A Zero Carbon Act for New Zealand

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Introduction

The MfE Consultation refers to different possibilities for creating a Zero Carbon Act (ZCA). We believe that the best interpretation of the ZCA is the interpretation best-aligned with the Paris Agreement, and that this suggests the primary aim of the ZCA ought to be to cease New Zealand's contribution to global warming by the end of the 2040s.

1. Of the 3 options discussed in the Consultation Document, only #2 (or a closely-related variant) is consistent with an effective ZCA and our international obligations.
2. The Paris Agreement commits countries to "holding the increase in the global average temperature to well below 2°C above pre-industrial levels" with Article 4 specifying that this is accomplished through "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century[.]"
3. So the best interpretation of Zero Carbon is the point where NZ is creating no additional warming, having achieved a balance between emissions by sources and removals by sinks of greenhouse gases.
4. Reaching this point requires a) an accurate assessment of where it lies and b) the best possible allocation of resources in the transition,
5. Resources risk being seriously misaligned under the way gases have been accounted for to date. So we suggest an improved way of making this assessment, via GWP*.
6. Note that this would give the best alignment with the goals; and would solve the methane/ agriculture issue.
7. It also provides a solid basis for domestic policy choices. This submission outlines some potential options and avenues for further development. The basic thinking is compatible with a range of potential targets, and does not prejudge treatment of sectoral policies.

This submission accompanies the submission by Myles Allen et al[1], which discusses the scientific elements of comparing methane and carbon dioxide in the context of NZ's transition to the required zero position.

The Zero Additional Warming Point.

A related brief outlines the scientific dimensions of weighing methane vs greenhouse gases with much longer timescales. In this submission, we outline some suggestions for how policy might best reflect the differences between greenhouse gases (GHG) which have very

[1] Myles Allen, Michelle Cain, Dave Frame, Adrian Macey, *Methane emissions under a Zero Carbon Act for New Zealand*, submission to Zero Carbon Bill Consultation, July 2018.

different properties. Annual GWP* emissions show that if CH_4 emissions decline in the next decade, then this will amount to a cooling of the climate compared with recent decades. Climatically, declining methane emissions play the same role as forestry: they cool the climate. Given that there is widespread consensus that agricultural CH_4 emissions will remain stable or decline, then New Zealand's climate policy will be required to deal intelligently with cooling signals as well as warming ones. Well-designed policies now could head off bad outcomes or incoherencies late.

The Paris Agreement commits countries, collectively, "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change."

The simplest, and most consistent, goal for a country's contribution towards this collective aim would be to announce a plan for holding our warming contribution below some specific level, and to attempt to do so as quickly, efficiently and effectively as possible. This is why the Zero Additional Warming (ZAW) point would be an excellent fit with the Paris Agreement: because Paris is denominated in °C, a concrete, credible plan to limit our contribution in °C would align best.

Metrics in the UNFCCC

Under the Kyoto Protocol, the use of GWP_{100} was expected. Under Paris, the situation is much more fluid and open. Brazil are using GTP_{100}, and have indicated that they will continue to do so because it is better aligned than GWP_{100} with their over-arching principle of historical responsibility.

Despite suggestions by some officials that some countries' negotiators would take a dim view of New Zealand innovating on the issue of metrics, there is no standard practice. The over-riding concern of the environmental and scientific communities ought to be environmental integrity. This is also the principle that governs the use of metrics in this submission: we believe in innovative use of metrics because we it enables demonstrably more accurate and effective climate policy. It is our expectation that scientists would welcome a clear, innovative articulation of the stopping of further warming as the primary goal of New Zealand's climate policy.

Metrics and equity

Different countries have different interpretations of the ethical dimensions of climate change, and there is little consensus regarding competing claims.

It is true that use of GWP* would place strong penalties while CH_4 emissions are rising. Climate justice claims are usually predicated on priorities being given to the emissions of developing countries, so the development of these sectors is quite consistent with the usual claims of climate justice, even if increases in CH_4 emissions are generally very undesirable (especially where these are elements of enhanced food security).

However, GWP* is neither to the permanent disadvantage of developing countries, nor is it unfair: once mature, agriculture systems are not penalised for warming to which they are not adding. Furthermore, because GWP* better approximates actual contributions to warming, it is fairer from a global perspective than GWP_{100}, which permanently penalises those countries with relatively large agriculture sectors: GWP_{100} which would price developing countries' CH_4 emissions even where these are no longer contributing to warming.

Long-term global CH4 stabilisation

In the long term the world will need to have a conversation about what level of CH_4 emissions are sustainable in the context of climate policy; but this conversation is entirely contingent on what happens with CO_2 since cumulative emissions of the latter is the primary determinant of warming. Emissions of CO_2 need to become net zero for temperatures to stablise, and it is against this requirement that CH_4 emissions can and should be stabilised.

Given that CO_2 is the main event in climate policy, it seems a little backward to argue that the setting of CH_4 stablisation levels needs to precede CO_2 mitigation: in fact the evidence "implies a 'peak CO_2 first' strategy: the need to limit cumulative CO_2 emissions would over-ride most opportunities to offset CO_2 reductions against SLCP[2] [including CH_4] reduction measures until global CO_2 emissions are falling."[3] Furthermore, "earlier implementation of SLCP mitigation that substitutes to any significant extent for carbon dioxide mitigation will lead to a climate irreversibly warmer than will a strategy with delayed SLCP mitigation."[4]

Inevitably, there will be pressure to reduce CH_4 emissions from current levels before and potentially after temperature stablilisation has been achieved. At the point where global CO_2 emissions are net zero, it is difficult to see where policy should go next, but three choices seem possible: (1) stay there; (2) further reduce CH_4 (and other non-CO_2) emissions; (3) make CO_2 emissions negative. The politics of negative emissions may not resemble that of getting to zero emissions, because of the lack of an obvious focal point in the negative emissions case.

Pressures for these approaches are likely to come from different sources. Countries which experience impacts that follow temperatures may be satisfied with temperature stabilisation, since adaptation to peak warming implies that there are few further changes to adapt to. Those who need to adapt to changes which scale with the integral of forcing or integrated temperature change (such as SLR, glacier changes, and potentially some ecosystem impacts) would be expected to argue for further mitigation. At this point forcing could be reduced by mitigating CH_4 and other SLCP, or by drawing down atmospheric CO_2. A stocks and flows interpretation of New Zealand's inventory would allow us to tune our response at this point to the policies that emerge at that time.

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[2] "Short-Lived Climate Pollutants", which includes CH_4.

[3] Myles Allen, Short-Lived Promise? The Science and Policy of Cumulative and Short-Lived Climate Pollutants, Oxford Martin School Policy Paper, May 2015.

[4] Pierrehumbert, R. T. Short-Lived Climate Pollution. *Annual Review of Earth and Planetary Sciences* **42**, 341-379, doi:doi:10.1146/annurev-earth-060313-054843 (2014).

A cogent and comprehensive understanding of the implications of the warming implications of different potential interpretations of Zero Carbon needs to precede new commitments, or serious reputational risks may arise. Failure to do so may lead to perverse or demonstrably unfair outcomes at a sectoral level, and may lead to unnecessary reputational damage, domestically and internationally.

Working through A Zero Additional Warming target

Using GWP* numbers, we can the blue-green numbers to set our 2005 baseline. Below is a very rough sketch. Emissions of CH_4, denominated in GWP*, are on the vertical axis, and emissions of CO_2 are on the horizontal. The dark blue line is a possible set of 2005 emissions that would be GWP* equivalent. New Zealand is at the aqua dot on the line, at the bottom right.[5]

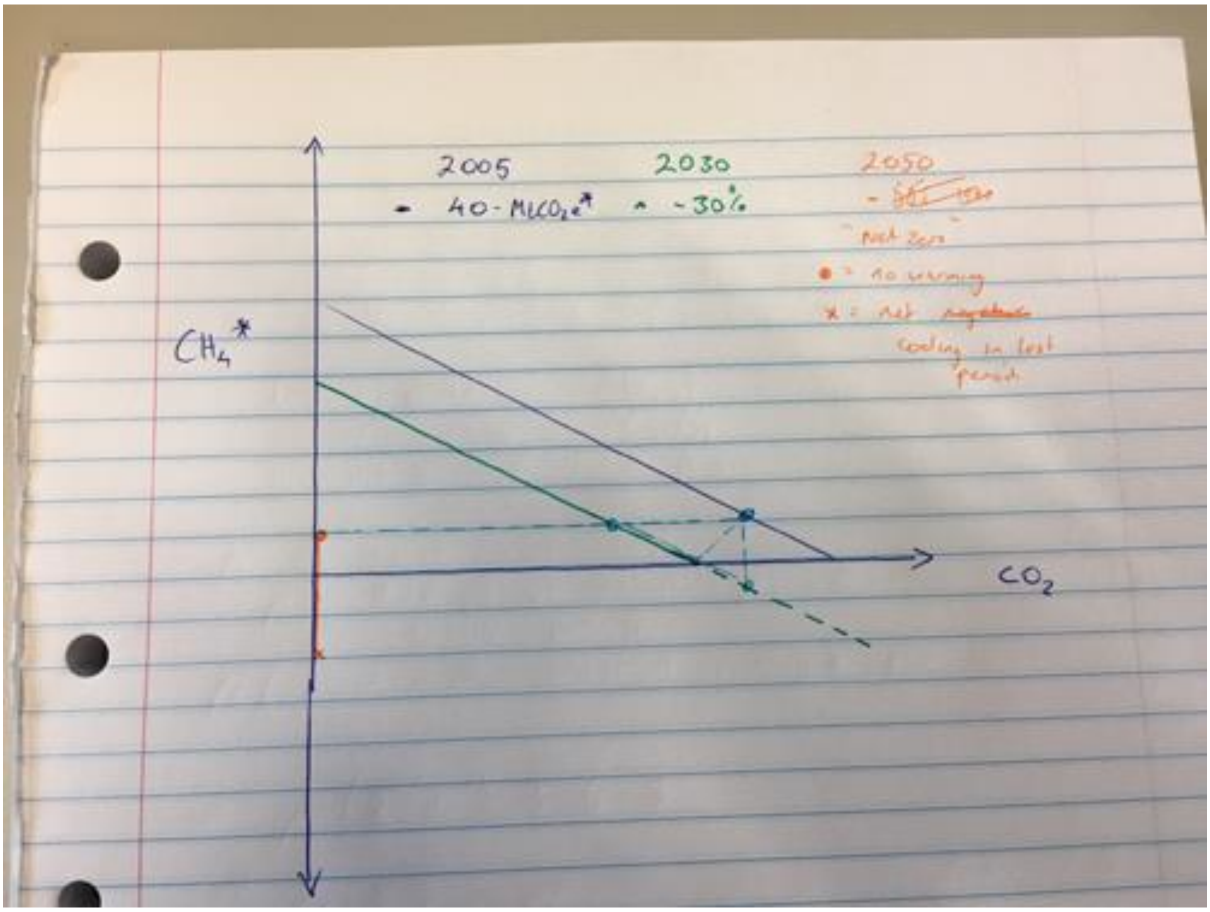

Figure 1: Sketch showing CO2 and CH4 under GWP* equivalence, as well as a -30% target by 2030 (green line) and potential mixes of approaches which amount to satisfying the 2030 NDC in GWP* equivalence. Achieving the orange circle – through entirely mitigating CO2 and stabilising CH4 emissions – would (to a good approximation) halt further warming. Moving to elsewhere on the orange line would reduce warming on current levels.

We have pledged to reduce emissions by 30% on 2005 by 2030. This amounts to moving to the green line. We could either get there by doing it all with CO_2 (the horizontal dashed line) or by doing some using CH_4. In theory we could do it all using CH_4 (vertical dashed line), which would involve significant CH_4 emissions reductions, and no CO_2 reductions. This

[5] For simplicity, this neglects N_2O. N_2O is a stock gas like CO_2, so "equivalence" is far less problematic for N_2O than is the case for CH_4.

would leave us more to do in the next period. (This option should be the most objectionable to environmentalists, since it would fall into the trap of leaving behind an “irreversibly warmer world” than we need to by focusing on the wrong bit.)

If we then set a net zero warming target for 2050, we would need to get to the orange circle on the axis (ignoring second order effects for now). If we wanted to offset some of our previous warming, or to have cooling in the final period, we could be at the orange cross, in which case we would have reduced CH_4 emissions as well as eliminating CO_2 emissions. Again, going above and beyond what Paris demands ought to be something future New Zealanders decide; but it would be quite consistent with a sensible, practical GWP*-based approach, in my view.

If we assume that sectoral fairness dictates everyone has to do some mitigation, then we move mainly on CO_2 but we also shadow the decline on CH_4, and arrive at the interior curve as intended. If we reduced our CH_4* emissions to zero, and our CO_2 emissions such that we get to the horizontal axis, then we would be at the aqua point where the horizontal axis intersects the green line. That would be one way of using GWP* in fulfilment of our NDC. The point is that GWP* gives a way of creating a scientifically defensible mix of emissions reductions targets for CH_4 and CO_2, and it needn't necessarily involve corner solutions. Exactly where we land on the green curve ought to be the result of domestic political and social negotiations between sectors.

In terms of farmers getting credit for emissions reductions: that depends on the allocation aspects of policy design. The government could, via a process like the one above, specify a rate at which CH_4 emissions need to reduce to complement the CO_2 reductions at the heart of our climate policy. That's a legitimate conversation regarding sectoral fairness in climate policy. Then the government could tax farmers if they have not reduced at that required rate, and reward them if they have exceeded it, and leave them alone if they have simply reduced emissions in line with it. There are other ways it could work in practice, but I don't see why that is in principle unworkable or unwieldy or too complex or whatever. Farmers already deal with numerous regulatory obligations. This would be one more.

Businesses deal with a great many regulations and obligations already. They pay several flavours of tax/surcharges/prices. They need to avoid multiple sorts of pollution, and to ensure (multi-dimensional) health and safety outcomes. I don't think the development of policies around this approach would be at all onerous, and doing so would have the advantage of superior environmental integrity and fairness on an issue that matters to New Zealand.

Climate policy levers and the stock and flow distinction

This section discusses emissions sources, sinks and mitigation investments in terms of a “stocks and flows” distinction. Scientifically, the aim here is to discuss how different potential mitigation investments could fit within a coherent policy framework. The best (i.e. most scientifically accurate) way to compare gases within an emissions reduction or emissions target framework is via GWP*.[6]

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[6] Allen, M. R., Shine, K. P., Fuglestvedt, J. S., Millar, R. J., Cain, M., Frame, D. J., & Macey, A. H. (2018). A solution to the misrepresentations of CO2-equivalent emissions of short-lived climate pollutants under

Our intention is to offer a scientifically strong, intellectually coherent framework which can underpin New Zealand's climate policy. Without a coherent approach, there is a risk of using a stock-flow distinction in some parts of climate policy without applying the distinction consistently, which may lead to unintended consequences, misallocation, and reputational loss. In terms of the first-order elements of climate mitigation policies, the matrix of possibilities for New Zealand can be represented as:

Stocks	Flows
Domestic CO_2 emissions	
	Domestic CH_4 emissions
International CO_2 purchases ←------→	International CO_2 purchases
Permanent forests ←-------	Temporary forests

Physically, we can in principle offset our stock CO_2 or N_2O emissions via the things in the left-hand column, and we can in principle offset our flow GHG emissions, such as biogenic CH_4, via the things in the right-hand column. All the things in the right-hand column are ways of temporarily addressing domestic climate obligations, but they do not address the need to reduce domestic CO_2 emissions. They may be ways of meeting (in a given period) obligations to reduce CO_2e emissions, or our radiative forcing perturbation to the climate. Dashed lines represent those elements that could be placed either in the stock box or the flow box, depending on other policy settings, as well as customary practices, norms and choices.

Climate policy is, in the first instance, about reducing CO_2 emissions to net zero. Permanent forest sinks are well-matched with this goal. International CO_2 emissions reductions could be, if the international accounting system were able to digest these as permanently buying down a country's emissions, such that the initialization of the next period would include those reductions, carried forward, instead of the domestic emissions inventory data.

But in essence flow sinks/reductions either counteract the where we haven't achieved our targets on LLCPs. They will be required as long as we emit significant net positive CO_2, since that condition is sufficient to require ongoing LLCP emissions reductions.

Stock and Flow pollutants

As we have seen, methane is a flow pollutant and CO_2 a stock pollutant. The difference is shown in the figure below: flow pollutant emissions do not persist, so emissions in period one, and the same emissions in period two lead to a constant amount of the pollutant in the atmosphere (or river, and so on). With stock pollutants, concentrations of the pollutant accumulate as emissions continue.

ambitious mitigation. Npj Climate and Atmospheric Science, 1(1), 16. https://doi.org/10.1038/s41612-018-0026-8

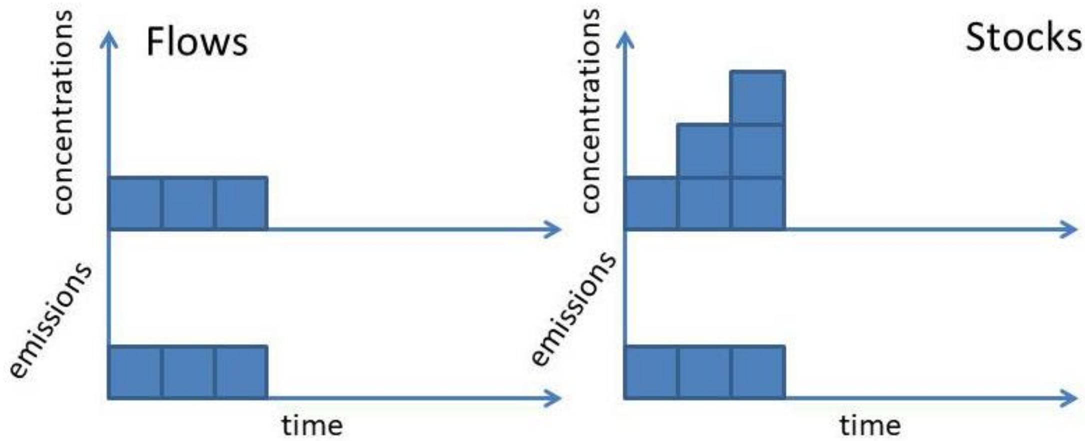

Figure 2: Flow and stock pollutants over time. In the first period, one unit of each pollutant is emitted, leading to one unit of concentration. After each period, the flow pollutant decays, while the stock pollutant remains in the environment.

The economic theory of pollution suggests different approaches for these. The marginal social cost of flow pollution is constant over time, if the next unit of pollution is just replacing the last, recently decayed unit, and if the economic valuation of the pollution is unchanged. If these conditions hold, the optimal price on flow pollution is constant over time. This justifies a constant price on flow pollutants.

In the case of stock pollutants, the marginal social cost of pollution increases with constant emissions as concentrations of the pollutant rise. If various conditions hold, this justifies a rising price on stock pollutants. Conceptually, there is a difference to note between fossil methane and biogenic methane: the former contains both flow elements (while it is methane) and stock elements (since CH_4 oxidises to CO_2); the latter is, in essence, a flow pollutant since $CO_2 \rightarrow CH_4 \rightarrow CO_2$ via the cycle of photolysis, digestion, emission, oxidisation. In this case, no new CO_2 is added to the atmosphere. For many parts of the world, "methane" refers predominantly to fossil methane from gas wells, while in many other parts of the world.

It is a necessary condition of achieving the aims of the Paris Agreement to hold global temperatures to under 2°C more than pre-industrial levels that net CO_2 emissions decline to zero.[7] This is not the case with biogenic CH_4 and other SLCPs. To stabilise temperatures, emissions of these species do not need to get to zero, but they do need to stablise.[8] So, under reasonable biogenic CH_4 emissions imply a flat social cost, and CO_2 emissions a rising social cost. Therefore, the two should not be pegged.[9]

[7] In principle the same is true of the other stock GHG like N_2O and SF_6.
[8] Fossil methane does, in principle, need to get to zero, since it is a new source of CO2.
[9] One defence of pegging could be the interpretation that in the first period, agricultural methane producers receive a certain amount of free allocation. Over time, pegging could imply that they are paying for a larger and larger share of their emissions. But this should saturate when they get to 100%. Beyond that point, their costs should no longer rise. So that defence of pegging fails beyond a certain point, and that point is set by the initial choice to say that agricultural emitters only pay for x% of their pollution.

At the same time, there is a question about the setting of initial prices for N_2O and CH_4. As with CO_2 prices, there is a wide range of strategies and approaches that could be taken. The first-best solution would be to charge the social costs of the different pollutants, though of course we argue that the prices associated with CH_4 should be calculated in a way that reflects the essentially flow nature of the pollution.

However, there are arguments from fairness that New Zealanders should not face a price on carbon (and other climate pollutants) that is radically higher than those prices faced by people in other developed countries. One approach that could be attractive from a sectoral equity perspective would be to draw on the available literatures on the social cost of carbon (or methane) and set the prices for N_2O and CH_4 at the same fraction of the social cost of carbon that CO_2 emitters feel through the ETS. So if the social cost of carbon is very roughly $80/tonne, and our ETS has a 2018 price of $18, then this implies a cost fraction of 18/80=0.225. A recent paper argued that the social cost of N_2O emissions was approximately $6,000/tonne for N_2O.[10] Making N_2O emitters fact the same fraction of the social cost of N_2O as is faced by CO_2 emitters implies a cost of around $1350/tonne of N_2O for a tax or an ETS price. The same argument could be applied to prices for methane – actual taxes or market prices could (temporarily) be lower than those dictated by first principles, on the basis that all sectors should face similar (fractional) burdens.

Options for forestry

Forestry could be treated either through the stock instrument, or through the flow instrument, or in both, depending on the forest.

A stock treatment of all forests could involve treating sinks as permanent, and then requiring the same price on emissions from forestry logging as would be incurred if the same quantity of CO_2 were released from a fossil source.

An alternative would be to treat permanent forests as stocks, and plantation forests as flows. A flow treatment of plantation forests could involve treating all sinks as temporary, whereby some payment is made for offsetting biogenic methane emissions. Permanent forests would be treated as stock sequestration. Potentially, this would place a lot of pressure on the regulatory scheme, and potentially on price mechanisms, too, since opportunities for arbitrage between the stock and flow instruments would be expected simply through naturally occurring volatility. Arbitrage could be discouraged by the imposition of large fees[11] for the conversion of forests from one type to another, especially for the conversion of “permanent” forests into plantations.

Forestry can go in either column, because some forest carbon sequestration is permanent (permanent forests, as well as the flux of carbon from forests that is permanently retired into the soil) and some is temporary (that which is sequestered in one period and then released to the atmosphere following the felling of plantations and the processing of wood

[10] Stephanie Waldhoff, David Anthoff, Steven Rose, and Richard S. J. Tol (2014). The Marginal Damage Costs of Different Greenhouse Gases: An Application of FUND. Economics: The Open-Access, Open-Assessment E-Journal, 8 (2014-31): 1–33. http://dx.doi.org/10.5018/economics-ejournal.ja.2014-31

[11] These fees could vary with the price of carbon so as to stay ahead of potential arbitrage gains.

products). If we were to create two instruments, then we should try to understand the relative roles of permanent and the temporary sequestration of carbon in forestry.

In the spirit of the stocks and flows discussion above, new plantation forests would warrant an initial payment during the first rotation, because that is new sequestration, but no further payments during subsequent rotations, since in this case the stock of carbon sequestered is alternately released and re-sequestered as the plantation is harvested and re-grown. So there would be payments in the first period but not in subsequent periods. Two exceptions to this could be justified: (1) if, after harvesting, some measured fraction of the carbon sequestered during the previous growing phase were sequestered permanently in the soil and; (2) if some measured fraction of the carbon stored were permanently stored as long-lived harvested wood products. Each of these would amount to additional permanent carbon sequestration, additional to the temporary sequestration inherent in the plantation's cycle of growth and harvesting.

Options for methane

Biogenic methane is a flow pollutant, and fossil methane is not. Reducing biogenic methane can reduce our CO_2e burden, and meet obligations, but from a physical point of view does not alter the centrality of reducing (net) CO_2 emissions to zero as the main object of climate policy.

We could address biogenic methane by pricing it according to a range of strategies. One way is to use separate treatments for stocks and flows. Other approaches based on a range of price-equivalence strategies are sketched in the appendix.

Two instrument approaches

1. Separate out CH_4, plantation forestry, and create an exchange rate between the two based on the warming effects of the two over 30 years.
    a. Pros: Avoids the use of an explicit metric but reflects the stock/flow nature of different pollutants/sinks.
    b. Cons: Will be challenged by those who have strong faith in allocative efficiency gains associated with multi-gas instruments.
2. Sectoral targets, including a land-sector target which would imply xMt CH_4 and –yMtC sequestered through forests so that the net radiative effects of each sector were to drop by some specified percentage.
    a. Pros: Avoids the use of an explicit metric but reflects the stock/flow nature of different pollutants/sinks.
    b. Cons: Will be challenged by those who have strong faith in allocative efficiency gains associated with multi-gas instruments. Sets, rather than backs out, sectoral targets. Is this the role of government?

It should be noted that anything other than a GWP_{100}-based approach will require significant support from scientists abroad to show that the approach is scientifically reasonable, i.e. has environmental integrity. We need to be able to show that we are acting consistently with the best climate science, and meeting our existing obligations.

Any option that creates a separate price instrument for CH4 would require an allocation strategy. There are many ways this could be developed, but one relevant and practical precedent, first discussed by Geoff Lewis at the Productivity Commission, is to mirror the approach taken in New Zealand regarding fisheries. Here there is a national cap set through a Total Allowable Catch (TAC), and this is then allocated via Individual Tradeable Quotas (ITQs). An analogous system could be developed in which we set a national cap on methane (Total Allowable Methane or TAM), and this is then partitioned via Individual Tradeable Methane Quotas (ITMQs). Initial allocation of ITMQs could be via some combination of grand-parenting and auctioning. Experience with fisheries provides a reasonable guide to the sort of ethical, social, political and economic considerations that would need to be addressed in such a scheme, though other arrangements are also possible – the mix between auctioning and grand-parenting is clearly an issue on which there will be many views; and as in all of New Zealand's resource allocation issues, Treaty of Waitangi obligations are an important consideration, but this ought to be equally true of any attempt to extend climate policy.

Single instrument approaches for methane

GWP_{100} options

1. Put CH_4 in the ETS at GWP_{100} (= 29, or latest IPCC estimate).
    a. Pros: This is probably the "default" way of going, given developed world practice, since this approach is used for fossil methane in the EU ETS. But since no one actually has agricultural emissions in their ETS, its status as "default" is unreflective and untested, as well as demonstrably scientifically suboptimal.
    b. Cons: Lots of cons. GWP_{100} lacks strong physical justification as an exchange rate between the effects of CH_4 vs CO_2. Lack of precedent in this sector elsewhere, and other agricultural exporters are unlikely to follow this practice. If we do this, there's a risk we will take on an onerous and isolated position, that may be costly to unpick. Andy Reisinger and Adolf Stroombergen showed that the worst outcome for NZ, in terms of GWP or GTP comparisions, is if we go GWP and no one else does anything (or settles on GTP). But this is, on current trajectories, also the most likely outcome, so it should be avoided.
2. Put CH_4 in the ETS at 29 (or latest IPCC estimate) with a transition phase, or with farmers only paying some fraction of their "obligation".
    a. Pros: Precedent in terms of using GWP_{100}; precedents in terms of partial obligations.
    b. Cons: Unhappy compromise, since it appears to imply that GWP_{100} is the "right" way to compare gases (which is not obviously the case) but then it implies that farmers aren't paying their "full" share. So it leaves the implication that it's a weak policy and that agriculture isn't doing its bit, while simultaneously charging farmers for warming when they may, if they are reducing their CH_4 emissions, actually be cooling the climate. I don't see how this would amount to equitable policy on any measure, or how it would be intellectually defensible.

GTP100 options

3. Put CH_4 in the ETS at 5 (or latest IPCC estimate).

a. Pros: About as much justification as GWP_{100}. Approach could be popular with other agricultural exporters, such as Brazil and other Latin American countries. Politically feasible domestically.
b. Cons: likely to be politically challenged as self-serving by some European climate people, who have threatened to go after New Zealand if we innovate around metrics. There would have to be a clear scientific demonstration that our intentions/INDCs remain at least as stringent as they currently are.

GWP options*

4. Flat option: Farmer has emitted the blue line in figure 1. The counterfactual is the purple line, along which he does not add to climate change. If he moves to the orange line, he receives a payout because he has lowered warming. The payout/charge a farmer receives in a given calendar year would be proportional to the emission changes across the preceding N years – whereby each of these previous individual years would be considered in isolation, treated as an instantaneous change in emissions under GWP*, followed by a constant emissions profile thereafter. The charge/payout for each of these discrete years would be then multiplied by 1/N, before the sum is taken across N years.

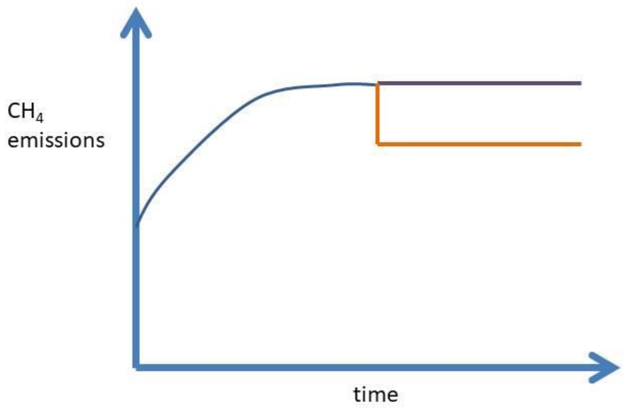

Figure 3: The Flat Option.

5. So if a dairy farmer sold off his herd overnight, the payout of this would be spread evenly over a period of N years. The implications of the fact that the last 20 years of methane emissions have not been flat. If, in a hypothetical scenario, if there was a change to a GWP* framework for emissions trading, then the preceding 20 (or so) years of emissions might suddenly become relevant. Though, as a corollary to the suggestion I've made above, a GWP*-based system could actually be phased in from today, with the first twenty years of the new system just taking into consideration only those X years since 2017.
   a. Pros: Reflects fact that stable methane emissions do not warm the climate.

b. Cons: Pays farmers for reducing pollution; which is a different approach to that taken elsewhere/within ETS. Seems overly generous to farmers, and has very strong grandparenting allocation

6. Rampdown option. Farmer has emitted the blue line in figure 1. The counterfactual is the purple line, along which he does not add to climate change. If he moves to the orange line, he receives a payout because he has lowered warming. But, policy specifies that methane emissions are expected to reduce over time, so the blue line points downwards. Farmers are penalised if they reduce at slower than that rate, rewarded if they go faster than that rate. Payout/fine depends on the progress of the orange line against the purple line.

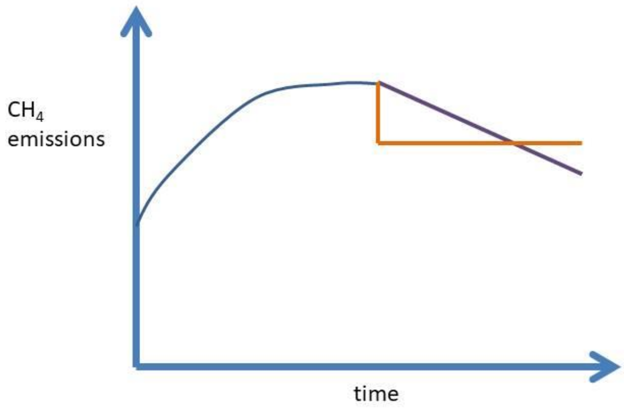

Figure 4: The rampdown option.

a. Pros: reflects stocks vs flows distinction used immediately above. Probably more financially sustainable and less vulnerable to the claim that farmers are claiming pollution rights in perpetuity, while others do not have those rights. Allows for methane reductions to be part of policy expectations.
b. Cons: single-instrument approaches face the issues about prices detailed in section above on stock and flow pollution; but then this is true of all the above single-instrument options.

The role of international markets in mitigation

Markets could be seen as stocks or flows. Buying permanent reductions overseas is a permanent reduction in CO_2 emissions. Biophysically, it is reducing stock emissions against a baseline, just as domestic stock emissions reductions are. From the perspective of developed country national mitigation, the question of which column to put this in depends on the international norm: if the international norm is constructed around getting domestic emissions of CO_2 to zero, then these credits are, in effect, a flow, since they meet emissions reductions obligations in the period in which they are purchased, but they do not lower the future obligation to reduce domestic emissions. If the norm were that countries' emissions reductions outside their borders were permanently counted against their baseline emissions, then these would amount to CO_2 emissions reductions at home. This would imply that future baselines consider not New Zealand's net or gross emissions, but our net or gross emissions minus the CO_2 emissions reductions we have created elsewhere. It is reasonable to expect that countries' domestic emissions will continue to form the baseline, so we have put international credits in the flow column. If this norm changes, then it should go in the stock column. Either norm is scientifically defensible, as long as the accounting behind it is coherent and has environmental integrity.

Conclusion

We have attempted to sketch out a range of policy options that fit well with the latest science in terms of comparing diverse gases, and which represent a good alignment with the Paris Agreement.

New Zealand has an opportunity to develop innovative policy around relevant stock and flow sources and sinks; and this in turn can give greater clarity and better guidance for other countries about the most scientifically defensible interpretations of Article 4 of the Paris Agreement which refers to the means to achieving temperature stabilisation involving “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases.”

The scientific material in the accompanying submission from Allen et al is compatible with single- or multi-basket approaches, and we have sketched options for both. Irrespective of the number of baskets, policy needs to take account of the flow nature of some sources (agricultural CH_4) and sinks (plantation forestry), and the stock nature of other sources (CO_2 emissions) and sinks (permanent native forests). The most important thing is that New Zealand's climate policy should be characterised by a high degree of environmental integrity; a property on which traditional GWP_{100}-based approaches fall short.

Finally, we reiterate that a full analysis regarding these issues ought to be conducted before any new NDC is announced. The most obvious next step is to evaluate New Zealand's existing NDCs through a stock and flow lens, and with a view towards developing potential transition plans. The development of new options and the thinking through of new policy options will assist planning towards just, low carbon transitions, and this will only bolster the credibility of future NDCs.