theoretically inconsistent with any given distribution. For example if the recycling is targeted to low income households the aggregate propensity to consume may change, along with the mix of consumer expenditure.

Hence modelling revenue recycling in DIM (if that is pursued) would entail constraining DIM in some way and/or iterating between DIM and C-PLAN. This is probably a second order issue, but it may not be.

Future research

Sensitivity analysis

Overall the results of the modelling system are heavily influenced by exogenous assumptions, whether about land use, industry survival, vehicle travel, or new technologies and their uptake. This is probably unavoidable when dealing with economic responses to something as historically unprecedented as climate change. It does imply, however, that sensitivity analysis is crucial.

Granted that at this stage there has not been time to run a suite of sensitivity tests with both ENZ and C-PLAN in an integrated manner. This should be a priority for future research.

Other scenarios

The small changes in GDP for quite large changes in carbon prices may imply that analysing lower cost ways to meet emissions reduction targets (eg NDCs) are almost pointless. Nevertheless if the actual rate of EV uptake falls substantially behind projections (perhaps limited by world supply) or the domestic carbon price increase is limited by political pressure, there may be a need to consider purchasing international emission units – given that an acceptable trading regime exists.

At this stage it is unclear whether C-PLAN can simulate such a scenario, but in time such a scenario would add robustness to the modelling results.

Another scenario to strengthen the envelop of modelling results would be to test the effects of a widespread shift to synthetic protein, such that dairy and meat exports are markedly (say 80%) lower by 2050.

CSO questions

In relation to questions raised in the CSO, the modelling system:

- Identifies potential emissions budgets.
- Determines whether the proposed emissions budgets are feasible technically, economically, socially – although the social impacts have yet to be presented.
- Determines whether the proposed emissions budgets are consistent with the targets for biogenic methane and all other gases.
- Identifies the macro and distributional, social and economic effects of the proposed emissions budgets; including by sectors such as agriculture and forestry – but again the social and distributional effects are yet to be released.

As to whether the modelling system is being used and maintained in a policy environment (rather than an academic or consultancy environment), I'm not sure what that means. If it means that the models will be available for use by others, that is promised.

Overall the models are sensible and have been used in a sensible manner. They are fit for purpose, albeit that 'purpose' may evolve over time.

Regarding Covid-19, the stance that the Commission has taken is appropriate. Either Covid-19 (or some other virus induced disease) will be a non-issue over most of the period, or it will be so pervasive that it will warrant its own detailed modelling.

I am happy to discuss any aspect of the above especially if I've misunderstood something.

Yours faithfully

Adolf

8

Dr Adolf Stroombergen
Chief Economist
Infometrics

Contact details withheld under section 9(2)(a) of the Act (to protect the privacy of natural persons, including that of deceased natural persons)

Released under the Official Information Act