Nourish Scotland submission to the Environment, Climate Change, and Land Reform Committee on

Sector Specific Evidence for the Climate Change (Emissions Reduction Targets) (Scotland) Bill – Stage 1

November 2018

About Nourish Scotland

We are an NGO campaigning on food justice issues in Scotland. We believe tasty and nutritious food should be accessible to everyone, be sustainable, and be produced, processed, sold and served in a way that values and respects workers. We campaign for solutions that work across the board: we take a systems approach toward food and health, poverty, fairness, workers' rights, rural economy, environment, climate change, land use, and waste. Nourish is a member of the Scottish Food Coalition, Stop Climate Chaos Scotland, and Scottish Environment Link.

Key points:

- Farmers manage **75% of Scotland's land area**. As land-based carbon sequestration is critical to mitigating climate change, farmers have an important role to play.
- Agriculture and related land-use is Scotland's second largest emitting sector, and will remain a large emitter of non-CO_2 gases – methane and nitrous oxide. However, the sector must deliver a fair share of emissions reductions, and must start now.
- We propose a 3-tiered approach to mitigation in the agriculture and land-use sector:
  1. Enforce efficiency improvements, starting now, to reduce non-CO_2 emissions. These are no-brainer approaches which are well known but not widely implemented to improve farm profitability and maintain output, while reducing emissions.
  2. Roll out agricultural practices to sequester carbon, starting now. Solutions in this tier are tried and tested but have little take up due to lack of incentives.
  3. Invest in research, feasibility studies, and dissemination of new knowledge and technologies. These are solutions which are in the pipeline and will give a competitive advantage to early adopters.
- We estimate tier 1 could abate up to **30% non-CO_2 emissions** by 2030 while maintaining the same output. **10 Mt CO_{2e} / year** could be sequestered by 2030 through tier 2 and an additional **10 Mt CO_{2e} / year** by 2050 through tier 3. See calculations in Appendix 1.
- Greater effort-sharing by farmers and land managers will not hurt Scotland's food production or its farmers. It will help them in four main ways:
  1 Increasing efficiency will reduce emissions per unit of production and make farms more profitable and viable, especially those which are currently underperforming;
  2 Demonstrating best practice in climate-friendly farming safeguards the reputation of our key products in both domestic and export markets;
  3 With 78% of Scots thinking tackling climate change is a priority, making climate change mitigation a priority for agriculture is important for the long-term financial and policy support for the sector;

4 Farmers should be paid for actions which reduce emissions or sequester carbon.

- None of the above can happen without support from the public purse. Commensurate investment to the size of the challenge ahead is needed, to build consensus among farmers, finance the necessary changes in practice, and continue to deliver world-leading research in agricultural climate change solutions.

Full evidence

In a briefing published alongside the Climate Change Bill last May[1], the Scottish Government argued that setting an emission reduction target above 90% would jeopardise Scottish food production:

> "It is not possible to produce food without generating greenhouse gas emissions. […] Requiring reductions in emissions from farming beyond what can be achieved through efficiency and technology would mean reducing the amount of food produced in Scotland."

Yet, while ambitious action on climate change is *not* a threat to Scottish agriculture, as we argue below, **inaction is an existential threat to Scottish agriculture, in two main ways**.

First, if we fail to deliver our fair share of mitigation, we cannot expect others to do better. This would have devastating consequences, with up to 4°C of warming by the end of the century and an unstable climate jeopardising our ability to produce high quality food into the future.

Second, ongoing trends in meat consumption and consumers demands for strong sustainability credentials are putting pressure on farmers, and are unlikely to fade away. Failing to engage with these major trends is a losing strategy for livestock and dairy industries in Scotland and around the world. Countries such as Ireland[2] and New Zealand[3] which are recognising and acting on these changing consumer demands are likely to gain a competitive advantage. We must also address the incoherence between the food industry's strategy, and our climate responsibility. It makes no sense for food and farming businesses to work toward doubling meat and dairy production when consumers are moving in the other direction.

We must aim higher and advance faster to reduce the climate impact of our food production to safeguard our international reputation and competitive advantage. Our agriculture will reap the benefits, as public money supports farmers in delivering climate mitigation, more efficient farms become more profitable, cutting-edge solutions are developed in Scotland, giving our farming sector a competitive advantage, and the Scottish brand demonstrates its truly green credentials, safeguarding domestic and foreign markets. These changes will not happen spontaneously, political leadership and investment in upskilling and continuing professional development for farmers are urgently needed.

There is an urgent need to build consensus with farmers around their role in tackling climate change. A helpful first step would be to improve how agriculture-related emissions are accounted and reported on in the current inventory, to reflect fairly farmers' efforts. Currently, mitigation measures are either reflected in other sectors, eg. tree planting in LULUCF, or not reflected at all, eg. methane emissions do not take account of genetic differences, or feeding strategies.

Agriculture is a key part of the solution: the sector holds significant potential for emissions reductions and carbon sequestration. The pathway can be seen as a 3-tiered approach.

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[1] Scottish Government, When to set a net-zero Greenhouse Gas emissions target year http://www.parliament.scot/S5_Environment/General%20Documents/20180524_Scottish_Government_Information_and_Analysis_Paper.pdf

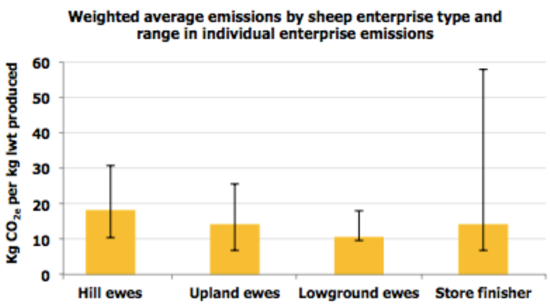
[2] Origin Green https://www.origingreen.ie/who-is-involved/meet-a-member/

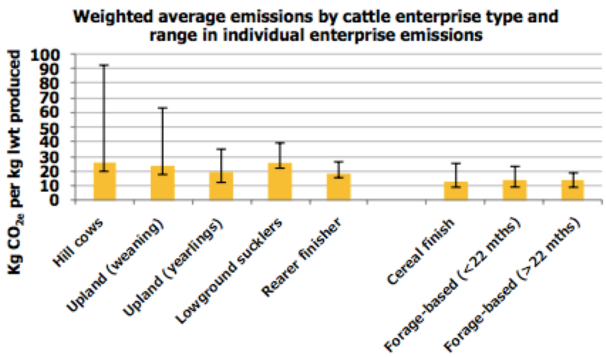
[3] https://www.wwf.org.uk/sites/default/files/2016-12/New%20Zealand%20-%20agriculture.pdf

1) Improving resource use efficiency in low- and medium-performing farms to reduce emissions quickly and cost-effectively.

Optimising fertiliser use and improving animal health are elementary and cost-efficient solutions to produce the **same level of output with less emissions and lower input costs** – meaning greater profitability.

Quality Meat Scotland's **Cattle and Sheep** Enterprise Profitability figures[4] show that while some farmers are already doing well, there is a long tail of underperforming farm businesses (see graphs). Performance figures show that the top 1/3 performing businesses are able to produce beef and lamb with up to 30% lower emissions and much higher profit margins (detail collated in Appendix 2) than the bottom third. Methane and nitrous oxide emissions from livestock can be reduced significantly by closing this productivity gap.





Nitrogen fertiliser is used very wastefully in Scotland (and much of the rest of the world), causing water and air pollution harmful to human health and ecosystems, as well as greenhouse gas emissions as nitrous oxide. Research[5] estimates that during manure or mineral fertilizer use, 2% or 2.5% of the nitrogen is converted to N_2O, respectively. In 2015, 326Kt of N were applied to agricultural land in Scotland (half as manure and half as mineral N fertiliser), of which only half was taken up by crops. This excess N, 92kg per hectare on average, ends up in watercourses, groundwater, and the atmosphere. Inefficient use of fertilisers is costing farmers £70 per hectare to pollute the environment[6].

Although N_2O emissions in 2016 were 13% lower than in 1990, N surpluses have been going up year on year since 2011, with N_2O roughly stagnant over that period. Yet, the figures above show there is considerable scope for improvement. Tackling inefficient use of nitrogen in Scottish agriculture must become a top priority, a recommendation also made by the UK Committee on Climate Change in their last Progress Report to this Parliament.

2) Rolling out agricultural practices which sequester carbon.

Scottish agriculture will always produce GHG emissions – the UK CCC estimates 6 $MtCO_{2e}$ will remain in 2050[7]. The only way to go further down would be to reduce our production, which is not desirable. However, the sector can sequester about as much carbon by adopting tried and tested practices which lock up carbon in soils and biomass. This can and should be implemented at scale within the next ten years. Unfortunately, the UK CCC did not consider this abatement potential in their advice on this Bill.

Soil carbon sequestration is critical for climate change mitigation and much underinvested in. Alcalde and colleagues estimate Scotland's potential 'negative emissions' from soil carbon

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[4] https://www.qmscotland.co.uk/sites/default/files/cattle_and_sheep_enterprise_profitability_in_scotland_2017.pdf
[5] The European Nitrogen Assessment (2011), ed. Mark A. Sutton, Clare M. Howard, Jan Willem Erisman, Gilles Billen, Albert Bleeker, Peringe Grennfelt, Hans van Grinsven and Bruna Grizzetti. Chapter 19: Nitrogen as a threat to the European GHG Balance. Published by Cambridge University Press.
[6] Ammonium Nitrate containing 34.5% N costs £260 per tonne (August 2018). AHDB UK Fertiliser Price Series September 2018 report
[7] https://www.theccc.org.uk/wp-content/uploads/2017/03/Advice-to-Scottish-Government-on-Scottish-Climate-Change-Bill-Committee-on-Climate-Change-March-2017.pdf

sequestration range between 0.22 and 7.2Mt CO_{2e}/year[8]. Other countries have shown leadership on this front: France, for example, launched the '4 per 1000' initiative[9] at COP21, which highlights the role of agricultural soils in mitigating climate change and recommends practices such as agroecology and agroforestry.

Agroforestry (combining trees with pastures and crops), is recognised as an effective way to increase carbon sequestration in soils and biomass, with multiple added benefits, such as diversification of farm income, nutrient management, reductions in soil erosion and leaching, and biodiversity enhancement[10]. Agroforestry systems produce up to 30% additional biomass per hectare[11], and increase carbon sequestration without reducing production.

Organic farming, a form of agroecology, typically leads to higher soil carbon sequestration[12]. In addition, research consistently demonstrates that organic farming uses less energy and delivers lower greenhouse gas emissions per unit of area and in some cases per unit of product.[13]

We also need mechanisms which make it easy for farmers to sequester carbon on land that is only marginally suited for food production. With minimal impact on food production, this would help deliver national targets for peatlands restoration and tree planting.

3) Investing in the development and dissemination of new agricultural technologies.

There is a wealth of emerging knowledge and technologies which are likely to get us well behind the net-zero line by 2050 (provided we take necessary action to decarbonise our economy in this half of the century). Yet, only BECCS is included in the UK CCC scenarios – arguably the least secure carbon abatement method of the ones listed below.

Biochar is a charcoal that can be made by heating biomass in a zero-oxygen environment, locking up the carbon from the biomass into solid char. It is a proven and low-cost technology with triple wins[14] for: 1) climate mitigation: it provides long-term carbon storage, 2) agricultural productivity: it is an excellent soil improver, as it can act like a slow-release 'sponge' for water and useful soil nutrients, and 3) the circular economy: it can be made from almost any type of dry biomass, including waste materials.

Alcalde and colleagues estimated that if deployed at scale on agricultural land marginally suited for food production, this technology could sequester up to 5.5Mt CO_{2e}/year. Biochar could also be produced using biomass from agroforestry, short coppice rotations, and other green waste.

Methanotrophs are bacteria which oxidise methane from the atmosphere. They are naturally present in soils, but their activity can be hindered by certain agricultural practices, such as tillage and application of nitrogen fertilisers[15]. Understanding better how these bacteria work is a vital area of research, as new insights may lead to biotechnological applications that would allow us to reduce methane emissions in agriculture[16].

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[8] Alcalde, J., Smith, P., Haszeldine, R., & Bond, C. (2018). The potential for implementation of Negative Emission Technologies in Scotland, *International Journal of Greenhouse Gas Control 76* (2018), 85–91. https://doi.org/10.1016/j.ijggc.2018.06.021

[9] https://www.4p1000.org/

[10] https://www.climatexchange.org.uk/media/2020/cxc-woodlands_agroforestry_policy_brief.pdf

[11] http://www.nuffieldinternational.org/rep_pdf/1341272658Stephen-Briggs-2011-report.pdf

[12] Gattinger, A. et al http://www.pnas.org/content/109/44/18226

[13] Lynch, D. et al The Carbon and Global Warming Potential Impacts of Organic Farming: Does It Have a Significant Role in an Energy Constrained World? *Sustainability* 2011, *3*, 322-362; doi:10.3390/su3020322

[14] UK Biochar Research Centre: https://www.biochar.ac.uk/what_is_biochar.php

[15] Jardine, C. et al (2016). Methane UK. Environmental Change Institute, Oxford University. https://www.eci.ox.ac.uk/research/energy/downloads/methaneuk/chapter02.pdf

[16] Newcastle University. Methanotrophs: Could bacteria help protect our environment? ScienceDaily, 26 August 2015. Accessed: www.sciencedaily.com/releases/2015/08/150826135724.htm

Scottish research institutes are developing **technologies to reduce methane emissions from livestock**: from feed additives, to using genetics to breed low-methane cattle, many more solutions to help the livestock industry cut its emissions intensity are in the pipeline.

Enhanced weathering is another upcoming Negative Emissions Technology with great potential in Scotland. It involves speeding up the geological carbon cycle by spreading rock dust on farm land or beaches. Alcalde and colleagues estimated that this technology could lead to between 5 and 8 Mt CO_{e2}/year sequestered.

Finally, **Bioenergy with Carbon Capture and Storage, BECCS,** is another emerging technology with great abatement potential, which could be deployed later in this century to get to and stay at net-zero emissions. Scotland could develop a competitive advantage by investing in R&D for BECCS, we have considerable storage capacity and world-leading geologists.

Concluding remarks

To sum up, 'uncertain feasibility' cannot hold us back in setting and delivering a net-zero target for Scotland. There is a wealth of practices and technologies already at our disposal to reduce and offset emissions, and many more on the horizon. What is holding us back, is that we are not currently implementing these tier 1 and 2 actions seriously, or across the whole sector. Mitigation efforts have so far mainly been driven by voluntary measures and learning opportunities, which have shown their limitations with low take-up & stagnating emissions.

It would be disingenuous to pretend that nothing will change for Scotland's farmers and rural communities by 2050. In addition to the social and economic challenges linked to an ageing farming population and low farm-gate prices, the rise of flexitarian diets in recent years is already showing that the status quo on our plates will not last forever.

Scottish livestock and dairy producers will have to differentiate their produce with credible climate credentials to thrive. Some will need support to diversify their business, or retire. Our countryside will not look the same in 2050, but the change is in our hands. This is a challenge and an opportunity. It is paramount that farming communities are supported through the transition to the low-carbon economy, with commensurate investment to the scale of change required and advice from the Just Transition Commission, like other sectors which are having to adapt to the post-fossil fuels area.

Appendix 1

Tier 1

Better nitrogen use efficiency could halve N_2O emissions = -1.3 Mt CO_{2e}/year
Better efficiency in livestock and dairy could cut methane emissions by 20% = -0.9 Mt CO_{2e}/year
→ Achievable cuts by 2030 = 2.1 Mt CO_{2e} = 30% of total non-CO2 emissions in 2016

Tier 2

LULUCF	-6 to -6.9MTCO_{2e}/year (Climate Change Plan)
Soil Carbon Sequestration	-0.22 to -7.2Mt CO_{2e}/year (Alcalde et al.)
Agroforestry	?

→ Achievable yearly sequestration by 2030 (assuming we achieve 50% of technical potential range for SCS) = - 6.9 - 3.5 = 10.4

Tier 3

LULUCF	-6.8 Mt CO_{2e}/year (Tyndall)
Agroforestry	?
Biochar	-0.84 to -5.5Mt CO_{2e}/year (Alcalde et al.)
EW	-5 to -8 Mt CO_{2e}/year (Alcalde et al.)
BECCS	-4.4 Mt CO_{2e}/year (UK CCC)

→ Potential yearly sequestration by 2050 (assuming we achieve 50% of technical potential range for Biochar and EW) = - 6.8 - 2.3 - 6.5 - 4.4 = 20

Appendix 2

Net margins & emissions intensity in beef and lamb production, figures from QMS[17]

	Bottom Third	Average	Top Third

LFA hill suckler Herds

Net Margin	**(-)406.05**	**(-)99.34**	**33.35**
CO_{2e} Kg/net lwt kg produced	29.7	25.6	23.0

Extensive upland suckler herds selling weaned calves

Net Margin	**(-)87.53**	**2.91**	**113.19**
CO_{2e} Kg/net lwt kg produced	24.6	23.6	21.5

Upland suckler herds selling yearling calves

Net Margin	**(-)216.98**	**(-)27.65**	**122.60**
CO_{2e} Kg/net lwt kg produced	21.14	19.43	19.62

Non-LFA lowground suckler herds

Net Margin	**(-)81.84**	**2.95**	**106.32**
CO_{2e} Kg/net lwt kg produced	24.6	25.7	26.3

Rearer finisher herds

Net Margin	**(-)104.83**	**(-)0.57**	**138.45**
CO_{2e} Kg/net lwt kg produced	19.32	18.09	16.68

Cereal-based cattle finishing enterprises

Net Margin	**(-)79.95**	**40.17**	**183.93**
CO_{2e} Kg/net lwt kg produced	14.34	12.72	10.12

Forage-based cattle finishing under 22 months

Net Margin	**(-)216.78**	**(-)74.20**	**131.99**
CO_{2e} Kg/net lwt kg produced	15.48	13.62	11.12

Forage-based cattle finishing over 22 months

Net Margin	**(-)130.35**	**(-)104.75**	**(-)31.01**
CO_{2e} Kg/net lwt kg produced	14.30	13.86	11.88

LFA hill ewe flocks

Net Margin	**(-)30.78**	**(-)17.53**	**(-)8.94**
CO_{2e} Kg/net lwt kg produced	20.12	16.62	15.73

LFA upland ewe flocks

Net Margin	**(-)8.27**	**4.53**	**17.39**
CO_{2e} Kg/net lwt kg produced	13.75	12.95	12.77

Lowground ewe flocks (average only)

Net Margin	**26.40**
CO_{2e} Kg/net lwt kg produced	9.91

[17] https://www.qmscotland.co.uk/sites/default/files/cattle_and_sheep_enterprise_profitability_in_scotland_2017.pdf

Store lamb finishing (average only)

Net Margin	**1.48**
CO_{2e} Kg/net lwt kg produced	12.98