Action on agricultural emissions

Technical appendix 5

Free allocation for agriculture

Free Allocation for Agriculture

Contents

1. Purpose

This technical appendix provides further information on free allocation for agriculture, including:

- Information about the data and methodology used to model free allocation methods.
- Further graphs and analysis generated by modelling free allocation methods.
- Some key issues relevant for implementing agricultural free allocation, particularly for a farm-level agricultural GHG levy/rebate scheme.

In relation to the modelling on free allocation methods, due to the relatively limited amount of farm data available for analysis, the results are illustrative. While they provide a sense of the potential scale and range of impacts on farms, the results cannot be assumed to be complete or representative of all farms in New Zealand.

2. Background

Chapter 10 of the Committee's report, *Action on agricultural emissions*, outlined key issues and options for agricultural free allocation, including:

- A discussion of the purpose of free allocation, which in the Committee's view should be to help manage the social impacts of emissions pricing on farmers and rural communities, with emissions leakage risk a lesser concern.
- Consideration of several free allocation methods, with a conclusion that the most appropriate farm-level allocation method for both the dairy and drystock sectors is a hybrid of output- and land-based allocation, while free allocation at processor-level should be output-based.
- Identification of further work required to implement this hybrid option, including developing a suitable proxy for the productive capacity of land on which to base land-based allocation, determining the ratio of output- to land-based allocation, and eligibility rules – with a need to give particular consideration to Māori land.
- An option to allow farmers to capitalise free allocation to encourage the uptake of low emissions technologies, practices and land uses and thereby accelerate farmer innovation and learning.
- An outline of how free allocation could be adjusted over time, including that:
    - livestock-related allocation factors should be set so that they reduce in line with expected business as usual improvements in emissions intensity, with periodic reviews if the business as usual level of emissions intensity changes
    - any phase down of the 95% allocation rate should be well signalled and predictable. Changes in the rate of allocation should be informed by independent advice from the proposed Climate Change Commission.

3. Free allocation modelling – samples and methodology

The analysis of farm-level free allocation approaches used datasets from DairyNZ Economic Service, Beef+Lamb New Zealand (B+LNZ) Economic Service, and MPI.[1] These datasets combined physical, financial and environmental information.

- Physical data included farm descriptors such as farm system, stock numbers, stocking rate and performance information.
- Farm financial data included gross revenue, farm operating expenses, and farm profit.
- Environmental data included Overseer outputs for greenhouse gas emissions.
- The B+LNZ dataset contained farm files for Waikato and Canterbury regions only.

Table 1: *Key parameters of farm datasets used in free allocation analysis*

	DairyNZ Economic Service	B+LNZ Economic Service	MPI Farm Monitoring - Dairy	MPI Farm Monitoring – Drystock
Sample year	2015-16	2015-16	2010-11	2010-11
Number of farms	382	47	81	81
Overseer version	6.2.3	6.1.3 & 6.3.0	5.4.10	5.4.10

The more recent datasets from DairyNZ Economic Service and B+LNZ Economic Service relating to the 2015-16 year formed the basis for most of the analysis. The older MPI dataset from 2010-11 was primarily used to build some initial free allocation models and for comparative data purposes.

The following graphs compare the dairy and drystock emission profiles on a per hectare basis across the datasets. Even though the MPI data is 5 years older and uses a different version of Overseer, the emissions profile is similar.

[1] For a fuller description of the MPI dataset, see Henry (2017).

Figure 1: *Dairy emissions profile t CO_2e/ha*

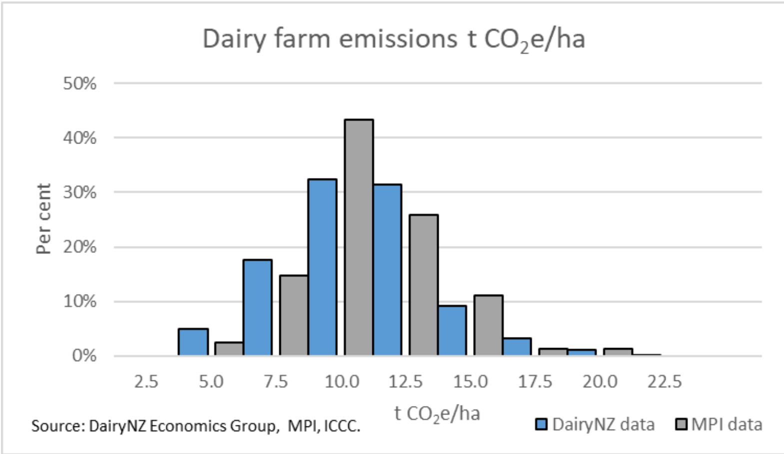


Table 2: *Key parameters related to dairy emissions profile*

	DairyNZ Economics Service	MPI
Average	9.7	9.5
Lower Quartile	7.9	8.0
Median	9.7	9.0
Upper Quartile	11.3	10.8

Figure 2: *Drystock emissions profile t_2CO_2e/ha*

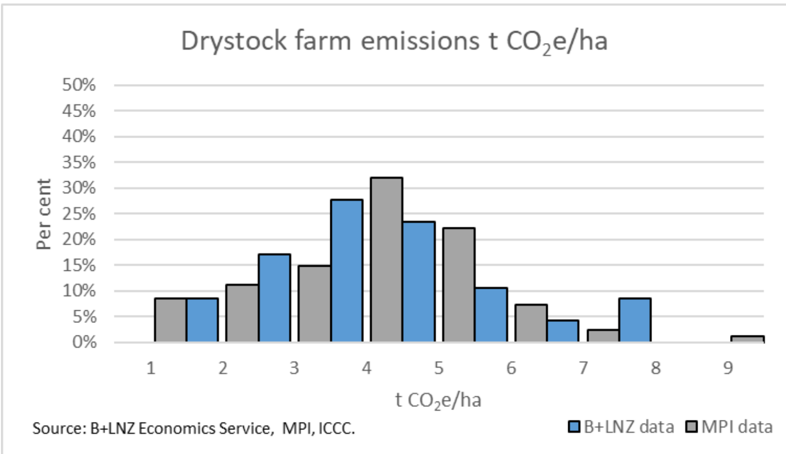


Table 3: *Key parameters on drystock emissions profile*

	B+LNZ Economic Service	MPI
Average	4.1	3.4
Lower Quartile	3.0	2.5
Median	3.8	3.5
Upper Quartile	5.0	4.4

Other datasets

The DairyNZ sample and results of the allocation modelling were discussed with Fonterra, which holds a much larger set of farm Overseer emission estimates that is therefore likely to be closer to a population dataset. Fonterra's dataset displayed a similar distribution but with wider spread and a higher maximum. This is likely to be due in part to how the data was collected, with different quality assurance procedures, as well as the greater number of farms. The trends indicated in the free allocation modelling were in general corroborated by Fonterra's analysis of its dataset.

Overseer data

The greenhouse gas emissions used from Overseer are for biological emissions; methane and nitrous oxide from livestock and emissions from fertiliser. Additional carbon dioxide emissions from fossil fuel use were excluded (e.g. from farm vehicles) as they are already covered by the Emissions Trading Scheme.

A separate estimate of emissions from fertiliser was available in the B+LNZ Economic Service dataset. This figure was subtracted from the total farm emissions, so that the analysis could be undertaken on livestock emissions only. This was done given that the recommended point of obligation for fertiliser emissions is at the processor level. Separate fertiliser emissions estimates were not available in in the other datasets, so emissions from fertiliser could not be subtracted.

Overseer settings for estimating nitrous oxide emissions were changed from the default Farm Specific emissions factors to Annual Average emissions factors before data was extracted for analysis, to align farm-level emissions data from Overseer with the methodology used in the national GHG inventory. The mode with Annual Average emissions factors is now the recommended method to use in Overseer for nitrous oxide calculations. [2]

Scaling the Overseer data

The farm files making up the B+LNZ and DairyNZ datasets are not nationally representative, as they comprised farms who had volunteered to participate. The Overseer data was therefore scaled in line with the national inventory, to coefficients derived from the inventory to be used. For the purpose of the analysis, the samples were considered to aggregate to an effective national inventory using national average emissions intensity per milk solids for dairy and stock-units for drystock. The Overseer figures were then scaled so in aggregate they were the same.

Table 4: Scaling factors

DairyNZ	B+L[3]	MPI dairy	MPI drystock
-5%	-20%	-5%	-5%

Modelling output-based allocation

Allocation factors are used to determine how much free allocation is provided per unit, for example per kilogram of milk produced. Allocation factors were derived using three-year averages of

[2] de Klein et al. (2017)

[3] Only two regions (Canterbury and Waikato) were represented in the B+LNZ dataset, which may have contributed to the degree of scaling required.

emissions data from the New Zealand's National Greenhouse Gas Inventory 1990-2015 (December year) and farming parameters like milk solids yield and livestock numbers from StatsNZ (June year).

For output-based allocation, the allocation factors represent the national average emissions intensity per unit of output. For dairy, the output used was milk solids. For drystock farms, stock numbers and/or stock units were used as the proxy for output. This was due to the diversity of drystock farms, with not all farms producing meat.

Table 5: *Allocation factors per unit of output:*

Unit of output	Factor (kg CO_2e)
Cattle SU	324
Deer SU	342
Sheep SU	370
Kg MS	10.1

Modelling land-based allocation

Allocation factors for land-based allocation would ideally vary the amount of allocation provided per hectare according to land characteristics, such as the productive capacity of the land.

Due to lack of data to enable varying the allocation factors in this way, land-based allocation was instead modelled using a flat rate per hectare. The allocation factors represent the average emissions per hectare for each sector and were derived from the national inventory and national agricultural production statistics for each sector.

Table 6: *Allocation factors per hectare*

	National average (t CO_2e/ha)[4]
Drystock land	1.9
Dairy land	10.5

The B+LNZ dataset had a small number of extensive farms in Canterbury. These farms received a very large share of the available allocation volume with the land-based allocation approach, due to their large size and the use of a flat rate per hectare allocation factor. This would not occur in reality if differential allocation factors based on the productive capacity of land were used. For the analysis these farms were removed, to avoid the large skew they created in the modelling.

Other key assumptions:

- The allocation rate was set at 95%.
- The emissions price used was $25 per tonne CO_2e.

[4] Based on the New Zealand National GHG Inventory 1990-2015 and national agricultural production statistics. For the modelling, the allocation factors were recalibrated to match the total emissions for the dataset, so that the samples were treated as if they were representing total national emissions.

4. Farm-level free allocation - further information

The Committee considered five methods for providing farm-level free allocation:

- Grandparenting
- Proportional
- Output-based
- Land-based
- A hybrid of output- and land-based allocation.

To supplement the discussion of these methods in the report, table 7 overleaf provides a summary of the key issues associated with these five different methods.

Table 7: *A summary of the different approaches for providing free allocation.*

Free allocation method	Basis for free allocation	Potential rationale for this method	Incentive to reduce emissions intensity – at $25/tCO_2e$	Incentive to reduce output – at $25/tCO_2e$	Who is advantaged?	Who is disadvantaged?
Grandparenting	Historic data, such as historic emissions, animal numbers or production	To assist with stranded farm assets, both loss of land value and investments in irrigation or other plant	$25	$25	Farmers with higher historic emissions	Farmers with lower historic emissions Owners of underdeveloped land Iwi/Māori land holdings
Proportional	Current emissions	Simple to implement	$1.25	$1.25	Farmers with higher current emissions	Farmers with lower current emissions
Output-based	Output and national average emissions intensity[5]	To slow the pace of land use change so as to assist with social impacts and stranded processing assets To reduce emissions leakage risk	$25	Varies for each farm, depending on its emissions intensity. In datasets analysed, ranges from around -$20 to $14, $0.24 on average.	More emissions efficient farmers	Less emissions efficient farmers
Land-based	Land area, with the allocation rate per hectare potentially determined by the productive capacity of the land	To assist loss of land value	$25	$25	Less intensive farmers, relative to their land's potential. Iwi/Māori owned land holdings	More intensive farmers, relative to their land's potential.
Hybrid of output- and land-based	A combination of land area and output	To provide a balance of the benefits of output- and land-based allocation.	$25	Varies for each farm, depending on its emissions intensity. In datasets analysed, ranges from around $2 to $20, $12.60 on average.	Farmers who are less intensive and more efficient	Farmers who are both intensive and not very efficient

[5] emissions per kgMS or per head of stock or SU

4.1. Analysis and modelling of free allocation methods

Four allocation methods were modelled – proportional, output-based, land-based and a hybrid of output- and land-based allocation. The modelling used datasets from DairyNZ Economic Service, B+LNZ Economic Service, and MPI, as per the information in section 3 of this paper.

This section contains a fuller set of the graphs and other outputs of this analysis, to complement the cost distribution and marginal price incentive graphs included in the Committee's report on agriculture.

4.1.1. Cost distributions

Figures 3 – 10 overleaf show the modelled distributions of cost per hectare across the DairyNZ Economic Service and B+LNZ Economic Service datasets. The net obligation costs on the horizontal axis scale represents the emission costs faced by farmers per hectare, after the free allocation is taken into account. A negative value means that the farmer receives a rebate (i.e., the farmer's emissions are less than the free allocation volume).

Tables 8 and 9 below provide the average, lower and upper quartiles relating to these distributions. This more clearly shows how the hybrid option somewhat narrows the distribution of costs, avoiding the most extreme cost outcomes shown when output- or land-based allocation was used alone.

Table 8: *Key statistics for the modelled allocation methods – Dairy, costs per hectare*

Allocation method	Lower quartile	Average	Upper quartile
Proportional	$12	$15	$18
Output-based	-$19	$23	$58
Land-based	-$37	$17	$69
Hybrid (output and land)	-$28	$18	$57

Table 9: *Key statistics for the modelled allocation methods – Drystock, costs per hectare*

Option	Lower quartile	Average	Upper quartile
Proportional	$3	$4	$5
Output-based	-$6	$6	$14
Land-based	-$10	$12	$29
Hybrid (output and land)	-$8	$9	$20

Figures 11 – 18 provide graphs showing the cost distributions per kilogram of milk solids per dairy, and per stock unit for drystock.

Figure 3: *Dairy – proportional allocation, $ / ha*

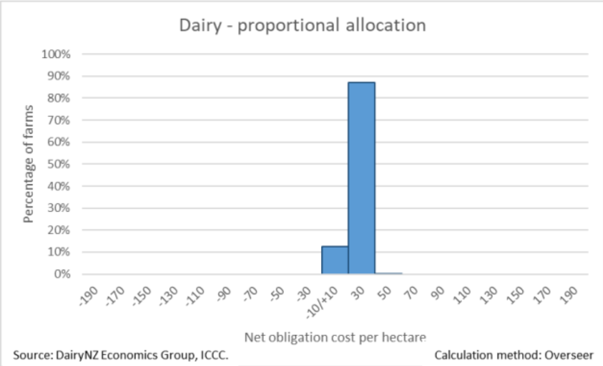


Figure 4: *Dairy – output-based allocation, $ / ha*

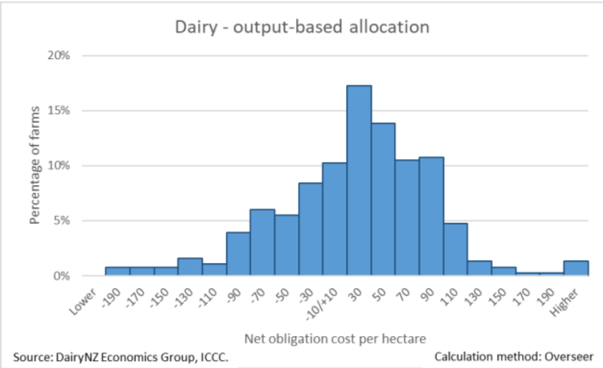


Figure 5: *Dairy – land-based allocation, $ / ha*

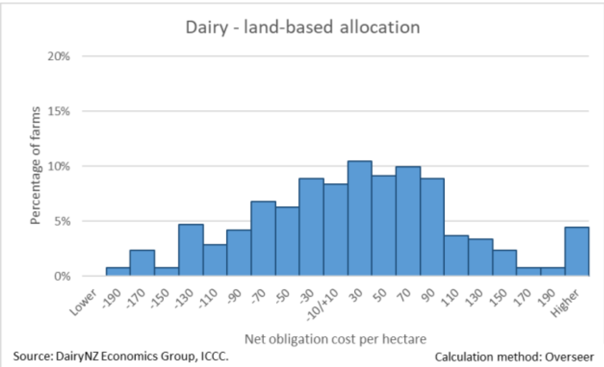


Figure 6: *Dairy – hybrid allocation, $ / ha*

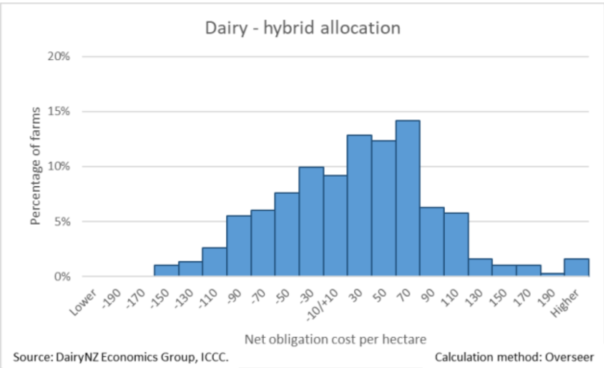


Figure 7: *Drystock – proportional allocation, $ / ha*

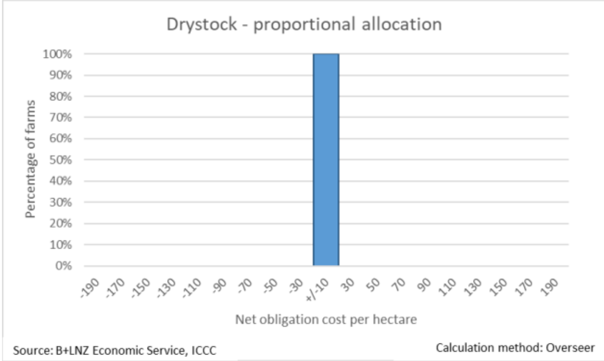


Figure 8: *Drystock – output-based allocation, $ / ha*

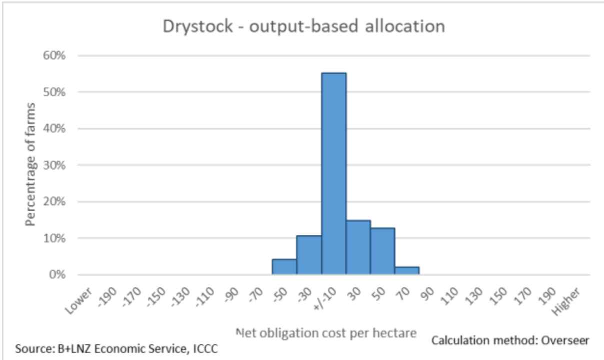


Figure 9: *Drystock – land-based allocation, $ / ha*

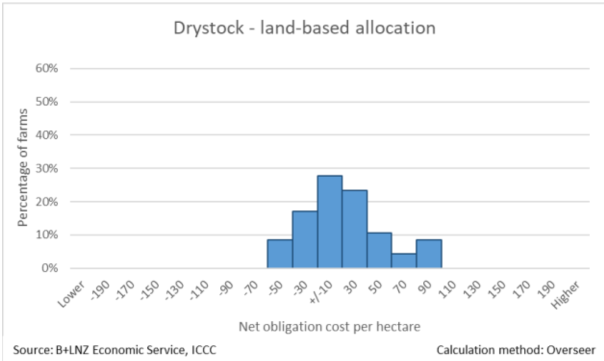


Figure 10: *Drystock – hybrid allocation, $ / ha*

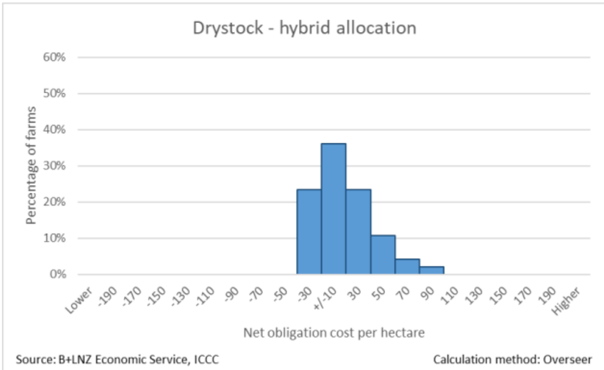


***Figure 11:** Dairy – proportional allocation, $ / kgMS*

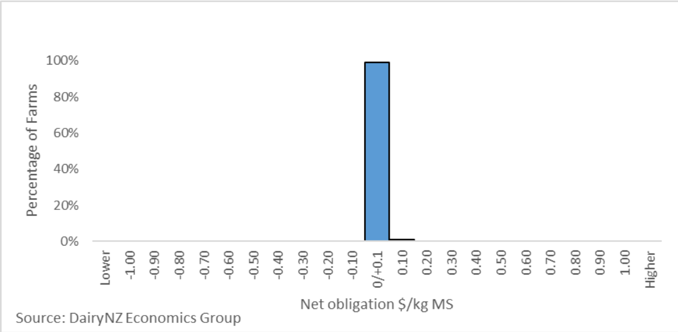


***Figure 12:** Dairy – output-based allocation, $ / kgMS*

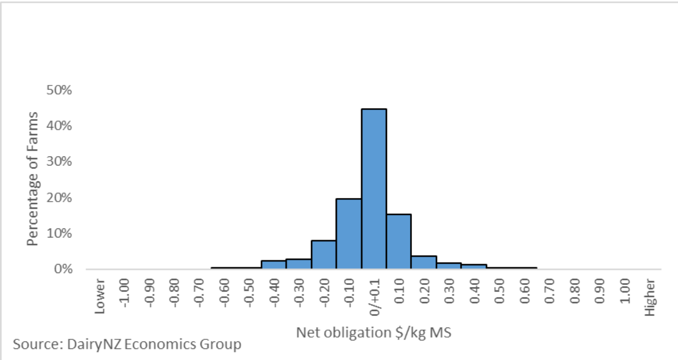


***Figure 13:** Dairy – land-based allocation, $ / kgMS*

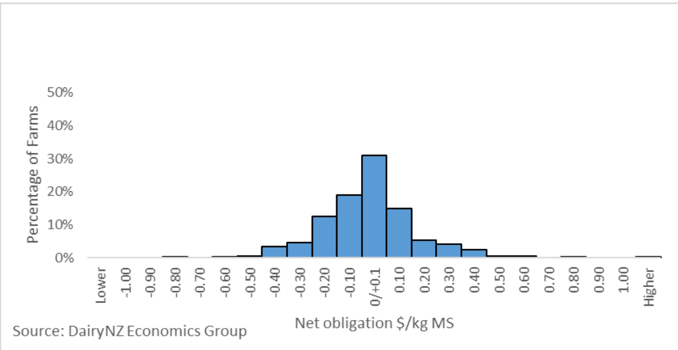


***Figure 14:** Dairy – hybrid allocation, $ / kgMS*

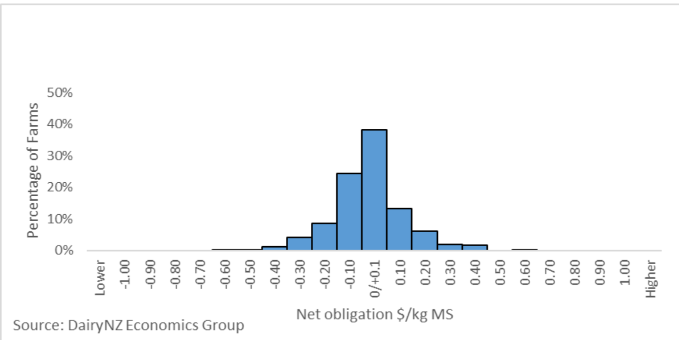


***Figure 15:** Drystock – proportional allocation, $ / SU*

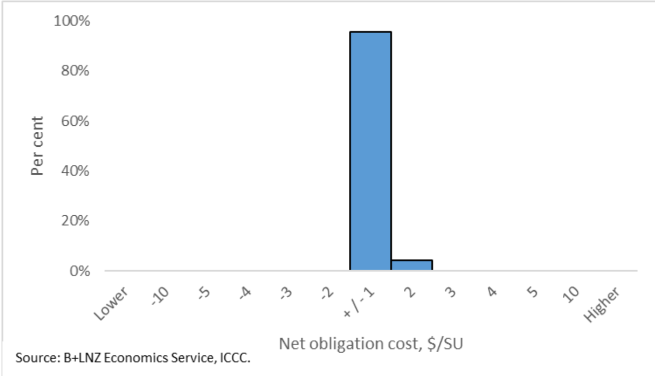


***Figure 16:** Drystock – output-based allocation, $ / SU*

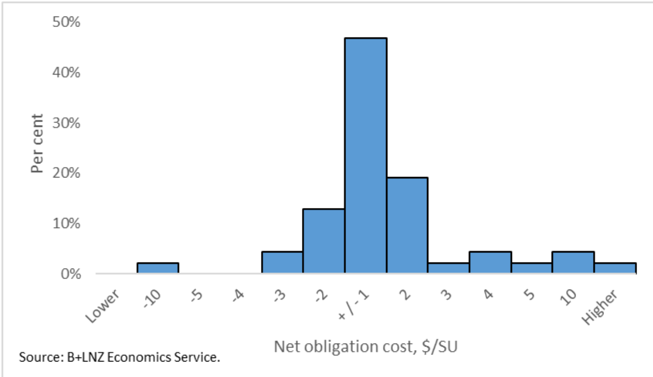


***Figure 17:** Drystock – land-based allocation, $ / SU*

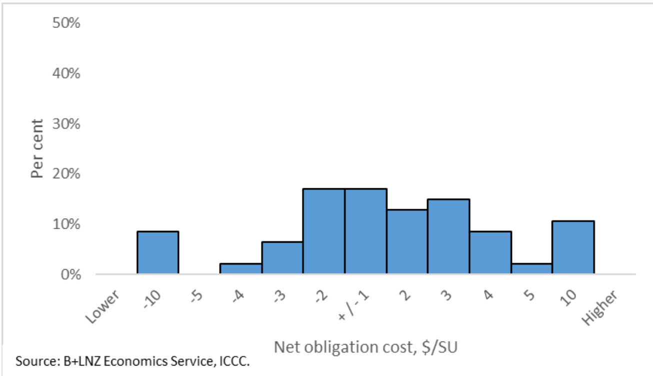
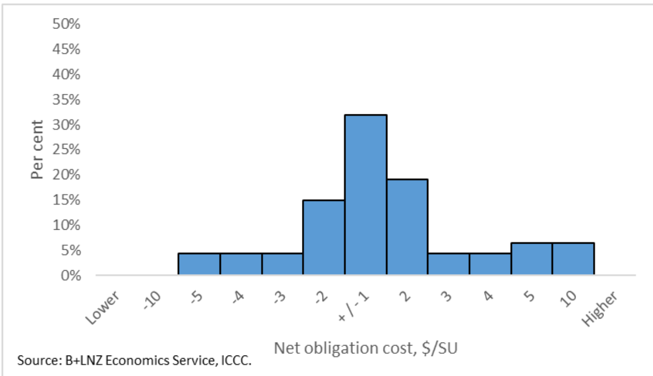


***Figure 18:** Drystock – hybrid allocation, $ / SU*



4.1.2. The hybrid method reduces extreme outcomes

Figure 19: *Variance in net cost between land- and output-based allocation*

This graph shows the difference between the net cost per hectare when the land-based allocation method is used, versus when output-based allocation it used. The choice between these methods can have a very large impact for some farms.

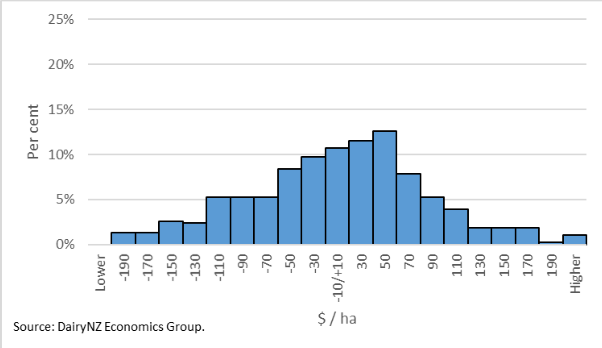
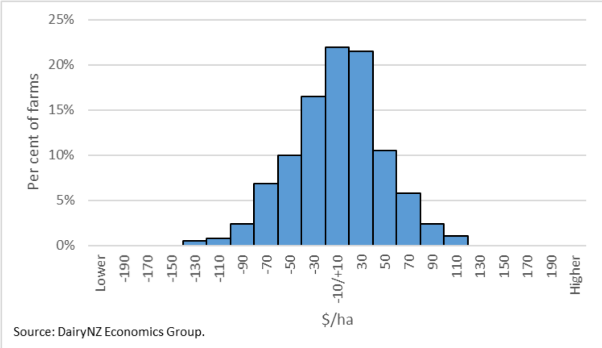


Figure 20: *Variance in net cost between land-based allocation and the hybrid method*

This graphs shows the difference between net costs per hectare for the land-based vs the hybrid method. It illustrates that the hybrid method reduces extreme outcomes in terms of costs on farms. The variance between the output-based and the hybrid methods is a mirror image of this graph.



4.1.3. Illustrating impacts of allocation methods on individual farms.

Figures 21 – 25 below give some examples of cost impacts on individual farms. They more clearly show that who is advantaged or disadvantaged can change significantly for output-based allocation as compared to land-based allocation. These graphs also demonstrate that the hybrid method results in cost impacts between those of the output- and land-based allocation used alone.

Figures 21 – 23 show dairy farm examples, while figures 24 - 25 show examples of drystock farms.

Figure 21: *Impacts of different allocation methods - example dairy farm 1*

This is a low input dairy farm in Northland.

Stocking rate: 1.9 cows / ha

Production: 294 kgMS / cow

Emissions: 6.7 t CO_2e / ha

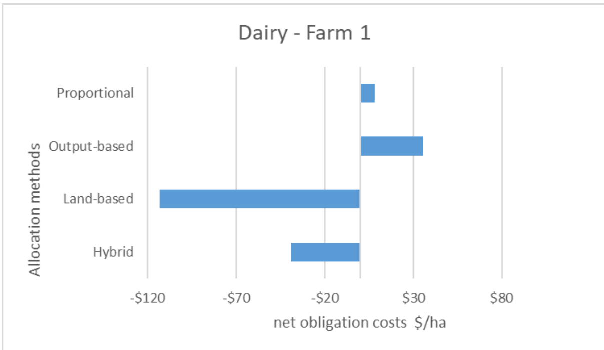
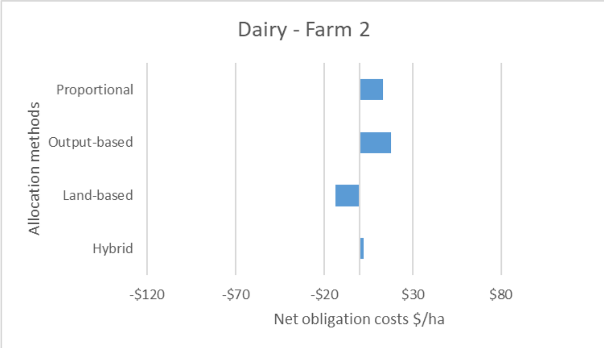


Figure 22: *Impacts of different allocation methods - example dairy farm 2*



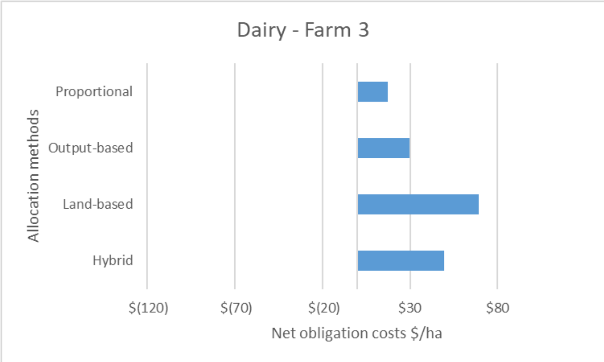
This is a low input dairy farm in Waikato.

Stocking rate: 2.9 cows / ha

Production: 363 kgMS / cow

Emissions: 10.7 t CO_2e / ha

Figure 23: *Impacts of different allocation methods - example dairy farm 3*



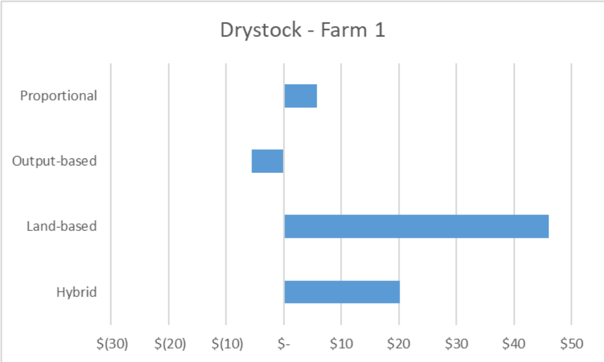
This is a high input farm in Canterbury

Stocking rate: 3.2 cows / ha

Production: 419 kgMS / cow

Emissions: 14.0 t CO_2e / ha

Figure 24: *Impacts of different allocation methods - example drystock farm 1*



This is a North Island intensive finishing farm.

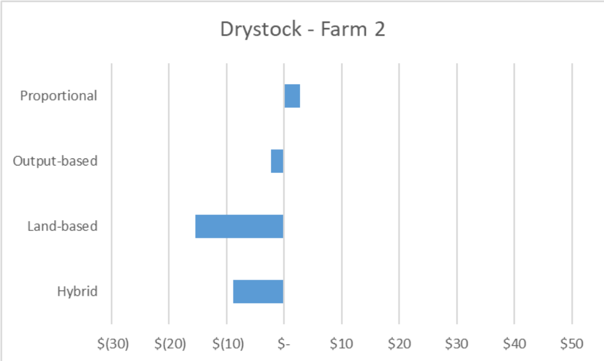
Stocking rate: 15.8 SU / ha

Total sheep: 2004 hd

Total beef: 1000 hd

Emissions: 5.8 t CO_2e / ha

Figure 25: *Impacts of different allocation methods - example drystock farm 2*



This is a North Island intensive finishing farm.

Stocking rate: 8 SU / ha

Total sheep: 654 hd

Total beef: 223 hd

Emissions: 2.7 t CO_2e / ha

4.1.4. Putting costs in context

Dairy

To give some context to the emissions costs or benefits indicated by the allocation modelling, Figure 19 below shows dairy operating expenses and operating profit per hectare over the last 10 seasons for owner-operators from the DairyNZ Economic Survey.

Average operating expenses were $4,893/ha over this period and relatively constant from year to year. While average operating profit was $1,951/ha, it was much more variable from year to year, reflecting volatility of milk prices. The range of emissions costs per kgMS compares to a total Fonterra dairy payout average of $6.40 per kgMS for the past ten years, with the highest payout at $8.50 and the lowest at $4.30). Note that these impacts on individual farms can be substantially different from what these averages indicate.

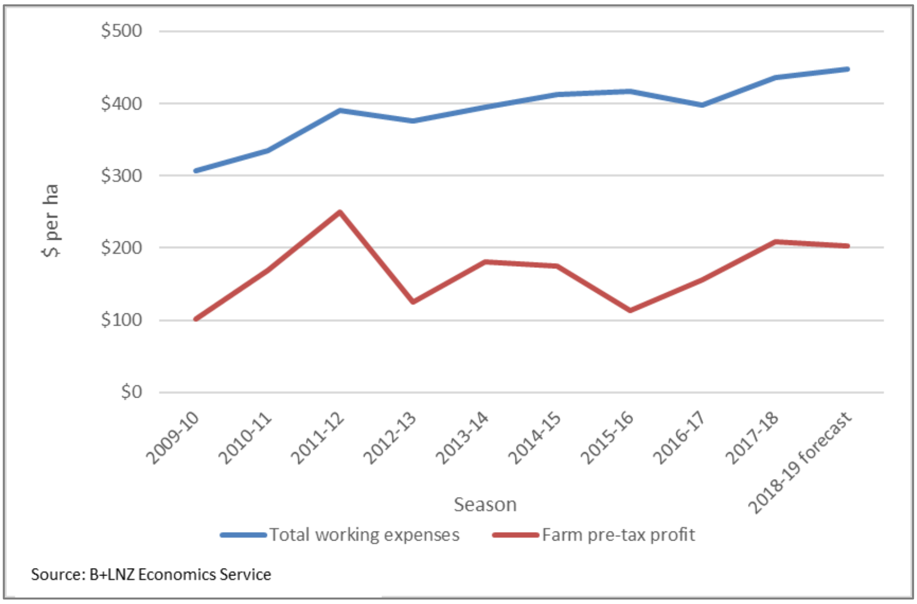
Figure 26: *Dairy operating expenses and profit per hectare*

Source: DairyNZ Economics Group

Drystock

Figure 20 below shows working expenses and pre-tax profit for all sheep and beef farm classes, from the Beef+Lamb New Zealand Economic Survey. Average working expenses over the nine years until the 2017-18 season were $385/ha and average farm profit $165/ha. Both were variable year to year but within a reasonably tight bound. Again, note that these impacts on individual farms can be substantially different from what these averages indicate.

__Figure 27:__ Sheep and beef farm working expenses and pre-tax profit per hectare



4.1.5. Impact of calculation method choice

The allocation modelling was undertaken using emissions estimates calculated by Overseer, a complex calculation method that uses a significant amount of farm-specific data. Using a less farm-specific calculation method would reduce the spread of cost impacts across farms, as as less of the variation in emissions is captured in the emissions estimates. Figures 28-29 below illustrate this effect.

__Figure 28:__ Dairy - cost distribution with output-based allocation, using Overseer calculation method

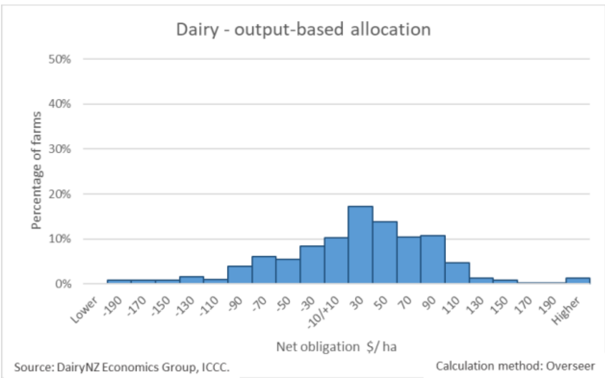
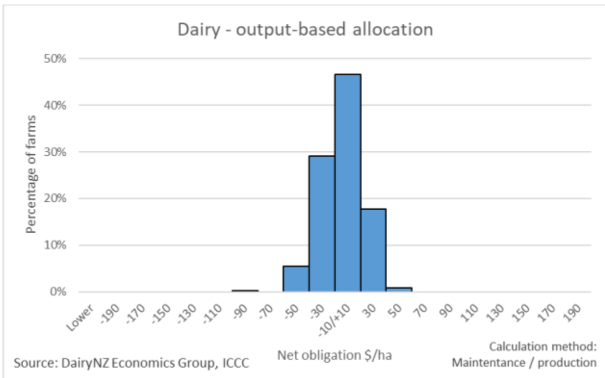


__Figure 29:__ Dairy - cost distribution with output-based allocation, using maintenance/production calculation method



4.1.6. Allocation and stocking rate

A concern raised in relation to the output-based allocation method is that it could strongly favour more intensive farming systems, as more intensive farms may be more likely to have lower emissions intensity per unit of product.

The scatter graphs below of the DairyNZ dataset indicate that there is some basis for this concern, although it does not hold in all cases as there is such wide variation in emissions efficiency across farms. In these graphs, the farms receiving a rebate are below the horizontal axis, while those facing a net cost (i.e. they will have to pay the levy) are above it.

The scatter indicates that farms with a higher stocking rate and higher production of milk solids per hectare are somewhat more likely to be more emissions efficient and receive a rebate. Nevertheless, it also shows that some low stocking rate dairy farms manage to produce milk solids very efficiently – so it is not universally true that the more intensive the farm, the better off the farm will be if the output-based allocation method is used.

For contrast, figures 32 – 33 are the same graphs by for land-based allocation.

Figure 30: *Dairy with output-based allocation: net cost vs stocking rate*

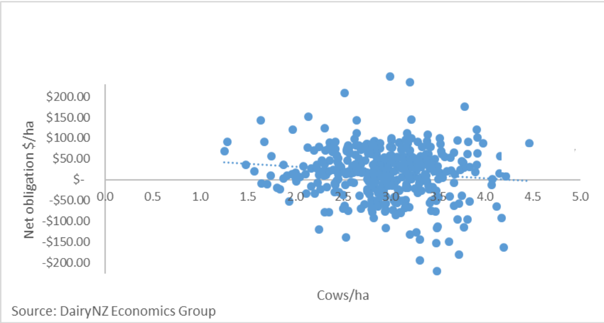


Figure 31: *Dairy with output-based allocation: net cost vs kg milk solids/ha*

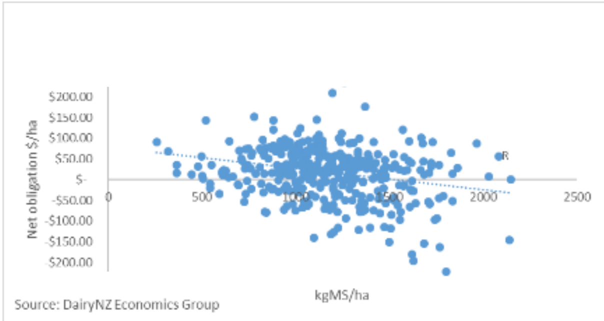


Figure 32: *Dairy with land-based allocaiton: net cost vs stocking rate*

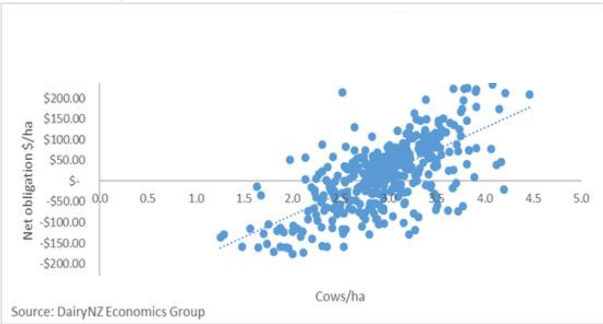
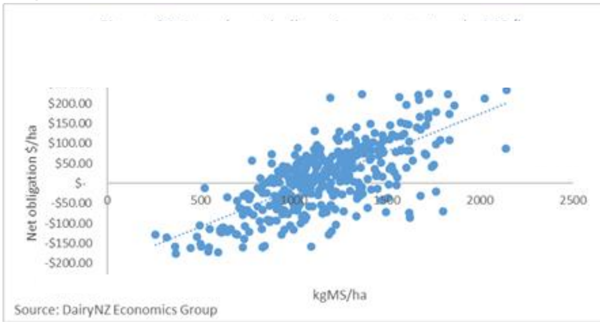


Figure 33: *Dairy with land-based allocation: net cost vs kg milk solids/ha*



4.1.7. Allocation and emissions intensity

Figures 34 – 37 show how output-based allocation benefits farms with low emissions per unit of product while land-based allocation benefits farms with low emissions per hectare.

Figure 34: *Dairy with output-based allocation: net cost vs emissions / kgMS*

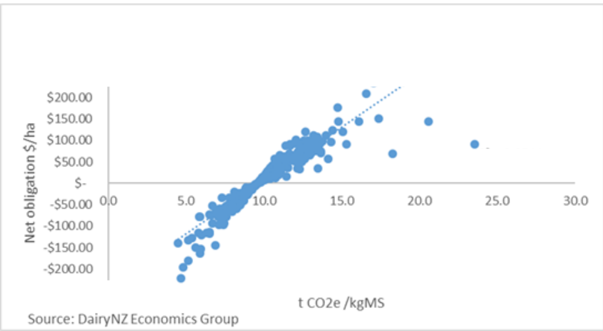


Figure 34: *Dairy with output-based allocation: net cost vs emissions / ha*

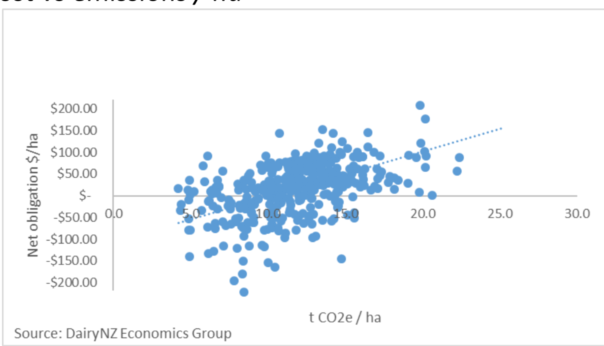


Figure 36: *Dairy with land-based allocation: net cost vs emissions / kgMS*

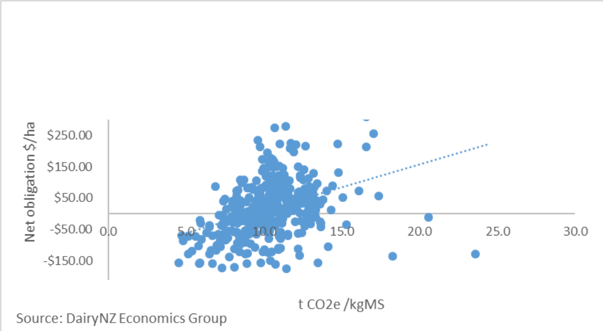
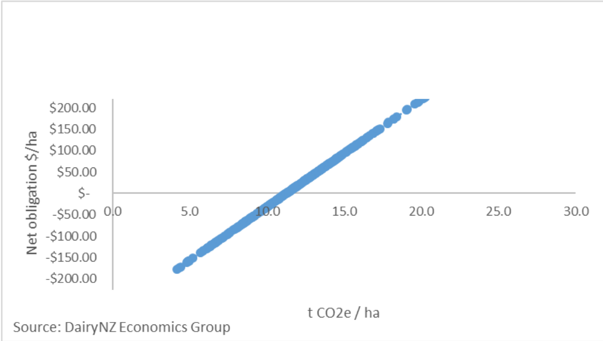


Figure 37: *Dairy with land-based allocation: net cost vs emissions / ha*



4.1.8. Impact of altering the allocation rate

Figures 38 and 39 below illustrate the impact of a reduction in the allocation rate from 95% to 80%. The distribution shifts to the right along the horizontal axis. This example is illustrative only, as it assumes that there is no mitigation as a result of the emissions price. If mitigation occurs, the cost increases would be lower.

Figure 38: *Drystock - hybrid allocation at 95% rate*

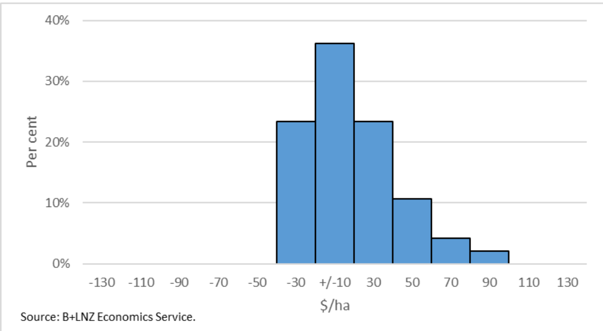
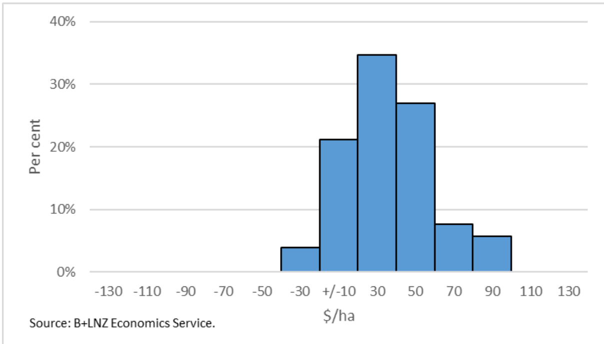


Figure 39: *Drystock – hybrid allocation at 80% rate*



4.1.9. Marginal price incentives

Figures 40 – 47 overleaf show graphs of the marginal price incentives created by the different allocation methods, on one page to allow easier comparison. Graphs for both the dairy and drystock sectors are provided.

Figure 40: *Incentives - dairy with proportional allocation*

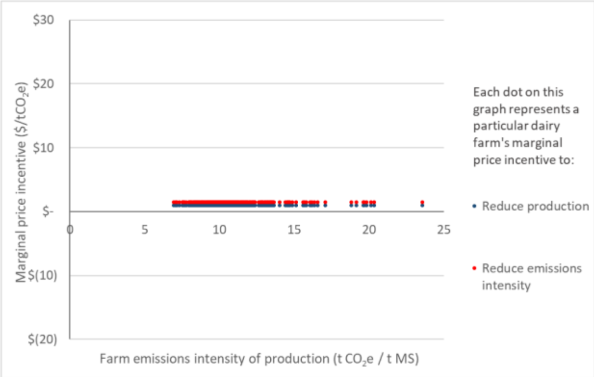


Figure 41: *Incentives – drystock with proportional allocation*

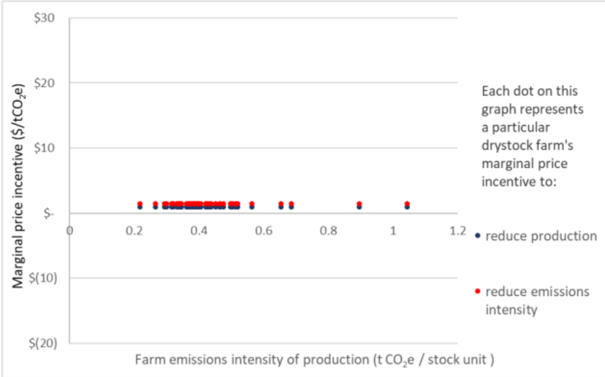


Figure 42*: Incentives - dairy with land-based allocation*

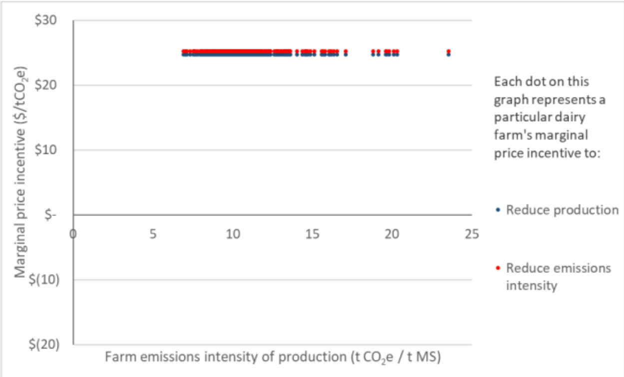


Figure 43: *Incentives – drystock with land-based allocation*

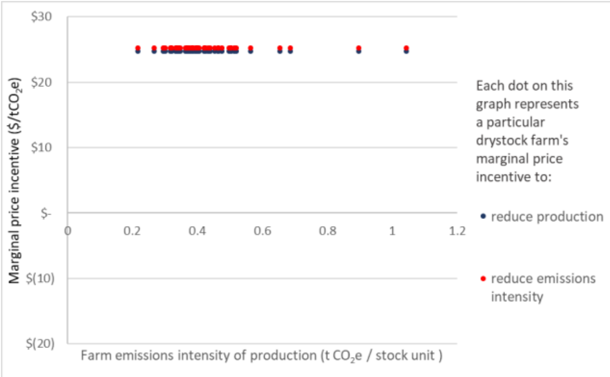


Figure 44: *Incentives - dairy with output-based allocation*

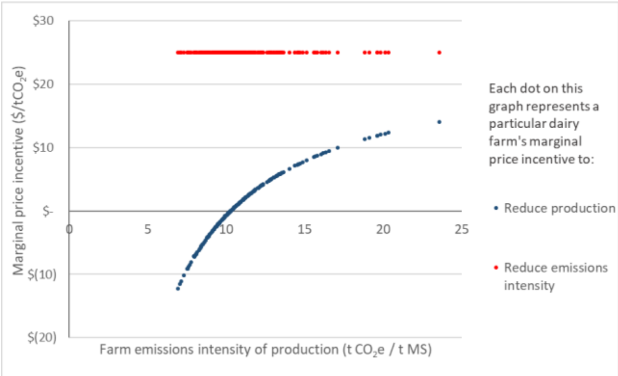


Figure 45: *Incentives – drystock with output-based allocation*

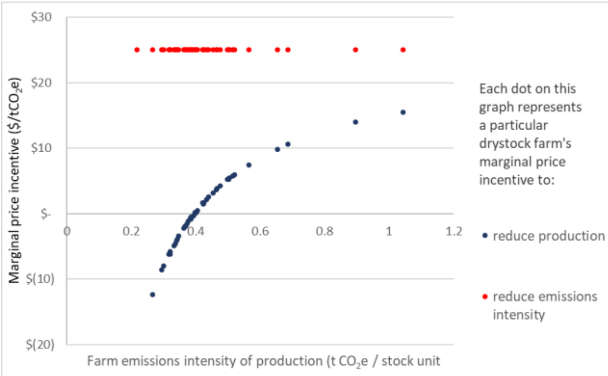


Figure 46: *Incentives - dairy with hybrid allocation*

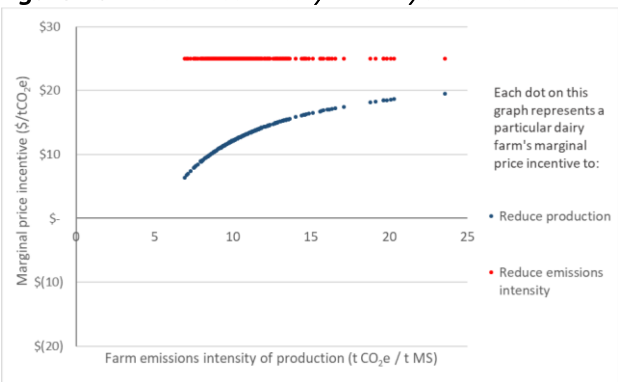
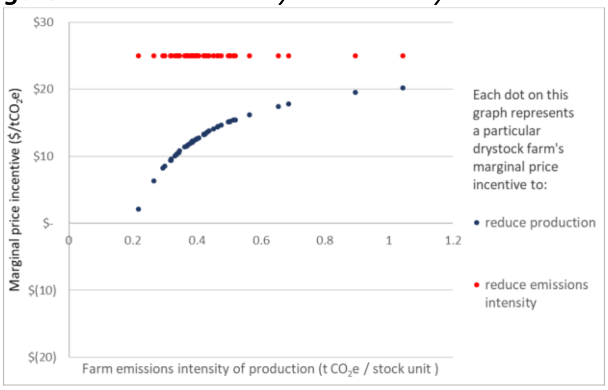


Figure 47: *Incentives - drystock with hybrid allocation*



Source: MPI

Source: B+LNZ Economics service

4.2. Implementing free allocation - considerations for further work

4.2.1. Integrating the levy/rebate scheme with the NZ ETS

The Committee has outlined that the farm-level agricultural GHG levy/rebate scheme should be integrated with the NZ ETS. In particular, the emissions covered by the levy/rebate scheme should be part of the same decision making process and rules for setting the NZ ETS cap, and the levy rate should be based on the NZ ETS emissions price.[6]

Integrating the levy/rebate scheme with the NZ ETS will enable a feedback loop between the two policies. This serves two purposes:

- Ensure the emissions price on agriculture is consistent with that on the rest of the economy, to promote cost effective emission reductions across sectors.
- Ensure that agricultural emissions are factored in when NZ ETS unit supply decisions are made, so that NZ ETS settings reflect emission reductions occurring in the agriculture sector and help New Zealand to meet emission reduction targets.

As background, the Government is intending to introduce a cap on the NZ ETS, to limit emissions covered by the NZ ETS in line with New Zealand's emission reduction targets. A coordinated decision making process on NZ ETS unit supply settings will be central to establishing this cap, with NZ ETS unit volumes and price controls set for five years into the future and annual updates to provide a rolling five-year cap. Decisions on the components of the cap will have to be generally consistent with relevant emissions budgets set under the Zero Carbon Bill, and relevant Nationally Determined Contributions (NDCs) for the purposes of the Paris Agreement.[7]

A key element of the cap will be an overall limit on the number of New Zealand Units (NZUs, the unit of trade), which will determine how many NZUs can be auctioned.

Integrating the levy/rebate scheme with the NZ ETS would require, at a minimum, that any decisions on the NZU limit determining the number of NZUs to be auctioned in the NZ ETS factor in:

1. actual agricultural emissions during the relevant emissions budget/target periods to date
2. projected agricultural emissions for the next five years taking into account expected reductions driven by the agricultural GHG levy/rebate scheme.[8]

Emission reductions in the agricultural sector will be driven by the NZ ETS emissions price as the levy rate will be updated annually to reflect the prevailing market price. Increases to the NZ ETS emission

[6] The exception to this would be if a separate long-term target for methane is set in the Zero Carbon Bill, in which case the levy rate for methane should be set at a level that is consistent with the pathway for meeting the long-term methane target. See Technical Appendix 4 on Achieving differentiated (split-gas) 2050 emissions targets.

[7] See Cabinet Minute CAB-18-MIN-0606.01 *Amendments to the Climate Change Response Act 2002: Tranche One*, 10 December 2019. Available from: https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/amendments-to-ccra-tranche-1-cab-18-min-0606.01.pdf

[8] If agriculture were brought into the NZ ETS, it would be necessary to factor agricultural free allocation volumes into the NZU limit. However, it should be kept in mind that agricultural allocation in the levy/rebate scheme would be provided as an emissions volume that reduces levy/rebate scheme participants' obligations, rather than as tradeable units. The agricultural allocation volume cannot impact emissions covered by the NZ ETS, so it does not need to be factored in to the NZU limit. Rather actual and projected agricultural emissions should be factored in.

price can be expected to flow through to greater reductions in the agriculture sector. If agricultural abatement costs are high and the emissions price results in limited reductions, this will feed back through to the setting of the NZ ETS cap, impacting the supply/demand balance in the NZ ETS. Any resulting increases to the emissions price in the NZ ETS will in turn increase the levy rate.

4.2.2. Proxy for land-based allocation

A key reason for using a land-based allocation method is to lessen the impact on farmers of reductions in land value. Pricing agricultural emissions will affect the profitability of farming ruminant livestock, which in turn can be expected to affect the value of land, likely to be a farm's largest asset.

Land is different from other potential stranded assets, such as farm infrastructure (e.g. irrigation), because it does not depreciate and any loss of value is ongoing.

A land-based allocation method requires the use of a proxy related to land value, to underpin allocation factors so that an appropriate amount of allocation is provided per hectare. This proxy would ideally target the long-term loss of value as closely as possible. For use in a national emissions pricing policy, it would have to be available at the same, consistent high quality across the country.

Land Use Capability (LUC) has been suggested as a possible proxy, as it has been used in in some regional freshwater allocation policies. LUC assessments across the country are available through the New Zealand Land Resource Inventory (NZLRI). NZLRI includes mapping of five key physical soil and land resource factors that drive land use capability (soil, rock type, slope, presence and severity of erosion, and vegetation) (Lynn et al. 2009).

There are several drawbacks to LUC that mean it may not be appropriate or acceptable to use for allocation in a national emissions pricing scheme, including:

- The LUC system was developed for regional planning purposes, and is not well-targeted to approximate the productive capacity and therefore value of land used for pastoral farming.[9]
- The national LUC/NZLRI map is at a scale of scale of 1:50 000, which is too coarse for use at farm-scale.
- Much of the LUC/NZLRI mapping took place in the 1970s and 1980s, and the assessment techniques used may not be viewed by stakeholders as sufficiently objective and robust.
- Although some more recent and higher resolution LUC assessments have been undertaken for certain farms or particular areas, they cannot be used for allocation which must be nationally consistent.

The Committee suggests that an alternative proxy more tailored to pastoral farming such as the intrinsic grass growth potential of the land be developed. "Intrinsic" grass growth potential is intended to refer to the capacity of the land to grow grass, taking into account standard practices

[9] In relation to its use in setting nitrogen limits, for example, criticisms have included that it focuses on arable cropping rather than pastoral land use, and high variability of pastoral productivity within a LUC class. See Lilburne et al. (2016).

that correct for known nutrient deficiencies (e.g. sulphur, phosphorus, potassium and lime) but excluding N fertiliser use and improvements such as irrigation.

The intent would be to develop a measure that approximates the long-term component of pastoral land values, rather than shorter term investments in improvements or intensive management practices. The output-based component of a hybrid allocation method would assist with emissions pricing impacts on farms with those investments or practices.

Developing the proxy would need a national map of intrinsic grass growth potential at a scale sufficient to capture individual farms. It is likely to involve the use interpolated climate and soil data combined with a physiologically based grass growth model. A significant amount of national spatial data are already available on the factors affecting grass growth, such as soil type, slope, aspect, temperature and rainfall. The relationships between these variables and grass growth are well understood.

The map would only have to be made once – because it is intended to reflect intrinsic grass growth potential, updating would not be necessary. The methodology for using national scale datasets to create it should be developed rigorously and with consultation.

The free allocation rules should be defined legally in such a way that this map could not be challenged on a case by case basis.

4.2.3. The ratio of output- to land-based allocation in a hybrid method

In chapter 10 of the agriculture report, the Committee recommended that a hybrid of output and land-based allocation be used for allocation in the levy/rebate scheme. It was noted that ratio with which these methods are combined will influence the extent to which the incentive to reduce production is weakened, and how costs are distributed across farmers.

A drawback of output-based allocation is that for farms that are very emissions efficient producers, it would encourage increased production. A key consideration for the ratio in which output and land-based allocation should be combined is avoiding giving any farm a positive incentive to increase production.[10]

The Committee heard a concern that any approach involving land-based allocation could have implications for the allocation volumes received by the dairy and drystock sectors. A way to implement this hybrid method that preserves the ability of both the dairy and drystock sectors to each receive allocation totalling 95% of its emissions is outlined below.

- The total allocation pool for both sectors combined would be set at 95% of total business as usual emissions across both, consistent with the methods used to calculate each sector's emissions.
- A share of this total pool, for example half, could be allocated to levy/rebate participants through land-based allocation. The land-based allocation approach would be common

[10] It was also raised with the Committee that freshwater policies, such as N limits, could act as a brake on farmers' ability to intensify and therefore limit the effect of any positive incentives created by an output-based method. However, these freshwater policies remain unclear. In any case it would be preferable to avoid creating perverse incentives wherever possible through the design of the levy/rebate scheme itself, rather than relying on other policies to counteract them.

across both sectors, i.e. using same allocation factors (determined using the proxy for grass growth potential) irrespective of whether land is being used for dairy or drystock production.

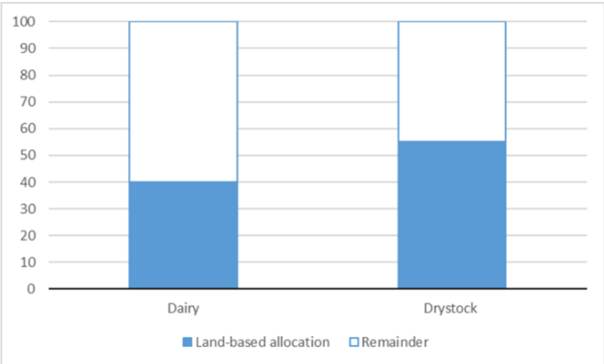
- This is likely to result in shares of the land-based allocation pool going to dairy versus drystock that do not reflect their business as usual share of emissions.

- However, this could be evened up by adjusting how the remaining half of total allocation pool is provided through output-based allocation for each sector. The sector specific output-based allocation factors could be adjusted to make sure each sector overall receives 95% of its own total business as usual emissions.

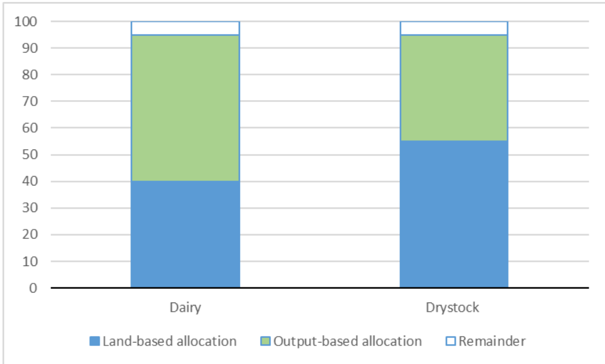
Graphs to illustrate this approach are provided below. Note the emissions and allocation volumes are completely hypothetical.

Figure 48: *An option for determining the ratios of land- and output-based allocation*

Step 1. Total livestock emissions are 200 Mt, so at 95% a total allocation pool of 190 Mt is available. Half of this (95 Mt) is allocated across farms in both sectors using a common land-based method. Dairy receives 40Mt, while Drystock receives 55 Mt.



Step 2. The remaining free allocation volume is distributed using output-based allocation. The allocation factors for dairy and drystock activities are adjusted to ensure that overall each sector received 95% of the sector's own total emissions. Each sector would get a different ratio of land versus output based allocation.



It may be challenging to identify precisely how much of the land-based allocation pool has been distributed to the dairy as opposed to the drystock sector. For some farms, land use is mixed or can change from year to year, so in these cases exactly what sector pastoral land is used might be unclear. This difficulty would also be encountered if a sector-differentiated approach was used for distributing land-based allocation.

4.2.4. Eligibility rules

To avoid perverse incentives or perceptions of inequitable outcomes the eligibility rules for agricultural allocation using a hybrid of output- and land-based methods require careful consideration.

For output-based allocation, eligibility is usually determined on an activity-basis. As output-based allocation is calculated using the amount of production in a year, it inherently relies on the productive activity occurring.

How this works is that a person would be eligible to receive an allocation if the person carries out a specified activity in that year. It also means that if the person stops doing the activity and stops being impacted by emissions costs, they also stop receiving free allocation. This is how eligibility is currently defined in the NZ ETS for both industrial (s80 of the CCRA) and agricultural allocation (s81(1) and Part 5, Schedule 3 of the CCRA).[11]

This activity-based approach should be retained for any output-based allocation to farmers in the agricultural GHG levy/rebate scheme. Any farms that are compulsory participants in the scheme would also qualify for the output based allocation. This is a simple approach that does not incorporate any element of grandparenting into the eligibility rules.

For the land-based component, the considerations are more complex.

Eligibility could be linked to activities, to give uniform rules with output-based allocation. This would create risks that some low profitability farming activities continue longer than they would otherwise, simply in order to continue receiving free allocation. There is experience of similar effects in the EU ETS, when grandparented free allocation was provided on an activity-basis.

A more suitable approach would be to link allocation eligibility to land. This approach would mean that that land use at a specified date in time would determine the land's ability to receive allocation.

The date chosen should be prior to when the announcement is made that a land-based allocation method will be adopted. This is to avoid creating perverse incentives for more livestock farming than would occur otherwise, such as by discouraging land owners from planting forests or encouraging them to expand the area they use for livestock. For example, if the Government announced that land-based allocation will be used in a farm-level levy/rebate scheme in early 2020, then year used for determining eligibility should be no later than 2019.

With the agricultural GHG levy/rebate scheme, there is likely to be a delay between the Government announcing its intention to implement such a policy and the actual start of the policy, as the scheme may not be in place until 2025. Relying solely on a much earlier year, such as 2019, to determine eligibility, may be problematic as there may be land that moves out of pastoral agriculture entirely between 2019 and 2025. Providing allocation to this land is likely to be viewed as unfair.

A way to address this would be to make eligibility dependent on two things:

1. that the land is being used for pastoral agriculture in the relevant year e.g. 2019 (excluding any land area in either pre-1990 or post-1989 forest as of that date), and

2. that the farm landowner or leaseholder must be a participant in the levy/rebate scheme when it commences i.e. they are undertaking leviable activities.

The second criterion could relate to the year that the mandatory reporting starts, rather than the year that obligations start. This would minimise the gap between the two elements of the eligibility criteria, to minimise any perverse incentive to keep livestock on grassland.

[11] For agricultural allocation, unlike industrial allocation, the eligible activity is aligned with the activity subject to the emissions obligations. In terms of livestock emissions with a farm point of obligation, as currently defined in the CCRA for the NZ ETS the specified activity would be farming, raising, growing or keeping ruminant animals, pigs, horses, or poultry for reward or the purpose of trade in animals, animal material or animal products taken or derived from those animals.

Once the levy/rebate scheme has started, even if the use of the land changes (e.g. to forestry, or horticulture) and the land-owner or leaseholder ceases to undertake the leviable activity, free allocation should continue to be given out on the basis of the previous land use for a period of time. This would maintain the incentive for land-use change and avoid a perverse incentive to keep a minimal number of livestock. It would allow the owner of the land leaving ruminant agriculture to receive more of a benefit from contributing to the social good of reduced emissions.

The land-based allocation should not continue indefinitely when land use changes, however, as this is likely to be seen as unfair. The government should set a period of time after which eligibility for land-based allocation is lost, if a leviable activity is no longer occurring. This could be aligned with any time period applicable to the option for capitalising free allocation (see section 4.2.5 below for further information).

A drawback of this approach is that it introduces an element of grandparenting to the eligibility rules, given that it depends on land use at a certain point in time. This may disadvantage owners of Māori land, who for a range of reasons have been less able to develop land for pastoral farming.

There is a strong case to apply different rules to Māori land. Any Māori land not meeting the proposed eligibility rules outlined above could nevertheless be deemed eligible, if at some time in the future it starts to be used for leviable livestock farming activities.

The Government could even consider making Māori land that is already in pre-1990 or post-1989 forest potentially eligible for land-based allocation. This would however create a perverse incentive toward deforestation which would be inconsistent with the purpose of a policy to price livestock emissions. Nevertheless in most cases the rewards from post-1989 forestry and the cost of deforesting both types of forest, including any ETS liabilities, are likely to outweigh the benefit that could be gained from land-based allocation for livestock activities especially when the new activities would face the levy.

4.2.5. An option to capitalise free allocation

Farmers could be given the option to capitalise their free allocation. Rather than receiving their allocation year-by-year, they could be given it as an advance lump-sum payment. Farmers who take up this option would then face the full cost of their livestock emissions over the period covered by the lump-sum.

This would not provide any extra allocation to these farmers than what they would otherwise receive, but would bring it forward in time. It could also be structured in such a way that the government receives a small fiscal benefit.

The purpose of this option would be to give some farmers more capital resources and encouragement to move into low emissions land uses and take up low emissions technologies and practices.

Pastoral farmers looking to change land use or change practices to reduce emissions in an innovative way could apply for this lump-sum option. Their experiences could help other farmers learn about these options and lower the cost and risk of later mitigation. It could also hasten emission reductions, if the lump-sum enables investments that wouldn't otherwise happen or shifts them earlier in time. It could be particularly helpful to farmers who face capital constraints.

A requirement to place a long-term covenant[12] on the land of farms using this option, to ensure permanent land use change, was considered but judged undesirable. Covenants are complex and are likely to discourage uptake.[13]

In any case, the main purpose of this option would be to enable experimentation and associated knowledge spill-overs, rather than incentives for permanent land use change. Therefore a requirement that farms simply pay a full obligation on any livestock emissions for the period covered by the capitalised allocation would be more appropriate.

Some elements to work through in designing an effective option of this nature include:

- Limit on total amount available
  - The government may wish to put a limit on the total amount of allocation that could be made available through this option each year. This would help manage its fiscal timing impacts, and also to mitigate risk that it could drive land use change too rapidly.
- Selection criteria
  - Basic criteria could include that it would apply to farms that are both undertaking leviable activities and eligible for agricultural allocation, and that only land owned by the applicant farm would be eligible for the capitalised allocation.
  - Other criteria could be set about the innovation, experimentation or information sharing required for receiving the capitalised allocation.
  - A share of the limited annual amount could be allocated to Maori land and to smaller farms and the total could be allocated in fixed proportions between drystock and dairy.
- Period covered
  - The amount of time this option would cover would influence the amount of allocation that could be capitalised and paid to the farmer as a lump sum.
  - In other schemes involving capitalisation of units, the period has been 6 years (grants for pine forests under the One Billion Trees programme) and 10 years (the Afforestation Grants Scheme).
- How to determine the lump-sum payment amount
  - An appropriate discount rate should be applied to any capitalised allocation.
  - It would be relatively simple to determine the amount of allocation to capitalise for the land-based component of a farm's allocation. How to determine the capitalised amount for the output-based component is less clear.

[12] A covenant is a legally binding agreement that is registered on the title of the land.

[13] For an outline of the experience of using covenants in another climate-related policy, the Permanent Forests Sinks Initiative (PFSI), see p29 of Te Uru Rakau (2018).

5. Processor-level free allocation – further information

In the Committee's report on agricultural emissions, it is noted that with a processor point of obligation, the proportional and output-based methods result in identical incentives and cost impacts. This is because at the processor level both emissions and free allocation are calculated based on output (emissions per tonnes of milk solids or animals slaughtered).

For example, as laid out in the Climate Change (Agriculture Sector) Regulations 2010, meat processors calculate emissions as follows:

Emissions = tonnes of animal type slaughtered x emission factor

The calculation for dairy processors is:

Emissions = tonnes of milk solids x emission factor

In both these calculations, the emission factor used represents the national average emissions per tonne of the relevant product (slaughtered animal, milk solids).

Proportional allocation would be calculated using the formula:

Allocation = emissions x allocation rate (95%)

Output-based allocation for these processors would be calculated as per a formula of the type:

Allocation = total product x allocation factor x allocation rate (95%)

where the allocation factor would represent the national average emissions per tonne of the relevant product (slaughtered animal, milk solids). Agricultural allocation in the NZ ETS is currently outlined in s85 of the CCRA using the output-based method.

As can be seen from these formulae, the emission factors and allocation factors used in output-based allocation would be the same, so resulting allocation volume would be identical to the result of proportional allocation.

Reasons to use an output-based allocation method, even though it is ostensibly more complex that proportional allocation, include:

- It is consistent with the method used for industrial allocation in the NZ ETS.
- Some processors may be able to work with farmers to undertake more specific emissions calculations and gain the benefit from the more accurate calculations, for example through the use of Unique Emissions Factors. In this case, output-based allocation would differ from proportional allocation by providing a stronger reward for improved emissions intensity.

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