KPMG

Climate Change Bill Impact Assessment

Prepared for Northern Ireland Agri-food Industry Representatives

Final Report

11 August 2021

KPMG Sustainable Futures

KPMG
The Soloist Building
1 Lanyon Pl
Belfast
BT1 3LP

Tel: +353 1 410 2000
Fax: +353 1 412 2000
www.kpmg.ie

FAO: Northern Ireland Agri-food Industry Representatives

Date: 11 August 2021

Climate Change Bill Impact Assessment – Final Report

Dear Mike,

We are delighted to submit to you our **Climate Change Bill Impact Assessment Draft Report.**

The Private Members Bill's (PMB) target to reach net zero emissions in Northern Ireland by 2045 is expected to have far-reaching impacts on Northern Ireland's economy. While the PMB sets a clear target for 2045, it does not indicate the scale decarbonisation required at a sector level. Furthermore, no economic impact or rural needs assessment of the potential mitigation activities needed to meet this target has been developed.

Agriculture is a crucial contributor to Northern Ireland's economy and is also a significant driver of greenhouse gas emissions. Whilst the pathway to net zero remains unclear in Northern Ireland, it is expected that agriculture will contribute to decarbonising the economy. As such, it is essential to understand the expected economic impacts and opportunities of agricultural decarbonisation in order to ensure a just transition to net zero in Northern Ireland.

Drawing on best available data from the UK Committee on Climate Change, DAERA, NISRA and through consultation with sector experts, we have completed an impact assessment of the PMB on the agricultural sector using two scenarios: Baseline and PMB. The key findings of the impact assessment are:

- The impact at farm-level varies across the respective sectors. The viability of the beef, dairy and sheep sectors are the most at risk from herd reductions, while the pig and poultry sectors are likely to be relatively less impacted. Farm level viability become significantly challenged once herd reductions reach 20%-40%
- Total economic output would fall by between 8%-66% across the sectors analysed. The negative impacts extend further when considering a reduction in the sector's capital investment activities, as well as the knock-on impact of herd reductions on abattoirs and other processors
- Overall herd reductions could lead to a 54% decrease in total employment.

Sincerely,

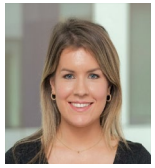
Russell Smyth

Partner | KPMG Sustainable Futures

Contents

The contacts at KPMG in connection with this report are:

Russell Smyth
Partner
Sustainable Futures
russell.smyth@kpmg.ie



Julie Stokes
Associate Director
Sustainable Futures
julie.stokes@kpmg.ie

Daragh Mc Greal
Associate Director
Strategy
daragh.mcgreal@kpmg.ie

About this report

High-level scope

Background & Context

Analyse recent legislative proposal relating to decarbonisation in NI and assess the relevance of this proposal to the agriculture industry.

Mitigation actions & Costs

Consider the range of mitigation actions required by agricultural sub-sectors to meet emissions goals and the costs to achieve these.

Economic Impacts

This study examines the potential farm-level and economic impacts of the PMB on agriculture's sub-sectors.

Key sources

Conversations with representatives of the agriculture sector in Northern Ireland, in particular with:

- Northern Ireland Dairy Council (DCNI)
- Ulster Farmers Union (UFU)
- Livestock and Meat Commission (LMCNI)
- Northern Ireland Meat Exporters Association (NIMEA)
- Northern Ireland Grain Trade Association (NIGTA)
- Northern Ireland Poultry Industry Federation

Desktop research of third party papers and reports, including from:

- The Climate Change Committee (CCC)
- Department of Agriculture, Environment and Rural Affairs (DAERA)
- Northern Ireland Statistics and Research Agency (NISRA)
- Scottish Rural Colleges
- Ulster Farmer Union (UFU)

Bespoke modelling of the NI agriculture industry and economy, utilising data on:

- Farm-level financial information
- Industry and sector employment
- Agriculture emissions intensity
- Processor financials
- Land use surveys

KPMG

Executive summary

Executive summary – key numbers

Sector-level herd numbers would fall by between **11%** and **86%** in the Private Member's Bill (PMB) scenario by 2045. In absolute terms, the reductions are stark: beef and cattle (-1.12 million), sheep (-1.71 million), and dairy (-270,000)

The beef sector's total direct and indirect economic output would fall from **£583m** in 2021 to **£210m** (-64%) in 2045. Total direct and indirect economic output in the dairy sector would fall from **£748m** in 2021 to **£252m** (-66%) in 2045

The negative impact of herd reductions on economic output varies by sector, and ranges from **8%** to **66%.** In absolute terms, the greatest falls would be in the dairy sector (-€495 million) and in beef sector (-€375 million)

Beef and sheep farms operating in less productive land could see a decrease in farm numbers of **98%** with 14,800 farm ceasing to operate

Over the period 2021-2045, the total aggregate 'lost' economic output in the PMB scenario would be **~£11 bn**

Beef and Sheep farms operating in lowlands could face a fall in numbers of **79%**, with ~4,100 farms ceasing to operate in these areas

The PMB scenario could result in a **54%** decrease in farm employment - a loss of **13,000** jobs

The dairy sector could see a decrease of **86%** to the number of farms, ~2,250 farms would cease operations.

Executive summary

Policy context

The proposed Climate Bill for Northern Ireland, put forward as a Private Member's Bill, sets an economy wide net zero carbon target by 2045.

Two scenarios are developed to understand the Bill's impact on the agriculture sector: the Baseline and the PMB scenario.

The PMB scenario would be ambitious, requiring significant reductions to herd numbers across sectors.

Climate Change (Northern Ireland) Bill 2021

- **In June 2019, the UK passed legislation requiring the government to reduce economy wide carbon emissions to net zero by 2050**. In response, the Climate Change Committee (CCC) recommended a series of sectoral targets and budgets for the UK, including Northern Ireland.
- Separately**, a proposed Climate Bill for Northern Ireland, the *Climate Change (Northern Ireland) Bill 2021 (the "PMB" or the "Bill")* was** put forward as a Private Member's Bill by the Green Party, which **sets an even more ambitious objective of net zero carbon across all sectors of the Northern Ireland economy by 2045**.
- While the PMB is clear on the target for 2045, it does not indicate the scale and magnitude of actions required for each sector of the economy, nor has it provided an economic impact or rural needs assessment.
- In the absence of such information, KPMG has been commissioned by NI agriculture sector representative bodies to **assess the potential economic impact of the Bill's targets on the agricultural and rural economy in Northern Ireland** in particular since this sector is likely to be most impacted by such a target.
- In order to undertake this assessment, we have **utilised information produced by the CCC, which we consider to the most credible, comprehensive and authoritative source of data available at this time**, supplemented by proprietary KPMG analysis.
- In December 2020, the CCC recommended a number of carbon reduction targets for Northern Ireland reflecting various ambition levels. **While its base case achieves an 82% reduction by 2050, under a more aggressive "Tailwinds scenario", the CCC put forward a reduction target of 94% by 2050, compared to 1990 levels**. It noted that such a target would require the implementation of stringent mitigation measures, including a significant reduction in meat and dairy consumption, and cautioned against implementing such a target.
- **In order to assess the impact of the PMB on the agriculture sector, we have utilised this Tailwind scenario, scaled up further to achieve a 100% carbon reduction, and accelerated to meet the target five years earlier, in 2045.**
- **In undertaking our analysis we have developed two core scenarios: the Baseline and the PMB scenario.**

Executive summary

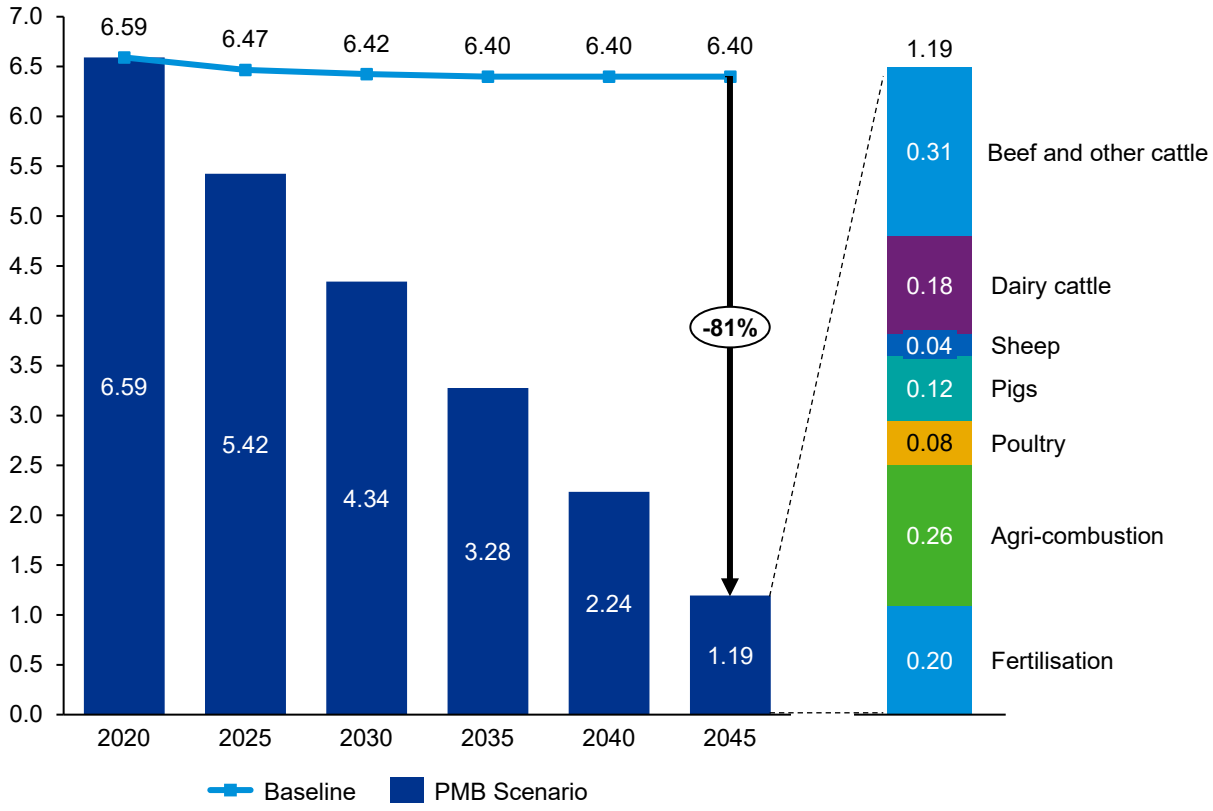
Emissions outlook

The PMB scenario encompasses each of the agriculture-specific mitigation measures modelled within the CCC's Tailwinds scenario in addition to further reaching actions to allow the agriculture sector to decarbonise as far as possible.

The Baseline Scenario shows a 3% reduction in carbon emissions between 2020 and 2045, resulting in a residual carbon footprint of 6.40 $MtCO_2e$.

The PMB Scenario results in a residual agriculture carbon footprint of 1.19 $MtCO_2e$ (81% reduction in carbon emissions compared to the 2045 baseline).

Carbon Emissions Future Trajectory ($MtCO_2e$)



Executive summary

Farm-level and financial Impacts

Sector-level herd numbers would fall by between 11% and 86% in the PMB scenario by 2045

On the farm level, viability across sectors becomes a challenge from at which a 10%-40% herd reduction arises, varying by sector

43% of NI farms are located on less favoured land – the coupling of less productive land with herd reductions will result in farms in the rural communities facing viability challenges first

Farm-level impacts

- **Based on CCC data, mitigation measures and innovation will provide only a modest reduction in agricultural emissions, with 92% of the required reduction arising from dramatic cuts in herd numbers by 2045 (referred to by the CCC as "behavioural changes")**. These behavioural changes will result in beef, dairy and sheep herd numbers falling by 86% and pig and poultry herd numbers falling by 11%.
- Viability in the respective sectors depends on farm size, farm type, and the productivity of the underlying land. **Falls in herd numbers of 10% challenges the viability of farms in the beef sector, given the sector's slim profit margins.** Beyond that fall, larger farms are likely to be those that remain. In the sheep and dairy sectors, viability on an average farm is significantly challenged from a 30% and 40% cut in herd numbers respectively
- Very small and small farms currently make up 97% of beef and sheep farms in NI. It is likely with the reduction in herds that these small farms will consolidate to try and achieve economies of scale. Farms located in less favoured areas will be likely to be the most impacted farm-type
- **In terms of impacts on farm numbers, beef and sheep farms operating in less favoured areas could see a decrease in farm numbers of 14,800 (-98%). Beef and Sheep farms operating in lowlands could face a fall in numbers of 4,100 (-79%), and the dairy sector could see a decrease of 2,250 (-86%)**
- With Fermanagh & Omagh, Mid Ulster & Newry, and Mourne and Down accounting for 43% of NI farms located on less favoured areas, farming communities in these local authority areas may be most impacted during the initial period of any reduction to overall herd numbers
- The pig and poultry sector is assumed to be less impacted by the changes required by the PMB than the dairy, beef, or sheep sectors, on the basis that the pig and poultry sectors contributes less to overall emissions in the baseline. Nonetheless, pig and poultry herd numbers would fall by 11% compared to 2020
- **Broadly, reductions to herd numbers impact farm-level viability in addition to negatively impacting viability in the wider supply and value chain (i.e. viability at processors, food processing operators, transport, and retail, amongst others).** These impacts will lead to significant negative impacts on rural communities, with farm-level and wider income falling, resulting in less overall spend flowing to communities that depend on the agriculture industry to survive.

Executive summary

Economic and employment impacts

The negative impact of herd reductions on economic output varies by sector, and ranges from 8% to 66%

Over the period 2021-2045, the total aggregate 'lost' economic output in the PMB scenario would be ~£11 bn

The PMB scenario could result in a 13,000 (-54%) fall in farm employment on farm levels by 2045

The focus of this report is on the livestock sector. However, there will be knock impacts to arable farmers in NI who are largely supplying the livestock sector with feed. There may be some opportunities for horticulture to expand, but these will be limited by land type

Economic impacts (PMB scenario)

- Across the five sectors analysed in this report, total economic output would fall by between 8% - 66% in the PMB scenario
  - The **beef sector's total direct and indirect economic output would fall from £583m in 2021 to £210m (-64%)** in 2045. Given the sector's close embeddedness with its supply chain and other operator in the sector, the multiplier impact of this fall in output is likely to be significant
  - Total **direct and indirect economic output in the dairy sector would fall from £748m in 2021 to £252m (-66%) in 2045**. In the PMB scenario, if consumer demand does not shift away from dairy-based products, after a certain point the UK would begin to import dairy-based products from overseas markets with less carbon-efficient dairy sector. Effectively, this would equate to exporting carbon emissions while reducing economic output in the dairy sector.
  - In the **sheep sector, total direct and indirect economic output would fall from £113m in 2021 to £50m (-56%) in 2045**. As the sheep sector is more prevalent in areas with marginal land and, typically, relatively lower household incomes, the impact of reduced economic output may be relatively large in these areas.
  - The **pig and poultry sector's current farm gate output is ~£255m and ~£627 respectively, and would fall to £215m (-16%) and to ~£578m (-8%) by 2045**, assuming livestock numbers fall in line with the PMB
- Capital investment will fall on a farm- and sector-level: over 2021-2045, this could result in the contribution of capital spend to Gross Value Add (GVA) being ~£2bn lower in the PMB scenario than it otherwise would be. However, the combined capital expenditure to implement the required mitigation measures could generate an impact ~£1.4 billion in 2021-2045. On a macro level, for producers who remain in the market, investment in mitigation measures could make their produce relatively more expensive for NI consumers, compared to international produce
- Up to a -20% reduction in herd numbers, the impact on employment levels is not significant (-6%). After a -30% reduction there is a significant decrease in employment. **With a herd reduction of 86% for dairy, beef & sheep and a 11% reduction for poultry and pig there is a 54% decrease in farm employment, with ~13,000 jobs lost**. Additionally, indirect employment in processors and other value chain operators will fall as throughput and wider activity falls. It is assumed that **a 10% reduction in throughput would challenge processors' viability: any closures of processing facilities would have a negative impact on regional economies** through job losses and lower economic output.

Executive summary

Key statistics

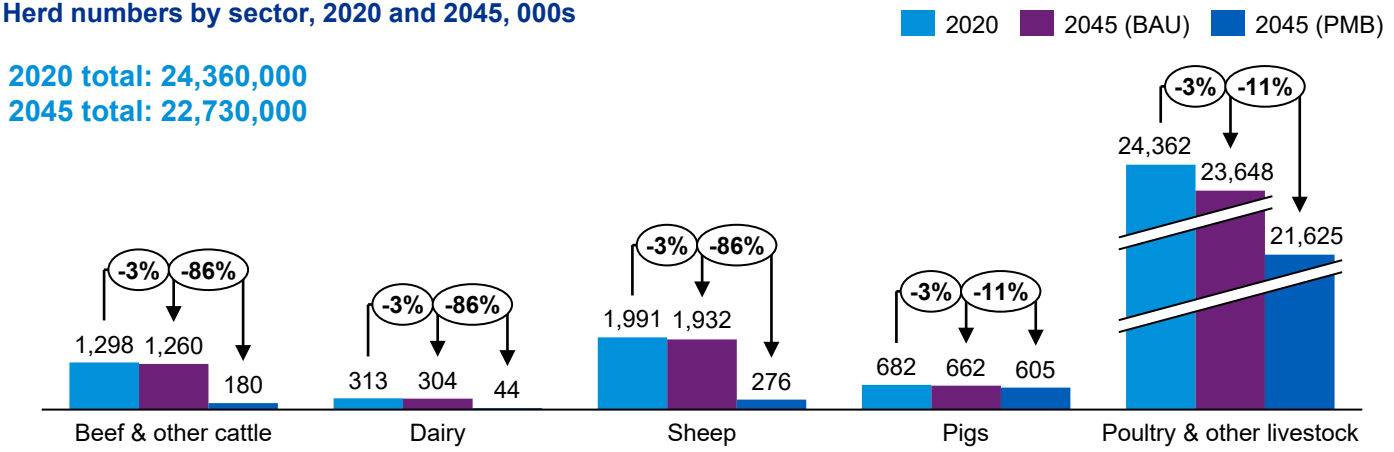
Sector-level herd numbers would fall by between 11% and 86% in the PMB scenario by 2045.

The beef, dairy, and sheep sectors are broadly aligned in terms of livestock reductions; pig and poultry sectors are less negatively affected.

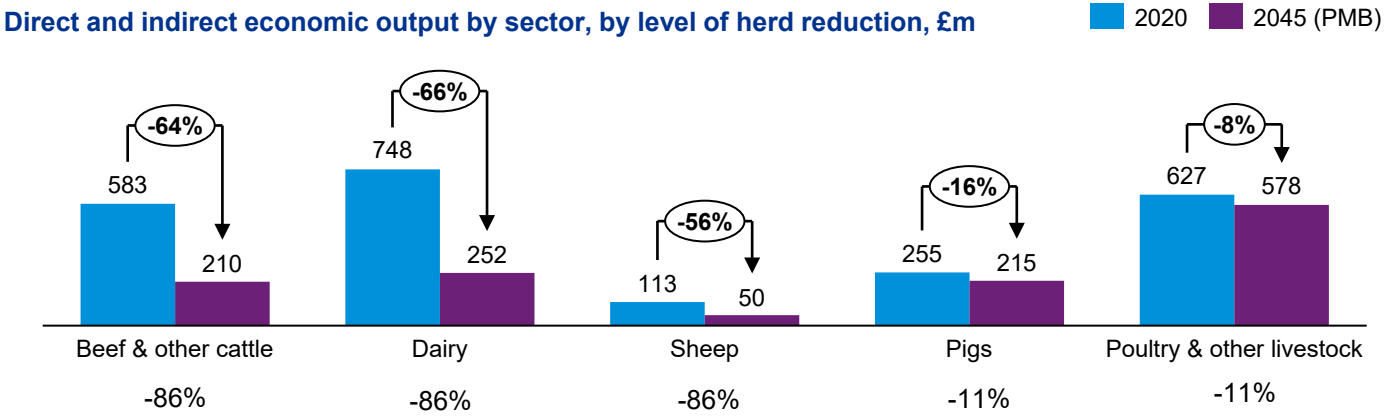
The PMB would reduce economic output across all sectors in agriculture.

Impacts on economic output would be greatest the dairy and beef sectors.

Herd numbers by sector, 2020 and 2045, 000s



Direct and indirect economic output by sector, by level of herd reduction, £m



KPMG

Background and context

Background

Context

A proposed climate bill for Northern Ireland, the *Climate Change (Northern Ireland) Bill 2021 (the "PMB" or the "Bill")*, put forward as a Private Member's Bill by the Green Party, sets a net zero carbon target by 2045 across all sectors of the economy. While the proposed Bill is clear on the target for 2045, it does not indicate the scale and magnitude of actions required for each sector, including the agriculture sector. In addition, no economic impact or rural needs assessment of the potential actions required to reach this target has been developed.

The purpose and aim of this report is to provide an understanding of the impact of the Bill on the agriculture sector, the wider economy and rural communities.

The report is split into 2 parts:

1. **Context setting and Scenario Analysis:**
   - Policy context
   - NI emissions profile
   - Approach to Scenario Analysis
   - Scenario Analysis Results
2. **Economic and Rural Communities impact assessment:**
   - Farm level financial impacts
   - Sector level financial impacts
   - Economic impacts
   - Employment impacts

Policy context

The UK's climate targets are ambitious, with a clear roadmap. NI policy evolving.

While the proposed PMB is clear on its ambition – reaching net zero carbon across all sectors by 2045 – the extent and level of effort or contribution required by each sector, including the agriculture sector, needs to contribute to this ambition is unclear.

In June 2019, the UK passed legislation requiring the government to reduce national carbon emissions to net zero by 2050. In response, the Climate Change Committee (CCC) recommended a series of sectoral targets and budgets for the UK, including Northern Ireland, based on robust data and analysis. As part of their recommendations, in December 2020, the CCC recommended at least an 82% reduction in Northern Ireland's sector-wide carbon emissions by 2050, compared to 1990 levels. This target reflects a balanced approach and recommended as part of Northern Ireland's fair contribution to the wider UK 2050 net zero target.[1] The CCC have also modelled the most 'far reaching' scenario (Tailwinds) where Northern Ireland reach a reduction target of 94% by 2050 (compared to 1990 levels).

In their analysis of a fair and balanced approach, the CCC have allocated the extent and magnitude of which the agriculture sector needs to decarbonise by 2050 - a reduction of 36% between 2020 and 2050, leaving a residual carbon footprint of 4.22 $MtCO_2e$. Even under Tailwinds, a stark reduction in agriculture sector emissions is required, reducing by 57% between 2020 and 2050, leaving residual emissions of approximately 2.84 $MtCO_2e$.

According to the CCC, going beyond these modelled scenarios and reaching net zero in Northern Ireland would require extensive cuts to the agriculture sector. It would mean a greater than 50% fall in meat and dairy production (and hence a cut in herd numbers) in NI by 2050 alongside a corresponding shift to plant based diets to meet demand. A much greater share of greenhouse gas removal technologies would also be needed to be implemented in NI. In addition, in a recent message to Members of the NI Assembly, the chair of the CCC, Lord Deben, reiterated that there is 'no credible path' for NI to reach net zero by 2050 and that asking people to do so would be 'morally wrong'.[2]

1. Note that this 82% reduction target is reflected in DAERA's Climate Bill brought forward to NI Assembly by Minister Edwin Poots.

2. https://www.farmersjournal.ie/net-zero-target-is-morally-wrong-mlas-told-628811

Key takeaways

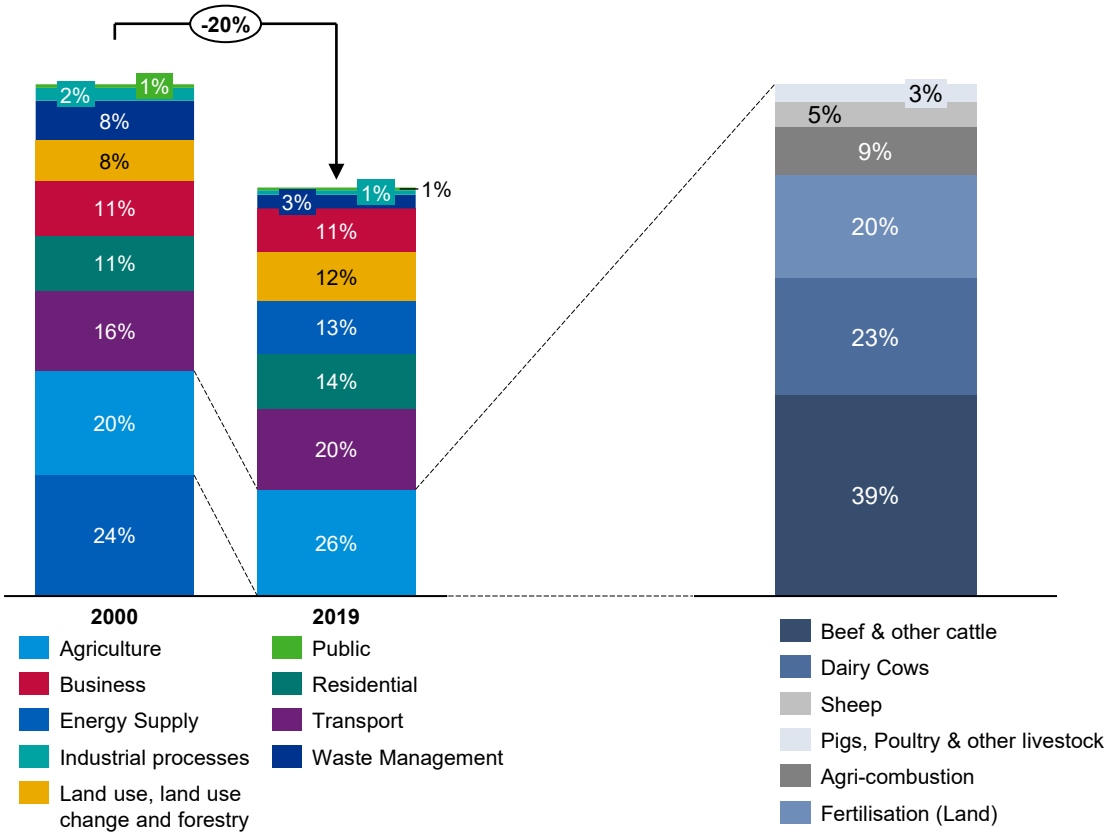
- **NI Climate Bill put forward as a PMB advocates for a net zero target by 2045.** it is not clear how and by what means this target will be reached or what sectors will contribute most
- Agriculture is one of the highest emitting sectors of NI's economy. It is also considered to be one of the 'hardest to abate' sectors due to the majority of the emissions sources arising from methane emissions from ruminants. In order to reduce these emissions, a cut in herd numbers is considered the only option.
- **The CCC recommend a target of at least 82% reduction in NI's sector wide carbon emissions by 2050 compared to 1990 levels of which agriculture is expected to decarbonise by 36% during 2020 and 2050.** This reflects a fair contribution to UK's wider net zero target by 2050
- **Even in the CCC's most far reaching scenario, NI doesn't reach net zero.** Under this scenario, agriculture is required to decarbonise by 57% between 2020 and 2050
- **According to CCC, net zero would require extensive cuts to the agriculture sector beyond what is modelled in their most far reaching scenario.** This would include greater than 50% fall in meat and dairy consumption and hence a cut in herd numbers in NI by 2050

NI carbon emissions profile

Total carbon emissions[1] have been reasonably flat. Agriculture carbon emissions growing slightly.

Carbon emissions split by sector (2019, $ktCO_2e$)

Split by agriculture sector



Key takeaways

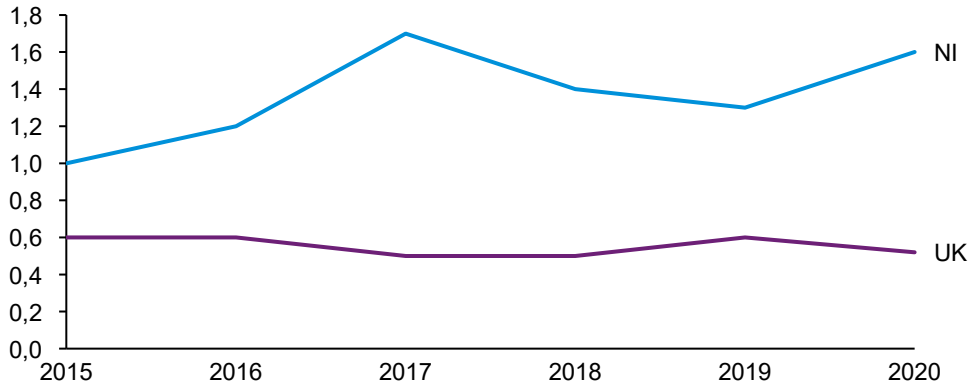
- **Agriculture sector accounts for approximately 26% of Northern Ireland's carbon footprint**
- Carbon emissions have risen slightly since 2000 by approximately 2% to levels seen in 2019
- In 2019, beef and dairy cattle accounted for the majority of emissions (39% and 23%, respectively) with fertilisation accounting for the next largest proportion at 20%. Agri-combustion accounts for 9% of total emissions with the remaining 8% accounted for by sheep, pigs and poultry and other livestock (horses, ponies and goats)

1. Carbon emissions refers to all greenhouse gases, including carbon dioxide and methane. Carbon emissions are reported as carbon dioxide equivalent (CO_2e) to allow for all greenhouse gas emissions to be reported as one number.

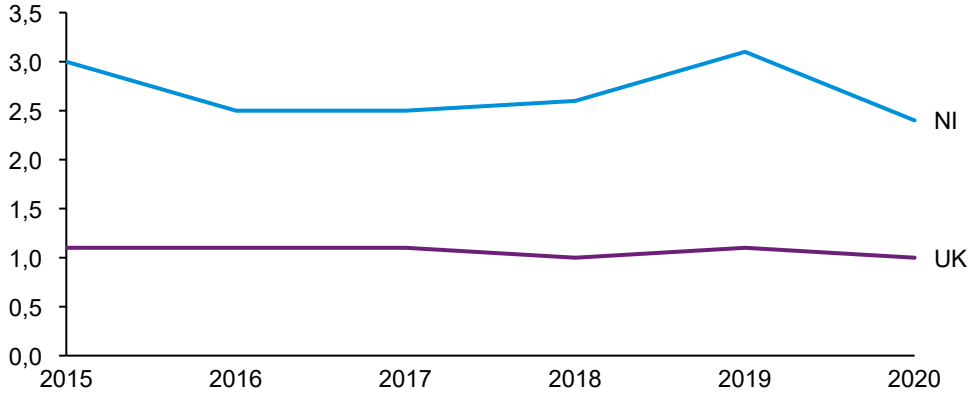
NI agriculture

The NI agricultural sector is a key contributor to economic output and employment.

Agriculture as % of total GVA, 2015-2020



Agricultural employment as a % of total civil employment, 2015-2020



Key takeaways

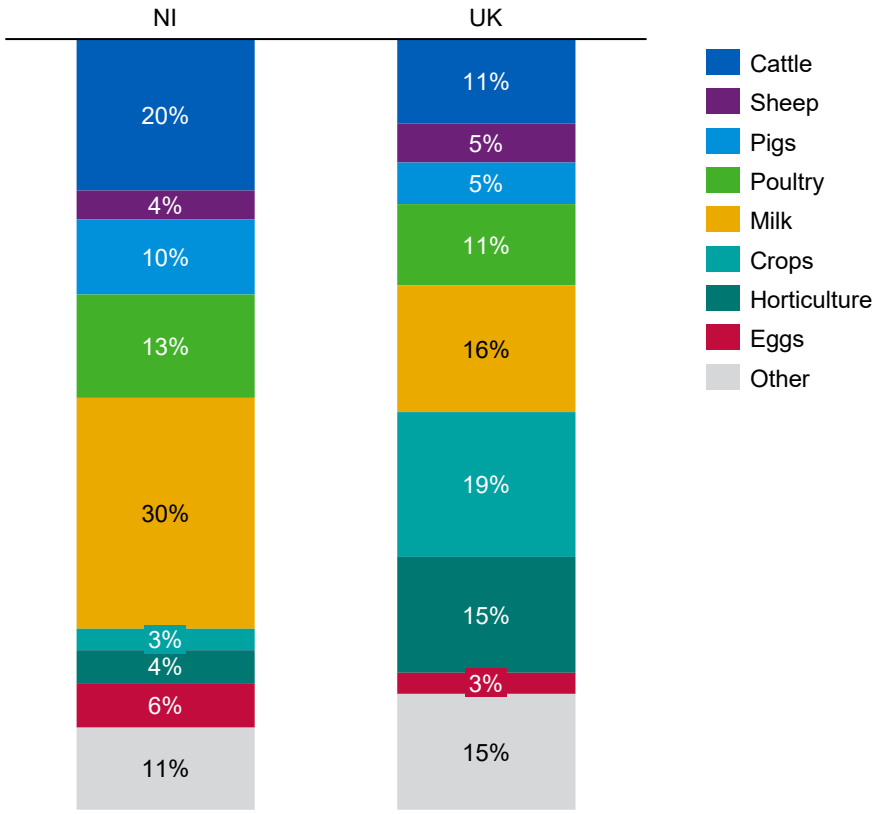
- The NI agricultural sector plays an important role in terms of its contribution to economic output, employment and the rural economy
- In the last 5 years the Gross Value Added ('GVA') created by NI's agricultural sector has increased by 67% from £402m to £673m
- Northern Ireland's total agricultural labour force in 2020 was 51,301. Agricultural employment as a % of total civil employment in NI was 2.4% (2020)
- There were ~25,896 active farm businesses in Northern Ireland at June 2020. This highlights the importance of agriculture for the rural economy
- Based on 2018 figures, 36% of the population lived in rural areas
- In terms of land use, roughly 79% of the total Northern Ireland land area (1.35 million hectares) is used for agriculture, including common rough grazing

Source: DAERA (2020), KPMG analysis

NI agriculture

The NI dairy and cattle sectors represent the largest share of gross output.

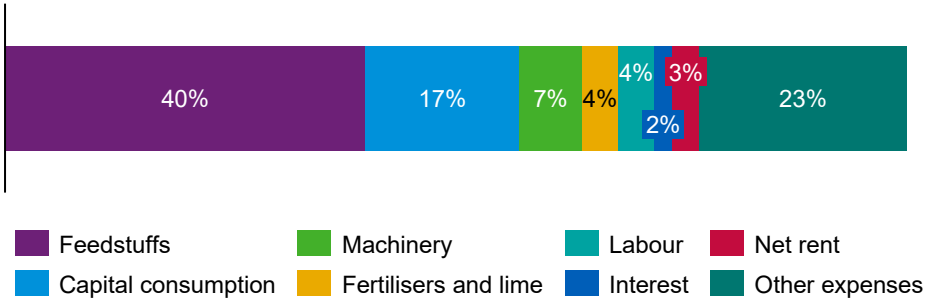
Gross output of NI and UK agriculture, 2020



Key takeaways

- The NI dairy and cattle sectors represent the largest share of gross output, which totalled £2.23 billion in 2020
- On the UK level, the dairy and cattle sectors make up a relatively lower share of gross output
- Gross input amounted to £1.55 billion in 2020, with feedstuffs being the single biggest input
- Feedstuff costs increased by 0.9 per cent in 2020 to £837 million

Total expenses of NI agriculture, 2020



Source: DAERA (2020), KPMG analysis

KPMG

Approach to scenario analysis

Scenario Analysis

The NI agriculture sector is a significant contributor to economy wide carbon emissions.

NI's agriculture sector is one of the highest contributing sectors to economy-wide carbon emissions (approximately 26% of NI's total carbon emissions in 2019) and as such has an important role to play in assisting Northern Ireland meet its long-term Net Zero ambitions. However, it is widely recognised that the sector is one of the hardest to decarbonise, as well as being a key driver of the Northern Ireland economy.

In undertaking an economic impact assessment for the agricultural sector, we have adopted the following methodology:

- Since the PMB does not provide clear sectoral targets or budgets to reach net zero by 2045, we have instead used the most credible **science-based analysis** from the CCC 6th Carbon Budget to build an understanding of the PMB's impact on the agriculture sector.
- Due to its contribution to NI's economy and the difficulty to decarbonise the sector, it is considered reasonable for NI's agriculture sector to decarbonise to such a point by 2045 that it will **still result in some residual emissions**.
- These residual emissions will be **offset and removed** by areas of NI and wider UK which have been identified as 'net carbon sinks' as well as through the use of engineering technologies. As a result, the agriculture sector in NI will not inhibit NI / UK in reaching net zero ambitions.
- In line with the CCC assumptions, we have assumed that reductions in herd numbers are driven by reduced consumer demand for meat and dairy (labelled "behavioural change") alongside a shift to plant based diets, as well as a reduction in food waste. Importantly, this measure does not mean demand is met by increased imports and production elsewhere – the same proportion of UK food demand is met by UK food production. If an increase in food imports occurs, there is a risk of carbon leakage and the whole model will not be viable. In particular, as some countries do have Net Zero targets (e.g. Australia in the context of the UK trade deal), leakage may be more pronounced. For further detail on carbon leakage, refer to the 'Assumptions and Limitations' section of the Appendices.

Two scenarios have been developed to understand and assess the impact of the PMB on the agriculture sector:

- **Baseline scenario:** reflects a reasonable worst case scenario, used for comparison purposes, and;
- **PMB scenario:** reflects a net zero carbon target by 2045.

Scenario Analysis

Baseline Scenario

- The baseline scenario adopts the CCC's projections of carbon emissions for the agriculture sector, without additional mitigation measures and presents a reasonable worst case scenario. It reflects the latest data from Northern Ireland government and shows a reduction of approximately 3% between 2020 and 2045. This reduction reflects a slight decrease in livestock numbers, the stabilisation of carbon emissions from agricultural soils alongside existing agriculture policy and no new policy introductions.
- The baseline scenario is developed for the purpose of comparison and to understand the impacts of the PMB proposal on the economy and rural communities.

PMB Scenario

- Analysis from the CCC, specifically the Tailwinds scenario, forms the basis of the PMB scenario and is used to build an understanding of the impact of the PMB's net zero by 2045 ambition on the agriculture sector.
- The Tailwinds scenario reflects a highly optimistic scenario, stretching feasibility in a wide range of areas and going beyond the current evidence in others, including the agriculture sector. The assumptions supporting this scenario means that it is necessary for policy to work first time and with full effect, requires changes to behaviour and a range of uncertain technologies are implemented at the upper end of expectations.
- Economy-wide, the Tailwinds scenario achieves a 94% carbon reduction in NI by 2050 (compared to 1990 levels) and a corresponding reduction in agriculture sector emissions of 57% between 2020 and 2050.
- Adopting this approach to assess the impact of the PMB assumes NI gets to net zero by the actions set out in the CCC's Tailwinds scenario across all sectors, but with an additional effort from agriculture. This includes a further reduction to meat and dairy consumption which for the purpose of this analysis translates to a cut in herd numbers.
- As one of the 'hardest to decarbonise' sectors, the CCC believe that it is not possible or reasonable to mitigate against all emissions the agriculture sector produces as this would essentially mean removing the entire sector leading to destabilising results to NI's economy. Our approach does not reduce agriculture carbon emissions to 'zero' but shows the agriculture sector decarbonising as far as KPMG deems possible without impacting the wider NI economy target of reaching net zero by 2045 – we consider this to be the most conservative approach.
- The residual emissions from the agriculture sector are then assumed to be removed or offset by 'net carbon sinks' and engineering technologies.

Scenario Analysis

PMB Scenario

The PMB scenario encompasses each of the agriculture specific mitigation measures modelled within the CCC's Tailwinds scenario in addition to further reaching actions to allow the agriculture sector to decarbonise as far as KPMG deems possible without impacting the wider NI economy target of reaching net zero by 2045.

The mitigation measures are categorised as follows:

- **Behavioural change**[*,**]
- **Crops and soils**
- **Livestock**
- **Machinery**
- **Waste management**

Each of the mitigation measure categories have been allocated to each of the agriculture industry sectors for reporting purposes:

- **Beef and other cattle**
- **Dairy cattle**
- **Sheep**
- **Pigs**
- **Poultry & other livestock**
- **Agri-combustion**
- **Fertilisation**

*As mentioned, the behavioural change mitigation measure reflects a reduction in meat and dairy consumer demand alongside a shift to plant based diets, as well as a reduction in food waste. Importantly, this measure does not mean demand is met by increased imports and production elsewhere – the same proportion of UK food demand is met by UK food production.
**It should be noted that there is research showing that a reduction in consumption of animal-based products alongside a shift towards a plant-based diet does not necessarily mean a reduction in carbon emissions. For example, modelling work using the Optimeal™ Tool shows that when the current dairy intake of the European diet is halved and replaced with alternatives to achieve a similar nutritional value, there is little or no accompanying reduction in carbon emissions (around 1%).

Scenario Analysis

A three-stage approach has been used to evaluate the PMB Scenario.

The following steps have been adopted to model the impact of the PMB on the agriculture sector:

1. The rate at which the Tailwinds scenario decarbonises each of the sectors of NI's economy is accelerated by 5 years, bringing forward the sector wide carbon emissions in 2050 to 2045. All but the agriculture sector remain at this rate and magnitude of decarbonisation in the PMB scenario.

2. Each of the agriculture abatement measures set out under the Tailwinds scenario have been reviewed and explored to understand the extent to which the agriculture sector needs to decarbonise by to reach an economy wide net zero target by 2045. An additional 'level of effort' has been applied across most of the carbon reduction measures, with the exception of machinery.

3. An **allocation exercise** of each of the mitigation measures has been undertaken to present the carbon emissions by each of the agriculture reporting sectors.

Scenario Analysis

Step 1 & 2:

The mitigation potential of each measure implemented under the PMB Scenario is presented below. The % contribution of each measure is shown as well as a comparison to the CCC's Tailwinds scenario. Importantly, the analysis shows a high reliance on reducing consumer demand for meat and dairy and hence, a cut in herd numbers to mitigate carbon emissions (92%). Outside of this mitigation measure, there is limited opportunity from innovation and improved efficiency measures.

Mitigation measure	CCC Tailwinds	PMB Scenario	% of overall mitigation in agriculture under PMB scenario
Behavioural Change	50% less meat and dairy by 2050 with 30% meat replaced with lab-grown meat. 50% fall in food waste by 2030; 70% by 2050. **2.74 $MtCO_2e$ mitigation by 2050**	Accelerate Tailwinds by 5 years to 2045 and increase impact by 75% resulting in: **4.79 $MtCO_2e$ mitigation by 2045**	**92%**
Crops and Soils	Grass leys, cover crops and grass legumes. **0.21 $MtCO_2e$ abatement by 2050**	Accelerate Tailwinds by 5 years to 2045 and decrease impact by 75%: **0.05 $MtCO_2e$ mitigation by 2045**	**1%**
Livestock	Breeding measures, livestock health, livestock diets and increased milking frequency. **0.26 $MtCO_2e$ abatement by 2050**	Accelerate Tailwinds by 5 years to 2045 and decrease impact by 75%: **0.07 $MtCO_2e$ mitigation by 2045**	**1%**
Machinery	Static and mobile machinery decarbonisation (hydrogen, electrification & biofuels). **0.28 $MtCO_2e$ by 2050**	Accelerate Tailwinds by 5 years to 2045 and leave magnitude of mitigation measures unchanged from Tailwinds: **0.28 $MtCO_2e$ mitigation by 2045**	**5%**
Waste management	Anaerobic Digestion (AD) cattle, AD pigs and covering slurry. **0.07 $MtCO_2e$ abatement by 2050**	Accelerate Tailwinds by 5 years to 2045 and decrease impact by 75%: **0.02 $MtCO_2e$ mitigation by 2045**	**1%**
Total mitigation potential	**3.56 $MtCO_2e$**	**5.20 $MtCO_2e$**	**100%**

Scenario Analysis

Step 3:

The estimated proportions (%) of each mitigation measure allocated to each of the agriculture reporting sectors is presented in the table below. The vast majority of mitigation comes from the 'Beef and other cattle', 'Dairy' and 'Sheep' sector and therefore, result in the most severe cuts to each industry including reductions in herd numbers.

'Pigs' and 'Poultry & other livestock' produce a smaller proportion of total agriculture carbon emissions (2% pigs carbon emissions and 1% poultry & other livestock carbon emissions) and therefore it is considered fair that these sectors have a smaller, albeit still important, role to play in agricultural decarbonisation. As such we expect limited reductions in herd numbers will be required from these sectors.

The pig and poultry sectors are already limited by strict planning restrictions and a future ammonia policy and other environmental controls will likely restrict further opportunities to substitute growth in these lower-carbon sectors to facilitate reductions in other higher emitting sectors.

Mitigation measure	Beef & other cattle	Dairy	Sheep	Pigs	Poultry & other livestock	Agri-combustion	Fertilisation
Behavioural Change	45%	26%	6%	0.2%	0.2%	1%	22%
Crops and Soils	-	-	-	-	-	-	100%
Livestock	56%	32%	7%	3%	2%	-	-
Machinery	-	-	-	-	-	100%	-
Waste management	60%	35%	-	3%	2%	-	-

KPMG

Scenario analysis results

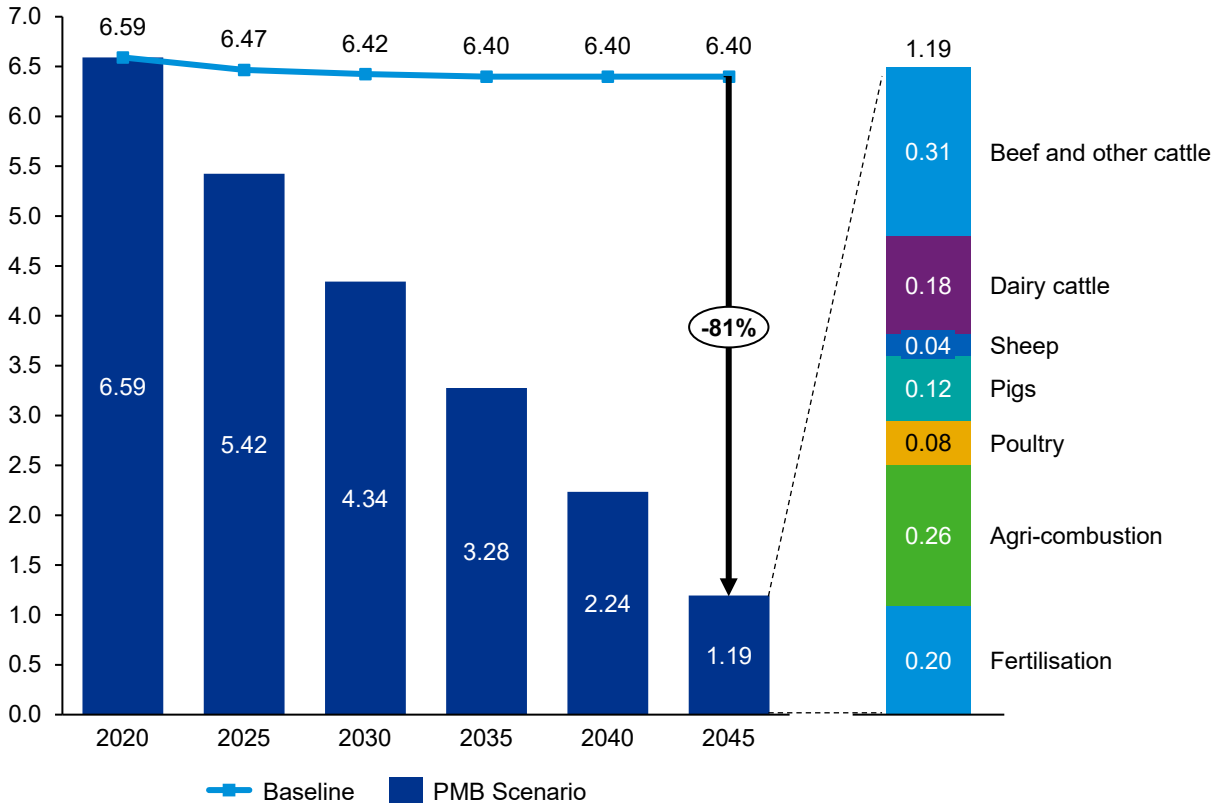
Baseline Scenario v PMB Scenario Results

The table below presents the results of both the Baseline Scenario and PMB Scenario analysis. The agriculture sector carbon emissions in 2020 and 2045 under each scenario is presented, including a breakdown by agriculture reporting sector. Carbon emissions reported in 2045 under the PMB Scenario reflect the implementation of all mitigation measures which equates to a total mitigation potential of approximately 5.20 MtCO2e.

	Baseline Scenario		PMB Scenario	
	2020	2045	2020	2045
Economy wide reduction target	-	Business as usual	-	Net Zero carbon emissions by 2045
Agriculture industry reduction target	-	Reflect CCC's baseline scenario - **3% reduction in carbon emissions** between 2020 to 2045	-	Agriculture sector emissions **decarbonises by 82% between 2020 and 2045**, leaving approximately **1.19 $MtCO_2e$ residual emissions** associated with the agriculture sector.
Total Agriculture ($MtCO_2e$)	6.59	**6.40**	6.59	**1.19**
Beef and other cattle ($MtCO_2e$)	2.59	2.51	2.59	0.31
Dairy cattle ($MtCO_2e$)	1.51	1.46	1.51	0.18
Sheep ($MtCO_2e$)	0.33	0.32	0.33	0.04
Pigs ($MtCO_2e$)	0.14	0.13	0.14	0.12
Poultry ($MtCO_2e$)	0.09	0.08	0.09	0.08
Agri-combustion ($MtCO_2e$)	0.61	0.59	0.61	0.26
Fertilisation ($MtCO_2e$)	1.34	1.30	1.34	0.20

Baseline Scenario v PMB Scenario Results

Carbon Emissions Future Trajectory (MtCO2e)



Key takeaways

- Implementation of all mitigation measures under the **PMB Scenario** results in a residual agriculture carbon footprint of **1.19 $MtCO_2e$**, equating to an **81% reduction in carbon emissions compared to the 2045 baseline**
- The **Baseline Scenario** which represents a 'Business-as-Usual' scenario shows a 3% reduction in carbon emissions between 2020 and 2045, resulting in a residual carbon footprint of **6.40 $MtCO_2e$**

Source: Ag sector scenario comparison

KPMG

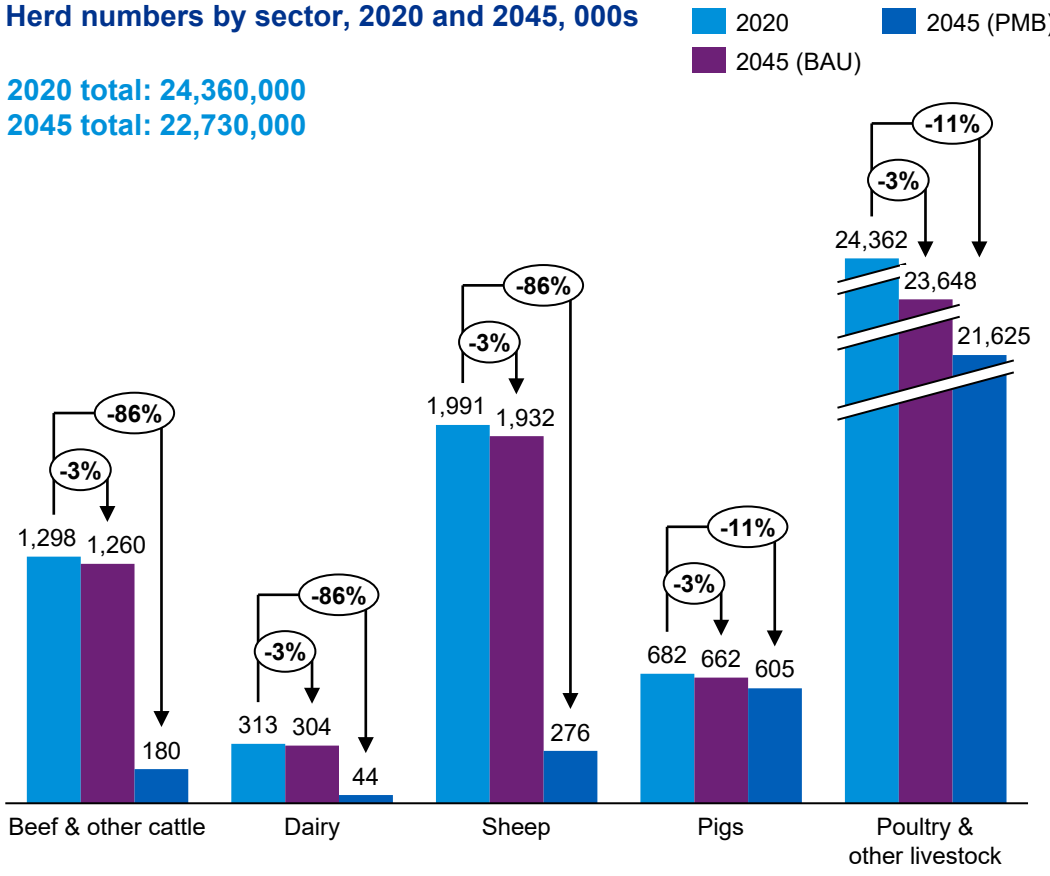
Farm-level impacts

Sector-level herd numbers

Sector-level herd numbers would fall by between 11% and 86% in the PMB scenario by 2045.

Herd numbers by sector, 2020 and 2045, 000s

2020 total: 24,360,000
2045 total: 22,730,000



Key takeaways

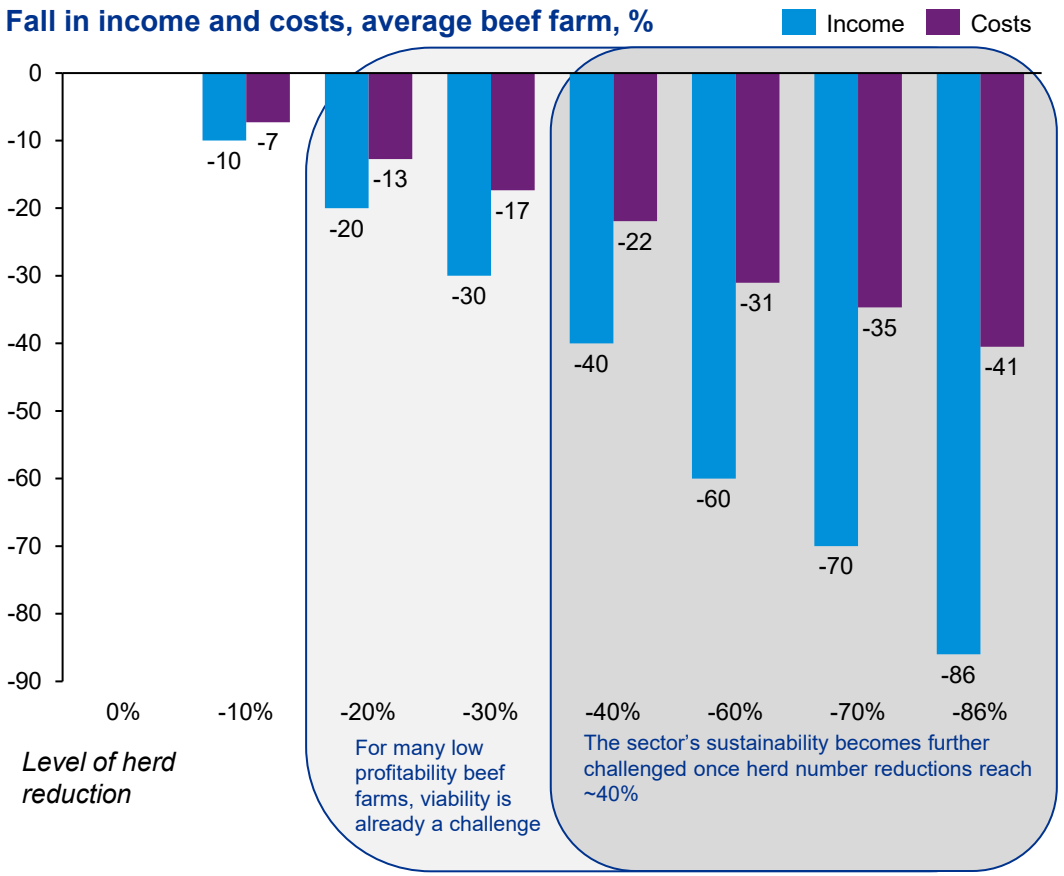
- Applying the level of carbon reduction outlined in PMB scenario results in a reduction of agriculture emissions of approx. 82% in 2045, compared to 2020 levels, leaving residual carbon emissions of 1.19 MtCO2e associated with the agriculture sector
- Behavioural change carbon reduction measure accounts for majority of carbon reduction measures (92%), which results in a substantial reduction to herd numbers by 2045
  - **By 2045, beef, dairy, and sheep herd numbers would fall by 3% in the Business as Usual (BAU) scenario and would fall by 86% in the PMB scenario**
  - **Herd numbers in the pig sector and in the poultry sector would be 3% lower in 2045 than in 2020 in the BAU scenario and would be 11% lower than 2020 numbers in the PMB scenario** – pigs and poultry are assumed to less impacted as these sectors contribute proportionate less to overall agriculture emissions
- **The fall in herd numbers across the sectors will impact viability on the farm level. A direct relationship is assumed between lower consumer demand, a smaller herd, and farm level incomes. Sectors with higher fixed costs may find it more challenging to remain viable, as these costs remain stable while income falls.**

Source: DAERA (2020), KPMG analysis, industry consultation

Financial viability - beef sector

Viability for marginal beef farmers becomes a challenge once herd reductions reach 10%.

Fall in income and costs, average beef farm, %



Key takeaways

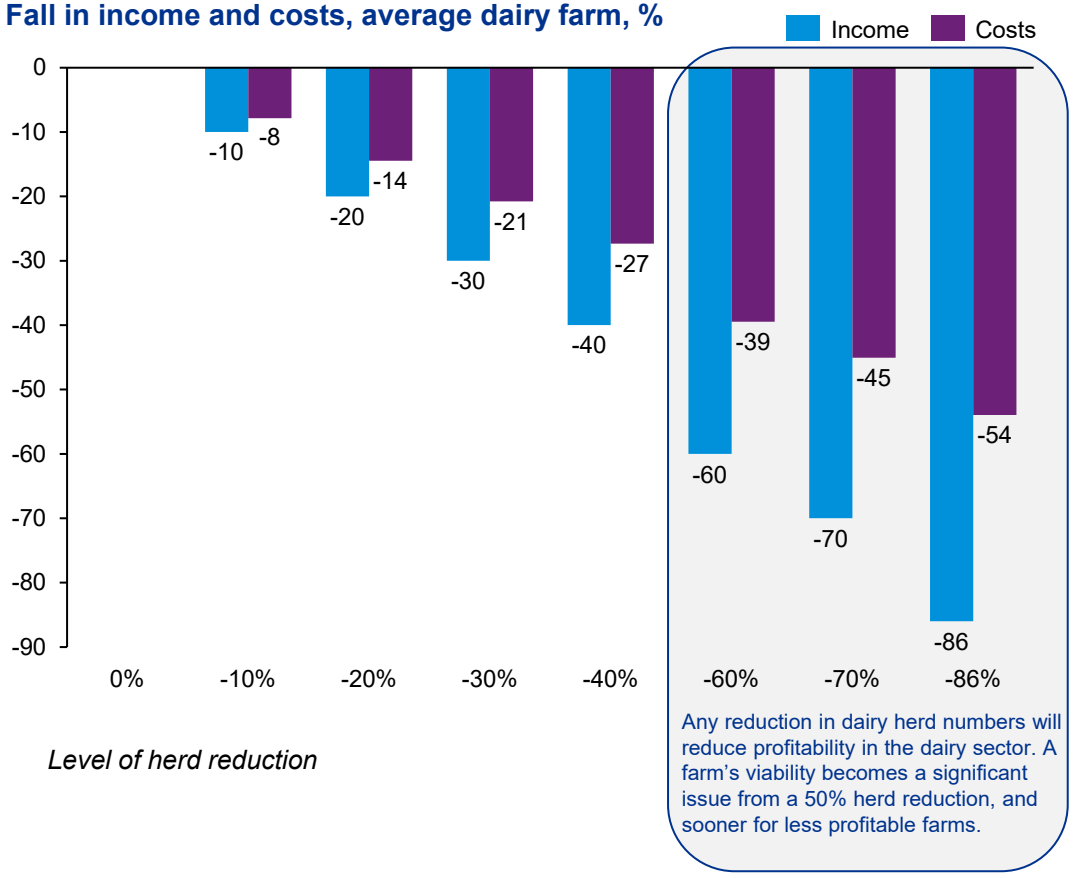
- Profitability including subsidies in the beef sector on an average farm is typically in the range £10,000-£20,000, depending farm type, size and land quality.
- Looking forward, variable costs are assumed to fall by different rates, depending on the type of cost. While the cost of feedstuffs falls in line with the reduction to the beef herd by 2045, the cost of fertiliser, seed and sprays (-43%) and other costs (-57%) fall by less than the fall in herd numbers, on the basis that these costs are more inelastic than feedstuff costs
- Fixed costs, such as machinery costs, other fixed costs, and labour costs are more inelastic than variable costs. Fixed costs are 18% lower by 2045, where the herd is 86% lower by 2045. By 2045, total costs would fall 41%
- If farms consolidate, costs could fall by more than otherwise, if economies of scale are achieved through consolidation. If consolidation occurs, costs will fall by 50% by 2045, compared to -41% without consolidation. As between 85%-90% of beef farms have 1.5 FTEs or fewer, it is reasonable to assume that consolidation will be likely
- **In the wider supply chain, lower viability on the farm level is assumed to influence activities within abattoirs and other downstream intermediaries** (see later analysis).

Source: DAERA (2020), KPMG analysis, industry consultation
Note: Depending on farm size the subsidies included are between £11,000-£20,000 per lowland cattle and sheep farm (39%-43% of output) These are assumed not to decrease with herd numbers.

Financial viability - dairy sector

Viability becomes a significant issue for the dairy sector once herd reductions reach ~50%.

Fall in income and costs, average dairy farm, %



Any reduction in dairy herd numbers will reduce profitability in the dairy sector. A farm's viability becomes a significant issue from a 50% herd reduction, and sooner for less profitable farms.

Key takeaways

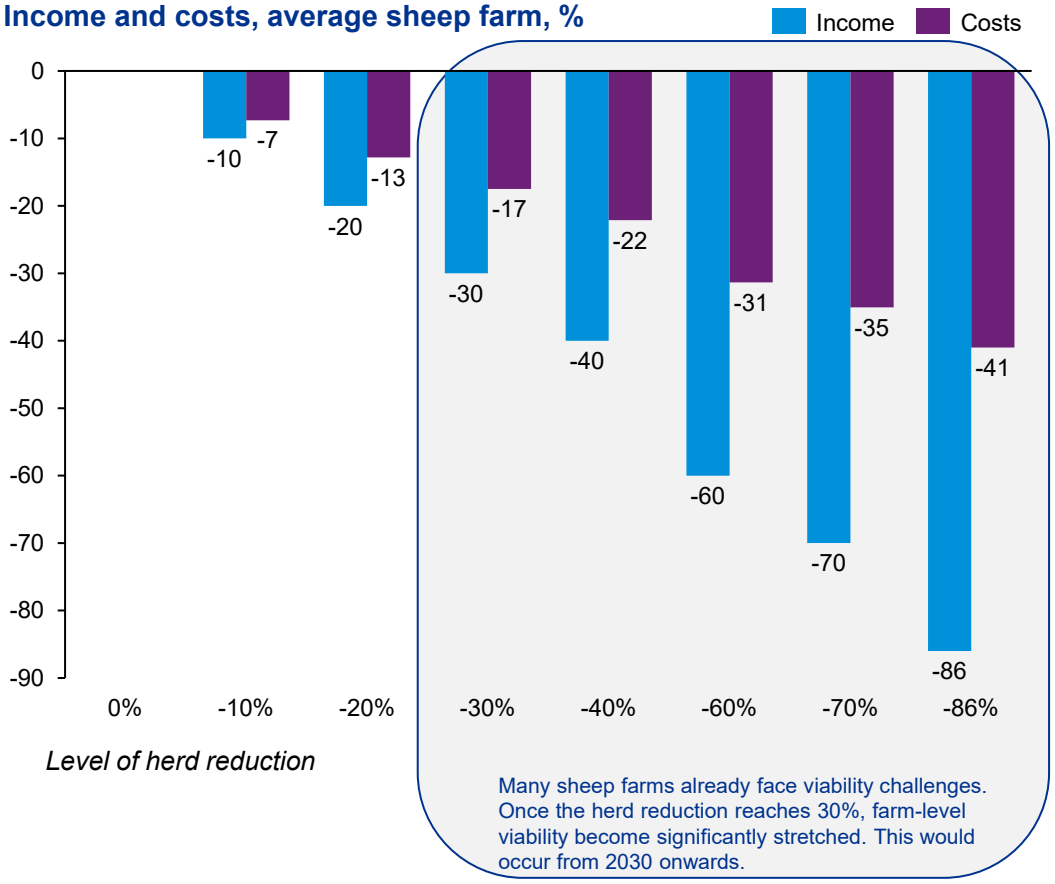
- In the dairy sector, profitability varies by the size of the farm, with gross profit in the range £11,000-£82,000 from very small to large farms. Drivers of the differences include fixed costs, variable costs, and direct farm incomes
- **As the herd is reduced in line with the PMB scenario (-86%), income is projected to fall accordingly – fewer livestock reduces dairy income at the farm gate**
- By contrast, costs are not assumed to fall at the same rate. Variable costs change at different rates: the cost of feedstuffs fall at the same rate as herd reduction (-86%), while the cost of fertiliser, seeds, and sprays (-43%) and other costs (-57%) fall at different rates. Fixed costs are assumed to change at a slower pace, as these costs are more inelastic
- **Based on changing rates of income and costs, viability is challenged once the herd reduction reaches 50%**
- The extent of likely consolidation is unknown. Very small farms (<1 FTE) may remain operational if these are part-time farmers who have a second income that can compensate for farm losses. Small farms (1.5 FTEs) will also face viability issues, if fixed costs cannot be reduced. Medium-sized farms (2.5 FTEs) and larger farms (5 FTEs) may withstand negative impacts in early periods, before also facing viability challenges once efficiency measure are exhausted.

Source: DAERA (2020), KPMG analysis, industry consultation
Note: Depending on farm size the subsidies included in the profit calculation are between £7,000-£42,000 per dairy farm (10%-40% of output). These are assumed not to decrease with herd numbers

Financial viability - sheep sector

Viability becomes a significant issue for the sheep sector once herd reductions reach >30%.

Income and costs, average sheep farm, %



Many sheep farms already face viability challenges. Once the herd reduction reaches 30%, farm-level viability become significantly stretched. This would occur from 2030 onwards.

Key takeaways

- Should the herd reduction in the sheep sector materialise, variable costs are assumed to fall by different rates, depending on the type of cost. While the cost of feedstuffs falls in line with the reduction to the herd by 2045, the cost of fertiliser, seed and sprays (-43%) and other costs (-57%) fall by less than the fall in herd numbers, on the basis that these costs are more inelastic than feedstuff costs
- Fixed costs, such as machinery costs, other fixed costs, and labour costs are more inelastic than variable costs. Fixed costs are 18% lower by 2045, compared to the herd being 86%
- Above, the changes to both fixed costs and variable costs assumes no consolidation of farms. If farms were to consolidate, costs could fall by less, if economies of scales are achieved through consolidation
- Many sheep farms are located on marginal land in severely disadvantaged and disadvantaged areas. As the herd reduction grows, remaining profitable may be more challenging in these areas than in others
- **As profit margins are tightest on Severely Disadvantaged Areas, farms located in these areas may face financial difficulty earliest.**

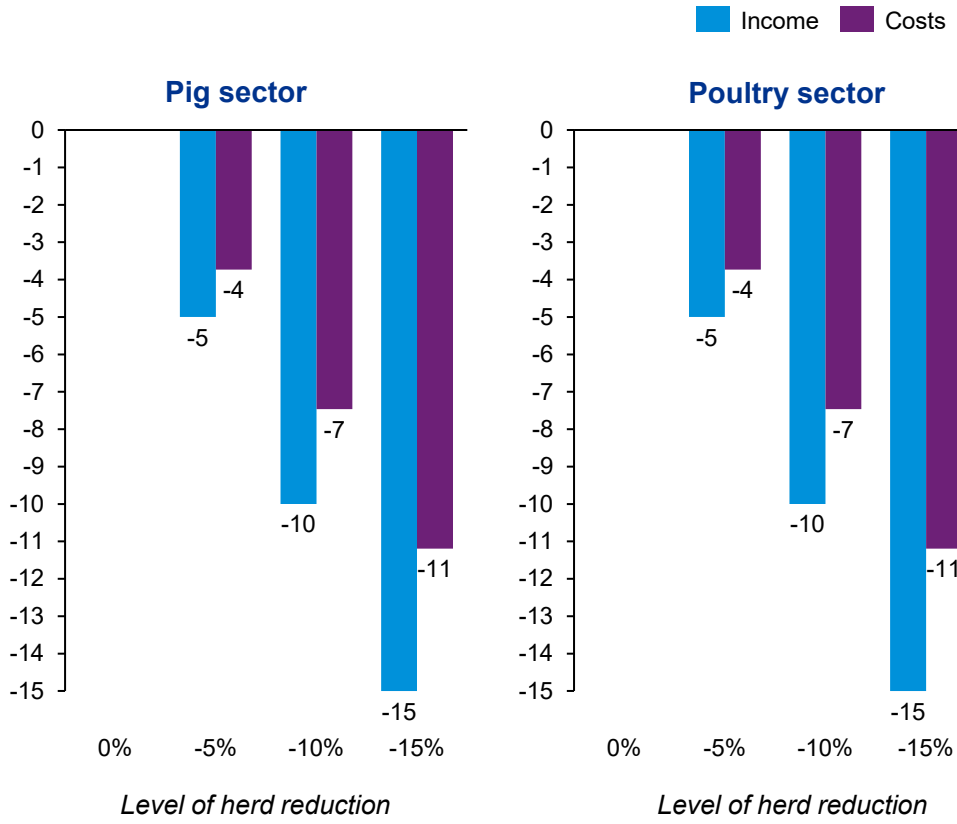
Source: DAERA (2020), KPMG analysis, consultations

Note: Depending on farm size the subsidies included in the profit calculation are between £10,000-40,000 per LFA sheep farm (35-50% of output). It is assumed not to change with herd reductions

Financial viability - pig and poultry sectors

Less downward pressure on herd numbers means less of an impact on viability.

Income and costs, pig and poultry sectors, no consolidation, %



Key takeaways

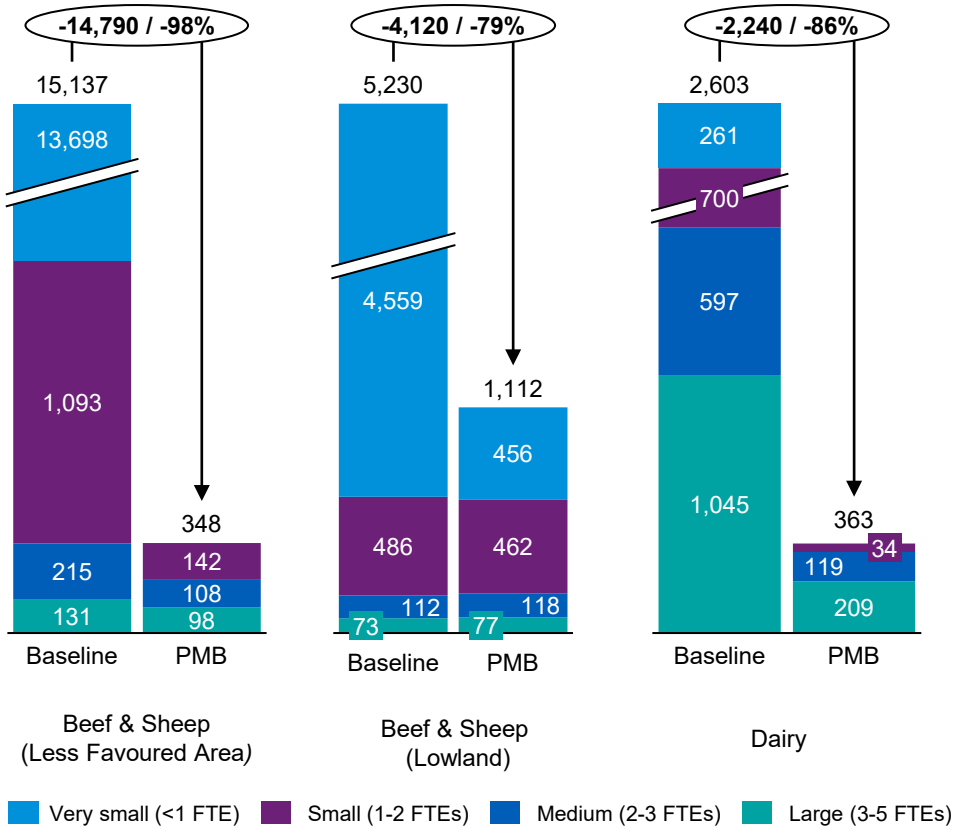
- The pig sector is assumed to be less impacted by the changes required by the PMB than the dairy, beef, or sheep sectors, on the basis that the pig sector contributes less to overall emissions in the baseline. Nonetheless, pig herd numbers would fall by 11% compared to 2020
- Similarly, the requirements on the poultry to reduce herd numbers are assumed to be less, given its relatively small share of overall emissions
- For both the pig and poultry sectors, variable costs and fixed costs account for 77% and 23% of total costs respectively. The rate of change over the period 2021-2045 varies: the cost of feedstuffs falls in line with the reduction to the pig herd by 2045 (-10%) while other costs (-7%) fall by less than the fall in herd numbers, on the basis that these costs are more inelastic than feedstuff costs
- Fixed costs, such as machinery costs, other fixed costs, and labour costs are more inelastic than variable costs. Fixed costs are assumed not to change, as the reduction in herd numbers is assumed to be accommodated by existing workers
- It is not anticipated that viability would a major challenge for most pig/poultry farms. Changes to both fixed costs and variable costs assumes no consolidation of farms.

Source: DAERA (2020), KPMG analysis, consultations

Impacts on total number of farms

A reduction in herd numbers is most likely to impact farms in less favoured areas.

Total number of farms by farm size



Key takeaways

- **An 86% reduction in herd numbers in the dairy, beef, and sheep sectors results in a significant decrease in the number of farms operating**
- Very small and small farms that have less than 2 full time equivalent (FTE) employees (including the farmer) currently make up 97% of beef and sheep farms in NI. It is likely with the reduction in herds that these small farms will be consolidation to try and achieve economies of scale.
- Farms located in less favoured areas will be likely to be the most impacted farm-type. The move to decrease emissions through increasing farming efficiencies, better animal health and decreasing the slaughter age, will generate pressures to decrease herd numbers on less productive land. Some farms located in less favoured areas may adapt to other activities (e.g. carbon farming, forestry, renewable energy, etc)
- **On this basis, beef and sheep farms operating in less favoured areas will see a decrease from 15,137 to 348 farms (-14,789 / -98%). Beef and Sheep farms operating in lowlands will see a decrease from 5,230 to 1,112 farms (-4,120 / -79%). Dairy farms will see a decrease from 2,603 to 363 farms (-2,240 / -86%).**
- Fermanagh & Omagh, Mid Ulster & Newry, Mourne and Down account for 43% of NI farms located on less favoured areas. Therefore these regions will be impacted the most and face the greatest reduction in economic activity from a reduction in herd numbers.

Source: DAERA (2020), NIFDA (2021), KPMG analysis, consultations
Note: Pig and Poultry herds to reduce 11% in PMB scenarios – employment for these sectors is held constant. Owners are included in the employment data. Some figures are rounded.

KPMG

Economic impacts

Understanding the significance of rural areas and communities

Rural economies make a vital contribution to NI's overall economic output.

Given the significance of the contribution made by rural areas and communities to NI's economy and society, it is vital that governments, local communities, and the voluntary and community sector continue to work together to help sustain existing groups, support balanced regional growth, and tackle rural disadvantage.

NI's rural economy comprises a strong agriculture industry, dynamic agri-food industry, and significant levels of activity in manufacturing and related sectors. Many of these sectors are intertwined. Micro and small businesses are particularly dominant in rural economies and family ownership is important, with 78% of micro businesses family owned.

The future success of the rural economy is inextricably linked to the capacity of rural agriculture and agri-food businesses to innovate and to identify new opportunities that develop, strengthen and grow NI's rural economy. A recent DAERA paper noted that consultees to the paper observed that the development of a rural framework could only truly support rural communities if there were no division between agriculture, environment and rural development.

Key statistics

£26k

average farm income in 2019/2020, a ~23% fall on average farm incomes the previous year with only cereal business showing a slight increase

58%

of all businesses in NI are located in rural areas. Rural businesses account for one fifth of employees and roughly a quarter of total business turnover

36%

of the population live in rural areas in NI (~670,000 people)

£2.23bln

of gross output contributed by NI agriculture to the UK economy in 2020

£673m

GVA contributed by NI agriculture to the UK economy in 2020

>51,000

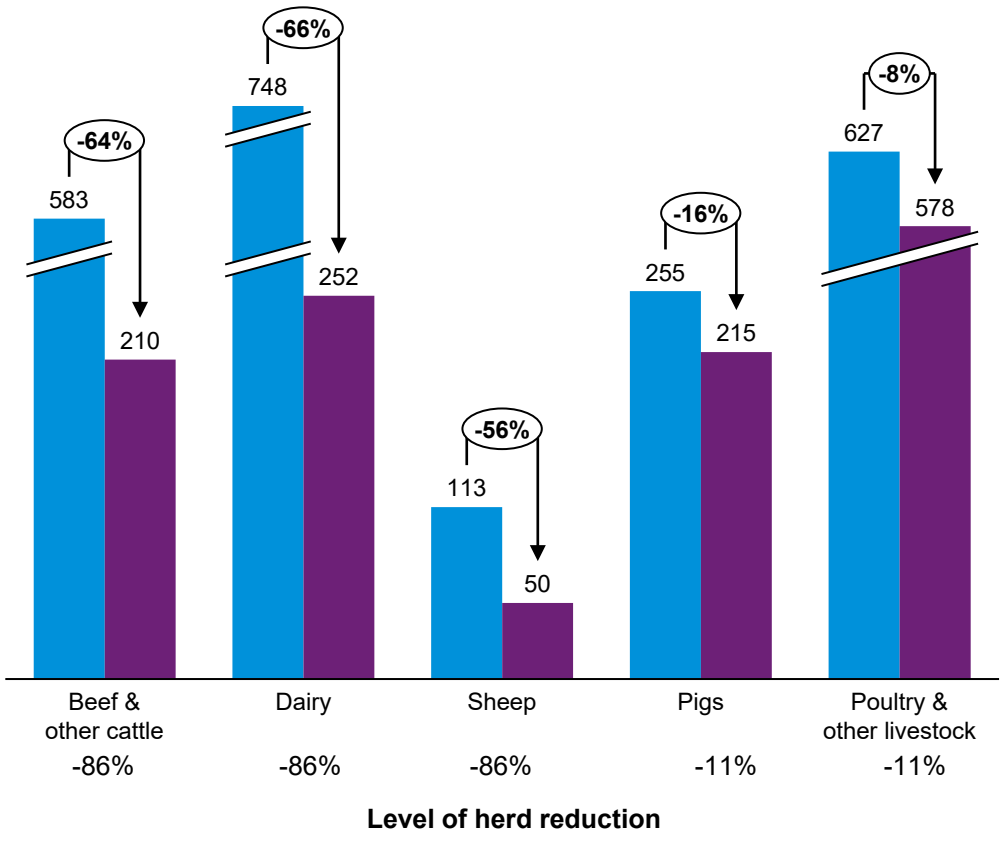
jobs were contributed by NI agriculture sector directly in 2020

Sources: DAERA (2021), Contributions of UK Agriculture (2017)

Economic output - all sectors

The PMB would reduce economic output across all sectors in agriculture.

Direct and indirect economic output by sector, £m



Key takeaways

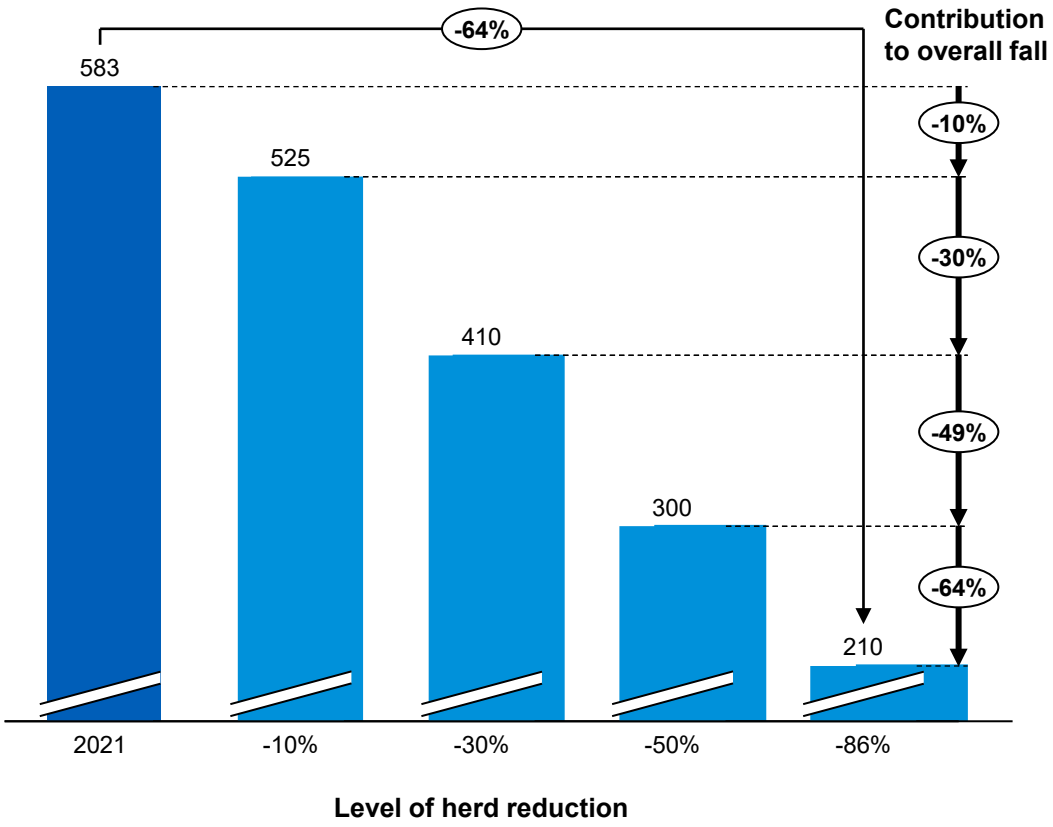
- **The aggregate impact of the PMB on each sector's total economic output has been analysed for the respective sectors. Output includes the total spend by players in the respective sectors (direct output) and the additional spend by suppliers (indirect output)**
- The overall assumption is that lower levels of consumer demand drives lower production, which results in lower levels of direct and supply chain economic activity within the NI economy
- The cost of abatement measures have been factored in as a economic benefit over the period to 2045, on the basis that this generates economic returns
- The relationship between direct and indirect outputs is assumed to remain constant over the period – i.e. no change to the nature of spending with the economy
- Should demand for meat and other proteins remain stable in UK, in the PMB scenario this demand would be met by international imports. These may flow from countries with less efficient means of livestock production
- **In the PMB scenario, total economic output would fall by between 8% and 66% across the five sectors analysed**
- **Over the period 2021-2045, the total aggregate 'lost' economic output in the PMB scenario would be ~£11.1bn**

Source: DAERA (2020), NISRA (2018), KPMG analysis; Notes: figures include capital formation, livestock breeding, and wider supply chain activities (including processors), may differ slightly from other sources

Economic output - beef

Under the PMB, total economic output from beef would be 64% lower in 2045 than in 2021.

Direct and indirect economic output, beef sector, by 2045, £m



Key takeaways

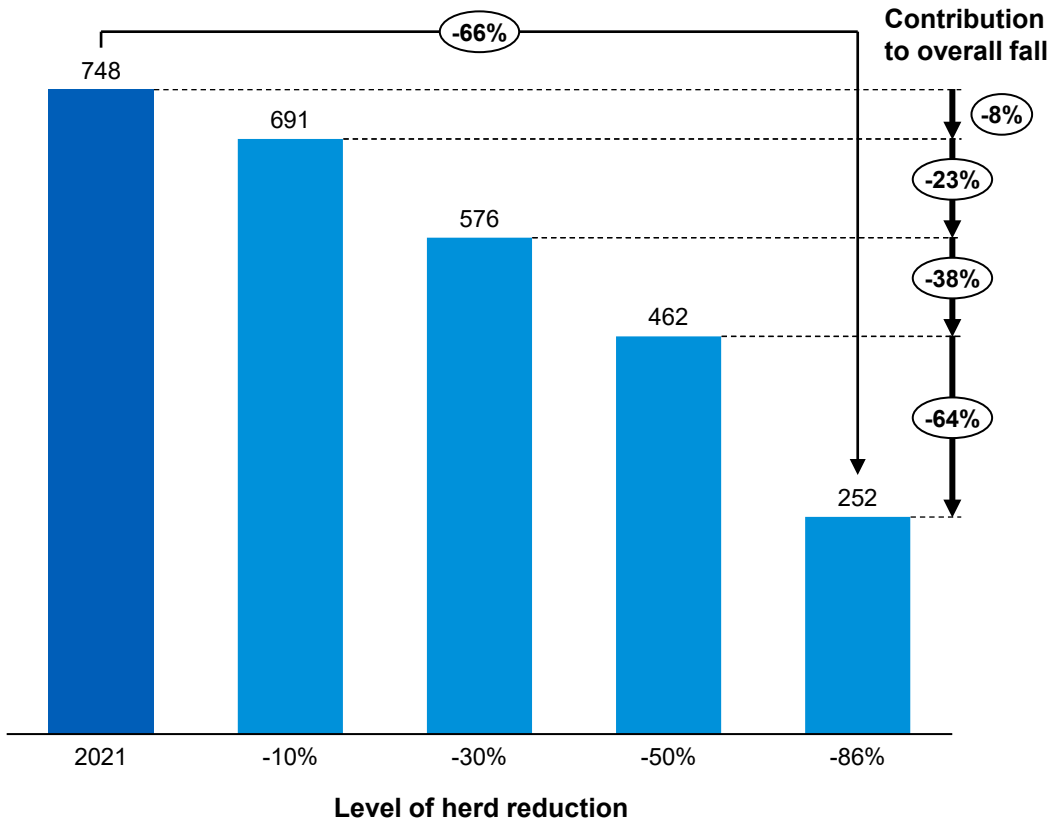
- **The beef sector's total direct and indirect economic output would fall from £583m in 2021 to £210m in 2045, a fall of £375 million / -64%**
- The overall fall is driven by a fall in the sector's total level of spend, which stems from lower activity on the farm level. Additionally, negative indirect impacts on players in the supply chain, such as abattoirs, are also captured within overall economic output
- Total negative economic impacts on the beef sector (-64%) are not as severe as the impact of the cut to herd numbers (-86%) – this is due to fixed costs falling by a slower rate than variable costs, and the inclusion of the economic benefits of investments in abatement measures
- The extent of the negative impact moves at a similar rate to the rate at which herd numbers fall. This can be explained by it becoming more difficult for economies of scale to be realised – hence output falls broadly in unison with livestock numbers in the early periods
- **The extent of the fall in economic output captures direct and indirect output. The actual outturn of negative impacts in the supply chain is uncertain, but likely to be severe**
- **If there is a reduction in the domestic herd while consumer demand remains constant, imports of beef would increase. The UK Government has agreed to permit 170,000 tonnes of Australian to enter the UK annually by 2035, greater than NI's total cattle throughput, despite cattle emissions in Oceania being 54% higher than emissions in Western Europe.**

Source: KPMG analysis

Economic output - dairy

By 2045, economic output from dairy would be 66% less than in 2021 under the PMB.

Direct and indirect economic output, dairy sector, by 2045, £m



Key takeaways

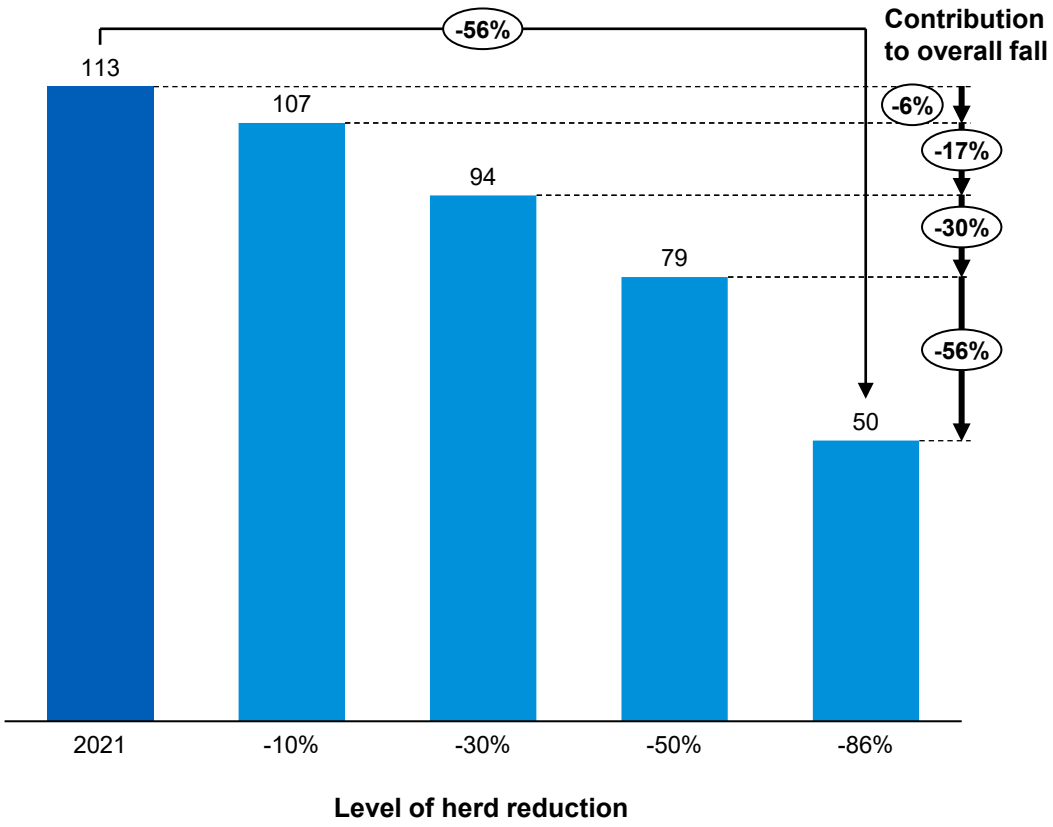
- **The dairy sector's total direct and indirect economic output would fall from £748m in 2021 to £252m in 2045, a fall of £495 million / -66%.** This change would be driven by consumers' transition to plant-based diets and the related reduction to herd number that this would entail
- The development and implementation of policies to deliver net zero by 2045 would mean that the sector's trajectory towards this goal would not be linear. Significant reductions in dairy cow numbers with consequential reduction in milk production, would mean a series of tipping points would be reached within dairy processing plants, where falling throughput would render plants inefficient and unprofitable
- Inevitably, unprofitable plants would have to close, triggering rationalisation and job losses; and as milk production continued to fall, so the cycle of plant closures, job losses and rationalisation would be ongoing, eventually transforming what is currently a thriving Northern Ireland dairy sector into a cottage industry. In addition, this would have significant consequences for the many ancillary and service businesses that engage with the dairy supply chain, as well as negatively impacting the NI economy and rural communities.
- **In the PMB scenario, if consumer demand does not shift away from dairy-based products, the UK would begin to import dairy-based products from overseas markets with less carbon-efficient dairy sector. Effectively, this would equate to exporting carbon emissions while reducing economic output in the dairy sector.**

Source: KPMG analysis

Economic output - sheep

Economic output from sheep would be down 56% by 2045 under the PMB.

Direct and indirect economic output, sheep sector, by 2045, £m



Key takeaways

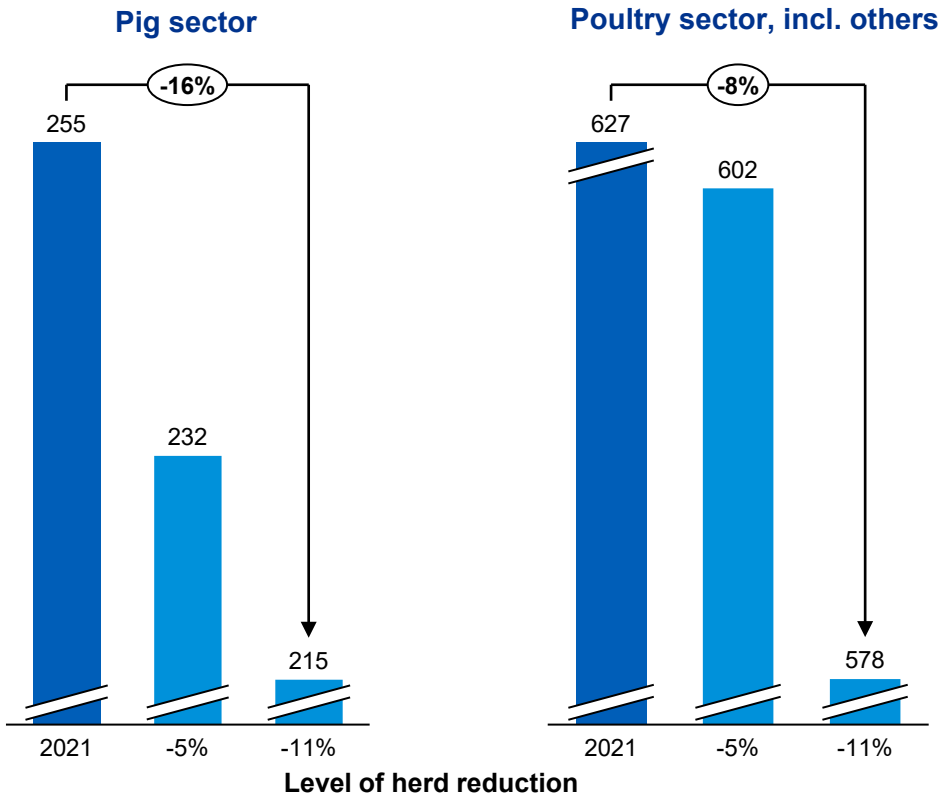
- **The sheep sector's total direct and indirect economic output would fall from £113m in 2020 to £50m in 2045. a fall of £63 million / -56%**
- The fall in economic output can be explained by a fall in the quantum of input costs, which generates fewer economic benefits
- Indirectly, this fall would also have negative impacts for other players in the sector's value chain (e.g. processors, see later analysis)
- When compared to the beef sector and to the dairy sector, the negative economic impacts on the sheep sector are 8-10 percentage points lower
- Impacts in the supply chain would include lower spend on inputs, impacting local retailers, wholesalers, veterinarians; less throughput at processing facilities, impacting viability at that level; and lower levels of social activity arising from the decline in the sector
- **As the sheep sector is more prevalent in areas with marginal land and, typically, relatively lower household incomes, the impact of reduced economic output may be relatively large in these areas.**

Source: KPMG analysis

Economic output - pigs and poultry

Output from pigs and poultry would be respectively 16% and 8% lower under the PMB.

Level of farm gate output, pigs/poultry sector, by 2045, £m



Key takeaways

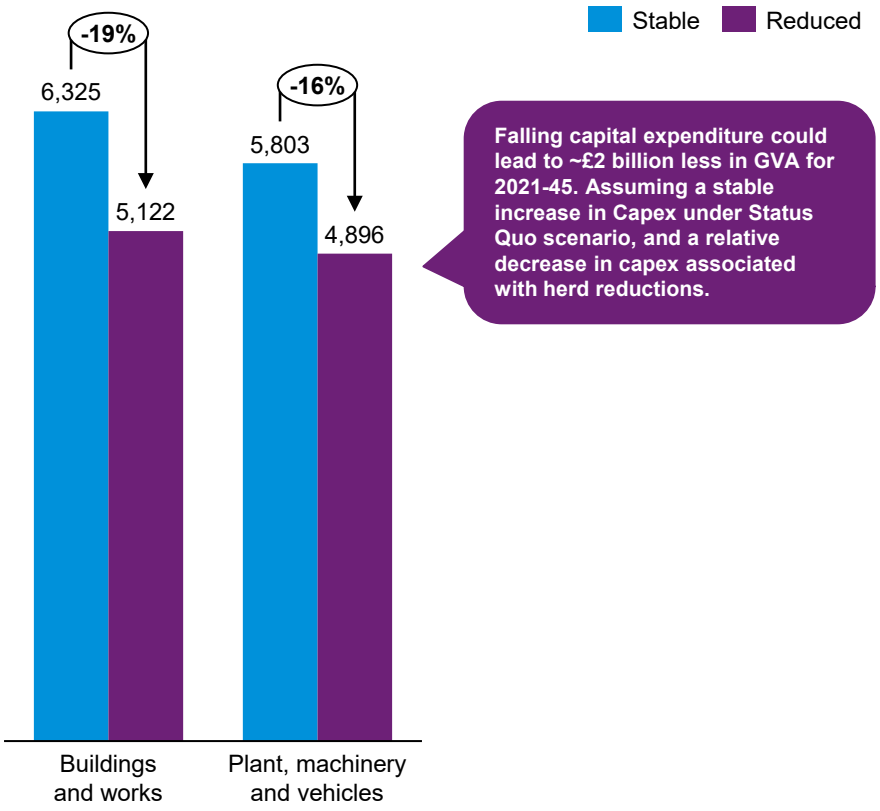
- **The pig sector's total farm gate output is ~£255m currently, and would fall to £215m by 2045 (-£40 million / -16%), assuming livestock numbers fall in line with the PMB**
- Impacts in the pig sector are greater than the fall in livestock number, as variable costs are a high share of total costs (76%) and as supply chain impacts are relatively greater than in other sectors
- Currently, players in the pig sector are closely embedded in the processing supply chain. Impacts on this level are considered to be relatively strong, explaining the higher fall in economic output than the fall in livestock. Knock on impacts for areas with high concentrations of pig farms would be more strongly impacted
- **The poultry sector's total farm gate output is estimated to be ~£627m in 2021 and would fall to ~£578m by 2045 (-8%), under the PMB**
- **The fall in economic output in the poultry sector is less than the fall in livestock numbers, as variable costs are a lower share of total costs and reflective of the sector's relative strength in the NI economy**

Source: KPMG analysis, Institute for Global Food Security, QUB (2021)

Economic impact - reduced capital expenditure

Smaller-sized sectors will require less capital expenditure on investment and upkeep.

Multiplier impact: comparing stable and reduced capex , 2021-2045, £m



Key takeaways

- The agriculture industry's total capital expenditure across buildings and works, and plant, machinery has been reviewed for the current year and over the period to 2045
- In the base case, capital investment could increase steadily over the 2021-2045 period, as building and works and renewed and as plant, machinery and vehicles are repaired and replace
- In the PMB scenario, capital investment will fall and the respective contribution of capital to overall economic could equate to a ~£2 billion lower contribution to Gross Value added (GVA) for the 2021-2045 period
- The multiplier impact of expenditure on buildings and works could be 19% lower, while the impact of expenditure on plant, machinery and vehicles could be 16% less

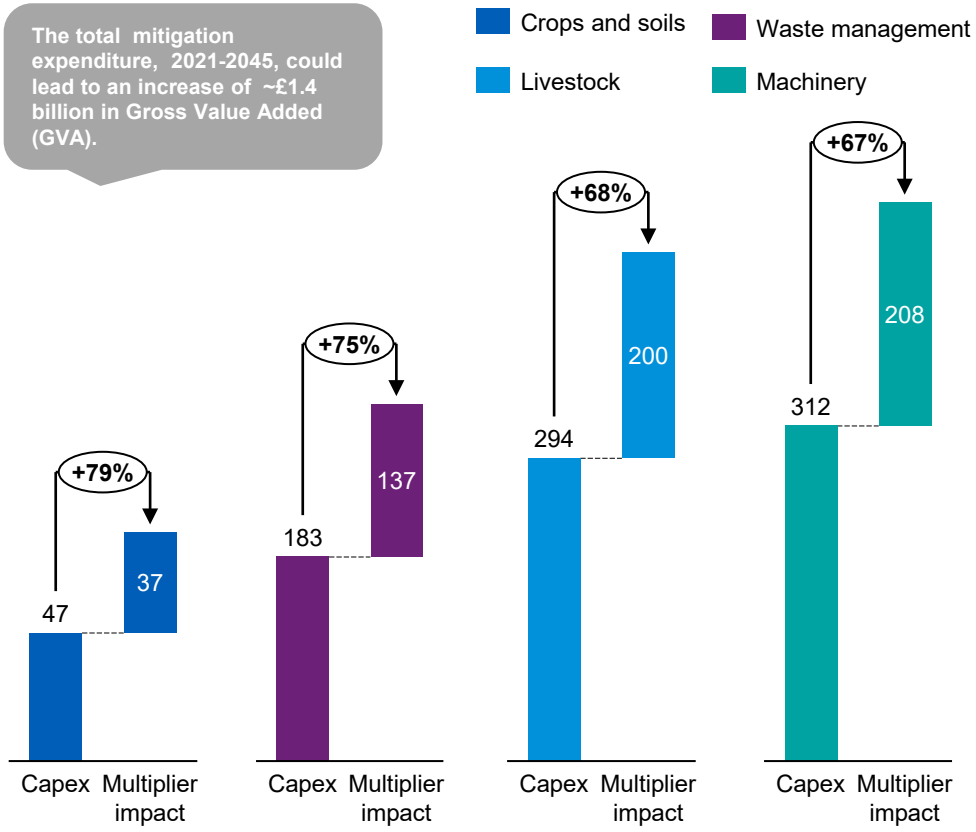
Source: KPMG analysis

Economic impact - capital expenditure for mitigation measures

While mitigation measures will have an overall negative impact, there are some upsides.

Direct and multiplier impact of mitigation expenditure, 2021-2045, £m

The total mitigation expenditure, 2021-2045, could lead to an increase of ~£1.4 billion in Gross Value Added (GVA).



Key takeaways

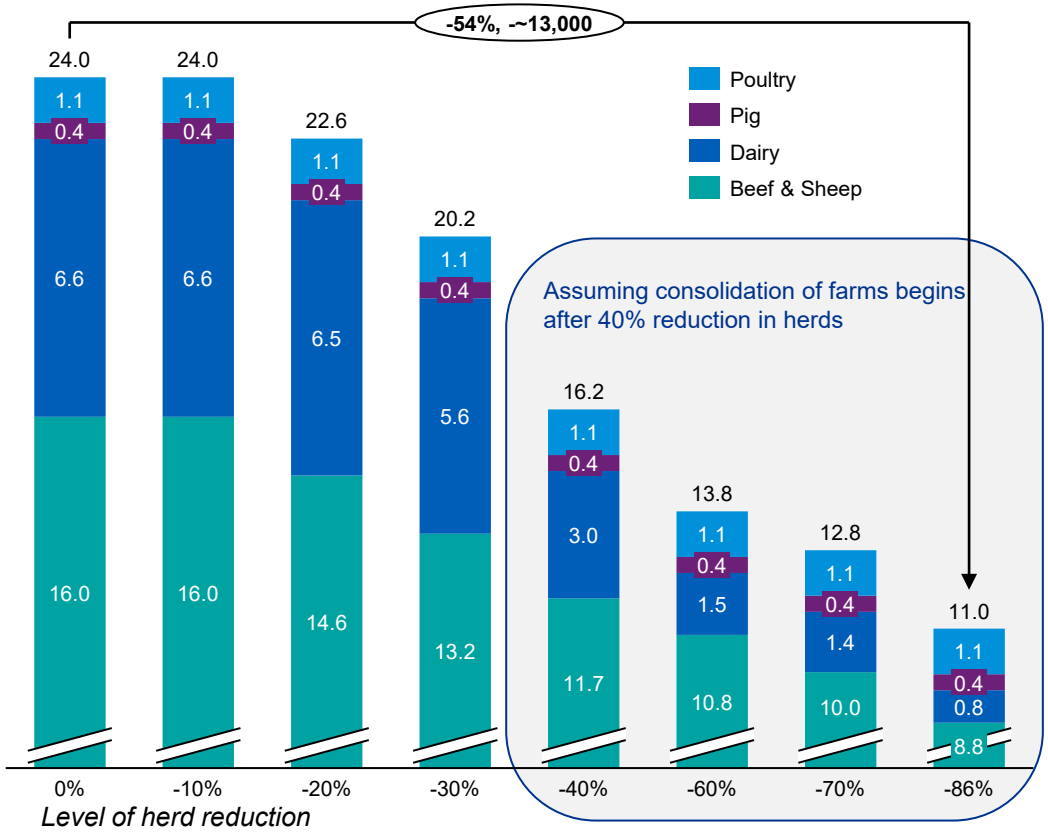
- **Investment in mitigation on the farm-level will require investment in capital projects, new farming techniques, and repairs/replacements, which will vary by sector**
- These investments in mitigation measures will yield some positive economic returns for the NI economy
- The largest quantum of capex and overall impact are generated by the machinery and livestock sectors
- The strongest relative multiplier impact, when comparing the direct capex to the GVA multiplier impact is for crops and soils, and waste management
- The combined capital expenditure for mitigation measures of ~£836m, over the 2021-2045 period, could produce a total multiplier impact ~£1.4 billion
- Investment in mitigation measures will require a level of available capital on farm levels, while incomes fall in line with the overall sector-level herd reduction
- **On a macro level, for producers who remain in the market, investment in mitigation measures could make their produce relatively more expensive for NI consumers, compared to international produce**

Source: KPMG analysis

Employment- impact on farm employment

A 86% reduction herds could result in a 54% decrease in farm employment.

Farm employment by sector in PMB scenario (with herd reductions), 000s (FTE)



Key takeaways

- Up to a -20% reduction in herd numbers, the impact on farm employment levels is not significant (-6%). **After a -30% reduction there is a significant decrease in farm employment. With a herd reduction of 86% for dairy, beef & sheep and a 11% reduction for poultry and pig there is a decrease in farm employment of ~13,000 (-54%)**
- Beef and sheep makes up the greatest share of NI agriculture farm employment. Currently employing over 16,000 full time equivalent (FTE) employees across 18,000 farms. The majority of these FTEs work part time and receive a secondary income.
- Dairy comprises the second largest share of agriculture farm employment with over 6,500 full time equivalent employees. The majority of those are employed by large farms that employ greater than 3 FTE employees
- The beef and sheep sector consists mainly of small farms with 75% of the farms having less than 1.5 FTE employees (including the owner). Many of these smaller farms may be likely to consolidate once the herd reduction exceeds 40%. Consolidation may arise in the beef and dairy sectors in particular
- The reduction in poultry and pigs herds, at 11%, is assumed to not materially impact farm employment
- **NIFDA research shows that the agri-food sector supports 113,000 jobs. On a skills level, there is a relatively even split of skills: ~32% are skilled or highly skilled, ~37% are semi-skilled and 31% are have lower formal skills. Any negative impacts on farm level employment will have indirect impacts across agri-food production, vet services, haulage, engineering, and retail (see next page).**

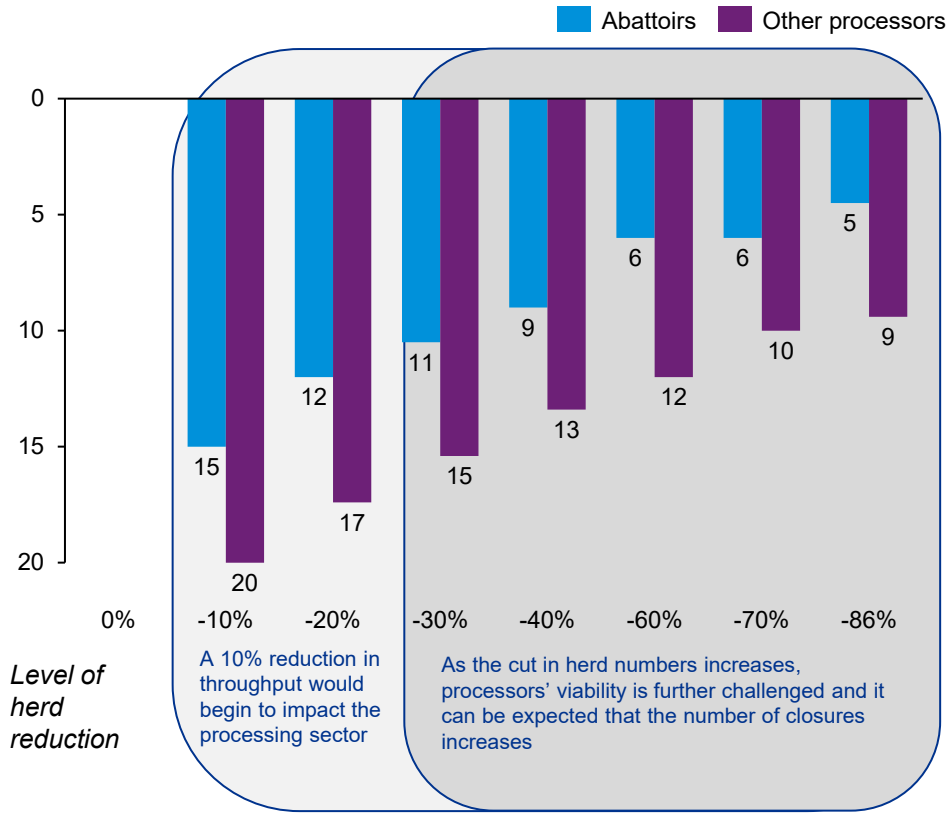
Source: DAERA (2020), NIFDA (2021), KPMG analysis, consultations

Note: Pig and Poultry herds to reduce 11% in PMB scenarios – employment for these sectors is held constant. Owners are included in the employment data. Some figure are rounded.

Economic impact - indirect employment

The low margin processing sector will feel an immediate impact from any herd reductions.

Number of processing facilities based on herd reductions



Key takeaways

- NI currently has ten beef abattoirs, consisting of seven large and three small facilities. There are three sheep abattoirs in NI. There were previously more sheep abattoirs and the two largest were closed between 2000-2010. **NI red meat abattoirs currently have excess capacity, where profit margins range between ~1.5% to 2%. Any reduction in throughput will have immediate negative impacts**
- Additionally, there are 122 merchants registered with DAERA and over 70 feed manufacturers all dependent on the ruminant sector. Additionally, the value chain workforce also includes vets, agri-contractors, hauliers, and rural garages/engineering works, amongst others. Many businesses will no longer be viable in the PMB scenario
- The graph on the left provides an illustrative example of the potential impact of herd reductions on key processors in the value chain. It is likely that smaller abattoirs may be impacted first and would have to close due to lower levels of input. Larger abattoirs may be in a slightly better position to either withstand input changes or to adapt their processing accordingly
- In the scenario on the left, a 10% reduction in throughput would already challenge the viability of processors and the threat would grow with higher herd reductions. The closure of processors would negatively impact regional economies through job losses and lower output
- **For abattoirs, reductions in beef/sheep herds could drive the biggest disruptions to the supply chain, while pork production is affected less. The associated reduction in milk production has a key impact on other processors, while the production of poultry products is affected less**
- **Additionally, impacts on the wider food and drinks processing sector would also be negative, likely jeopardising some of the ~24,000 jobs supported in the sector by agricultural activity.**

Source: KPMG analysis. Note: Potential cattle imports for slaughter from the Republic of Ireland (RoI) and elsewhere are not considered in this example.
*DEARA & NISRA (2018)

Overall impacts on the rural economy

The PMB scenario would generate a range of negative impacts for the rural economy.

Over 70% of land in NI is farmed, making agriculture one of the key sectors for many rural communities. In the PMB scenario, moving to net zero emissions would have a significant impact on the sector. Overall, economic output in rural areas would fall. This would reduce employment on the farm-level, in processing facilities, and in the wider food and agriculture value chain. A clear knock-on impact would be a fall in aggregate incomes in rural communities.

1. Farm viability

- Financial viability varies on the farm level by sector, farm size, and land quality, amongst other factors
- Going forward, viability will fall as livestock numbers fall, with a 10% reduction impacting viability in the beef sector and anything greater than a 30% cut bringing significant challenges to farms in other sectors
- Viability will be particularly affected in areas with lower levels of land productivity, generating challenges for communities dependent on these incomes

2. Capital expenditure

- In the PMB scenario, there would be a fall in capital investment, impacting suppliers based in, and supplying, rural communities
- The contribution of capital investment to GVA could be ~£2 billion lower for the 2021-2045 period
- Some mitigation measures will generate positive impacts, though the net loss would be ~€600 million

3. Economic output

- In the PMB scenario, total economic output would fall by between 8% and 66% across the five sectors analysed
- Over the period 2021-2045, the total aggregate 'lost' economic output would be ~£11bn in the PMB scenario
- The fall in economic output will be felt most severe in rural areas and in particular in areas with marginal land, generating challenges for the economic viability of rural communities dependent on agriculture for economic activity

4. Farm and indirect employment

- Broadly, across all sectors, farm employment is significantly impact from a 30% reduction in herd numbers
- With a herd reduction of 86% for dairy, beef & sheep and a 11% reduction for poultry and pig there is a 54% decrease in farm employment
- Amongst processor, a 10% fall in throughput impacts viability and bring knock-on impacts for processors' employees

KPMG

Appendices

Assumptions & Limitations

A number of assumptions have been included and limitations identified in our PMB scenario analysis.

Assumption / Limitation	
Carbon Leakage	In line with the CCC assumptions, we have assumed that reductions in herd numbers are driven by reduced consumer demand for meat and dairy products (labelled "behavioural change") alongside a shift to plant based diets, as well as a reduction in food waste. Importantly, this measure does not mean demand is met by increased imports and production elsewhere – the same proportion of UK food demand is met by UK food production. However, if this shift in reduction in consumption demand doesn't take place at the rate and extent the CCC has indicated, there is a risk of shifting production overseas and importing in, potentially leading to carbon leakage. This means that higher carbon emissions are likely due to a shift in production to less efficient meat and dairy systems, outside of the UK, to meet similar levels of consumer demand. For example, the average carbon emissions intensity of milk production in NI is 1.279 kgCO_2e/kg Energy Corrected Milk (ECM)[1]. In a recent publication from the Food and Agriculture Organisation (FAO) of the United Nations and the Global Dairy Council[2], the average global carbon emissions intensity of milk production is 2.5 kgCO_2e/kg product produced. A similar story can be told for beef production. The global average grassland beef production system generates 99kg CO_2e/kg meat compared to 48kg CO_2e/kg meat in the UK. Therefore, NI can produce dairy in a much more carbon efficient way, potentially saving almost half of the carbon emissions associated with the global average dairy production. Given that average global estimates of beef and dairy are significantly higher than NI and wider UK alongside the UK's high reliance on NI and livestock products to deliver on UK's food security, if a reduction in meat and dairy production occurs without a reduction in consumed demand, production will simply be shifted to a higher net carbon emitter and hence, increasing global emissions. In addition, the UK trade deal plans with Australia may lead to increased imports of cheaply produced Australian beef which in turn may drive down prices of beef produced to a higher standard and at a higher cost. This may lead to carbon leakage, in that consumer demand is being met by a high carbon emitting producer.

1. DAERA, Northern Ireland carbon intensity indicators 2020: Northern Ireland carbon intensity indicators 2020 | Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)
2. FAO and the Global Dairy Council, Climate Change and the Global Dairy Cattle Sector. Climate-Change-and-the-Global-Dairy-Cattle-Sector.pdf (dairysustainabilityframework.org)
3. Centre for Innovation and Excellence in Livestock, Net Zero Carbon & UK Livestock: (CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-revised-May-2021.pdf (cielivestock.co.uk))

Assumptions & Limitations

A number of assumptions have been included and limitations identified in our PMB scenario analysis.

Assumption / Limitation	
Lack of detail in the PMB	The lack of more detailed and granular detail supporting the proposed PMB has meant that the CCC's research analysis has had to be manipulated to reflect the requirements of the PMB. The CCC's Tailwinds scenario has been used as the basis of our approach and represents a robust and detailed account of the decarbonisation of the agriculture sector. Therefore, the PMB impact assessment is believed to robust and our approach defensible.
In reality, the burden to decarbonise should not only be on the agriculture sector but also on other sectors of the economy. A reliance on carbon removal technologies should also be explored.	Our analysis provides an indication of what actions the agriculture sector would have to implement to contribute to the PMB's target of reaching net zero by 2045. It does not consider any mitigation measures outside of the agriculture sector beyond the acceleration of the decarbonisation rate of all sectors by 5 years (from 2050 to 2045). The PMB scenario analysis adopts a conservative approach and represents a worst case scenario. To reach net zero by 2045, the agriculture sector may not need to decarbonise to the magnitude and extent analysed in this impact assessment. A number of options could be available to NI, including*: • Other sectors of the economy will have to decarbonise at a quicker and higher rate of magnitude than the CCC Tailwinds scenario presents; • Increased reliance on the potential for soil carbon storage and carbon sequestration. Note that any increases to carbon storage and sequestration will likely require a shift in land use away from agriculture land and hence could lead to a decrease in herd numbers. This potential carbon impact would need to be analysed carefully. • Increased reliance on carbon removal technologies. *These potential options are outside the scope of the impact assessment.
Behavioural Change mitigation measure	The CCC's Behavioural Change mitigation measure refers to reductions in both meat and dairy consumption and food waste. For the purposes of our assessment, we have applied the following ratio to model the level of mitigation potential associated with each: • 80% of the behavioural change mitigation potential is associated with the reduction of meat and dairy consumption; and • 20% the behavioural change mitigation potential is associated with the reduction of food waste The mitigation potential associated with reduction in food waste remains the same as its mitigation potential in Tailwinds. Only the mitigation potential associated with the reduction in meat and dairy consumption increases under the PMB Scenario analysis. An important assumption behind the reduction in meat and dairy consumption is that any changes to food demand is not met by increased imports - the same proportion of UK food demand is met by UK food production from now up to 2050. In addition, this measure assumes a reduction in carbon emissions of UK's imported food alongside a change in diets reflected in reduced imports of meat and dairy products.

Assumptions & Limitations

A number of assumptions have been included and limitations identified in our PMB scenario analysis.

Assumption / Limitation	
All Livestock categories	To align with NI national carbon emissions reporting and for ease of reporting, emissions from enteric fermentation and manure management have been allocated across each of the livestock categories. In addition, the following assumption has been made: • Category '3B25 Manure management - N2O and NMVOC - indirect N2O emissions'[1] has been apportioned across all livestock categories based on their % contribution to Manure Mangement N2O and NMVOC emissions.
Beef and other cattle	Under the PMB scenario, Beef & other cattle carbon emissions are projected to reduce by 86% under the PMB scenario. We assume this translates into an 86% reduction in the associated herd numbers.
Dairy cattle	Under the PMB scenario, Dairy cattle carbon emissions are projected to reduce by 86% under the PMB scenario. We assume this translates into an 86% reduction in the associated herd numbers. For ease of reporting, dairy cattle carbon emissions includes the following carbon emissions as per NI national carbon emissions reporting[1]: • '3A1a Enteric Fermentation - dairy cows'[1] • '3B11a Manure management - CH4 - dairy cows' • '3B21a Manure management - N2O and NMVOC - dairy cattle' • '3B25 Manure management - N2O and NMVOC - indirect N2O emissions' (see assumption under 'All Livestock categories')
Sheep	Under the PMB scenario, Dairy cattle carbon emissions are projected to reduce by 87% under the PMB scenario. We assume this translates into an 87% reduction in the associated herd numbers.
Pigs, poultry and other livestock	Informed by consultation with NI pig and poultry sector experts, it is assumed that both these sectors will not endure as severe a reduction to herd numbers to align with the 2045 net zero target. This is deemed an appropriate assumption as there is strong evidence and research supporting a net zero trajectory for the pig and poultry sector. In addition, the pig and poultry sector represent a small proportion of total agriculture carbon emissions (5%, 2% and 1%, respectively). Therefore, it is considered fair that these sectors undertake a minor reduction in herd numbers. As a result, under the PMB scenario, pigs and poultry and other livestock carbon emissions are projected to reduce by 11% under the PMB scenario. We assume this translates into an 11% reduction in the associated herd numbers.

1. National Atmospheric Emissions Inventory, Greenhouse Gas emissions Reports: https://naei.beis.gov.uk/reports/reports?section_id=3

Assumptions & Limitations

A number of assumptions have been included and limitations identified in our PMB scenario analysis.

Assumption / Limitation	
Potential for carbon removals associated with agriculture land through carbon sequestration and storage	The potential for carbon removal through carbon sequestration and storage on agriculture land is currently not accounted for within the agriculture sector's carbon footprint. Therefore, the benefits of potential carbon reductions associated with on-farm initiatives to store and sequester carbon cannot be claimed by the agriculture sector. Recent amendments to the Republic of Ireland's Climate Action Bill have led to the potential for carbon removals through carbon sequestration and storage associated with agriculture land be accounted for in its carbon budgets and targets. The extent to which this will support and contribute to the decarbonisation of the agriculture sector as well as Ireland's 2050 net zero target is uncertain. However, a research project currently being developed by Teagasc, has highlighted a number of areas for enhanced carbon sequestration potential, including agroforestry and hedgerows. A similar approach to accounting for carbon emissions within the agriculture sector could be adopted by NI. If so, the potential carbon savings potential associated with a number of initiatives are shown below: **Agroforestry** • Carbon sequestration potential: 0.0052 $ktCO_2e$/year/hectare • Using this carbon sequestration potential factor, if 10,000 hectares of land was made available for agroforestry in NI over a 10-year period, approximately 520 $ktCO_2e$ would be sequestered. • This would equate to an annual saving over a 10-year period of approximately 1% of NI's current agriculture carbon emissions. **New Hedgerows** • Carbon sequestration potential: as 0.00095 $ktCO_2e$/year/km • Using this carbon emissions intensity estimate, if 10,000 km of new hedgerows were planted over a 10-year period, approximately 95 $ktCO_2e$ could potentially be sequestered. • This would equate to an annual saving over a 10-year period of less than 1% of NI's current agriculture carbon emissions. **Better Management of Hedgerows** • Increasing height and/or width of existing hedgerows and allowing these to develop every 6-10m could lead to an increased sequestration potential of approximately 0.00065 $ktCO_2e$/year/km • Using this carbon emissions intensity estimate, if 10,000 km of new hedgerows were planted over a 10-year period, approximately 65 $ktCO_2e$ could potentially be sequestered. • This would equate to an annual saving over a 10-year period of less than 1% of NI's current agriculture carbon emissions.

Assumptions & Limitations

A number of assumptions have been used to model economic impacts.

Assumption / Limitation	
Farm Level Impacts - Individual farms	A key source for the analysis is the Northern Ireland Farm Performance Indicators 2019/2020, produced by the Department of Agriculture, Environment and Rural Affairs (DAERA). This is an annual survey of more than 360 different Northern Ireland farms providing average costs and average income for each farming type (sub-sector). This data was used to estimate the impact of herd reductions on the individual farm level income and costs for each sub-sector and to determine their potential tipping points. The following assumptions were made with the Farm Performance Indicators data for the individual farm analysis: ▪ The total cost for each farm type has been split between the variable cost and fixed cost. This is due to herd levels influencing the variable and fixed costs at different rates. Variable costs have a more direct relationship with herd numbers where as fixed cost machinery maintenance and rates are likely to decrease at a slower rate with the reduction in herd numbers ▪ The average cost per animal type (sub-sector) were used to determine the variable costs. These included; concentrates, hay, silage, forage, grazing, veterinary services, medicine & sundries ▪ The average fixed cost per hectare (per output for pigs) for each farming type were used to determine the fixed costs. These included; conacre rent, depreciation of fixed capital expenditure, depreciation of machinery and equipment, upkeep and running costs of machinery and equipment , farm fuel, rates, building repairs, labour, and miscellaneous. The farmer and spouse labour was excluded as this was considered the profit for the farm ▪ Income is assumed to have a direct relationship with herd sizes. For example, a 10% decrease in beef herd numbers results in a 10% decrease in income from beef ▪ The predicted income and cost at different herd level reductions was used to determine profitability. This informed the estimated tipping point between profit/loss for the various herd levels ▪ Beef and sheep costs and income per farm were calculated together as their fixed cost are split between the two herds/flock ▪ Subsidies and grants were not included when calculating each farm's income ▪ There was limited data on poultry costs, therefore the assumption was made that costs and income would change with herd reductions, similar to that in the pork industry

Assumptions & Limitations

A number of assumptions have been used to model economic impacts.

Assumption / Limitation	
Farm Level Impacts - Sector level	DAERA's Statistical Review of Northern Ireland Agriculture 2020 and the Northern Ireland Farm Performance Indicators 2019/20 are the main sources of information for analysing the sector-wide impacts. This data was used to estimate the impact of herd reductions across five sectors: dairy, beef, sheep, pork and poultry. The following assumptions are made, using the DAERA data for the sector level analysis: • The aggregate gross margin estimates for the main agricultural sectors were used to establish the income (outputs) and variable costs per sector • Information on the breakdown of fixed costs per sub-sector is limited. Fixed costs for each sub-sector are calculated based on total variable costs (a percentage of same), from the Farm Performance Indicators data • Herd reductions are assumed to be linear between 2021 and 2045 and aligned with emissions analysis • As herd levels decrease there is also a reduction in total variable and fixed cost. The rate of cost reduction is determined by the individual farm level analysis for variable and fixed costs • Income is assumed to have a direct relationship with herd sizes. For example, a 10% decrease in the beef herd results in a 10% decrease in income from beef • No inflation is applied to values over the period

kpmg.ie