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DATA LOGIC ACTION

Submission on Climate action for Aotearoa: comments on C-PLAN modelling[1]

Key points

1. The C-PLAN modelling results appear logical, given the assumptions made on key modelling inputs and the model set up.
2. But determining this was far from easy. The quality of the presentation of the approach to the C-PLAN modelling was not commensurate with standards of good practice, the significance of its findings and its potential implications for regulatory and policy settings out to 2050.
3. The C-PLAN modelling appears to have been used primarily to generate the headline number for economic costs. Distributional effects across industries generated by C-PLAN received no attention in the draft advice.
4. Both the input assumptions and modelling set up could be documented and communicated far more effectively in the next report. This would help improve the transparency of the modelling and lift readers' confidence in its findings.
5. Greater effort needs to go into explaining and justifying the assumptions used in the Current Policy Reference (CPR) scenario. The CPR accounts for around 83% of the required reduction in net long-lived gasses from today's levels to get to net zero by 2050. It is not surprising that the *additional* economic cost of getting to net zero from the CPR is relatively low.
6. As such, the economic cost results were determined largely before the model was run – by those collectively providing the input assumptions to the CPR. And there is insufficient information to judge whether these assumptions are reasonable and consistent with each other.
7. There has been no discussion of the costs associated with moving to the CPR. We appreciate this was not asked for in the Terms of Reference, but it's not irrelevant for informing the public and politicians. If the CPR is assumed to be achievable at zero cost, it should be stated.
8. Sensitivity analysis around key CPR assumptions (e.g. EV uptake, afforestation, etc.) would provide an indication of how important those assumptions are in determining the overall economic cost of getting to net zero by 2050.
9. Our confidence in the results would be improved with the publication of a wider range of standard CGE modelling outputs, including factor price changes. This is particularly important when the quantity of factors such as labour and land are determined exogenously, because it shows where adjustment costs fall.
10. Future research could tackle challenging technical issues such as endogenous innovation, dynamic policy responses and international coordination effects.

[1] We are happy for these comments to be published by the Commission and will look to do so ourselves in the interests of informing public discussion on the economic modelling.

Ten questions we'd hope can be answered in the next report, ideally in a stand-alone CGE modelling chapter

i. What are the welfare impacts of getting to net zero?

ii. How do they compare with the GDP impacts?

iii. Do the CPR assumptions, such as Essential Freshwater policies, come with any costs?

iv. What are the impacts of alternative EV uptake assumptions in the CPR?

v. What are the impacts of alternative net forestry removals assumptions in the CPR?

vi. How do assumptions around the strength of climate policy action taken by the Rest of the World affect the costs of New Zealand getting to net zero?

vii. Which industries' output is determined exogenously, in which scenarios?

viii. How are real wages at the industry level affected by the transition to net zero?

ix. What happens to land prices?

x. What are the main differences between these results and those from other New Zealand and international CGE analyses, and why?

Understanding the CPR is more important than seeing the inner workings of C-PLAN

11. Much of the public commentary on the CGE modelling to date has focused on concerns about C-PLAN not being released. We understand it will be released mid-year. However, we think concerns about releasing the model code are misplaced from a technical perspective.

12. While releasing the model code and datasets would be helpful for the purposes of transparency and be more in line with what was expected when the study was announced, it would not throw much light on the most important modelling issues – the assumptions.

13. Not releasing the code and datasets has had the unfortunate effect of casting doubt on the model's quality or implementation – the 'they must be hiding something!' argument.

14. We think it's unlikely that anything is being hidden intentionally. We suspect it's an oversight under tight timeframes rather than a conspiracy.

15. C-PLAN is based on the well-regarded EPPA model, which has a long history of being used for climate policy analysis around the world. We have no reason to doubt its theory, structure and parameters are reasonably appropriate for the task at hand. The modeller using C-PLAN has extensive academic and consulting experience in modelling climate change policy.

16. From what we can see, C-PLAN does precisely what would be expected, given the assumptions used and chosen model closure.

17. If we ran our MDG6-NZ dynamic emissions CGE model and used all the same assumptions and closure choices, we would likely deliver almost identical results to those generated by C-PLAN.

Understanding the CPR baseline is vital because it does much of the heavy lifting to get to net zero

18. In any CGE modelling exercise, getting the baseline right (i.e. a realistic presentation of a BAU outlook) matters, as results are reported as deviations from the baseline.

19. In the context of emissions modelling, getting the baseline right matters more than usual. The more that emissions-reducing technologies and policies are baked into the baseline, the less the economy has to adjust when seeking to move from the baseline to an emissions target – and hence the lower the overall economic cost.[2]

20. The CPR, which "assumes market conditions, technology cost reductions and policies continue on current trajectories" (Ch.7, p.4) is ambitious compared to previous modelling exercises. That's not to say it's wrong – previous exercises were probably too conservative based on what we now know about emissions-reducing technologies.

21. The ENZ model was used to generate the CPR documented in the draft advice. It estimates the CPR would move New Zealand from emitting 36.3Mt CO2-e of net long-lived gasses in 2018 to 6.3Mt CO2-e in 2050 (Table 7.1, p.9).

22. That is, the CPR (in ENZ) does around 80% of the emissions reductions needed to get from today's net emissions of long-lived gasses to net zero in 2050.

23. So if the C-PLAN had used the ENZ CPR emissions profile (it didn't, see next section), it would only have to abate a further 20% of net long-lived gasses to get to net zero. Unsurprisingly, this is not very costly.

24. There is no mention of whether the CPR's emissions reductions come with any costs attached. Previous analysis suggests policies like Essential Freshwater will not be cost-free.[3]

25. We understand why you haven't reported any such costs – you are interested in the difference between the CPR and the counterfactual scenarios – but care needs to be taken when suggesting there would be minimal overall costs of getting from where we are today to net zero by 2050, which is how some users of your advice may interpret the narrative.

Do the differences between the C-PLAN CPR and the ENZ CPR matter?

26. We note ENZ's CPR endpoint of 6.3Mt in 2050 is different to that used in the C-PLAN baseline, which is 12.6Mt.[4] The Commission's website acknowledges this.

27. This is not surprising – aligning model baselines can be challenging. But some discussion of whether the differences matter, and if so, how much, would have been helpful. Presumably if C-PLAN had use the ENZ CPR emissions baseline of 6.3Mt CO2-e the economic costs of getting to net zero would have been lower still.

28. It would also be useful to know whether the economic projections in C-PLAN in the CPR scenario are consistent with the degree of structural change assumed. As we understand it,

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[2] This is alluded to on p.5 of Ch.7, which states "If these uncertainties cause variations for the Current Policy Reference case, a different degree of work would be required to meet emissions budgets and the 2050 target".
[3] See, for example, NZIER (2020) https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/economic-effects-of-water-quality-proposals-modelling-scenarios.pdf
[4] Using data from the 'Emissions' tab of https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/C-PLAN-results-dataset-for-2021-draft-advice-v2.xlsx

C-PLAN's economic projections are calibrated to a 2019 report, before key policy changes embodied in the CPR were announced.[5]

The CPR assumptions warranted much greater exploration and sensitivity testing in the advice

29. Chapter 7 of the draft advice provides extensive guidance on the ENZ CPR. In this respect, the Commission has been highly transparent about the CPR.

30. But it's not clear precisely how closely this maps with the CPR used in C-PLAN because C-PLAN has not been properly documented yet.

31. Regardless of the mapping, the draft advice would have been more helpful if it had more clearly explained:

    a. Which were the most important assumptions in the CPR.

    b. How the economic costs from C-PLAN would differ under different CPR assumptions.

32. For example, the draft advice notes "[t]he decrease in transport emissions is largely due to the projected electrification of the light vehicle fleet. This is one area where the ENZ Current Policy Reference case differs significantly from other Government projections". (Ch.7, p.10).

33. Given the "significant" divergence in views from those of transport officials, this begs the question: how would lower-than-expected EV uptake in the CPR affect economic costs?

34. The same goes for net forestry removals: how would lower or higher net forestry removals in the CPR (as opposed to the counterfactuals) affect the costs of getting to net zero?

35. We appreciate that time was tight for this analysis, and that it's easy to suggest multiple model runs and sensitivity analysis with the luxury of not having to actually deliver them in a set timeframe and budget.

36. But this modelling is likely to influence the shape of economic and environmental policy for decades to come. It's not good enough to say "we ran out of time" when the consequences for New Zealand as a whole are likely to be material. We also note that time was less tight than for many of the comparable analyses conducted in the past.

37. As such we agree fulsomely with the peer reviewer who stated:

    I believe <u>some</u> quantitative analysis of key uncertainties is necessary to give policymakers a "confidence interval" for future emissions. With the exception of afforestation, the Chapter provides only a qualitative discussion of uncertainties. Alternative growth, commodity price (oil, milk, meat, log), exchange rate, and EV capital cost penalty scenarios would identify which assumptions are more important than others and give policymakers a range of potential outcomes that more effectively communicates the level of uncertainty than a single reference case. [6]

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[5] See cell B5 in the 'GDP' tab in the C-PLAN results dataset published online: "The Current Policy Reference case (CPR) was calibrated to match the GDP assumptions used in government emissions projections produced for the Fourth Biennial Report (2019)".

[6] Hafstead, M. 2020a. 'NZ Climate Change Commission Model Review, Part 1'. https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/reviews-for-website/Hafstead-Model-Review-Part-1.pdf

What happens in the Rest of the World *should* have implications for New Zealand: does it in the C-PLAN modelling?

38. While not discussed much in the draft advice, C-PLAN is a global model rather than a single-country one. New Zealand's interactions with the global economy are therefore captured by the modelling approach.

39. This is a real benefit of the EPPA-style model selected for the analysis, so it is surprising that there is no mention of any analytical findings related to Rest of the World climate change policy and its impacts on New Zealand.

40. Our understanding is that in the CPR and some of the years in some counterfactual scenarios, the assumed global carbon price is higher than the New Zealand carbon price.

41. This indicates that emission-intensive, trade-exposed New Zealand businesses do not face a competitive disadvantage from the proposed pathways to net zero. That is, competitiveness-at-risk effects are essentially assumed away through assumptions around the relative price of carbon between New Zealand and the Rest of the World.

42. We may be entirely wrong here and perhaps competitiveness-at-risk effects were captured within the model. But we simply don't know what's been assumed and how credible it is.

43. Greater discussion of these assumptions would enhance the transparency and credibility of the C-PLAN modelling.

Model closure choices seem to limit reported adjustment costs

44. In any CGE modelling exercise, the model closure choices are almost as important, if not more so, than the input assumptions. The closure of a CGE model refers to the elements that we tell the model about (exogenous variables) and those which we want the model to tell us about (endogenous variables).

45. There is very little information available on the model closure choices used in the C-PLAN work and their implications.

46. We do know the C-PLAN modelling assumes full employment in every period. This is fine for the long run – climate policy shouldn't determine labour supply in New Zealand.

47. But in the short run it also means there are precisely zero aggregate employment costs of reducing emissions beyond the CPR.[7] This seems unlikely if we're talking about decarbonising the economy, which entails implementing structural change on a large scale.

48. When aggregate employment is fixed, any labour market impacts must occur through changes to employment and real wages at the industry level. These were not reported in the draft advice or online as far as we know.

49. Alternative assumptions around labour market adjustment may present a slightly less rosy picture of the impact of climate policy on jobs. For example, we tend to use a sticky wage closure in our MDG6-NZ dynamic CGE model, so that short run impacts are felt mainly

[7] See for example Chisari and Miller (2015) https://publications.iadb.org/publications/english/document/CGE-Modeling-The-Relevance-of-Alternative-Structural-Specifications-for-the-Evaluation-of-Carbon-Taxes-Impact-and-for-the-Integrated-Assessment-of-Climate-Change-Effects-Simulations-for-Economies-of-Latin-America-and-the-Caribbean.pdf

through changes in employment, and long term effects mainly through changes in real wages.

50. Land use is also determined outside the model and imposed on it. This is not unreasonable. Incorporating realistic land use change within a dynamic CGE model is challenging.

51. But again, if aggregate land supply is determined exogenously, the impacts of climate change policy in the counterfactual must be through changes to land prices. These have not been reported.

C-PLAN industry impacts are determined largely by assumption

52. One of the key reasons for using a CGE model for climate policy analysis is that it is specifically designed to show how resources are reallocated across industries following changes in policy. It will show winners and losers.

53. Yet the report presented no industry results from C-PLAN. Those provided were from ENZ. As one peer reviewer noted[8], it's hard to understand why – that's precisely why you use a CGE model.

54. It appears much of the distributional impacts of getting to net zero has been determined outside of the C-PLAN model. That is, industry output was told to the model by assumption, rather than the model telling us about changes in industry output in response to climate change policy shocks.

55. From my review of the industry output by scenario results made available online, it seems that industry output for at least 17 of the 49 sectors in C-PLAN has been exogenously determined across the CPR and counterfactuals.[9] We appreciate that some of these assumptions are necessary to introduce new industries and technologies.

56. More industries (seven by my count) will be effectively constrained exogenously due to their very strong downstream linkages to these 17 exogenously assumed industries (e.g. dairy processing, meat processing, metal products, etc).

57. Again, this may all be fine. It's not unusual to get 'hands-on' with some industries in a complicated piece of CGE modelling. And Chapter 7 of the draft advice provides at least some support behind the industry assumptions in ENZ, which we assume are also used by C-PLAN.

58. But we have no clue from what's been reported to date whether relaxing any of these constraints would have any material implications for the adjustment paths to net zero, and their distributional impacts.

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[8] "I don't quite understand why much of the discussion in Chapter 12 is qualitative and doesn't present more C-PLAN results. What is the reasoning for this?" Hafstead, M. 2020b. 'NZ Climate Change Commission Model Review, Part 2'. https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/reviews-for-website/Hafstead-Model-Review-Part-2.pdf

[9] Beef and sheep farming (existing technology only); Beef and sheep farming with new methane-reducing technology; Biomass heat for horticulture (hor); Chemical, rubber, & plastic products including methanol Coal electricity; Electric heat for horticulture (hor); Hydroelectricity; Forestry, logging and related service activities; Fishing, fish farming and related services; Own-supplied household transportation electric vehicles; Horticulture, including wheat, barely, corn, oats, fruits and vegetables; Iron and steel production; Production and casting of copper, aluminium, zinc, lead, gold, and silver; Cement, plaster, lime, gravel, concrete; Dairy farming (existing technologies only); Dairy farming with new methane-reducing technology; Commercial road and rail transport with electric vehicles.

59. One peer reviewer hints at a similar point:

> *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.*[10]

Welfare and factor prices should be reported

60. As noted above, given the closure assumptions chosen around resources, we would expect changes in factor prices – and especially real wages by industry – to be reported. By not reporting them, you open yourself up to perceptions that they might not be palatable.

61. It is also highly unusual that no welfare metric results were presented in the draft advice or online. This was flagged by two peer reviewers but not acted upon.[11]

62. One reviewer noted that he would expect the welfare costs of getting to net zero to be around 1% larger than the GDP impacts reported.[12] This difference is not trivial for the narrative: a headline cost of 2% of GDP is quite different to a headline of less than 1%.

63. Because GDP is a limited measure of living standards, CGE models routinely provide results for Equivalent Variation, Real Gross National Disposable Income, Net National Income, household consumption, etc. – C-PLAN will be no different.

Modelling impacts out to 2050 is tough, but this is hardly the first time it has been attempted

64. The limitations of CGE modelling, especially over a 30-year projection period and when technological change is so uncertain, are well documented. Those limitations do not detract from the value of the modelling exercise, but caution should be taken when communicating the C-PLAN results.

65. In the almost 25 years since the Kyoto Protocol was signed there has been an average of more than one research report or academic article each year examining the impacts of climate policy on the New Zealand economy using CGE models.

66. There are several consistent findings from these reports – such as that mitigation in New Zealand is, from a global perspective, relatively expensive – but results vary because of slightly different perspectives, policy questions being asked, and modelling assumptions needed to answer specific policy questions.

67. It would have been excellent to see a more detailed comparison of the C-PLAN findings against the range of similar CGE studies that have been conducted in New Zealand or overseas – to understand if the C-PLAN results are consistent with other analyses, and if not,

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[10] Stroombergen, A. 2020b. 'Review of NZCCC Models and Modelling, Part 2'. https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/reviews-for-website/Stroombergen-Model-Review-Part-2.pdf (my emphasis).
[11] Stroombergen, A. 2020a. 'Review of NZCCC Models and Modelling, Part 1'. https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/reviews-for-website/Stroombergen-Model-Review-Part-1-v2.pdf and Hafstead, M. 2020b.
[12] Stroombergen, A. 2020b. 'Review of NZCCC Models and Modelling, Part 2'. https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/reviews-for-website/Stroombergen-Model-Review-Part-2.pdf

why not. The brief discussion in the draft advice was a good start but could be teased out further in the final report.

68. We would not have expected the C-PLAN results to be inconsistent with findings from other research because the C-PLAN modelling (and the other modelling in the Commission's suite of evidence) does not appear to have tackled any truly new ground, beyond adding new industries related to emissions-reducing technologies (which is a positive development).

69. Perhaps this assessment is overly harsh and there have been more modelling innovations in the C-PLAN work – but we simply don't know due to the lack of model documentation and methodological material presented to date.

70. From the existing research, and as long-time observers and modellers of climate policy, we suggest that any new modelling should tackle head-on the sorts of issues not well dealt with in past efforts. For us, this means:

    a. More attention to endogenous innovation responses to carbon prices (not simply imposing assumptions about rates of technological change).

    b. Greater focus on the impacts of alternative scenarios related to international coordination (as this affects international trade or the value of emissions).

    c. Explicit consideration of dynamic domestic policy responses to both costs and opportunities for mitigation (e.g. including a Climate Change Commission in the model, following a policy rule for managing mitigation at least cost).

71. The absence of novel analysis on the thornier technical issues is a missed opportunity in our view. We would have thought that this was the perfect process to tackle some of the more difficult issues not well addressed in prior modelling efforts (including our own). And given that a lot has been learned from the past it was about time for something new.

72. Perhaps these issues could be considered for future research efforts using C-PLAN or other models.

73. We would be happy to discuss any of the matters in this submission with you.

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