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1.0 Backgound

I am a self-employed consultant for Cranston Consulting LTD. I specialise in dairy farm systems and am also an expert in the use of Overseer and nutrient budgeting. I have long held an interest in climate science and have built up my knowledge over a number of years by reading scientific papers and talking to experts.

2.0 Key Points

2.1 NZ agriculture would benefit from establishing a scientifically robust ETS that models 'net' Methane and N2O emissions and CO2 sequestration. This model will more closely align with the true warming effect from agriculture than the current GWP100 model.

2.2 The Global community will not abandon the GWP100 metric. NZ would be best served by using a 'net' Methane metric for its internal ETS and product marketing purposes, but also convert the data to GWP100 for international reporting. The actual effect at the farm level will depend on incentives/tax and mitigations so the metric itself will not affect emissions.

2.3 The dramatic drop in sheep numbers largely offset an increase in dairy cow numbers and result in a minor 5.1% increase in enteric methane emissions since 1990. It is only this small increase of Methane that is contributing to warming since 1990.

2.4 The UN defines climate change as a "change in atmospheric concentration". Our ETS should follow the UN definition and model Methane on a 'net' (inflow vs outflow) basis.

2.5 Stock numbers in NZ are levelling off due a variety of reasons, Regional Council regulations, retirement of pastoral land, economic factors etc

2.6 If NZ agriculture can get Methane emissions to 'net zero' they can legitimately claim to have stopped any global warming from Methane (subject to Andy Reisinger's adjustment)

2.7 The other 17% of emissions come from Nitrous Oxide which is a long-lived gas and would need to reduce to zero to stop global warming. It is hypothesised that N2O emissions could be offset by on farm CO2 sequestration in trees.

2.8 Move to individual farm GHG modelling using Overseer. Incentives should be offered for reducing GHGs and a tax levied for increasing them. This will lead to more positive change on farm and a better result for the climate.

Potential Goal for NZ Agriculture:
'NZ Agriculture is committed to being Carbon/Nitrous Oxide neutral with no increase in atmospheric methane volume since 1990 when the IPCC was created"

If NZ agriculture can achieve this goal, they would be second only to the forestry industry in helping managing climate change. CO2 emitters would have to sequester all their cumulative emissions since 1990 to achieve a similar result for the climate.

3.0 Issues Paper Questions

3.1 Q1- How can the Commission add the most value in this inquiry?

3.1.1 The agricultural industry would benefit significantly if the Commission took a holistic approach to this subject and viewed it from a NZ inc perspective. NZ agriculture has the potential to become one of the few major exporters to be 'warming neutral' and in fact we are likely there already if the warming effect was to be calculated for 2018. This would offer major advantages to our products in the international market place.

3.1.2 One of our biggest competitors in future years is expected to come from lab produced protein makers, they already use climate change as a reason for buyers to avoid natural products. If an ETS is created which locks in the GWP100 accounting system, synthetic protein makers will be able to use NZ government data as a reason to not buy our products.

3.1.3 The GWP100 accounting system has no direct correlation to warming and is very mis-leading given NZ's current GHG emission flows. The commission should look for metrics which accurately reflect warming as this is a strategic advantage for NZ agriculture and the entire NZ economy. Metrics which attempt to reflect warming will also help inform the public about where the continued warming is actually coming from and help our country better target these emissions. If the goal is to limit warming to 2 deg C, we need to focus on emissions which are bringing us closer to that ie CO2.

3.2 Q2 - What other approaches would help identify opportunities to effectively reduce emissions?

3.2.1 There is some great work being done on agricultural GHG mitigation options, this should be supported.

3.2.2 The use of Overseer (or similar model) to create an individual farm GHG budget is the only way to place incentives/disincentives around Methane and CO2 sequestration from trees. Taxing farmers on a 'kg of product basis' will simply act as another levy with no signal for on farm behaviour change. If a robust model is created, farmers will be able to model different management scenarios and use that information for strategy decisions.
-What effect will planting those back paddocks in trees have on our ETS payments?
- Should we increase cow numbers or try and get more from the cows we have?
- Will reducing stock numbers make us more profitable?

3.2.3 A suitable technology for assessing woody vegetation on farms should be developed. High resolution satellite imagery may be sufficient. This information could then be cross referenced by on farm consultant visits (Regional Council Farm Environment Plan visits?) for height, if its actively growing, what species etc and entered into Overseer to create a true whole farm GHG model. If animals are taxed under the ETS but no credit is given for on farm CO2 sequestration, farmers may get disillusioned and not buy into the value of GHG reduction.

3.3 Q3 - To what extent is it technically and economically feasible to reliably measure biological emissions at a farm level?

3.3.1 This will entirely depend on the robustness of Overseer (or similar tool) for this purpose. If the model is of acceptable standard, the additional cost to create an on farm GHG model would be minimal. Most farms in NZ will have an Overseer nutrient budget already with the number ever increasing due to Regional Council regulations. Nearly all the relevant data is already being entered for nutrient management purposes. Some minor alternations to data input and data collection may be required.

- Increased information around effluent system and management (this has a significant effect on GHG model)
- Specific management blocks to be set up for various classes of trees (pines, scrub, native). Overseer would need an upgrade to process this information.
- Fonterra (and other) dairy diaries should be reviewed to reflect any other specific information required for GHG modelling.

3.3.2 A model such as Overseer will have significant advantages over a more simplistic National GHG Inventory approach. The main one being it offers the farmers continued opportunity/incentive to improve management. Different feeds will create different methane outputs, this signal should be created for farmers to base decisions on.

3.4 Q4 - What are the main opportunities and barriers to reducing emissions in agriculture?

3.4.1 The opportunity here for NZ agriculture and NZ as a whole is significant. What is required is some vision and open mindedness and NZ could be selling our products internationally as 'warming neutral'. The obvious advantages of doing this will help achieve farmer buy in and get more positive change at the farm level.

3.4.2 This opportunity relies on finding a suitable metric to be used for Methane which accounts for changes in atmospheric concentration and can pick up warming/cooling trends over time.

3.4.3 Given Methane inflows are only 5.1% ahead of 1990, and when the 12-year atmospheric life of Methane is taken into account, the goal of getting atmospheric volume of CH4 back to 1990 levels and holding it there long term is easily achievable. Having such a realistic goal such as this will help motivate farmers to succeed.

3.5 Q5 - What are the issues for government to consider in encouraging alternative low-emissions land uses?

3.5.1 The most important issue has to be, 'will this stop further warming'? If the government uses GWP100 accounting to base land use decisions on then it will lead to unintended consequences. Many dairy farms which now have stable stock numbers are not warming the planet (from Methane). The GWP100 metric may encourage major land use change at a significant cost to the NZ economy due to a fundamental bias against steady flow CH4 emissions. The science says a steady state farm only needs to achieve a minor CH4 reduction to be warming neutral. What would be the justification for land use change given 80% of farm emissions are CH4?

"To achieve a stable temperature, the stock of atmospheric short-lived gases must continue to decrease very slightly over time. This is because recent research shows that a very minor ongoing warming effect occurs after atmospheric concentrations of CH4 have stabilised" (Andy Reisinger, pers. comm. 27 January 2018)

3.6 Q7 - What policies, including adjustments to the New Zealand Emissions Trading Scheme, will encourage more sequestering of carbon in forests?

3.6.1 The main barrier is the lack of incentive. Farms should be regularly assessed for woody vegetation cover and given incentives to increase the area. The current rules do not incentivise shelter belt planting, hill side stabilisation planting, riparian planting, native bush regeneration etc. A better method should be created using satellite imagery (or other technology) to calculate total CO2 sequestration from all trees on a property.

3.6.2 Carbon credits should be allocated for all (actively growing) trees on farmland. This can be used too offset other GHG losses from the farms.

3.7 Q37 - Should New Zealand adopt the two baskets approach? If so, how should it influence New Zealand's emissions reductions policies and long-term vision for the future?

3.7.1 I support the two-basket approach, it is the only way to treat short and long-lived gases the same with regards to effect on the climate. Option 3 is the best approach because it monitors changing atmospheric concentrations, as pre the UN definition of climate change.

Option 3: Split target (gas-based)

- **Target 1**: Reduce total long-lived gas emissions to a certain percentage below a reference date by a specified future date (eg, to 50% below 1990 levels by 2050)
- **Target 2**: Stabilise short-lived gas emissions by a specified future date (eg, 2030)

3.7.2 I would highly recommend NZ agriculture use the target of net zero N2O and CO2 emissions and CH4 stabilised at the 1990 atmospheric volume. This goal will allow NZ agriculture to target being warming neural. If CH4 is stabilised at 1990 levels then NZ agriculture has effectively limited warming from CH4 to what they were in 1990, when the IPCC was created and people started learning about climate change. To go beyond this date would be penalising farmers for something that had no way of anticipating. N2O emissions

and any remaining net increase in CH4 emissions would likely be offset by CO2 sequestration from on farm trees (if measured more accurately). If this true GHG balance is used, NZ agriculture is not likely to currently be warming the planet. The only way to prove this significant fact is with the two-basket approach and more specifically Option 3.

3.7.3 The GWP100 metric will distort both public perception and potential ETS payments for agricultural Methane. Using the Sheep and Beef sector as an example, they have reduced CH4 emissions by over 6,200 kt CO2 -e since 1990 (Table 5.2.1). In real terms, a significant drop in atmospheric methane volume such as this would create a cooling trend relative to 1990. Very few people understand this as emissions are always quoted in GWP100 which still assigns a warming value to the remaining 13,893 kt CO2 -e of emissions from the sector. Sheep and Beef farmers will be responsible for millions of dollars in emissions (as per) CO2 equalivents while they contribute no year on year warming at all. This would be a fundamental flaw in the ETS and would treat farmers disproportionality as compared to actual warming. The atmospheric volume in 2018 will almost certainly be less than in 1990, so this sector would also not meet the UN definition of contributing to climate change. Unfortunately, the general public, product buyers and indeed most S&B industry representatives have no understanding that GWP100 does not correlate to warming which has impeded an honest discussion on agricultural emissions.

Table 5.2.1 Trends and relative contribution of enteric fermentation from livestock categories between 1990 and 2015

Livestock category	Emissions (kt CO_2-e) 1990	Emissions (kt CO_2-e) 2015	Change from 1990 %	Change from 1990 Difference (kt CO_2-e)	Share of Enteric fermentation category 1990 %	Share of Enteric fermentation category 2015 %	Share of total Agriculture sector 1990 %	Share of total Agriculture sector 2015 %
Dairy cattle	5,951.6	13,665.3	129.6	7,713.7	22.3	48.6	18.0	35.6
Non-dairy cattle	5,737.5	5,198.6	–9.4	–538.9	21.5	18.5	17.3	13.5
Sheep	14,361.3	8,695.0	–39.5	–5,666.3	53.8	31.0	43.4	22.6
Deer	415.6	489.2	17.7	73.6	1.6	1.7	1.3	1.3
Minor livestock	249.5	42.6	–82.9	–207.0	0.9	0.2	0.8	0.1

Note: Percentages presented are calculated from unrounded values.

3.7.4 The government is not currently measuring atmospheric volume of CH4 and has no agreed method of doing so. The UN requires we measure changes in atmospheric concentration if the emissions are to be defined as 'contributing to climate change' (UN definition below). I have been in contact with both MFE and MPI, neither of which could provide me an atmospheric CH4 volume/concentration for NZ agriculture. Without this information it is impossible to know if the atmospheric concentration is changing. The Government must start collecting and publishing this information.

2. "Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

3.7.5 An appropriate method in my view would be to combine the last 12 years accumulated CH4 emissions (Methane survives on average 12 years in the atmosphere). When this is done, the net change in atmospheric CH4 volume and N2O emissions in CO2-e would only require 106,000 ha of actively growing forest to offset (workings below). This would, subject to minor feedbacks being taken into account, mean NZ agriculture would have net zero GHG emissions and net zero warming as of 2016. The main unknown in this calculation appears to be the value that should be placed on CH4 for each year it exists in the atmosphere. The GTP1 figure of 120 x the potency of CO2 for all 'net' Methane seems to match most research I have viewed, this point should however be open to further discussion.

Year	Emissions (kt CO_2-e)		
		1 CO2 eq	120 CO2 eq
1990	"34,182.62"	1367.3048	164076.576
1991	"34,464.07"	1378.5628	165427.536
1992	"34,008.38"	1360.3352	163240.224
1993	"34,143.41"	1365.7364	163888.368
1994	"35,146.20"	1405.848	168701.76
1995	"35,657.84"	1426.3136	171157.632
1996	"36,032.43"	1441.2972	172955.664
1997	"36,870.41"	1474.8164	176977.968
1998	"35,970.91"	1438.8364	172660.368
1999	"36,198.64"	1447.9456	173753.472
2000	"37,328.43"	1493.1372	179176.464
2001	"37,704.21"	1508.1684	180980.208
2002	"37,848.43"	1513.9372	181672.464
2003	"38,567.01"	1542.6804	185121.648
2004	"38,573.26"	1542.9304	185151.648
2005	"38,966.82"	1558.6728	187040.736
2006	"38,995.43"	1559.8172	187178.064
2007	"37,605.75"	1504.23	180507.6
2008	"36,341.85"	1453.674	174440.88
2009	"36,521.53"	1460.8612	175303.344
2010	"36,642.20"	1465.688	175882.56
2011	"37,248.26"	1489.9304	178791.648
2012	"38,073.87"	1522.9548	182754.576
2013	"38,160.71"	1526.4284	183171.408
2014	"38,474.84"	1538.9936	184679.232
2015	"37,992.12"	1519.6848	182362.176
2016	"37,638.54"	1505.5416	180664.992

2016 volume 2172777.21 (year 2016 plus previous 12 years combined volume)

2004 volume 2112197.664 (year 2004 plus previous 12 years combined volume)

net methane 60579.552

2016 N2O	8688.25	
Total	69267.802	kt CO2 eq
	" 69,267,802 "	t CO2 eq

Forest required to offset GHGs Ref: http://max.nzfsa.govt.nz/sustainable-forestry/tools/sequestration-rates.htm

Mix of pine/native/scrub at 650 tCO2/yr **" 106,565.85 " hectares**

3.7.6 The UN requires Methane be accounted for from a inflow vs outflow perspective to be described as climate change. Accounting for 'net' Methane will also allow farmers to receive credits for a permanent reduction in Methane which will be a fair way to incentivise land use change. A Sheep farmer thinking of converting part of their farm to trees could receive Carbon credits from both dropping sheep numbers and planting trees.

3.7.7 Net Methane accounting will remove another injustice in the ETS. Under the current GWP100 metric, a CO2 emitter can offset 100% of their emissions (no change in atmospheric CO2 concentration or warming) and pay no ETS. By comparison a farmer with steady CH4 emissions (no change in atmospheric CH4 concentration or warming) would still pay an ETS on their CH4 emissions on the day. The ETS should treat all emitters the same relative to the warming they cause.

3.7.8 Andy Reisinger's research indicates a very small warming effect from stable CH4 emissions (below). This warming effect needs to be quantified so NZ agriculture can take it into account for their emissions targets to achieve 'warming neutral products'.

"To achieve a stable temperature, the stock of atmospheric short-lived gases must continue to decrease very slightly over time. This is because recent research shows that a very minor ongoing warming effect occurs after atmospheric concentrations of CH4 have stabilised" (Andy Reisinger, pers. comm. 27 January 2018)

3.7.9 It is generally accepted that the international community will not change the GWP100 metric for international reporting. Indeed, it has its merits for this purpose, and its only countries with a large agricultural sector which are significantly disadvantaged by this. I would recommend we continue using the GWP100 for international reporting, however NZ should create an internal agricultural GHG model based on 'net' Methane for the specific purpose of assessing if the agricultural industry is 'warming neutral'. Once the data is collected, it's a simple matter of adjusting the metric to account for emissions in GWP100 or 'warming effect'. The 'net' Methane approach will likely achieve more positive change at the farm level so will actually return more favourable GWP100 results as well.

3.7.10 The great advantage of the 'net' Methane approach will be the ability to reward farmers positive actions (changes in stock numbers or stock diet etc) with Carbon credits. Conversely farms that intensify and increase CH4 emissions will potentially face a greater disincentive as CH4 will be valued accordingly to its full potency (120 x CO2). This will actively

encourage farmers to find offsets or look for mitigation options. Farmers that have a steady state system will not be penalised, but with reductions in CH4 receiving credits and an increase in CH4 receiving an ETS tax, there will be a far stronger signals to farmers to encourage behavioural change. By default, a GWP100 based ETS would have to be set so low as to not make farms financially unviable, the difference between paying an ETS for having 400 cows and 450 cows would be minimal. The 'net' Methane approach could place a far greater dis-incentive on intensification. Credit trading is also an option once established so productive land is used most appropriately, farms would only intensify if another farm has made a similar reduction.

3.7.11 Individual farm GHG budgets could use national GHG inventory data for the first 3-5 years. This would monitor the entire NZ agriculture GHG balance while data was being collected on an individual farm basis. Once there is 3-5 years data collected, its possible to switch to individual farm GHG modelling, credits or tax can be allocated on changes to CH4 emissions between year 1 and year 3-5 of the scheme.

3.7.12 Quotes questioning how appropriate the GWP100 metric is

Professor Keith Shine contributed to created the GWP100 as part of the IPCC
"Did something go wrong here? How did "a simple approach" which was "adopted . . . to illustrate . . . difficulties" become established in a major piece of environmental legislation, where it had the potential to influence big investment and policy decisions?"

Andy Reisinger, NZ climate scientist.
"Agriculture directly contributes about 10-12% of current global anthropogenic greenhouse gas (GHG) emissions, mostly from livestock. However, such percentage estimates are based on Global Warming Potentials (GWPs), which do not measure the actual warming caused by emissions and ignore the fact that methane does not accumulate in the atmosphere in the same way as CO2".

3.8 Q40 - What does your long-term vision for a low-emissions economy look like? Could a shared vision for New Zealand be created, and if so, how?

3.8.1 New Zealand has the opportunity to become a world leader in the management of agricultural GHG emissions. Making the ETS directly relate to warming effect will encourage other agricultural industries to follow suit, thus protecting our industry long term from mis-informed marketing by the synthetic protein industry. NZ has two strategic advantages with GHG modelling,
1. Our CH4 emissions are relatively stable since 1990 due to the drop in sheep numbers.
2. We have a massive area of farm land in actively growing woody vegetation with the ability to increase this area significantly.

Even if other countries take a 'net' Methane approach, few will be able to claim they are 'warming neutral' (possible exception of Australia who we could work together with)

3.8.2 New Zealand should be selling our agricultural products as 'warming neural' via an internationally peer reviewed internal GHG modelling scheme.