CLIMATE CHANGE AND THE ENVIRONMENT

AGRICULTURE AND CLIMATE CHANGE

Under the Climate Change (Scotland) Act (2009), Scotland is committed to reduce greenhouse gas (GHG) emissions by 80%, based on 1990 levels, by 2050 with an interim target of 42% reduction by 2020. With around 20% of GHG emissions in Scotland attributed to agriculture and related land use, the rural sector has an important role to play in helping Scotland and the UK achieve its targets. The challenge for the industry is therefore to produce more food with lower emissions.

The three main GHGs produced by agriculture and their sources include:

- Nitrous oxide (N_2O), released during the application of synthetic and organic fertilisers to the soil and from urine deposition by grazing animals.
- Methane (CH_4), produced as a natural by-product of enteric fermentation during ruminant digestion and, to a lesser extent from management of organic manure.
- Carbon dioxide (CO_2), produced through burning fossil fuels such as coal, oil and diesel to produce energy.

The above emissions are typically displayed in terms of CO_2e (CO_2 equivalents) based on their relative global warming potential (GWP) over a 100 year period, see table below.

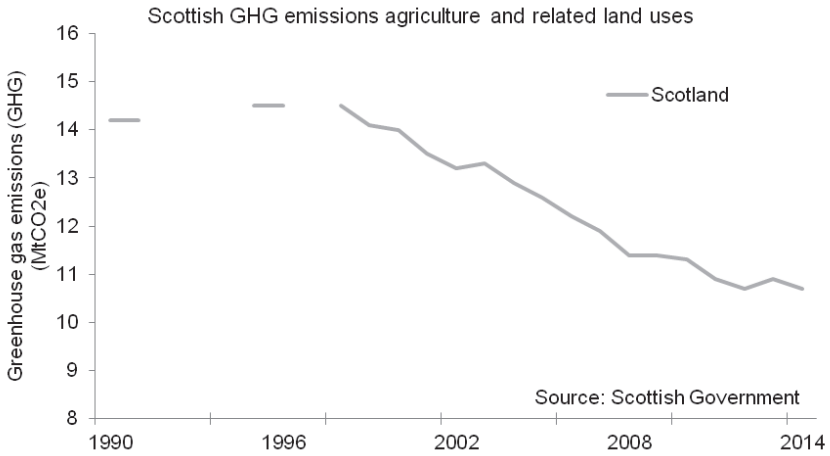
Expressing emissions as CO_2e allows bundles of GHGs to be quantified as a single number allowing year-on-year results to be easily compared.

GHG	**GWP multiplying factor /kg gas emitted**
Carbon dioxide	x1per kg emitted
Methane	x25 per kg emitted
Nitrous oxide	x298 per kg emitted
	PAS 2050 (*Source: IPCC 2007*)

The following chart shows Greenhouse Gas Emissions from Agriculture and Related Land Use in Scotland between 1990 and 2014 and includes net emissions from cropland and grassland and emissions from livestock, agricultural soils, stationary combustion sources and off-road machinery.

In 2014 Scottish agriculture and related land use was estimated to contribute 10.7 $MtCO_2e$ to Scotland's total net GHG emissions, a reduction of 0.2 $MtCO_2e$ (-1.7%) compared to 2013 and a 3.6 $MtCO_2e$ (25.0%) fall since 1990.

The gradual decline in emissions between 1998 and 2014 is attributed to improvements in practices on agricultural soils, reduced rate by which land has been converted to cropland and a decline in cattle and sheep numbers.



Steps to reduce GHG emissions from agricultural sources are mainly focussed on education and voluntary measures however several UK supermarkets and other commodity buyers request that their suppliers deliver lower carbon produce and the preparation of farm carbon audits is now incorporated into some of Scotland's Rural Development Programme Schemes (see 392-398 for further information). At the farm level, making more efficient use of resources (inputs) by managing animals, soils, waste and fertiliser better will reduce GHG emissions and save money.

Carbon foot-printing for farms

The amount of GHG emissions produced on-farm in a year can be determined using a carbon calculator. This measure of emissions is known as a carbon footprint, also referred to as a carbon audit or resource use efficiency audit and can be prepared for the whole farm, individual enterprises or products. Carbon calculators typically calculate total emissions and emission intensities (i.e. CO_2e per ha or per unit of output). Presenting emissions as an intensity allows changes in production to be taken into account as well as changes in total emissions.

Using AgRE Calc ©, SAC Consulting's Agricultural Resource Efficiency Calculator (www.agrecalc.com) typical estimates of GHG emissions for various enterprises are shown in the table below:

	Beef (/kg dwt)	**Sheep (/kg dwt)**	**Dairy (/l FPC milk)**	**Pig (/kg dwt)**	**Barley (/kg grain)**
kg CO_2e	30.97	30.19	1.23	2.75	0.38

Benchmarking the quantity and source of GHG emissions produced with similar enterprises highlights areas where mitigation actions could be targeted. As well as reducing emissions and benefiting the environment, mitigation can also present cost savings to the farmer.

FARMING FOR A BETTER CLIMATE

Managed by SAC Consulting, Farming for a Better Climate is a Scottish Government initiative which suggests practical steps to improve business efficiency and reduce GHG losses from the farm, based on work with farmers, industry specialists and consultants. The efficiency measures can be grouped into five key action areas:

1. Optimise livestock management - improve livestock productivity through better grazing management and nutrition.
2. Optimise the application of fertilisers and manures - save through better utilisation of nutrients.
3. Locking carbon into soils and vegetation - protect soils and improve soil quality for future generations.
4. Using energy and fuels efficiently - reduce your spend on fuel and power.
5. Developing renewable energy - save on purchased energy and earn from surplus energy sold to the national grid and from renewable heat production incentives (pages 277-284).

As part of the Farming for a Better Climate initiative, SAC Consulting are working with volunteer Climate Change Focus Farms, forming farmer discussion groups across Scotland to trial and develop suitable solutions to reduce emissions and improve farm profitability. The Climate Change Focus Farms host on-farm meetings around five times a year to highlight practical measures and/or new technologies to improve both efficiency on the farm and reduce the farm carbon footprint.

For more information, including practical guides, farmer case studies, details of forthcoming meetings or to register for the free e-newsletter highlighting what other farmers are doing, email climatechange@sac.co.uk, visit www.farmingforabetterclimate.org, find Farming for a Better Climate on Facebook or follow on Twitter @sacfarm4climate.

FORESTRY AND CLIMATE CHANGE

Afforestation is one of the methods by which climate change reduction targets can be achieved. The Scottish Government's expectation is to see forestry expand 25% of Scotland's land area by 2050.

Growing trees act as a carbon sink, sequestrating carbon dioxide from the atmosphere converting it to organic matter in particular wood. Where trees are felled and replanted equilibrium of carbon storage is reached.

The permanent planting of trees on agricultural land will result in a net gain of carbon to the land and trees but soils with a high organic content (peats with depths greater than 30 cm) should not be planted because this compromises the sequestration process.

For more information on forestry and woodlands see pages 262-274.

Carbon value
Tree planting on agricultural land will contribute to reducing a farms carbon-footprint, where:

- It is a permanent change in land use
- The planting is additional to the business
- The planting conforms to current environmental standards
- The risks to the planting and the accuracy of sequestration predictions are considered

Where woodland planting can be shown as additional it may qualify for payments under a carbon brokerage scheme. Current payments for new planting range from £350 to £1,000/ha net dependent on species, contract period, location and management regime.

Wood fuel
Wood can be used as a renewable heat source and is usually sold to the customer as logs, chips or pellets. Woodland owners can sell smaller sized roundwood from thinnings as logs. Values vary according to whether the wood is soft wood (conifer) or hard wood (broadleaf); for log prices see page 264.

Standing and lying deadwood can be of considerable ecological value, it may also have a low calorific value than 'live' wood. Where it is safe to do so, deadwood should be left in the forest.

Short Rotation Coppice (SRC) and Short Rotation Forestry (SRF) are both systems for producing woody biomass for renewable energy projects. For more information on these systems and biomass heating, see pages 289-291 and 296-297.

Woodland as pollution control
Native riparian woodland can provide an effective buffer against diffuse pollution. Woodland acts as a buffer reducing the risk of surface run-off, leaching, spray pesticide drift and fertilisers entering the watercourse. Trees can reduce the risk of erosion and when fenced can secure stock from entering the water courses.

POLLUTION AND THE ENVIRONMENT

If mis-managed, agricultural activities can have a number of negative impacts on the environment.

The Scottish Environment Protection Agency (SEPA) support NetRegs (www.netregs.org) an initiative to help small businesses reduce pollution risks and improve their environmental performance. NetRegs has a section specific to agriculture providing free, clear guidance on environmental legislation. Issues covered in NetRegs include: agricultural waste, emissions to water, disposal of animal carcasses and fuel storage.

Diffuse pollution

Scotland's water quality is generally good and water management has led to huge improvements in water quality over the last 50 years. However, diffuse pollution is now the largest source of pollution affecting Scotland's waters.

In April 2008, the Water Environment (Diffuse Pollution) (Scotland) Regulations were introduced. These regulations are referred to as the Diffuse Pollution General Binding Rules (DP GBRs). The seven DP GBRs focus solely on rural land use activities and aim to protect and improve Scotland's water quality.

The DP GBRs state minimum working distances for activities bordering watercourses, such as, application of manures and slurry or in-field cultivation practices. More detail can be found on page 447.

The DP GBRs are the focus of a 'Know the Rules' pocket size guide and 'Mind the Gap' tractor sticker, available free from SAC Consulting offices. Alternatively you can request free copies or download the information via www.farmingandwaterscotland.org

Further information on environmental policies, statutory requirements and guides can be found at the following websites:

- Agri-Environment Climate Scheme (AECS) includes information on funding for diffuse pollution and greenhouse gas mitigation measures: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/
- DARDNI: www.dardni.gov.uk/index/farming/countryside-management.htm
- Diffuse Pollution Priority Catchments: www.sepa.org.uk/environment/water/river-basin-management-planning/actions-to-deliver-rbmp/priority-catchments/
- Farming and Water Scotland; information to protect water quality and reduce pollution risks from routine practices: www.farmingandwaterscotland.org
- Pollution Prevention and Control (PPC) Regulations. Large pig and poultry units are covered by the PPC Regulations: www.sepa.org.uk/regulations/pollution-prevention-and-control/
- PLANET Scotland, free nutrient management computer software: www.planet4farmers.co.uk
- Prevention of Environmental Pollution from Agricultural Activity (The PEPFAA Code): Under development. For details see www.farmingandwaterscotland.org
- Scottish Water Best Practice Incentive Scheme. Provides grants for best practice measures to protect water quality. Available in designated catchments only: http://www.scottishwater.co.uk/about-us/corporate-responsibility/sustainable-land-management/slm-incentive-scheme
- SEPA: www.sepa.org.uk