Cleaner Air for Scotland Review (2019)

Agriculture, Industrial and Domestic Emissions Working Group (AIDE WG)

Introduction

The working group decided, at its first meeting, to address the rather diverse challenges of the three different emission source sectors by forming sub-groups to work in parallel. The subgroups are indicated in the list of group members in ANNEX D. The group members wish to stress that due to the substantial breadth of the topics discussed, no individual has complete expertise and overview of all fields addressed in the report, and hence the report reflects collective best estimates and views on information available or required, but does not constitute a fully endorsed and vetted review of the state-of-the-art of each sector. For the report, we have consolidated information on each emission sector under the respective headings, with ANNEXES referenced for background information where appropriate.

Section 1 - Evidence on air pollution trends

Domestic combustion emissions

The main sources of emissions from the domestic sector are particulate matter (PM_{10} and $PM_{2.5}$) Nitrogen Dioxide and Sulphur Dioxide. As a result of the BEIS Domestic Wood Usage Survey the estimated volume of wood burnt in the UK was tripled in DUKES 2015. The Stove Industry Alliance (SIA), the log suppliers and the Forestry Commission in England all disbelieve the BEIS estimate of 6 million tonnes, and the Forestry Commission estimates the volumes of logs consumed as between 2.3 and 2.5 million tonnes. The SIA) and Log Suppliers are comfortable with the Forestry Commission estimate which ties in with recent user survey research[1]. Defra are currently undertaking further research to verify the volume of wood being used but the results are not expected until late 2019. This had led to significant debate regarding the actual emissions of $PM_{2.5}$ produced from domestic burning. The uncertainty over the emission levels from domestic burning was highlighted in the Defra Impact Analysis. The suggested collaboration of emission levels with the work carried out by Kings College London is open to question.

- Trade sources suggest that c. 80 ktonnes of coal is burned in Scottish homes. This is a significant contributor to $PM_{2.5}$ due to the high particulate output of coal compared to approved smokeless fuels (20-25 g/hour -v- 5 g/hour – source HETAS and Kiwa Gas Tech).
- Non-approved fuels also account for significant SO_2 emissions and such fuels range up to c.7% in sulphur content.
- The National Atmospheric Emissions Inventory for Scotland shows a continuous reduction in $PM_{2.5}$ to below WHO limits. Research commissioned by Defra[2] showed that emissions from wood burning in UK cities, including Glasgow, Edinburgh and Dundee were going down between 2009 and 2015. This was against a background of increasing stove sales. The main reason given for drop in emissions is the replacement of open fires and older stoves with more modern appliances, that produce lower amounts of particulate matter, (PM_{10} and $PM_{2.5}$).
- Defra have estimated the reduction in emissions that will come about as a result of their Clean Air Strategy. It would be worth checking to see if a similar methodology can be used in Scotland.
- What we can say at this stage, is that the measures outlined in the Defra strategy will result in emission reductions.

[1] The SIA has recently co-ordinated a survey of over 10,000 wood users. The results are currently being analysed and can be made available to the Scottish Government shortly.
[2] Airborne particles from wood burning in UK cities, Kings College, London, March 2017.

- Establishing KPI's to measure improvement is not easy. A major hurdle is linking the emissions from the chimneys with the atmospheric emission inventories. The atmospheric emission inventories need further research work to confirm their accuracy.
- Further monitoring of $PM_{2.5}$ levels particularly in urban areas is desirable. Local area concentrations of $PM_{2.5}$ show significant peaks as demonstrated by the SAPPHIRE study in Ireland where regional towns shows $PM_{2.5}$ emissions of 10-15 times WHO limits and background levels. However there is considerable uncertainty about the use of aethalometers to measure the emissions and the use of laevoglucose as a chemical tracer to indicate the proportions of those emissions attributable to domestic biomass combustion. This needs further research before any reliance can be placed on these results.

Industrial Emissions

Emissions from industrial activities in Scotland have been subject to increasingly strict regulation since the mid-1990s as a result of EU and domestic legislation. SEPA has been recording the mass emissions from the largest regulated sites since 2002 using its Scottish Pollutant Release Inventory (SPRI) system, which collects data for the main pollutants of concern. Emissions from industry can be variable as controls are typically set based on emission limit values (ELVs) from point sources (rather than mass emissions from the installation as a whole). As a result, emissions can fluctuate due to production needs, but still be in full compliance with permit conditions. Charts showing the emission trends from SEPA-regulated sites since 2002 are included as Annex 1, with some of the main points of interest being:

- Emissions of PM_{10}, NO_x and SO_2 have decreased significantly since 2006 and the downward trend is continuing;
- Emissions of $PM_{2.5}$ are generally low with one site producing high emission levels during 2013/14;
- Emissions of NH_3 have decreased since 2008, although the trend has become static and levels have started to increase again;
- Emissions of NMVOCs have decreased since 2002 but have levelled-off since 2007 and now started tom increase;
- Emissions of CO have decreased since 2002 and the downward trend is continuing; and
- Emissions of Pb have decreased since 2004, along the trend has been very variable since then with increases and further reductions.

Anomalies of increased annual emissions may be due to mode of operation of the installations (e.g. increase in production), site-specific operational issues (e.g. abatement not performing correctly) and installations coming into regulation (i.e. starting to report for the first time). With the exception of emissions of NMVOCs (mostly from the food and drink and chemical sectors) and Pb (from combustion) industrial emissions are now only a relatively small component of Scotland's total emissions compared to transport, agriculture, and domestic, commercial and public sector combustion. It is anticipated the general downward trends of industrial emissions will continue while the current system of regulation is in place.

Agricultural emissions

Scotland emitted 34 kt of ammonia in 2016, which was 12% of UK emissions. Ammonia emissions have decreased by 12% since 1990; a much smaller reduction than for other pollutants. The agriculture sector dominated the ammonia emissions inventory, producing 90.1% of Scotland's ammonia emissions in 2016[3] (NAEI 2018).

[3] All data are from 2016 unless otherwise stated.

Since 1990, decreasing animal numbers and a decline in fertiliser use reduced emissions, however, an increase in use of urea-based fertilisers recently has led to higher emissions. This results in a plateauing of emissions since 2008, with an increase between 2013 and 2016. Cattle manure management[4] accounted for 38% of agricultural emissions in 2017 (non-dairy: 28%; dairy 10%), followed by cattle manure applied to soils (19%) and inorganic fertiliser application (16% total; 9% to tillage, 7% to grassland). Anaerobic digestion activity, particularly from the spreading of non-manure digestates on agricultural land, has increased the contribution from the waste sector.

Agriculture also produces appreciable amounts of particulates (PM_{10}: 14.4% and $PM_{2.5}$ 7.2% of totals) and volatile organic compounds (12.2% of total). Sources of PM_{10} include farm operations (31%) and manure management (cattle (25%), sheep (20%), laying hens (9%), other poultry and broiler chickens (6% each). Most emission sources have decreased since 1990, however those associated with laying hens has increased, especially since 2008.

$PM_{2.5}$ emissions arise manure management (cattle (57%), sheep (22%)) and farm operations (14%). Manure management associated with laying hens, other poultry and broiler chickens contribute 2% each. Emissions of $PM_{2.5}$ from all sources have declined or remain unchanged emissions since 1990, with little further change since 2010.

VOC emissions are dominated by cattle manure management (66%), followed by cultivated crops (14%). Most emission sources of VOCs have decreased since 1990, except for poultry.

Ammonia abatement options

The Gothenburg Protocol requires a national advisory code of good agricultural practice to control ammonia emissions. Guidance was provided in the UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions, and in Options for Ammonia Abatement from the Task Force on Reactive Nitrogen. Defra published a voluntary code of good agricultural practice for ammonia reduction for England in 2018; equivalents are in development in Wales and Northern Ireland.

There are concerns about the applicability of some existing abatement options in Scotland. Options need to be reviewed in a Scottish context (e.g. climate, soils, agricultural practice), when developing an equivalent voluntary code of practice. Recent work has been done on the health and environment impacts, and on the costs and benefits of ammonia reduction measures (for example, Defra Air Quality Expert Group 2018, Guthrie *et al* 2018, Reis *et al* 2015). These can be taken as a starting point to investigate the costs and benefits of application in Scotland. Recent analyses suggest the potential to increase nitrogen use efficiency by matching livestock producers with excess nitrogen to arable farms with demand (Leinonen *et al* 2019).

Effects of air pollution from agriculture:

The impact of air pollution on human health and on ecosystems has been demonstrated (e.g. Guthrie *et al* 2018). Ammonia binds with acids in the air to form fine particles which may be carried tens or hundreds of kilometres from the source, posing a human health risk (e.g. AQEG 2018). Ammonia is toxic to plants, with lichens and bryophytes (e.g. mosses) having greatest sensitivity (Cape et al, 2009; Sutton et al, 2009). Monitoring and vegetation surveys close to agricultural units have observed complete breakdown of sphagnum moss and lichens, and smothering by algae (Hicks *et al*, 2011).

[4] Manure management in the National Atmospheric Emissions Inventory includes emissions from livestock buildings, open yard areas and manure or slurry stores, see EMEP/EEA air pollutant emission inventory guidebook 2016: Technical guidance to prepare national emission inventories (EEA, 2016)

Section 2 - Policy framework

Domestic combustion emissions

The working group agree that Scotland should largely follow the strategy adopted by Defra. This recognises that wood burning emissions depend on the type of appliance and the dryness of the wood. Other factors include the way the householder uses the appliance and burns the wood. Maintenance of the appliance and the chimney also have an impact. For solid fuel the amount of sulphur released depends on the sulphur content of the fuel. Burning practice and particularly slumbering have an impact.

Defra proposals include a ban on the burning of bituminous coal due to the high $PM_{2.5}$ emissions from the fuels. In terms of appliances the main policy instrument is Ecodesign (ED)[5]. ED will introduce stricter emission limits for particulate matter (PM), CO, NO_x and OGC. Defra Exemption currently only looks at PM and CO. The most significant emission from wood burning is PM. The PM emissions limit in ED is 55% lower than for Defra Exemption and the limit for CO is 80% lower. Defra have incorporated ED in their Clean Air Strategy and when Defra say that '*they will only permit the cleanest stoves to be sold and installed'* they are using the ED regulations to achieve this. When it comes to fuels the log manufacturers believe that it will take legislation to change behaviour. Retailers will always be under pressure to supply a cheaper, if poorer quality, product. Removing that option creates a level playing field and allows log suppliers to concentrate on achieving the desired moisture content. Defra picked this up in their strategy and is planning to legislate that the supply of logs up to 2 cubic meters must have an average moisture content of 20%. Such logs will be mainly kiln dried. Research carried out by Leeds and Manchester universities confirmed independent tests from Kiwa that PM emissions increase significantly as the moisture content of wood increases above 20%. Freshly cut wood can have a moisture content between 60% and 80% depending on the species

Agricultural emissions

Approaches to reduce ammonia emissions from agriculture in England, Denmark, the Netherlands and Germany are varied, and the analysis of these systems could inform development of the Scottish approach *(see Annex C*).

It will be important that the sector is made aware of any differences between ammonia mitigation policies in Scotland compared to England, given that most of the media promotion on ammonia to date has been as a result of the Clean Air Strategy (CAS), and not a Scottish specific strategy.

The UK government need to report on the impact of air pollution on ecosystems, under the National Emissions Ceilings Directive (NECD). The Report on the UK Network to Monitor the Impacts of Air Pollution on Ecosystems (June 2018) describes how the UK will meet this obligation. For terrestrial ecosystems, the representativeness by habitats in Scotland and the suite of parameters measured are inadequate. However, there is good coverage for freshwaters and atmospheric chemistry. In Scotland it is likely that we will need monitoring of more parameters at a broader range of terrestrial habitats before we can detect ecological effects of air pollution abatement with any confidence.

The NECD has set targets for air pollutants as percentage reductions by 2020 and 2030. The UK NAPCP projections for the reductions that may be achieved by England's Clean Air Strategy exceeds the targets, however, there is large uncertainty in the projected reduction and it may be strongly affected by uptake of measures.

The Clean Air Programme for Europe includes a target for a reduction by 35 % of the ecosystem area subjected to eutrophication by 2030, compared with 2005. Applying

[5] Ecodesign (ED) is the European-wide programme to lower emissions and improve efficiency. It is due to come into effect in the UK in 2022 for wood burning and solid fuel stoves. The UK government has brought the European legalisation into UK law so that the Ecodesign regulations will still be applicable to the UK after Brexit.

this in Scotland would set a target of bringing a further 2,875 km^2 of habitat below critical load exceedance for nutrient nitrogen relative to 2015.

See ANNEX C2 for a detailed overview on international and national policies addressing agricultural ammonia emissions.

Section 3 Justifications/Incentives for emission reductions

Domestic combustion emissions

- It is also important to note that estimates of the proportion of $PM_{2.5}$ in Defra's Clean Air Strategy are based on ALL domestic combustion. This includes open fires, bonfires, open fired pizza ovens, chimeneas and older stoves. The proportions are not therefore representative of the new Ecodesign Stoves.
- In the Clean Air Strategy, Defra also highlights that 50% of all emissions are transboundary, which highlights the need for a consistent national approach, rather than a localised approach to reducing emissions.
- Defra and the industry have concluded that improving air quality will require action on the appliance, fuel, consumer behaviour and appliance/flue installation and maintenance.
- A weakness in Ecodesign is that it only applies to new stoves. This leaves the question of existing stock. Householders with open fires and older stoves need to be encouraged to upgrade their appliances to Ecodesign stoves, in the light of the 90% and 80% respective reductions in emissions this could achieve.
- Changes to fuel regulations provide immediate reductions in emissions produced from domestic burning, with smokeless fuels and controlled dried wood reducing emissions by c.80% when compared to coal and wet wood. The implementation of such measures complement advances in stove design, which require these fuels, and provide further certainty regarding particulate emissions reductions
- The BEIS survey estimated that 44% of wood in Scotland was burnt on open fires and 51% in stoves with 5% used in other appliances (pellet & wood chip appliances). The average age of stoves was relatively young: 23% were between 5 and 15 years and 11% over 15 years old. The SIA is recommending that stoves over 10 years old should be replaced.
- Given replacing an open fire with an Ecodesign stove reduce emissions by 90%, replacing the 44% of wood burnt on open fires with wood burnt in Ecodesign stoves would reduce emissions by approximately 40%. This alone is a convincing argument for incentivising the replacement of open fires with Ecodesign stoves.

Industrial emissions

Industrial emissions are subject to strict control under a well-defined legal framework using the principle of Best Available Techniques (BAT). The provisions of the EU Industrial Emissions Directive (IED) (which covers the most polluting industrial activities) along with domestic provisions (for smaller activities) which comprise the requirements of the PPC regime in Scotland are wide-ranging, comprehensive and provide for a good level of protection of the environment as a whole. In general terms, this is demonstrated by the annual reduction in emissions observed in the data contained within SPRI. Therefore any scope for requiring further reductions of emissions to air without imposing excessive burden on business or "gold-plating" of existing legislation must be considered very carefully.

There are some flexibilities in IED/PPC that could be used to further reduce impacts on air quality from industrial activities. BAT conclusions present mandatory ELVs as a range, however installations in Scotland tend to be permitted at the upper end of this range. Where air quality improvements are identified as a driver to reduce industrial emissions, controls for PPC Part A Installations could be reviewed and set towards the lower end of the range. It is also the case that while permitting decisions for PPC Part A installations are BAT conclusion-led, the legislation does allow SEPA the ability to include ELVs for any form of emissions control. This means SEPA could potentially

require wider emissions improvements from currently regulated activities where ELVs have not previously been set or abatement not installed.

SEPA also considers domestic Environmental Quality Standards (EQSs) in permitting, compliance assessment and enforcement of regulated sites and while it is not a strict legal requirement to meet these standards it plays an important part in SEPA's decision-making. There is clear guidance issued by SEPA for PPC Part A and PPC Part B activities on how permits are determined and issued (further details are provided as Annex 2).

The system for ensuring domestic AQ objectives are considered by SEPA in PPC permitting is robust and effective. The role of LAs in having to work towards domestic requirements captures the legal status effectively and clarity in the roles and responsibilities. At this time SEPA has no plans to approach Scottish Government to request a change to these requirements as part of the CAFS Review.

Agricultural emissions

Ammonia is a reactive nitrogen compound which is released when slurries, manures and nitrogen fertilisers come into contact with the air. Ammonia, and therefore fertiliser value, can be lost whenever slurry or manure is exposed in this way and so practices that reduce exposure in housing, storage or during application to crops can cut losses and result in the more efficient use of organic and inorganic fertilisers, thus saving businesses money in the long-run. Recovering as much nitrogen as possible will maximise returns from farm inputs and good practice in managing soil, manure, fertiliser and feed will help reduce ammonia losses.

In Scotland, until recently, there has been little coverage of ammonia in the agricultural press. Consequently there is generally poor awareness of this issue across the sector. Therefore, initial engagement with the sector should be farmer focused messages that can be used to introduce the issues. The concept of retaining the nutrient value of manures and fertilisers will resonate with the industry with messaging related to productivity of the sector and in managing costs.

It is important to recognise that in addition to the private business benefits that farmers achieve through reduced ammonia emissions, there are also public good benefits; work is required to analyse the costs and benefits of mitigation options. This is important because in some instances changing farm management to reduce emissions can require significant up-front investment, which may be difficult for many farmers to manage financially. As such, a more detailed analysis of the costs and benefits of possible mitigations set within the Scottish context is required.

Section 4 - Interventions for Reducing Emissions

Domestic combustion emissions

- Existing Clean Air Act provisions are difficult to enforce and did not stop burning of wood in open fires or burning of unauthorised fuels in smoke control areas. Many smoke control zones are outdated and poorly understood by fuel users.
- With current resource levels in local authorities, a key measure is to enforce the control of solid fuel standards at the point of sale rather than the point of use. This would improve enforcement significantly through trading standards, with retailers facing significant risk of inspection and detection of infringements.
- The current zonal policy is difficult to enforce and is open to abuse. A national scheme enforcing fuel standards (i.e. smokeless fuels and dry wood) and also stove standards at the point of sale will have an immediate impact on emissions.
- The control of fuels sold/available will have a clear impact (80% $PM_{2.5}$ reduction) and very rapid effects.
- This question of nuisance installations should be addressed in conjunction with the Building Standards Division, (BSD). At the same it would be worth checking if the provision of installer training is satisfactory. When tackling the issue we need to be clear on what constitutes a nuisance.

- Chimney sweeps could play a useful role in checking chimney/flue systems and giving helpful information to householders but we need to be confident that sweeps have the knowledge base. Their level of training needs to be improved and subject to a vetted accreditation.
- The SIA would support annual checking of the appliance/flue system by a suitably qualified person, who could also ensure the correct fuel is being used and educate consumers on how to operate the appliance to obtain a cleaner burn.
- A weakness in Ecodesign is that it only applies to new stoves. This leaves the question of existing stock. Householders with open fires and older stoves need to be encouraged to upgrade their appliances to Ecodesign stoves, in the light of the 90% and 80% respective reductions in emissions this could achieve.
- The log manufacturers believe that it will take legislation to change behaviour. Defra picked this up in their strategy and is planning to legislate that the supply of logs up to 2 cubic meters must have an average moisture content of 20%. Such logs will be mainly kiln dried.
- Continue to support the implementation of voluntary measures: *Ready to B*urn and *Ecodesign Ready* stoves.
    - In conjunction with Defra the main log suppliers agreed to brand appropriately dry wood as *Ready to Burn.* Woodsure launched the *Woodsure Ready to Burn* scheme in September 2017, with the support of Defra. In addition to promoting the scheme to retailers and the public, Woodsure quality assure the logs supplied and audit their moisture content.
    - Rather than wait until 2022 the SIA has marketed Ecodesign Ready stoves that will meet the Ecodesign requirements. There are now over 400 models available which account for approximately 40% of current stove sales. When launching Ecodesign Ready, the SIA was aware that it was marketing a product for which there was no public demand and that demand would need to be created through public awareness of the air quality issues
- The SIA is currently developing an accreditation scheme that will encourage appliance manufactures to produce appliances with even lower emissions than the Ecodesign requirements. Consumers will be able to clearly identify stoves with lower emissions than Ecodesign from the accreditation label. The scheme has been discussed with Defra and is expected to be finalised shortly during 2020 and will be made available to the Scottish Government when it is finalised.
- Educating stove owners on how to operate and burn wood in their stoves is an important part of the mix in reducing emissions from wood burning. Burnright is a useful education campaign being promoted by most chimney sweep organisations. The SIA & HETAS are expanding their education programmes, with material such as the SIA educational videos for stove users. The Scottish Government should support and advertise industry wide initiatives to promote consumer education.

Industrial emissions

There are a few areas which could be investigated for developing future interventions to further reduce emissions to air from industry; however, recognising the comprehensive legal framework which already exists, any environmental benefits must be balanced against costs of regulation and a robust justification provided for the need for inclusion for control. Areas for possible further investigation include:

- Whether there is environmental benefit in bringing currently unregulated sectors (which have not been prescribed by EU legislation) such as non-waste anaerobic digestion and short-term operating reserve (STOR) generators under the remit of existing legal frameworks for emissions to air;
- Whether amendments to the existing legal framework are necessary to remove ambiguities, loopholes and gaps (e.g. BAT not applying to activities falling within the provision of the Medium Combustion Plant Directive, clarifying legal definitions

and their intent), appropriateness of capacity thresholds, which could help increase control of emissions;

- Whether additional reductions in industrial sources of emissions can be achieved where certain pollutants are not showing a downward trend (e.g. NH_3 and NMVOCs). SEPA is currently conducting work through its sector planning approach which could help further reduce emissions of these substances from specific sectors (e.g. whisky, crop and dairy production) through "beyond compliance" measures. However, opportunities may be limited, as previously discussed, due to a number of installation/sectors already operating in accordance with BAT and their permit conditions and further emissions reductions being limited by production levels and site-specific factors. Emissions of NH_3 from intensive agriculture sector are discussed in the agricultural emissions section of this report.

Quantifying/estimating the types and levels of air pollutants being released by currently unregulated sectors to identify where opportunities exist to consider bringing them into regulation. In many cases currently unregulated sectors already operate under well-defined, regulator-approved, environmental guidance (such as Net Regs); however, to avoid the need to bring these sectors into formal regulation, consideration could be given to making the current guidance into formal Codes of Practice and enforceable through General Binding Rules (GBRs).

Agricultural emissions

Given that ammonia and the effects on human health and ecosystems/biodiversity of agricultural emissions have not been overtly included within air quality policy to date, and that the issues have not been communicated to the agricultural sector, the group believes that the emphasis of future action should be on engaging with and helping prepare the agricultural sector to reduce ammonia emissions.

Through advice already available via *Farming for a Better Climate* and *Farming and Water Sc*otland, there is good awareness on many farms of measures to improve nutrient efficiency on-farm through good soil, fertiliser, manure and slurry management. Improving awareness and implementation of these measures will help reduce ammonia emissions.

The Agriculture Sub-Group suggests that the Scottish Government work with industry to develop a voluntary code of practice. This code should identify the measures best suited to Scottish agricultural production, climatic and land conditions. A voluntary code supported by the industry could provide not only a clear indication of the actions that can be taken, but will also help address the wider communications need of introducing the subject to the sector with language targeted to engage the sector in relation to the needs of businesses.

While there are some opportunities to deliver both emission reductions and improved business performance, many of the established mitigation practices require investment in infrastructure and new equipment. Consequently, the development of a voluntary code will also need to be accompanied by an assessment of where some of the mitigations which require either a high capital investment or have low or no business benefits, can be supported.

Section 5 - Conclusion and Recommendations

Domestic combustion emissions

The Defra Clean Air Strategy provides a good basis on which to develop Clean Air for Scotland. The stricter standards for $PM_{2.5}$ in Scotland compared to rest of the UK mean that Scotland may need to consider further actions. The Defra strategy focuses on the fuel and consumer education. It relies on Ecodesign to achieve reductions in appliance emissions but Ecodesign only applies to new stoves. Effectively addressing the existing stock of open fires and older stoves is an important consideration. Supporting the new industry initiatives will lead to the installation of appliances that have significantly lower emissions than Ecodesign. The work on the Defra Strategy has

revealed the need to take action on four areas: (1) right appliance burning the (2) right fuel, (3) consumer education and (4) proper installation/maintenance.

The uncertainty over the level of emissions from domestic burning means that setting definite reduction targets are difficult. Further research into the proportion of emissions attributable to domestic burning, as well as speciation of observations, is required. Further monitoring of $PM_{2.5}$ levels particularly in urban areas is desirable, subject to finding an agreed method of measurement. As up to 50% of locally observed ambient concentrations of $PM_{2.5}$ can relate to long-range transboundary transport of emissions from outside of Scotland (or the UK) a consistent national and transboundary approach, rather than a localised approach to reducing emissions is required.

Industrial emissions

Industrial emissions in Scotland have been subject to increasingly strict regulation since the mid-1990s as a result of EU and domestic legislation. As a result, releases of the most significant pollutants have showed generally downward trends, although some are now increasing meaning further, concerted, action is required.

Due to the prescriptive nature of the legal regimes controlling industrial emissions, further reductions may be difficult unless measures which go beyond compliance are implemented, and SEPA is currently taking this approach with 15 sectors which partially/fully cover sources of industrial emissions. With the current uncertainty over the UK exit from the EU it is difficult to assess the implications on emissions moving forward; however, implementing EU requirements into domestic legislation has demonstrated that controls placed on industry are proportionate and effective in reducing emissions. This being the case, provided we maintain the current EU requirements on a domestic basis (as a minimum) further emissions reductions should be achieved, providing further environmental benefit.

Agricultural emissions

There is a large body of relevant evidence, however further work is needed to understand how this applies in the Scottish context. There is a good understanding of the practices that can mitigate emissions; many of these could be adopted voluntarily and have long-term positive business benefits.

Recommendations

Domestic combustion emissions

- Implement the recommendations on domestic burning emissions in the Defra Clean Air Strategy in Scotland, and endorse the implementation of Ecodesign (ED).
- Introduce legislation to ban house coal, restrict the volume of sulphur in smokeless fuels to 2% and prohibit the sale of wet wood.
- Continue to support the implementation of voluntary measures: *Ready to Burn* and *Ecodesign Ready*.
- Consider supporting the new industry initiatives when they are finalised to dive emissions lower than the ED limits.
- Co-ordinated SG & Industry-wide education to inform consumers on appliance choice (open fires and stoves) and fuel, efficient stove operation and how to maintain their appliance with particular emphasis on sweeping the chimney.
- Ensure correct installations of domestic appliances.
- Decide on best approaches for existing stock of open fires and older stoves, (ED only applies to new appliances): Education, replacement scheme or combination?
- Further work is required to clarify the level of PM emissions in Scotland and the percentage attributable to domestic burning. This will require re-evaluating the volume of wood burnt. User surveys being completed in 2019 should deliver new information to produce a more accurate current figure than the 2015 BEIS survey.

Industrial emissions

- The requirements of EU legislation on industrial emissions control which have been transposed and implemented into domestic legislation should be retained and new EU requirements should continue to be implemented to provide as high a level of protection of Scotland's environment as possible.
- Review the current legal framework to investigate whether all appropriate industrial sectors are subject to regulation, to identify and remove legal gaps and ambiguities from legislation and investigate the use of GBRs for ensuring compliance with codes of practice.
- Use SEPA's sector plan approach to further reduce emissions where "beyond compliance" measures may be required to achieve these (e.g. NMVOCs and NH_3).

Agricultural emissions

- Scottish Government (SG) should work together with SEPA and the agricultural industry to identify the feasibility of application and mitigation potential of abatement options in the Scottish context. This particularly includes carrying out an assessment of the appropriateness to Scotland of the agricultural measures set out in the UK Government's new Clean Air Strategy, as well as reviewing approaches in other relevant countries.
- Consider what level of detail is required to inform abatement options for appraisal, and for subsequent assessment of effectiveness.
- Obtain the most recent data from the UK agricultural ammonia emissions inventory to target abatement. Further detail of emissions by fertiliser, digestate and animal husbandry types is available.
- Assess the need for government funding and investment in infrastructure.
- SG should undertake work to develop an equitable approach and use this to set appropriate targets as part of the UK contribution to the NECD.
- In the context of challenges faced by the farming industry in reducing GHG emissions to meet proposed national targets by 2045, SG should take forward work on reducing ammonia emissions in a way that seeks to maximise the complementarity of these agendas. It will be important to avoid conflicting policy messages in order to maximise positive engagement with the farming industry and it will be critical to provide support to farmers, such as through the Farm Advisory Service, provide joined up and coherent practical advice on the ground.
- Develop agri-industry focused communications centred on the potential (economic and environmental) benefits of managing ammonia losses.
- SG should work together with SEPA and the agricultural industry to develop a voluntary code of practice (CoP) for Scotland. The CoP should be subjected to a review process to assess its uptake, effectiveness and compliance. If the review highlights an inadequate uptake, other mechanisms should be considered.
- Support investigation into current modelled nitrogen and particulate matter concentrations and depositions, and model development, in relation to emerging research indicating that there have been changes in the behaviour of reactive nitrogen compounds with changing atmospheric chemistry behaviour.
- Support investigation into the method of assessing risk of significant harmful ecological effects, comparing critical loads with dose-response or other options.
- Implement identified improvements to the current site condition monitoring of designated conservation sites, to improve on current method which doesn't detect air pollution effects.. Assess potential costs and identify funding mechanism.
- Review current monitoring of terrestrial ecosystems (and air pollution effects) in Scotland: is it capable of detecting ecological responses to changes in air pollution to inform CAFS review?

Section 6 - ANNEXES

A – Domestic combustion emissions

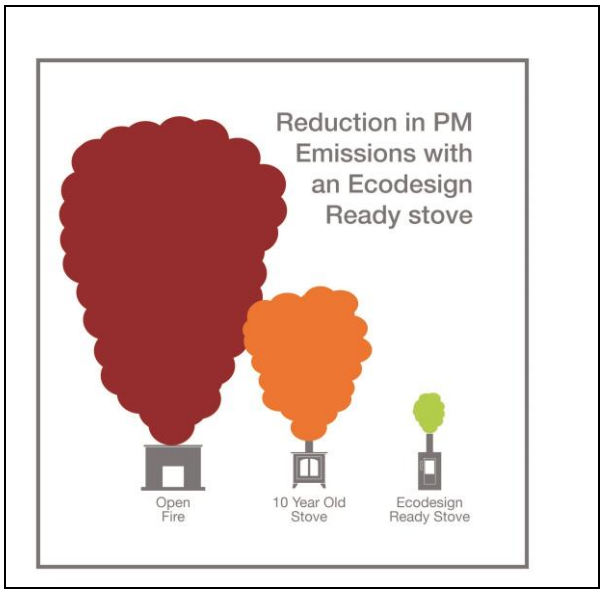
A1. General aspects

- The Appliance
- Wood
- Solid Fuel
- User Education
- Maintenance
- Value for the customer from low emission and high emission fuels

- **The Appliance**

The BEIS Domestic Wood Usage survey showed that the most common way to burn wood is on an open fire or in a stove.[6] Stove Industry Alliance (SIA) research has shown that 70% of stove owners only burn wood in their stove.

Independent research conducted by Kiwa on behalf of the SIA has shown that SIA Ecodesign Ready stoves can reduce particulate emissions by 90% compared to an open fire and 80% compared to an average 10 year old stove. Graphs showing the reduction in emissions are at the end of the Annex. The research report can be made available if so desired. The infographic below illustrates the reductions achieved. (The plumes are in relative scale to the emissions produced by each appliance.



The BEIS survey[7] estimated that 44% of wood in Scotland was burnt on open fires and 51% in stoves with 5% used in other appliances (pellet & wood chip appliances). The average age of stoves was relatively young: 23% were between 5 and 15 years and 11% over 15 years old. The SIA is recommending that stoves over 10 years old should be replaced.

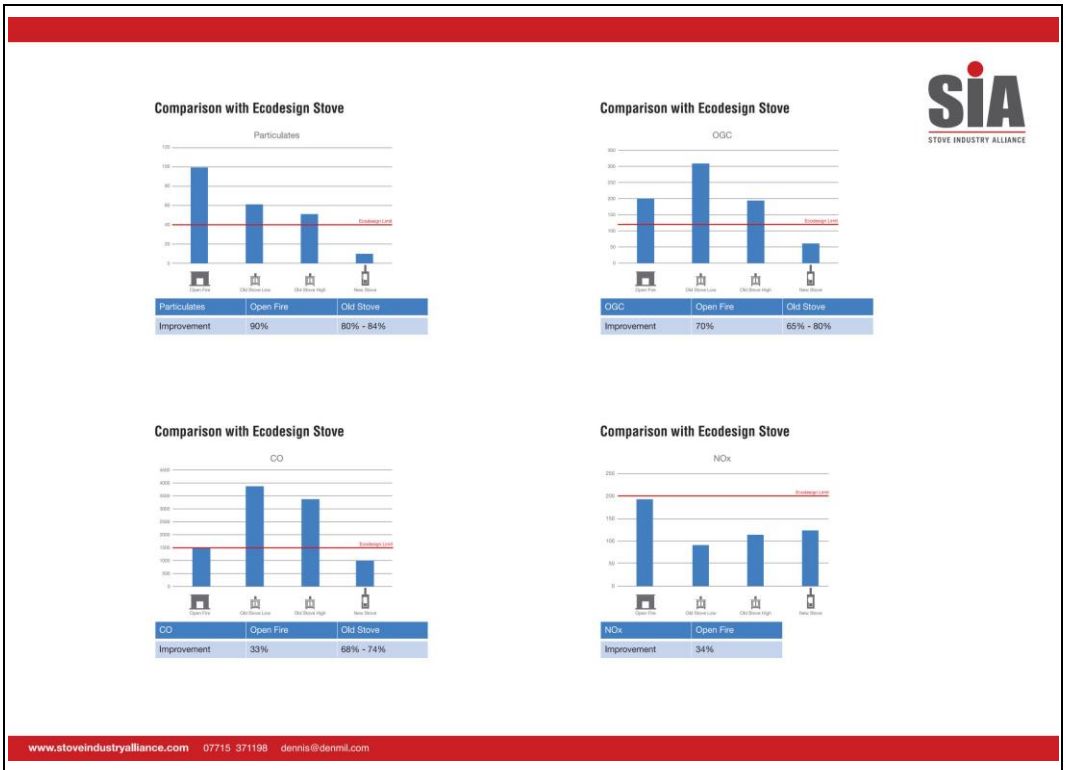
The media has latched on to the idea that stoves are only used for aesthetics. The BEIS survey [8] indicated that in Scotland 83% use wood for some heat and 4% for all heating.

[6] BEIS Domestic Wood Usage Survey 2016, page 8
https://www.gov.uk/government/publications/energy-trends-march-2016-special-feature-article-summary-results-of-the-domestic-wood-use-survey
Data tables:
https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey
[7] BEIS Domestic Wood Usage Survey 2016, Table 2.3
https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey
[8] BEIS Domestic Wood Usage Survey 2016, Table 1.5
https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey

The number of households in Scotland using wood was estimated at just over 117,000. The percentage of households is estimated at 16%.[9]

Note that replacing open fires with Ecodesign stoves would, on this basis, reduce emissions from domestic wood burning by nearly 40%.

The current Clean Air Act has been largely ineffective in reducing emissions. The Kings study has demonstrated that lowering emitting appliances can make a difference but the BEIS study estimated that 70% of wood burnt in London was on open fires despite the fact this is not permitted under the clean air act. The percentage is Scottish cities is unknown but is likely to be significant.



Ecodesign Ready stove comparison test results.

- **Wood**

  The supply of logs is an ill-defined and diverse market. The uncertainty in the market comes from what is referred to as the grey market. The grey market consists of wood that is collected by individuals or given to them and indeed sourced from their own trees. The BEIS study estimated the grey market for wood at 31% (21% for logs). 40% of logs are sourced from general and specialist suppliers. An important part this sector is the supply of bags of logs and as noted above too often the logs are supplied with too high a moisture content.

  Independent testing by Kiwa has shown that wood dried to c 18-20% moisture levels has emissions of c 5g/hour compared to 20-25g/hour for wood with c 40-50% moisture content. (The full report is available from Tim Minett of CPL Industries).

[9] BEIS Domestic Wood Usage Survey 2016, Table 1.1
https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey

Gravimetric smoke emission test for untreated ("wet") wood

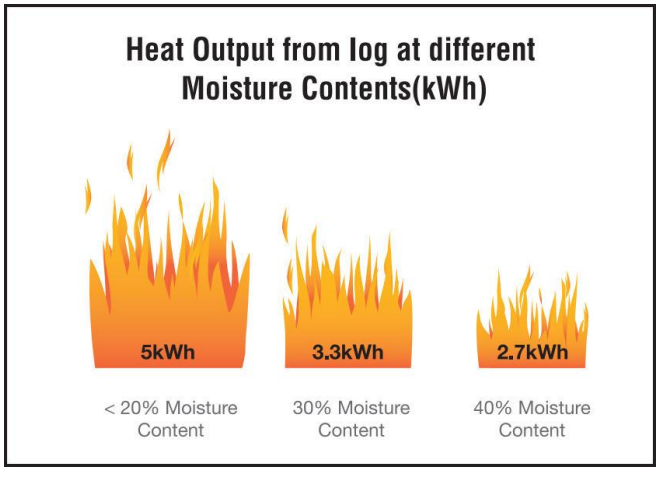
Test No.	Test Duration h	Radiation Output kW	Radiant Efficiency %	Smoke Emission g h^{-1}
1	1.23	0.92	13.5	21.0
2	1.40	0.91	15.0	18.1
3	1.38	0.86	13.8	23.5
4	1.25	1.05	15.3	16.7
5	1.00	0.83	9.7	26.1
Mean	**1.25**	**0.91**	**13.6**	**21.1**

Smoke testing of dried wood (less than 20% water content)

Test No.	Test Duration h	Fuel Burnt kg	Radiant Heat Output kW	Radiant Efficiency %	Smoke Emission gh^{-1}
1	0.82	2.51	1.82	13.4	4.1
2	1.02	2.51	1.75	15.8	2.9
3	1.03	2.51	2.05	18.7	4.3
4	0.75	2.48	1.38	9.3	7.6
5	1.00	2.51	1.41	12.5	4.0
Mean	**0.93**	**2.50**	**1.68**	**13.9**	**4.6**

Drying the wood to the required moisture content, which is known as seasoning, can take two to three years. Many stove owners do not have the space to season wood, so they need to buy wood that has already been seasoned, but too often wood sold as seasoned has too high a moisture content at a number of points in the process and distribution chain.

The higher price for kiln dried logs will be partially offset by the fact that the logs will produce more heat, as demonstrated in the infographic below:



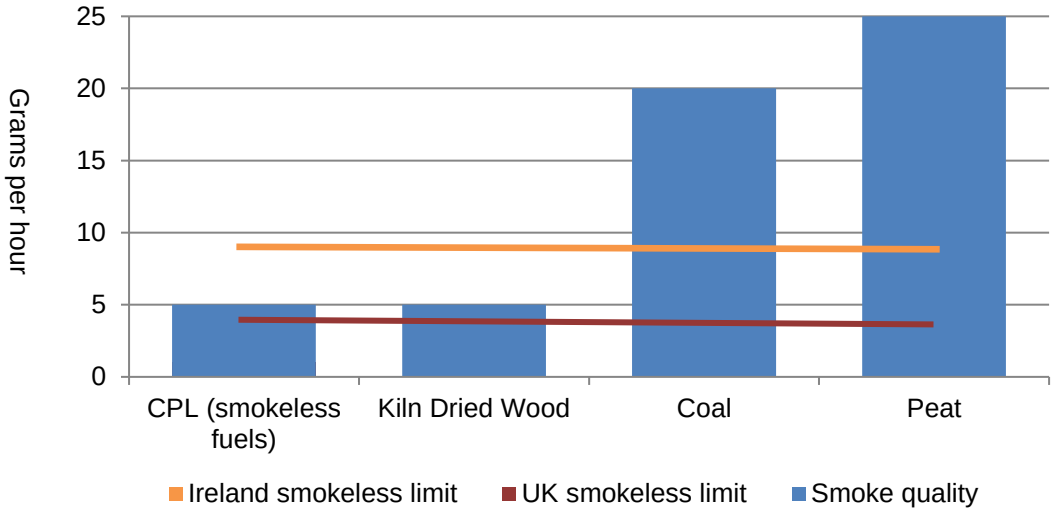
- **Solid Fuel**

Based on trade information Scottish homes burn c 80kt pa of bituminous coal and c 30kt of smokeless fuels. The differing emission characteristics of coal and smokeless fuels have been proven over 30 years through independent testing by

HETAS, Kiwa and testing for statutory acceptance as a smokeless fuel. The picture in terms of reducing particulate emissions is that while coal produces 20+ g/h of PM2.5, smokeless fuels (by statute) produce 5g/h providing a c 80% reduction in PM2.5 emissions.

The volume of sulphur released is greater with bituminous coal than smokeless fuels. Whereas, the amount of sulphur in bituminous coal is not easily controlled the volume of sulphur in smokeless fuels can be controlled

It is difficult to estimate but a level of peat burning continues in Scotland. However it must be in terminal decline and be largely restricted to the Highlands and Islands. Peat has been proven by studies in Ireland (where burning is prevalent) to be greater polluter than coal with $PM_{2.5}$ emission levels at 25-40g/h. (UCD study 2017)



Implementation of actions/legislation to control the fuels burn to smokeless solid fuel and moisture controlled wood will provide rapid impact on emissions and hence complements the medium term transition to Ecodesign stoves. The control of fuels provides a clear safeguard to air quality standards a strategy supported by Ricardo AEA in the Ireland intergovernmental study of 2014/15.

- **Control of Sulphur Content In Fuels**
  A consequence of the current smoke control legislation whereby smokeless fuels are required to be burnt only in smokeless zones is that unapproved fuels can be sold outside of those zones. A consequence of this is that fuels using high sulphur petcoke have developed significantly in the market resulting in sales of c.200kt (c.50% of total manufactured fuels in the UK) of such fuels. These fuels range in sulphur content from 4.5% to 7% compared to 2% for approved fuels.

  The inclusions of up to 90% petcoke (the solid residue from oil refining) results in elevated levels of nickel in these products (up to c500ppm).

  Hence while these high petcoke fuels provide low ash products with relatively high heat output, they contribute significantly to emissions from household burning resulting in such emissions representing c.18% of SOx on a UK basis.

  Nationwide regulations limiting sulphur content of fuels to between 1-2% are in place across a number of EU states (Ireland, France and Germany) and it is

recommended that such a sulphur limit forms part of emissions control on domestic heating.

The control of sulphur levels also effects some control on heavy metals content as petcoke contains high levels of nickel and vanadium. An overview of the heavy metals content of coal, smokeless fuels and petcoke is provided in an appendix to this report.

- **User Education**
  Educating stove owners on how to operate and burn wood in their stoves is an important part of the mix in reducing emissions from wood burning.

  The work carried out by G Coulson of the National Institute of Water and Atmospheric Research in New Zealand has shown that the stove user can have an important impact on the emissions from a stove. It's worth pointing out that the New Zealand research was carried out on older style stoves. Recent research from the Denmark has pointed to the conclusion that the emissions from well-maintained modern stoves can produce real life emission levels similar to those achieved in laboratory conditions[10].

  Individual stove manufacturers and HETAS have been producing consumer literature and videos on how to burn wood efficiently and in an environmentally friendly way but it is felt that the time has now come to produce industry wide consistent guidance. The SIA, Woodsure and HETAS are currently talking to Defra about creating a harmonised consumer education platform and campaign that could deliver easy to follow advice on how to burn wood and operate/maintain their stove to minimise emissions. The Guild of Master Chimney Sweeps has created a campaign called Burnright to help chimney sweeps give stove owners sound advice on how to burn wood and operate their stoves. The SIA has just produced a series of generic videos highlighting the benefits of Ecodesign stoves, how to best operate a Ecodesign stove and the importance and benefits of burning the right dry fuel on an Ecodesign stove. Rather than re-inventing the wheel it would seem sensible for Clean Air for Scotland to link it with a harmonised industry education programme.

- **Maintenance**
  Maintenance of the appliance & the chimney and in particular sweeping of the chimney have an impact on emissions. Proper maintenance will be an important part of the stove owner education. Regular chimney sweeping is most important. The frequency depends on how often the appliance is used but as a minimum the chimney should be swept at least once a year.

- **Value for the customer from low emission and high emission fuels**
  It is clearly important that the transition to cleaner domestic burning represents good value for the customer. The key measures for the consumer is the cost per kw of radiated heat (i.e. useable) heat, which takes into account the efficiency and calorific value fuels as well as the cost per tonne.

  The following shows the cost of radiant heat from wet wood -v- dry wood and coal -v- smokeless fuel when supplied through a coal merchant or retailer at typical current pricing:

[10] In-situ målinger af emissioner fra brændeovne i private boliger, Miljøprojekt nr. 2045, September 2018.

Unseasoned -v- Kiln Dried Wood

Fuel Type	Test Duration (hrs)	Weight of Fuel Burnt (kg)	Radiant Output (kW)	Radiant Output (kWh/kg)	Smoke Emission (g/hr)	Radiant Efficiency %
Wet Wood Open Fire	1.25	3.0	0.91	0.38	21.1	13.5
Dried Wood Open Fire	0.93	2.5	1.68	0.62	4.6	13.9

Average retail price for $1m^3$ (500kg) of unseasoned wood is £95, which equates to 0.50kWh/kg or £0.39 per radiant kWh.

Average retail price for $1m^3$ (500kg) of kiln dried wood is £145, which equates to 0.47kWh/kg or £0.39 per radiant kWh.

Coal -v- Smokeless Fuel (at retailer pricing)

	Smokeless Fuel	Standard Coal
Average Price (£/tonne)	£399	£299
Gross Calorific Value (kWh/tonne)	8850	7900
Delivered Energy Cost (p/kWh)	4.508	3.79
Heating Appliance Type	Open Fire	Open Fire
Assumed Efficiency (%)	37	28
Useful Energy Cost (p/kWh)	12.19	13.52
Annual Heat Demand (kWh)	3000	3000
Annual Cost of Heating Single Room (3,000kWh)	£365.55	£405.52

The increased burning efficiency of dried wood results in the fuel representing good value compared to wet wood.

The increased efficiency of smokeless fuel compared to coal has been established over 30 years of testing and reference data, such as the Sutherland Tables and British Coal research work can be provided.

The overall results of the above is that dried wood represents equal value for the consumer compared to wet wood, while smokeless fuels offer improved value to the consumer compared to coal.

A2. Heavy Metals in Solid Fuels

Materials Tested

The materials tested were high volatile Columbian coal, Welsh anthracites, two high sulphur pet cokes circa 5-6% sulphur and a low sulphur pet coke circa 1.2% sulphur.

The Columbian coal represents a high quality house coal which therefore acts as a standard for the coals being burnt in the home (lower quality Scottish coals are also consumed).

Anthracite is burnt as a boiler fuel but also used as a major component of smokeless solid fuels.

Petcokes are used as near 100% of the raw material component of non-authorised non HETAS approved solid fuels. These products are increasingly used to replace housecoal but their use is poorly policed. Low sulphur petcoke represents an alternative petcoke sometimes used to mitigate very excessive levels of sulphur though the high cost significantly limits its use in solid fuels.

Results in summary

The Table attached shows the results for heavy metal content of the various cols and fuels in mg/kg. Results were obtained using an XRF analyser that achieves measurement to 0.01%. The work was carried out by Birmingham University Chemical Engineering Dept on behalf of CPL. When using XRF the results have to apportioned on the basis of the carbon content of the material as carbon is transparent to XRF scanner. The table data has been proportioned in this way and the fixed carbon content for each product is indicated at the top of each column. These carbon values are averages for each product taken from routine testing carried at Immingham Briquetting Works over a number of years . Looking at the data there is as expected a good correlation between heavy metals in the coals and the smokeless fuels as the coals are blended to produce the finished fuel and the binders used have very low if any heavy metal content. There is also a good correlation with the data collected by the EA for their report which is included in the final column. The report from August 2016 Report – SC130040/R9 Version 2 Material Comparators for End of Waste Decisions - Materials for Fuels: Coal analysed 20 coal samples (including anthracites and house coals) sourced in the UK from retail and industrial outlets. The analysis used was different using LE I metals (ICP-OES) 01 – digestion block aqua regia extracted under reflux; determined by inductively coupled plasma optical emission spectrometry (ICP-OES).

Arsenic and Mercury

In our analysis neither was found at a detectable level. In the EA report all analyses for mercury was reported as below the limit of detection 0.2 mg/kg. Arsenic in the coal was reported in a range 3 – 6 mg/kg. Although this was below the LOD in our XRF work, the experienced testing staff at Birmingham University expressed the clear opinion that arsenic and mercury were not present in the samples to a level of any significance.

Lead

In terms of lead content using XRF it was detected in only one of the petcoke samples at a level of 38 mg/kg. In the EA report over the range of tested coals Lead was detected in all samples with a mean content of 13 mg/kg. Using XRF there were no detectable levels in either smokeless fuels.

Nickel and Vanadium

The coals showed levels of nickel and vanadium similar to the results from the EA report (6 mg/kg Ni and 38 mg/kg V) with anthracite having slightly elevated levels of nickel (23 – 45 mg/kg).

Analysis of the petcoke samples shows a high content of nickel and vanadium content in the fuel compared to the other coals and to the EA comparator. The high sulphur petcoke samples are reasonably consistent in terms of nickel (Ni) and vanadium (V) content showing levels of 327 – 386 mg/kg for Ni and 548 – 647 mg/kg for vanadium.

The sample of low sulphur petcoke does appear (based on one sample) to have slightly lower levels of nickel at 379 mg/kg and particularly vanadium at 265 mg/kg.

The two CPL products show slightly elevated levels (58 – 66 mg/kg Ni) and (79 – 92 mg/kg V) due to the circa 10 – 15% petcoke used in the blending to reduce ash and increase reactivity in the product.

The particular issue with petcoke is the very low ash contents. CPL carried out some ash heavy metals analysis as part the investigation and the results indicated that after combustion the Nickel and Vanadium remained in the ash. With ash contents typically less than 1% the concentration effect gave results as high as 50,000 mg/kg Nickel and 118,000 mg/kg Vanadium. It is reported that the nickel and vanadium contents derive

from the catalyst used to aid cracking of the very heavy oil distillate which is processed to produce the very last high fractions and the solid petcoke.

Brief Summary

The heavy metals content of coals, anthracites and solid fuels using anthracites as a major constituent are very similar. The CPL products Homefire and Phurnacite show slightly elevated levels of vanadium and nickel due to the inclusion of c 15% petcoke. This results in relatively low results of c0.1-0.15% for the metals in the product but would result in over 1% vanadium in the ash.

The major issue is that those fuels made from circa 100% petcoke are in most cases produced using very high sulphur material (circa 5%) due to its low price. This results in excessive levels of sulphur oxides during combustion and at circa 0.05% nickel/vanadium within the petcoke briquette and 5-10% in the ash.

Possible regulatory options to control petcoke in solid fuels include the national prohibition of fuels with sulphur content above circa 1.5 -2% or restrictions regarding the maximum petcoke content of fuels. Either of these would lead to significant reductions in Nickel and Vanadium in the ash of solid fuels.

To illustrate the effect of the high price differential between high sulphur petcoke and low sulphur petcoke also attached are 6 blend formulation sheets which are used by CPL to assess the cost of various input raw materials blends. The six sheets show 3 blend formulations for CPL's premium smokeless open fire product Homefire and 3 for a generic 100% petcoke briquette. For Homefire the blends are for decreasing sulphur contents 2% , 1.5% and 1% and for petcoke the blends are a current 100% high sulphur petcoke briquette and the additions of low sulphur petcoke to get that product below 2% and 1.5% overall sulphur.

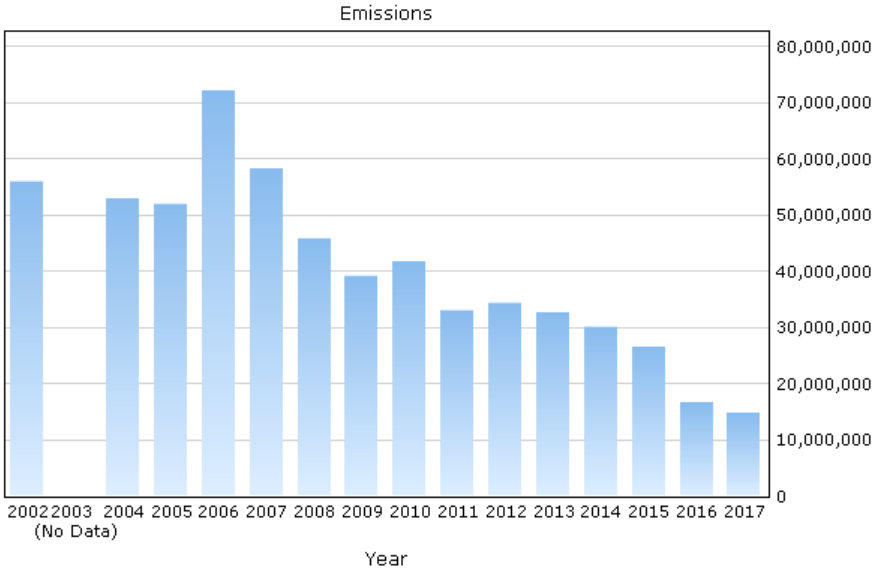
The formulations show the current delivered prices experienced by CPL and the blend calculations show the resulting proximate analysis of the proposed product and its cost of production. It clearly indicates that for a smokeless fuel such as Homefire, which is predominantly anthracite to maintain a low particulate emission, a stepwise reduction in total sulphur in cost terms is relatively neutral but would result in a higher ash, less reactive fuel for the final customer. For the 100% petcoke briquette the cost of even achieving the current smoke control area limit of 2% sulphur would result in 70% increase in raw material cost up by £61 / pt. This is not commercially viable so a reduction in the overall sulphur content will severely disadvantage the production of these products.

B – Industrial emissions

B1. Air pollutant trends (mass emissions) from industrial activities regulated by SEPA (2002 – 2017)

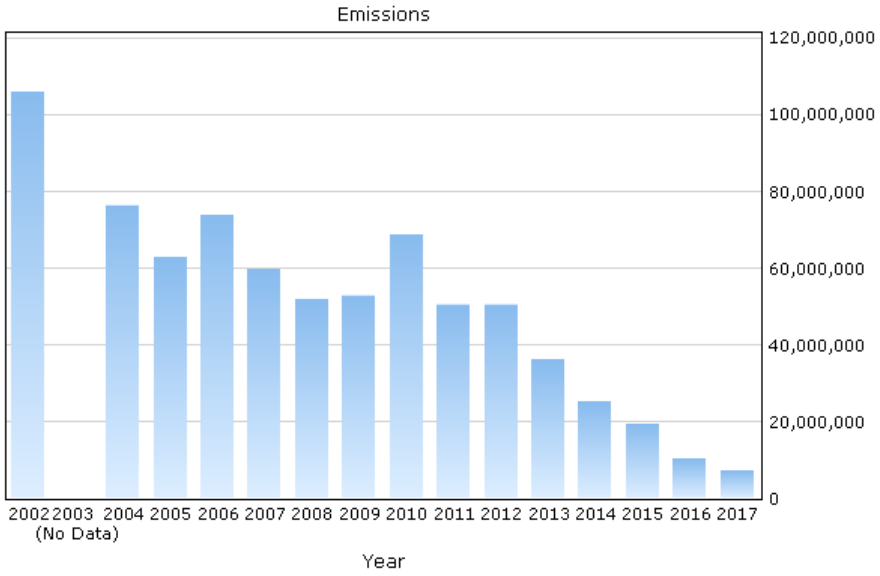
Oxides of nitrogen, NO and NO_2 as NO_2

Pollutant	Nitrogen oxides, NO and NO2 as NO2
Media	Air
Units	Kg
Industry Sector	All



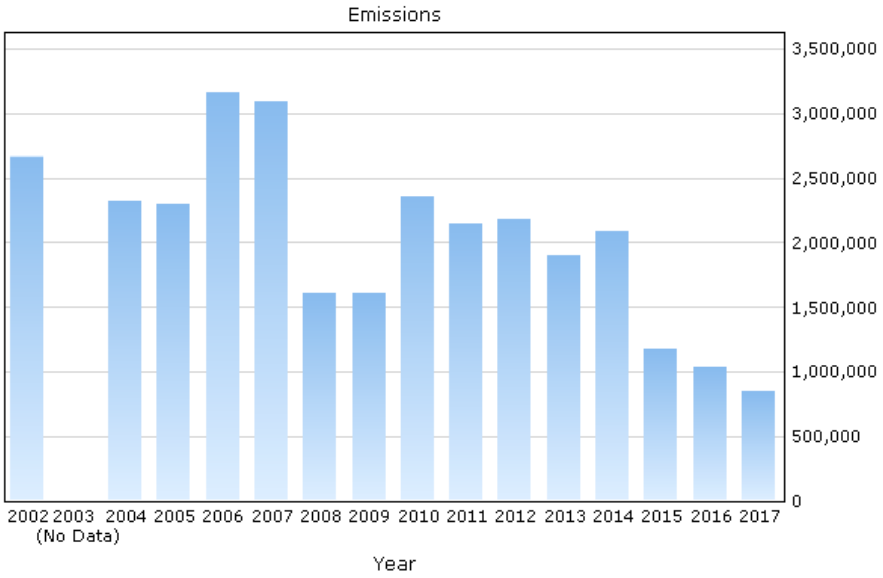
Oxides of sulphur, SO_2 and SO_3 as SO_2

Pollutant	Sulphur oxides, SO2 and SO3 as SO2
Media	Air
Units	Kg
Industry Sector	All



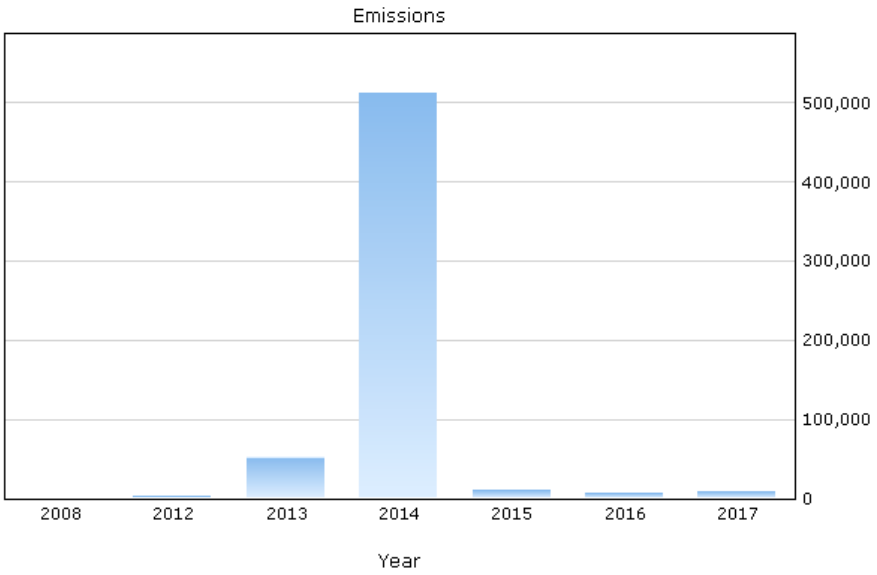
PM_{10} (particulate matter < 10µm)

Pollutant	Particulate matter - PM10 and smaller
Media	Air
Units	Kg
Industry Sector	All



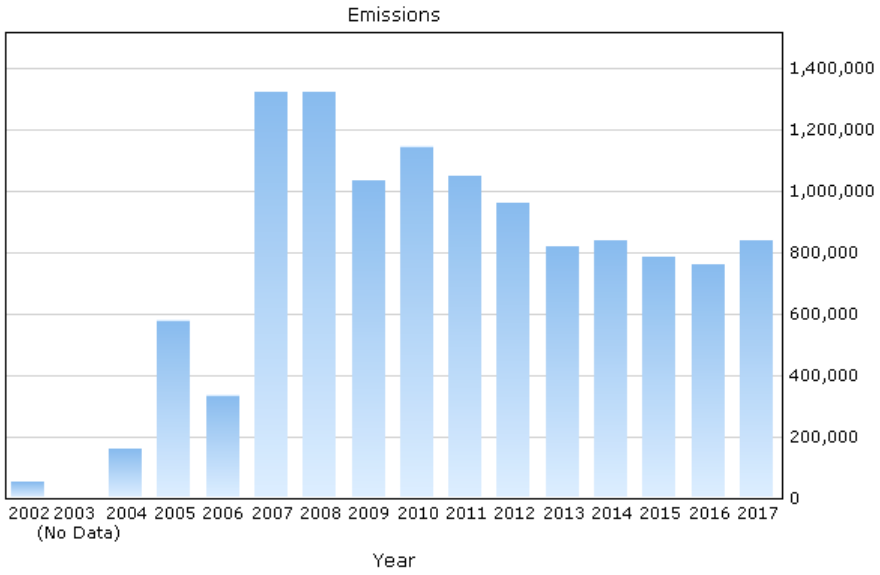
$PM_{2.5}$ (particulate matter < 2.5µm)

Pollutant	Particulates - PM2.5 and smaller only
Media	Air
Units	Kg
Industry Sector	All



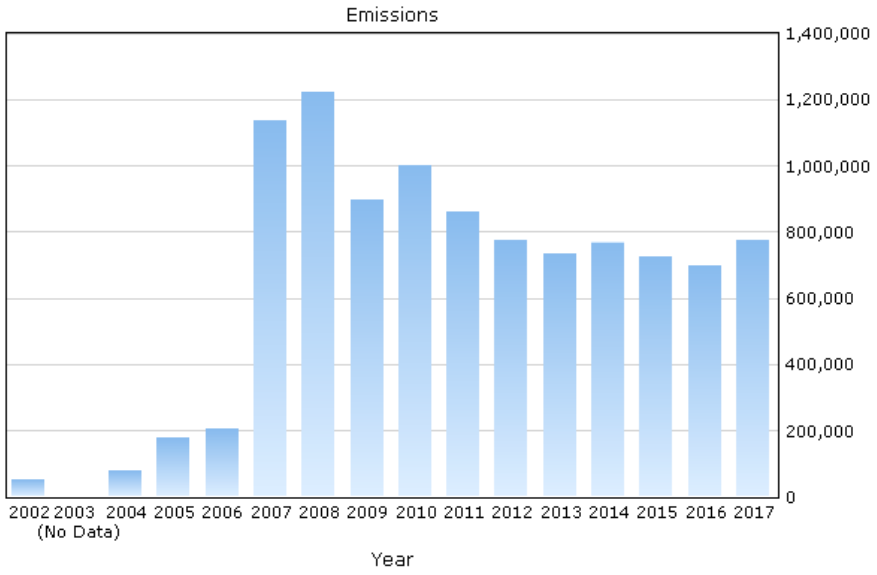
Ammonia (NH_3)
All Sectors

Pollutant	Ammonia
Media	Air
Units	Kg
Industry Sector	All



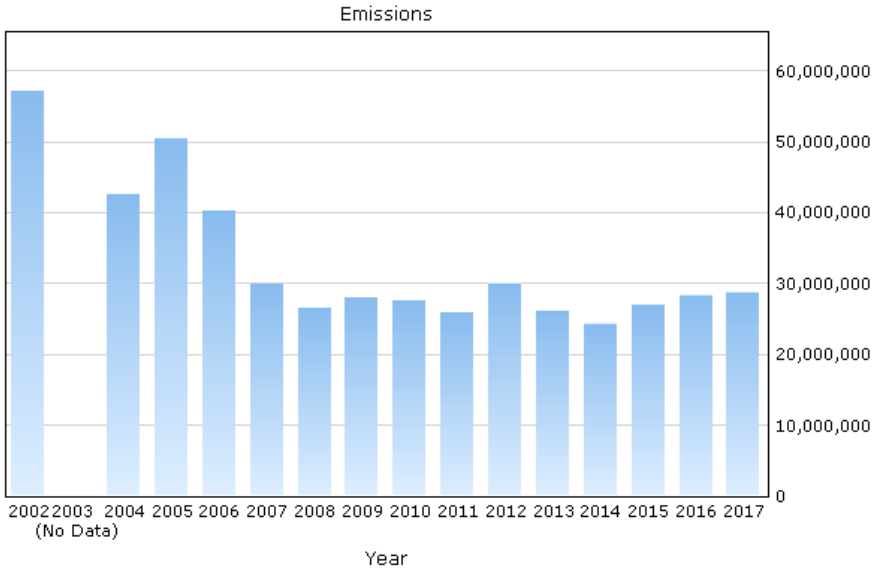
Intensive agriculture

Pollutant	Ammonia
Media	Air
Units	Kg
Industry Sector	Intensive rearing of poultry or pigs



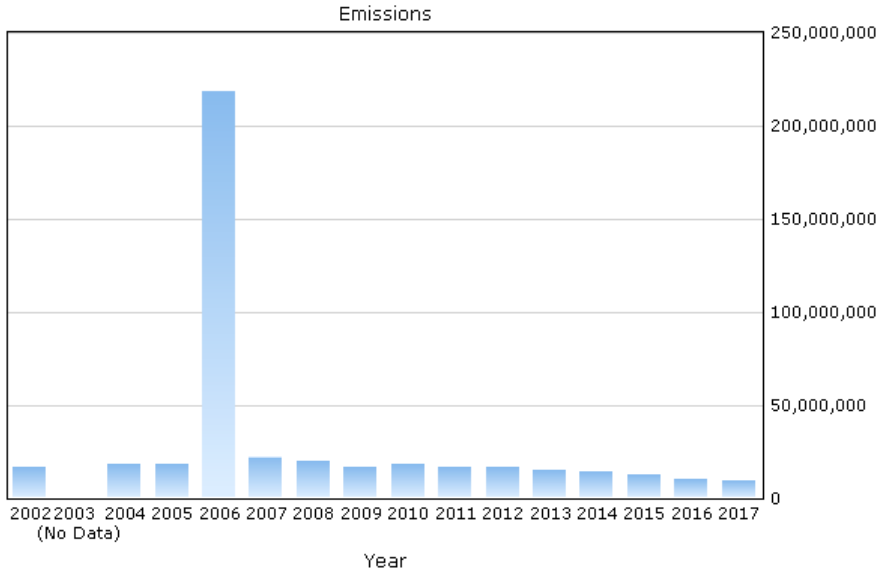
Non-methane volatile organic compounds (NMVOCs)

Pollutant	Non-methane volatile organic compounds (NMVOCs)
Media	Air
Units	Kg
Industry Sector	All



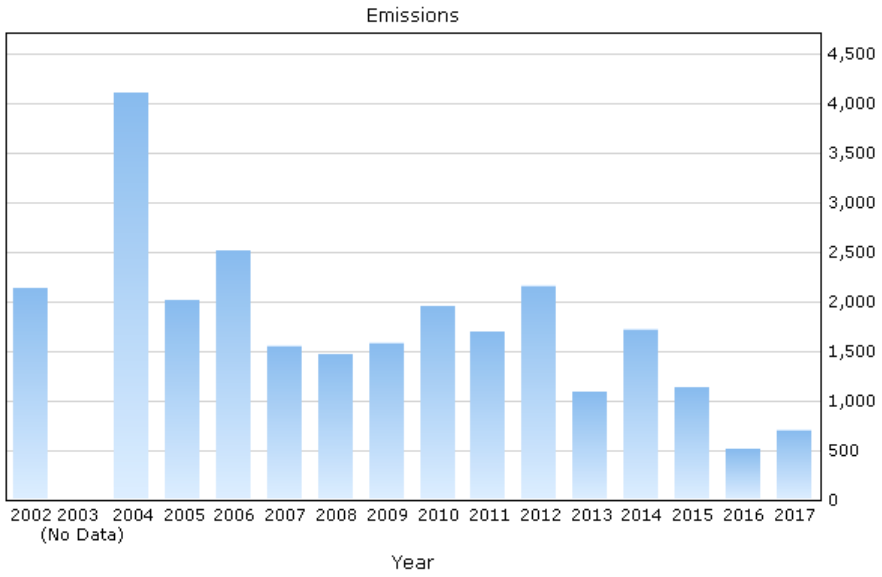
Carbon monoxide (CO)

Pollutant	Carbon monoxide
Media	Air
Units	Kg
Industry Sector	All



Lead (Pb)

Pollutant	Lead
Media	Air
Units	Kg
Industry Sector	All



B2 – Status of EU and domestic EQSs in relation to issuing permits under PPC

Background

EQSs are set within both European Union (EU) and domestic legislation. Where it is necessary to prevent an EU EQS being breached, PPC permit conditions stricter than Best Available Techniques (BAT) must be set. In setting permit conditions, SEPA must consider whether any EU EQS is being, or may be, breached. If so, SEPA will have to set Emission Limit Values (ELVs), based on how much the installation is responsible for the breach and the likelihood of remedial action elsewhere. This may require ELVs that are tighter than those required to implement BAT for the activity

Many domestic EQSs are the same as those set within the EU, and should be treated in exactly the same way. However, some Scottish standards/objectives are stricter (e.g. PM annual mean), or additional to (e.g. SO_2 15 minute mean), EU requirements. EQSs set at a Scottish level do not have the same legal status as EU EQSs, since they are not explicitly referred to in PPC 2012. Therefore, there is no absolute legal obligation under PPC 2012 for SEPA to impose any stricter conditions beyond BAT where this would be required to comply with a Scottish EQS only. The exceedance of an EU EQS gives rise to an additional, explicit legal obligation, whereas the exceedance of a Scottish EQS is a factor, albeit a major one, that is taken into account when determining BAT.

Scottish EQSs should still be considered as a major factor in determining ELVs and BAT for an installation, following the basic principle of using EQSs as a reference level for harm. Under the Environment Act 1995, SEPA is required to have regard to the Air Quality Strategy for England, Scotland, Wales and Northern Ireland, and hence any Scottish EQS, in exercising its pollution control functions, including permitting under PPC. Therefore, Scottish EQSs should inform a judgement on whether the installation should be permitted and, if so, what control options should be selected based on the balance of costs and advantages. Any significant contribution to the breach of a Scottish EQS should normally be judged unacceptable in terms of harmful effects. However, this will need to be considered on a case-by-case basis, taking account of the costs and advantages of measures to reduce or prevent the breach.

Where a SEPA-regulated installation is identified as contributing significantly (or is the main source) to the exceedance of a domestic-only AQ objective then SEPA works with the operator and local authority to put in place measures to achieve compliance (e.g. the Grangemouth AQMA for the SO_2 15 minute mean).

Determining BAT

Specifically in relation to the domestic EQSs for PM emissions, all SEPA installations are issued with permits containing BAT for that activity (which may be determined for the sector as a whole). Depending on the type of activity undertaken, BAT will be determined either at an EU (BAT Reference) or national level (Technical/Process Guidance). Many activities have similar BAT requirements and unless the PM emissions are from a point source (i.e. stack) many of the conditions of a permit will be in relation to activities undertaken within the installation (e.g. materials handling, coverings, vehicle movements and loading with the installation boundary, housekeeping, etc.).

Current UK Process Guidance for PPC activities (which is not statutory in Scotland but still forms the basis of determining BAT for SEPA permitting) states that “In areas where air quality standards or objectives are being breached or are in serious risk of breach and it is clear from the detailed review and assessment work under Local Air Quality Management that the permitted process itself is a significant contributor to the problem, it may be necessary to impose tighter emission limits. If the standard that is

in danger of being exceeded is not an EC Directive requirement, then industry is not expected to go beyond BAT to meet it.

Decisions should be taken in the context of a local authority's Local Air Quality Management action plan. For example, where a permitted process is only responsible to a very small extent for an air quality problem, the authority should not unduly penalise the operator of the process by requiring disproportionate emissions reductions." (Note: for the purposes of this guidance SEPA is the "authority")

It is clear that under the PPC Regulations SEPA has the ability to assess the impact of installations it regulates in relation to any relevant EQS for air pollutants and apply conditions it determines necessary to meet, or contribute to meeting, those standards through permit controls.

C – Agricultural emissions

C1 - Emissions from agriculture: EU and comparative perspectives[11]

Air pollution from agriculture is mainly caused by emissions of ammonia (NH_3), benzo[a]pyrene (BaP) particulate matter with a diameter of 10 µm or less (PM_{10}), methane (CH_4) nitrate (NO_3) nitrogen oxide (NO_x) and nitrogen dioxide (NO_2).[12] The emissions for many of these pollutants in the EU decreased overall in the period between 2000 and 2016 (figure 1),[13] but NH_3 have recently increased.[14] In 2016, agriculture was the main cause of NH_3 and CH_4 pollution in the EU, and a leading cause of BaP, primary PM10 and NMVOC emissions.[15] The most harmful of these air pollutants in terms of damage to ecosystems are NH_3 and NO_x.[16]

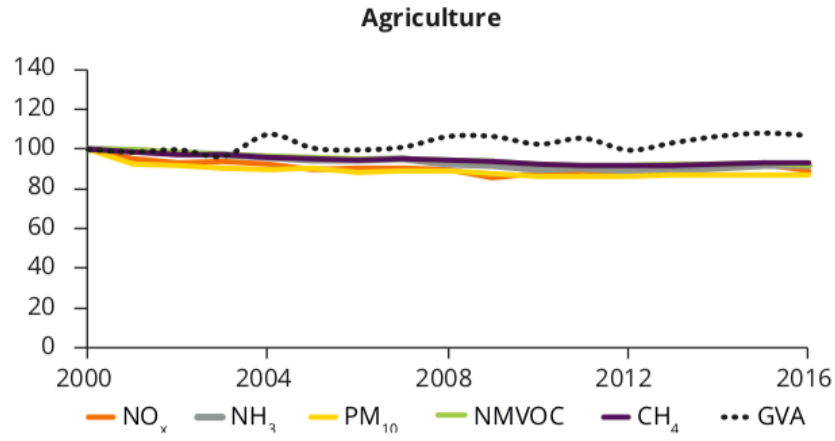


Figure 1: EU-28 emissions from main source sectors – source EEA, 2018

Emissions of air pollutants from agriculture in the EU are regulated by climate change law policy, as well as by specific air pollution-related measures.[17] Up until 2020, EU **greenhouse emissions from land use changes** (so-called LULUCF) – which include emissions from CH_4 and NO_x – are *accounted* for, but do not count towards the achievement of the EU's internal climate change mitigation targets.[18] Current EU rules have been criticised for not providing a rigorous quantification of the mitigation actions in this sector and related possible spillover and leakage effects. The so-called **LULUCF Regulation**[19] was adopted in 2018 to tackle these shortcomings. The Regulation –which will be implemented starting with 2021–establishes a LULUCF pillar in EU climate policy, with dedicated accounting rules and the commitment that the sector remain emission neutral – the so-called 'no debit rule'.[20] This means that if the

[11] This note has been prepared by Dr Annalisa Savaresi in the context of the CAFs ADE group, established by the Scottish Government. For any comments or suggestions, please contact: annalisa.savaresi@stir.ac.uk
[12] 'Air Quality in Europe - 2018' (European Environment Agency 2018) Publication <https://www.eea.europa.eu/publications/air-quality-in-europe-2018> accessed 1 April 2019.
[13] ibid 22–23.
[14] ibid 18.
[15] ibid 24.
[16] ibid 8.
[17] For an overview of EU law on air pollution, see: http://ec.europa.eu/environment/air/quality/existing_leg.htm
[18] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020, OJ L 140, 5.6.2009, p. 136–148
[19] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU, OJ L 156, 19.6.2018, p. 1–25 [LULUCF Regulation].
[20] LULUCF Regulation, Article 4.

LULUCF sector generates debits or credits, these will contribute, to a certain extent, to the emission reduction target under the Climate Action Regulation,[21] which covers agriculture, forestry, transport, waste and buildings. With the LULUCF Regulation, the EU has pioneered a new, comprehensive approach to the LULUCF sector, moving ahead of other developed countries. Even before its implementation started, however, the LULUCF Regulation has already been at the centre of two climate litigation suits, whereby a group of citizens and civil society organisations have challenged before the Court of Justice of the EU the EU's lack of climate ambition, as well as the ecological integrity of the rules concerning the use of renewable energy from biomass.[22] Whether or not the Regulation may be regarded as best practice, therefore, remains to be seen. At the very least, others will benefit from learning from the EU's travails, including its mistakes.[23]

Beyond climate change law, EU Member States have adopted specific measures to reduce emissions from ammonia, pursuant to Directive 2001/81/EC on emission ceilings.[24] The implementation of the directive has delivered an overall 24 % decrease in agricultural ammonia emissions in the EU of between 1990 and 2015. The vast majority of EU-28 Member States met the national targets set for 2010. There have however been significant variations amongst Member States. Some have achieved reductions in excess of 50 %, with Bulgaria (-74 %), the Netherlands (-68 %), Latvia (-61 %) and Lithuania (-59 %) reporting the largest decreases. Conversely, six Member States (Austria, Denmark, Finland, Germany, Spain and Sweden) missed their targets.[25]

A comparative study of measures adopted in Denmark, Germany and the Netherlands reveals that these countries have taken different regulatory approaches to ammonia emissions.[26] In Denmark the regulation centres around individual environmental permits, which are required for almost all livestock installations. The assessment and permit criteria have to an extent been standardised for so-called "ammonia sensitive" habitats, pursuant to the public authorities' duty to assess the effects of any plan or project that potentially and significantly affects the conservation goals and status of Natura 2000 sites. In 2015 Denmark reported it had made considerable progress towards achieving its targets (-44%).[27]

In Germany, a simplified environmental permit applies to livestock installations below certain thresholds. Other livestock installations are subject to building permits, which may also include the consideration of nature protection and environmental issues. A Natura 2000 assessment for "ammonia or nitrogen sensitive" habitats has been introduced, following court rulings laying down specific thresholds. Germany still lags behind in achieving its targets with emission reductions averaging 4,9% in 2015.

[21] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013, PE/3/2018/REV/2 OJ L 156, 19.6.2018, p. 26–42

[22] The text of the applications is available at: <https://peoplesclimatecase.caneurope.org/> accessed 2 November 2018; and <http://eubiomasscase.org/> accessed 27 March 2019> respectively - accessed 1 April 2019

[23] See Savaresi, A. and Perugini, L. 'The Land Sector in the 2030 EU Climate Change Policy Framework: A Look at the Future' Forthcoming: Journal for European Environmental & Planning Law, 2019, Forthcoming.

[24] See data reported in 'Agri-Environmental Indicator - Ammonia Emissions - Statistics Explained' <https://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_ammonia_emissions> accessed 1 April 2019

[25] Ibid.

[26] Anker, H. T., Baaner, L., Backes, C., Keessen, A., & Möckel, S. (2018). Comparison of ammonia regulation in Germany, the Netherlands and Denmark: legal framework. Frederiksberg: Department of Food and Resource Economics, University of Copenhagen. IFRO Report, No. 276

[27] See note 24 above.

While in Denmark and Germany livestock installations are primarily subject to emission limits and technology requirements when they apply for a permit, in the Netherlands a novel approach was introduced in 2015, with the so-called programmatic (or integrated) approach to nitrogen/ammonia (Programmatische Aanpak Stikstof - PAS). As a result, environmental permits in the Netherlands are only required for large pig and poultry installations, pursuant to the EU Industrial Emissions Directive (IED). Other permits, including Natura 2000 permits, may however be required for other installations.

The Dutch approach to ammonia pollution has been successfully challenged for lack of compliance with EU law. In 2018 the Court of Justice of the European Union has found that the Habitats Directive precludes national legislation that allows the application of fertilizers on the surface of land or below its surface and the grazing of cattle, without being subject to a permit requirement and to an individualized appropriate assessment of its implications.[28] The Court further found this would only be permissible if objective circumstances rule out with certainty any possibility that those projects, individually or in combination with others, may significantly affect Natura 2020 sites.[29] Even though the Netherlands has been successful in bringing down ammonia emissions (-68,2% in 2015), therefore, its approach has raised concerns related to its environmental integrity.

Conclusions

This overview of measures concerning air pollution from agriculture in the EU reveals that this sector is in flux and is going to undergo significant changes in the decade 2021-2030, as a result of the implementation of new measures included in EU climate change law. In the meantime, implementation of extant EU law has revealed that integrated measures are needed to avoid unintended consequences, and that the objective to tackle climate change and air pollution should be looked at in combination with other environmental objectives.

[28] Joined Cases C-293/17 and C-294/17, *Coöperatie Mobilisation for the Environment UA and Vereniging Leefmilieu v College van Gedeputeerde Staten van Limburg and College van Gedeputeerde Staten van Gelderland*, ECLI:EU:C:2018:882 (PAS judgment).
[29] See Squintani, L. 'Balancing Nature and Economy in the European Union: On the Concept of Mitigation under the Habitats Directive', RECIEL, 2019, Forthcoming.

C2 – National and International Policy Framework

1. International and EU Law

United Nations Economic Commission for Europe (UNECE) and Gothenburg Protocol - The UK is a Party to the 1979 Convention on Long-Range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE) and the original 1999 Gothenburg Protocol to the Convention which sets national emission ceilings for four air pollutants.

The 2012 amendment to the 1999 Gothenburg Protocol sets new national ERCs for five air pollutants: nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs), sulphur dioxide (SO_2), ammonia (NH_3) and fine particulate matter ($PM_{2.5}$), to be achieved by 2020 and beyond, and updating emission limit values of air pollutants at source.

National Emission Ceilings (NEC) Directive - A revised National Emission Ceilings (NEC) Directive implements the national ERCs agreed under the amended Gothenburg Protocol. The new NEC Directive requires overall reductions in UK anthropogenic emissions of five damaging air pollutants: as compared with levels in 2005.

The UK has international obligations under the UNECE Gothenburg Protocol and the National Emissions Ceilings Directive to meet targets for limiting ammonia emissions to protect human health and the environment. The UK also has requirements to protect sites designated for wildlife and conservation such as Sites of Special Scientific Interest (SSSIs) and Natura 2000 sites.

The UK is committed (and legally obliged) to reduce ammonia emissions by 8% by 2020 and by 16% in 2030, compared to 2005 levels.

Under the National Emissions Ceiling Directive and the transposing domestic legislation The National Emissions Ceiling Regulations (2018) the Secretary of State is required to prepare and publish a UK National Air Pollution Control Programme (NAPCP) by 1st April 2019. Subject to EU Exit negotiations, the NAPCP must also be submitted to the EC on this date.

The Industrial Emissions Directive (IED) - The IED is intended to place controls on the environmental impacts from a list of specified activities. Its aim is to ensure the application of Best Available Techniques (BAT) to prevent, or reduce, emissions to air, land and the water environment from these activities and to ensure that resources are used efficiently

2. International guidance

UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions

The Ammonia Framework Code is designed to support Parties in establishing or updating their national advisory codes of good agricultural practice to control ammonia emissions.

3. UK law and policies

In 2019 the UK government published a Clean Air Strategy (CAS) which outlines the actions to be taken in England (and across the UK where policies are reserved e.g. transports Road to Zero) to meet the ERCs. The Clean Air Strategy included the goal to halve the number of people living in areas exceeding World Health Organization (WHO) guideline limits, going beyond the EU targets.

The UK government's new Clean Air Strategy will be a turning point in cutting ammonia emissions.

This is the most significant document on controlling ammonia emissions that UK government has ever produced. It proposes a suite of regulations, permitting and financial support mechanisms, which, if adopted, would substantially reduce UK ammonia emissions

The Clean Air Strategy highlights ways for farmers to tackle ammonia emissions through new funding and the introduction of new regulations. It states that agriculture is responsible for 88% of UK emissions of ammonia gas which can travel long distances, be damaging to the environment, and combine with other pollutants to form fine Particulate Matter pollution, which are harmful to human health.

The Government stated it would provide farmers with the support they need to make important changes to tackle emissions. The Gov also committed to consult with the farming industry. Specific emissions-reducing practices highlighted by CAS included:

- A requirement to take action to reduce emissions from urea-based fertilisers. The government will consult on this policy in 2019 with a view to introducing legislation in the short timeframe.
- A requirement for all solid manure and solid digestate spread to bare land (other than that managed in a no-till system) to be incorporated rapidly (within 12 hours) with legislation to be introduced quickly.
- A requirement to spread slurries and digestate using low-emission spreading equipment (trailing shoe or trailing hose or injection) by 2025. The government will also consider options for phasing in this requirement so that those spreading digestate or large volumes of slurry may be required to adopt the practice at an earlier date.
- A requirement for slurry and digestate stores to be covered by 2027. The government will consider options for phasing in this requirement so that those producing or storing digestate or large volumes of slurry may be required to adopt the practice at an earlier date.
- Mandatory design standards for new intensive poultry, pig and beef livestock housing and for dairy housing. The standards will be designed in collaboration with industry experts and will include design features to improve animal health and welfare and minimise environmental pollution to air (including greenhouse gas emissions), water and land as far as practicable.

UK National Air Pollution Control Programme (NAPCP) - As air quality is a devolved matter and the devolved administration have their own independent policies, the UK needs to work collaboratively with each administration to achieve its statutory objectives. The UKs National Air Pollution Control Programme (NAPCP). is a UK wide document and sets out the proposed measures and technical analysis, which demonstrate how the legally binding 2020 and 2030 emission reduction commitments (ERCs) for 5 damaging pollutants (nitrogen oxides, ammonia, non-methane volatile organic compounds, particulate matter and sulphur dioxide) can be met across the UK.

The UK government and the devolved administrations (DAs) are strongly committed to improving air quality and the associated benefits for public health and the natural environment. Air pollution does not recognise national or international boundaries. Therefore, emissions in one nation can impact on air quality across the rest of the UK. In recognition of this, the UK government and DAs are working collaboratively to understand at a UK level what action is needed to improve air quality and the quality of life for current and future generations.

The UK government and the devolved administrations are conducting a focused consultation on NAPCP.

The NAPCP is a UK wide document that sets out the proposed measures and technical analysis to show how the 2020 and 2030 emission reduction commitments for nitrogen oxides, ammonia, non-methane volatile organic compounds, particulate matter and sulphur dioxide can be achieved.

The NAPCP is a largely technical document which assesses the emission reduction (abatement) potential of a range of measures to be deployed across the UK. Estimates of the impact of these measures are made for each pollutant in terms of emission reductions. Each UK administration has its own current and planned emission reduction commitments and this has been factored-in when preparing the document and conducting the analysis.

Scotland and the other devolved administrations have given their own current and planned emission reduction commitments and this has been factored-in when preparing the document and conducting the analysis. For England, the measures used in the NAPCP analysis are those specified in the English Clean Air Strategy (CAS).

EFRA have used the Clean Air Strategy measures to support the preparation of this NAPCP. Once the full suite of measures in each devolved administration has been accounted for fully, the NAPCP will be revised and republished in 2020.

4. Scottish law and policies

Cleaner Air for Scotland – The Road to a Healthier Future - Scotland's first separate air quality strategy. Cleaner Air for Scotland was published in November 2015 with an overarching vision that Scotland's air quality will be the best in Europe. Reviewed in 2020. The Scottish Government will publish a revised version of the existing Cleaner Air for Scotland strategy later this year.

Cleaner Air for Scotland – The Road to a Healthier Future (CAfS) is a national cross government strategy that sets out how the Scottish Government and its partner organisations propose to reduce air pollution further to protect human health and fulfil Scotland's legal responsibilities as soon as possible.

Scottish Government's Climate Change Plan (CCP) 2018-2032 - SGov's CCP include the following commitments and policy outcomes:

- By 2020, SGov will work with farmers so that they know the pH of the soil on a third of their improved land to encourage the efficient use of nitrogen fertiliser. SGov will encourage farmers producing a substantial proportion of Scotland's agricultural output to complete a carbon audit, and by 2030 most farmers will know the nutrient value of their improved soil and will be implementing best practice in nutrient management and application.
- By 2050, Scottish farmers will be making full use of technology to apply precision farming techniques across the board, and Scotland's land will be producing sustainable, healthy, nutritious and high quality food while providing a substantial contribution to Scotland's national carbon sink that offsets emissions elsewhere in our economy.
- Emissions from nitrogen fertiliser will have fallen through a combination of improved understanding, efficient application and improved soil condition.
- Reduced emissions from the use and storage of manure and slurry.
- To increase the efficient use of fertilisers, SGov will encourage greater uptake of precision farming; and provide information, advice, and practical demonstrations on the benefits of soil testing.
- SGov will reduce emissions from the use and storage of manure and slurry by looking into the feasibility of large-scale anaerobic digestion, and SGov will engage with farmers to establish how they can improve manure and slurry management

The Conservation (Natural Habitats, &c). Amendment. Regulations 2008 - SEPA is required to consider whether any adverse effects on the integrity of a designated site (SACs, SPAs, Ramsar sites) would be avoided by making any licence, consent or authorisation subject to conditions. Under Regulation 48, an appropriate assessment needs to be undertaken in respect of any plan or project which includes applications for licensing permits (e.g. PPC permits).

The Pollution Prevention and Control (Scotland) Regs 2000 - In Scotland, the IED Directive is implemented through the Pollution Prevention and Control (Scotland) Regulations 2012 (The PPC Regulations).

Under the PPC Regs 2000, SEPA needs to ensure that the permits contain the appropriate emission limits, conditions to ensure appropriate protection of the soil and conditions as appear appropriate for ensuring a high level of protection of the environment. This should take into account the principles that all appropriate measures should be taken against pollution (in particular through the application. of best available techniques); and that no significant pollution is caused.

These PPC Regulations apply to larger pig and poultry farms with “places” for more than 40,000 poultry1, 2,000 production pigs over 30kg or 750 sows. Farms with livestock places exceeding these thresholds are required to obtain a PPC permit from the Scottish Environment Protection Agency (SEPA) prior to going into production.

The PPC Regulations require that all installations will be operated using the Best Available Techniques (BAT) for preventing or, where that is not practical, reducing emissions and reducing the impact of the operation on the environment as a whole.

The overall environmental impacts of intensive pig and poultry installations are controlled under the Regulations. As well as focusing on issues such as waste minimisation and noise generation, PPC involves looking at raw material inputs, the transfer, collection and storage of manures and slurries, odour control, and efficiency of water usage.

Guidance on meeting the requirements of the PPC Regulations for pig and poultry rearing installations has been incorporated into the Standard Farming Installation Rules for Pig and Poultry PPC Installations developed by SEPA in conjunction with the industry and other UK organisations.

The statutory nuisance provisions under Part III of the Environmental Protection Act 1990 give local authorities power to act on complaints arising from agricultural activities.

Water Environment (Controlled Activities). (Scotland) Regulations 2011 - The Water Regulations apply regulatory controls over activities which may affect Scotland’s water environment. This legislation arose from the WFD becoming law in Scotland as the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act). Activities likely to cause rural diffuse pollution are regulated by the Water. Environment (Controlled Activities) (Scotland) Regulations 2011 and are referred to as the Diffuse Pollution General Binding Rules (DP GBRs).

GBRs cover fertiliser storage and application. This gives regulatory requirements to ensure fertilisers, sludges, AD, slurry and. manures are not stored or spread in poor conditions or too close to watercourses, and that nutrient application matches crop requirements.

Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations (2008) These measures include restrictions on the amount of manure spread on land, time of spreading, and location, to avoid run-off and watercourse.

Waste. Management Licensing Regulations 2011 - In these regulations, organic materials can be applied to land in order to provide agricultural and ecological benefits,

and where it does not cause environmental harm. The 'Relevant Objectives' of the WMLR require that waste is recovered or disposed of without "endangering human health and without using processes or methods which could harm to the environment and in particular without risk to water, air, soil, plants or animals.

Sludge (Use in Agriculture) Regs - SUAR seeks to control the use of sewage sludge in agriculture and to regulate its use in such a way as to prevent harmful effects on soil, vegetation, animals, and humans.

5. Scottish guidance

Prevention of Environmental Pollution from Agricultural Activity (PEPFAA) code - The purpose of PEPFAA is to provide practical guidance in Scotland for farmers and those involved in agricultural activities, including farm advisers, on minimising the risks of environmental pollution from farming operations. Section 13 is focussed on the prevention and control of emissions to air. This section includes advice on minimising ammonia losses from buildings and slurry and manure stores as well as from land application of slurry

Land Use Strategy - The Land Use Strategy sets out three Objectives relating to the economy, environment and communities – the three pillars of sustainability. It also provides a set of Principles for Sustainable Land Use to guide policy and decision making by Government and across the public sector.

Scottish Soil Framework (SSF) - SSF aims to promote the sustainable management and protection of soils consistent with the economic, social, and environmental needs of Scotland.

The rural diffuse pollution plan for Scotland - The Diffuse Pollution Management Advisory Group (DPMAG) is a statutory stakeholder group set up under the WEWS Act, 2003 which has produced a Rural Diffuse Pollution Plan. (RDPP) for Scotland to coordinate activities on mitigating diffuse pollution. A key part of this plan is the achievement of multiple benefits for land and soil. The plan also involves a targeted catchment approach to ensure sufficient changes are made to land management practices.

Other Scottish advisory information includes the following:

- The Farming and Water Scotland website provides detailed guidance for farmers on reducing pollution risk. This includes highly relevant advice on managing soils, fertilisers, , manures and slurries
- PLANET Scotland (Planning Land Applications of Nutrients for Efficiency and the environment) is a nutrient management decision support tool for use by farmers and advisers for field level nutrient planning and for assessing and demonstrating compliance with the Nitrate Vulnerable Zone (NVZ) rules.
- Technical note (TN650): Optimising the application of bulky organic fertilisers
- Technical note (TN651): Nitrogen recommendations for cereals, oilseed rape and potatoes
- Technical note (TN652): Fertiliser recommendations for grassland
- Technical note (TN655): Fertiliser recommendations for soft fruit and rhubarb crops
- Technical note (TN656): Soils information, texture and liming recommendations.
- Technical note (TN699): Agricultural use of biosolids composts anaerobic digestates and other industrial organic fertilisers
- Practical Guide: Soil Sampling II - Benefits to your business
- Practical Guide: Nutrient Budgeting I - The benefits to your business

- Practical Guide: Nutrient Budgeting II - Getting started
- Farmer's guide to sourcing and using digestate and compost
- RPID Inspector guidance brief for NVZ's
- Farming for a Better Climate Initiative
- Common Agricultural Policy (CAP)
- River Basin Management Plans
- 'Farming and Water Scotland'

6. England Guidance

Code of Good Agricultural Practice for reducing ammonia emissions - Defra have recently published a code of good agricultural practicefor reducing ammonia emissions' (COGAP) for England. It is a voluntary guidance code that is relevant to many farming practices and has been written specifically for English farming systems. The Code applies to England.

This Code explains the practical steps farmers, growers, land managers, advisors and contractors in England can take to minimise ammonia emissions from farms. Recommended measures include ways of storing and applying organic manures, ways of applying fertilisers, and modifications to livestock diet and housing.

A new online calculator and guidance has been developed to help farmers and others to design woodlands to capture airborne ammonia and so reduce air pollution. The capture of carbon and nitrogen by additional tree planting will play a role in helping the UK achieve its greenhouse gas emission reduction targets.

The calculator and guidance provide farmers and landowners with the information they need to help mitigate the ammonia produced by animal housing units while protecting soils, waters and the wider environment. The calculator is available free online at www.farmtreestoair.ceh.ac.uk

Other useful guidance covering England although also used in Scotland by some farmers include:

- The Nutrient Management Guide (RB209) provides guidelines for crop nutrient requirements and the nutrient content of organic manures and is maintained by the Agriculture & Horticulture Development Board (AHDB).
- Tried & Tested provide free nutrient management information and guidance and can help farmers to find suitable farm advisers or a laboratory for soil analysis
- Campaign for the Farmed Environment provide free advice on soil management and crop nutrition and has produced a short guide on how to reduce a farm's ammonia emissions.

ANNEX D – AIDE Working Group Membership

		Subgroup
Mark Aitken	SEPA	Ag
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Karen Dobbie	SEPA	Ag
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Dave Freeman	Agricultural Industries Confederation	Ag
Andrew Midgley	NFUS	Ag
Dennis Milligan	Stove Industry Alliance	Dom
Janice Milne	SEPA	Ind
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Stefan Reis	Centre for Ecology & Hydrology	*Chair*
Annalisa Savaresi	Stirling University	Ag
Ewen Scott	Scottish Government	Ag
Ian Speirs	Scottish Government	--