

Cynulliad Cenedlaethol Cymru
Y Pwyllgor Newid Hinsawdd,
Amgylchedd a Materion Gwledig
Ansawdd Aer
NHAMG (5) AA12
Ymateb gan Ymddiriedolaethau Natur
Cymru

National Assembly for Wales
Climate Change, Environment and
Rural Affairs Committee
Air Quality
CCERA(5) AQ12
Evidence from Wildlife Trusts Wales

Wildlife Trusts Wales response to: CCERA Air Quality Consultation

Introduction

We support the need for improving air quality in order to reduce the negative impacts of air pollution on our natural environment, ecosystems and biodiversity. We support Welsh Governments push to significantly address air pollution by meeting, and where possible, exceeding the requirements set down in UK and international guidance and legislation.

There are a range of cost-effective solutions available to policy-makers and land managers. Some solutions, such as green infrastructure can help us mitigate air pollution, but there is no substitute for stopping air pollution at source.

However, the consultation is limited in detail on the specific actions to tackle air pollution or it does not go far enough. For example, the consultation is light on detail about how it will address air pollution from farming. This is especially concerning given the ecological and climate impacts from agricultural and air polluter. In addition, a recent study¹² has shown that farming is the biggest single cause of the worst air pollution in Europe and *'cutting ammonia emissions from farming 'could save thousands of lives'¹³.*

This response covers the benefits of green infrastructure and air pollution from agriculture and transport. As green infrastructure solutions are appropriate for tackling a number causes of air pollution, we address this first.

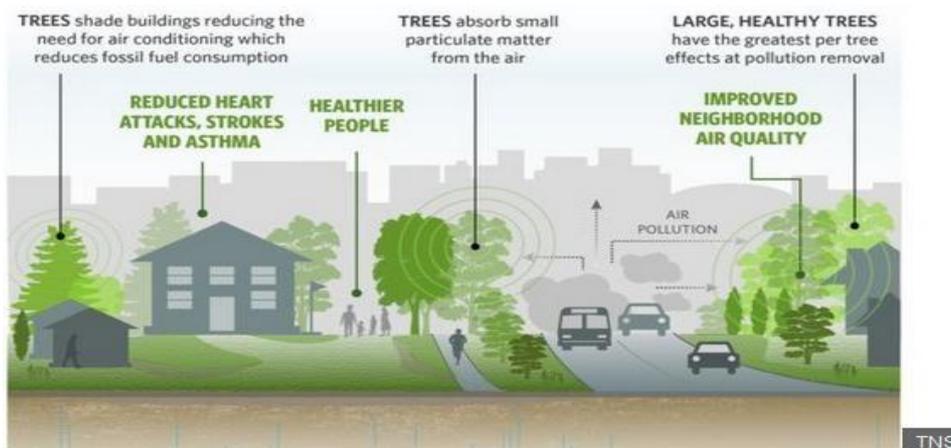
Green Infrastructure

Air quality benefits

Planting more green walls, green roofs and trees, in a strategic way, could be a relatively easy way to take control of our local pollution problem. Studies show that increased vegetation such as trees (or nature's high-tech air scrubbers) remove large amounts of air pollution such as particulate matter that consequently improve urban air quality⁴⁵⁶.

All trees act as air filters with different species/varieties performing this function to differing extents and across the full range of urban air pollutants. Particles stick to the surface of the leaves, and gases are taken up through pores on the leaf surface. Trees with complex, ridged or hairy leaves tend to capture more particles than trees with broader, smoother leaves⁷⁸⁹. Trees with the most leaf area capture gases and particles efficiently thus effectiveness depends on characteristics of the species chosen (e.g., foliage surface, canopy structure, and life span) and varies by particulate size. It was found that Ash, Alder and Silver had significant air quality benefits¹⁰.

One study shows that **tree leaves can capture more than 50% of particulate matter (PM)**¹¹. Another study¹² reported that **the average reduction of PM near a tree was between 7% and 24%**. Planting of vegetation in street canyons was found to reduce street-level concentrations in those canyons by as much as **40% for nitrogen dioxide - 60% for particulate matter** in high winds and less amounts in low winds¹³. CEH and Lancaster University developed an **Urban Tree Air Quality Score (UTAQS)**, using the West Midlands as a typical urban region in Great Britain¹⁴. They highlighted that there was up to **25% reduction on particle concentrations** depending on the area planted with trees.



Transport for London commissioned Biotecture to design, grow and install this eye-catching green wall in a determined effort to counter air pollution in London¹⁵. The huge green wall holds 14,000 plants of 15 different species with smaller leaves and a variety of textures, which were specifically chosen as they are better air filters of PM10 - harmful particulates from traffic fumes. It was confirmed that they have reduced PM emissions but also had wider benefits such as run-off, temperature regulation and biodiversity¹⁶.



Multiple benefits

Not only do they provide cheap and renewable air filters, but trees and biodiversity green infrastructure also provide multiple benefits¹⁷¹⁸ such as

- health benefits
- carbon sequestration therefore helping mitigate climate change
- encourage biodiversity (depending on the species chosen)
- aesthetic beauty,
- enhancement of property values,
- erosion prevention, •
- stormwater management •
- noise reduction.
- Recreation, parks also provide space for people to enjoy recreation which brings real physical and mental health benefits.

Cost effectiveness / Health

One study compared the cost-effectiveness of trees with other methods of cooling and cleaning air, in 245 cities around the world, **found that trees are as cost competitive with other options**¹⁹. While studies showed variation within cities, **the best neighbourhoods for street tree planting often had a 100-fold greater return on investment in tree planting compared to the least suitable neighbourhoods.**

I-tree surveys showed that

Swansea and the Tawe Valley trees removed 136 tonnes of air pollution per year, saving the NHS £715,000 by reducing asthma and heart disease²⁰

- **In Wrexham**, trees removed 60 tonnes of air pollution per year saving the NHS £700,000²¹
- **Bridgend trees**²² removed 61 tonnes of air pollution per year saving the NHS £326,000
- **London's urban forest**²³ survey found that **2241 tonnes pollution removed from the air every year, worth £126M**. They remove the equivalent of **13% of PM10 particulates and 14% of NO2 emitted by road transport**.

While green infrastructures cannot and should not replace other strategies to make air healthier, green infrastructure can be used in conjunction with these other strategies to help clean air and provide the other benefits mentioned above.

Agricultural pollution

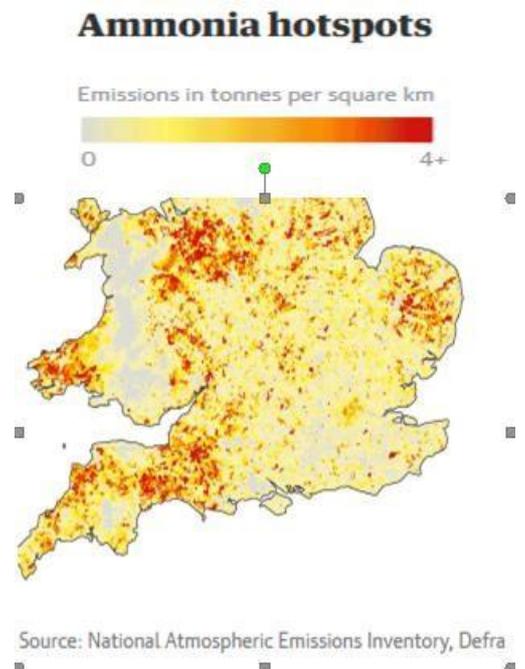
A recent study²⁴ has shown that farming is the biggest single cause of the worst air pollution in Europe. Ammonia emanates from animal excrement on livestock farms, some of the gas mixes with industrial or vehicle pollution away from farms, creating “particulate matter”, solid particles that can stick in the fine lung tissue of children and adults, causing breathing difficulties, impaired lungs and heart function, and eventually even premature death. The rest is deposited in the rural environment as nitrogen. It harms some plant species and boosts others as a fertiliser, damaging the balance of ecosystems and putting biodiversity at risk. Ammonia is also a significant greenhouse gas.

It's worth noting that **Ammonia is the only pollutant for which emissions are rising:** Defra figures suggest an increase of more than 10% between 2013 and 2017, to 245,000 tonnes²⁵. **The department says that nearly 90% of the UK's ammonia emissions come from agriculture, and that the sector is the main culprit for the emissions rise²⁶.**

In Wales, farming is the dominant source of ammonia emissions- 86% in 2015 - but only an estimated 5% of farm emissions come under direct regulation²⁷; those from the largest pig and poultry units (40,000 birds, 2,000 pigs or 750 sows). Production areas of ammonia emissions in the 2016 figures for Wales²⁸ are:

40% cattle manure management, 26% manure applied to soils, 14% inorganic fertilizers, 13% grazing animal excreta, 6% other manure management

Intensive systems will give bigger emissions in general, as they are associated with livestock housing, manure storage and manure spreading, all of which tend to increase emissions compared to an animal grazing out in the field²⁹.



The vast majority of ammonia comes from slurry, a mixture of faeces and urine. Intensive housed systems for cattle and pigs tend to produce more ammonia because the animals' urine and dung usually mix together in their sheds, producing slurry. This cocktail, which is more toxic than the substances are separately, emits ammonia at every stage of its use:

- when it is created,
- when it is stored in **uncovered slurry "lagoons"** Defra figures from 2017 suggest that 80% of cattle slurry lagoons and tanks and 76% of those on pig farms are uncovered³⁰.
- when it is sprayed onto fields as a fertiliser. When spread to land, research trials have shown that nutrient losses from overall spreading of slurry to the surface a grass field can result in up to 80% of the available nitrogen being lost to the atmosphere as ammonia³¹.

In contrast, when animals graze outdoors, their urine is absorbed by the soil, producing lower emissions.



It is also concerning that cattle farmers face few rules concerning their ammonia management³². Dairy and beef farms are the most polluting sector,

accounting for more than more than 50% of farm emissions and 40% of the total ammonia released in the UK, yet are under no obligation to mitigate or even monitor their air emissions because of a loophole in the regulations³³³⁴.

Enforcement

We continue to be concerned about the lack of enforcement. While most farmers stick to the rules some flout them so often they could be seen as “leading criminal lifestyles,” states one official in a log of farm inspections³⁵. Such farms view the fines they receive for polluting as part of routine running costs, it said. Without such monitoring, farmers can — knowingly or unknowingly — breach anti-pollution rules.

Welsh poultry industry

The striking expansion of poultry units has become a major cause for concern due to the direct impact of emissions on nearby wildlife sites³⁶. There are now more than 7 million birds in Powys, up from 1.7 million in 2010; the group says over 3 million are free-range³⁷.

The emission rates from poultry ventilation systems vary with: age of animal, bedding material, lighting & season, ventilation rates, local weather, food types and watering systems. The composition of this dust

has been repeatedly studied and is typically reported as containing: **faecal matter, skin, feathers, feed, bedding, proteins, fungal and bacterial species and various endotoxins**³⁸ as well as ammonia, odour, nitrogen, phosphorous, heavy metals, methane and nitrous oxides (Melse et al., 2009) with odour being strongly associated with and bound to particulate matter. **It is widely accepted that poultry units contribute considerably to air borne particulate matter.**

In 2015 officials at NRW noticed that free-range poultry farms were a major source of ammonia pollution. While big, they tend to fall below the 40,000 mark and therefore do not require an intensive farming permit, skirting regulations on managing ammonia emissions. In some areas, clusters of poultry units have developed but, as each unit holds fewer than 40,000 birds, an environmental permit is not required. **As a result, they can have a greater**



impact than larger units that are required to meet more stringent environmental standards. The cumulative emissions and other pollution from clusters of units can cause significant damage to local wildlife, watercourses and people³⁹.

A NRW commissioned a study of poultry-related ammonia emissions in Powys after a local objected to an 80,000-bird, non-free range unit that would have been regulated. They found 13 smaller poultry farms nearby. Simon Bareham from NRW said “Those that appeared off the radar, away from view... We’re [...] having these very high concentrations of ammonia that result from these units just being dotted round willy nilly in the countryside.”⁴⁰

The team calculated each farm’s ammonia footprint and discovered that several 12,000-bird freerange units were each producing more ammonia than the 80,000-bird farm would have. “The existing farms were unregulated, meaning they only needed permission to operate from local authority planning officers. NRW realised many planning officers were not considering the cumulative impacts on pollution from existing farms when considering new proposals.

Ecological Impact

In Wales, the most recent data shows that:

- 89% of sensitive sites suffered excess levels of nitrogen⁴¹.
- 94% of habitat in European-protected Special Areas of Conservation (SAC) has excessive nitrogen levels (for at least one species or habitat ‘feature’)⁴²
- 71% of SACs have ammonia concentrations above the critical levels⁴³
- Nitrogen deposition is having (or likely to have) an adverse impact on 58% of habitat or species ‘features’ on European-protected sites.
- The European-protected features most frequently affected are dry heaths, marsh fritillary butterfly and Western acidic oak woodland⁴⁴
- the growing evidence base of the detrimental impacts of ammonia emissions on Wales’s unique biodiversity.⁴⁵

Simon Bareham, NRW’s principal adviser on air quality and biodiversity, said that the threat agricultural ammonia posed to ecosystems was unprecedented. “If we

don't do something about it we risk losing some of these internationally important [ecological] communities that we have and have hung onto since the last ice age...In the short term, this poses one of the biggest threats to biodiversity that I've come across in my working career of over 30 years.⁴⁶

NRW have stated that “Ammonia is causing dramatic landscape-scale impacts on virtually every terrestrial ecosystem,”.

Studies across the UK and Europe have highlighted how nitrogen from agricultural ammonia is affecting biodiversity: grasslands are losing species, which can hit insects including pollinating, and fungi that help trees and other plants to grow are being killed off.



Moninea Bog vegetation assessment 2017



Still affected (close to former source)

Making Ammonia Visible - Impact of subsequent N Deposition on Sensitive Environmental Habitats

(Reproduced with thanks to Mark Sutton CEH)_

Recovering (away from former source)



Waters where oxygen is lower than 2 milligrams per litre

● Coastal dead zones ● Open ocean dead zones



Guardian graphic | Source: Global Ocean Oxygen Network, Science

It's worth noting that excess fertiliser use, a source of ammonia and nitrates, is also one of the biggest causes of pollution in the oceans, as run-off creates "dead zones" in the seas where oxygen is virtually eliminated and fish and other marine life can no longer exist⁴⁷.

Cost effectiveness of solutions

The Committee on Climate Change recent publication on Land Use⁴⁸ set out a range of measures that can be used to reduce on-farm methane and N₂O emissions from soils, livestock and manure management.

These farming practices can have multiple other benefits including improved air quality as well as water and soil quality, reduced pests and diseases and improved soil structure. They state that **"When considering just the emissions reductions and reduced air pollution benefits, these outweigh the costs of implementing these measures in aggregate.** These measures result in considerable private benefits to farmers e.g. from reduced fertiliser costs, lower veterinary bills from improved livestock health and higher yields from improving soils. **These result in overall lifetime savings to [UK] farmers of £8.3 billion in total. In total, these low-carbon farming measures can deliver air quality improvements, which have a value over the lifetime of the measures of £10.5 billion".**

In addition, Agroforestry Ammonia Abatement (AAA) has been shown to cost effective measures that can help to reduce the impacts of ammonia with tree belts are the most successful strategy for decreasing the impact of ammonia.

Transport

The WHO Health Statistics 2016 states that transport systems based primarily on individual motorised transport can lead to further deterioration in air quality⁴⁹.

Diesel fuel use is a key cause of air pollution in cities. However, researchers⁵⁰⁵¹ say brakes are a bigger source of particulates in roadside air than vehicle exhausts. Researchers have found that the metalparticle dust created by scraping the brake pads accounts for a 20% of tiny particulate pollution on the roads. By contrast, tail pipe fumes only make up 7% of the tiny particles found in roadside air - with the rest coming from sources such as wear and tear on tyres, clutch scrapings and general road dust. Diesel fumes and brake dust appear to be as bad as each other in terms of toxicity.

Therefore, **we need a wholesale change to active and public transport rather than facilitating more cars even if they are electric/low emission.** We need to reduce the number of vehicles that have to creep along in traffic. Therefore, we question the consultations via about “promoting ultra-low emission vehicles”.

A previous consultation highlighted reasons for the lack of progress to date on AQMAs:

- **poorly defined roles at a Local Authority level**, and consequently insufficient support from internal partners within the Local Authority, such as highways and planning teams, and those engaged corporately in higher level strategic and financial planning;
- **higher than expected emissions from diesel vehicles and an ever increasing volume of traffic on roads**

These problems need to be addressed. We support the Welsh Governments view that we need a modal shift away from private cars to more sustainable forms of transport. **Air quality from transport is not fixed by promoting more and more cars on the roads through providing more and more infrastructure such as motorways and dual carriageways.**

First Minister, Mark Drakeford AM, in relation to the M4 Relief Road, when stopping the M4 stated

“while the inspector found that 30,000 properties would have air quality improved, he also found that in 29,500 of those properties the impact would be negligible or minor, that only 12 of those 30,000 properties would see a major impact on their air quality. So, the air quality issues are really important. We are more aware of those today than we were even five years ago, but the M4 relief road turned out not to be a solution to the air quality problems faced by the people of Newport, and I think there are other solutions that will have a greater benefit to them”.⁵²

However, it is still argued by pro-road enthusiasts that new roads over rural areas create reduce air pollution in urban area it bypassed. This is a false narrative because the original road will continued to be used and induced traffic will mean that both roads will quickly fill up.

Recommendations

Green Infrastructure

- We must expand the provision of green infrastructure in towns and cities, this means enhancing current poor greenspace, creating new areas of biodiverse greenspace, plant more street trees, create new green roofs and green walls (including through retrofitting) etc.
- Welsh Government and public bodies should lead the way retrofitting green walls and green roofs on public buildings and creating biodiversity greenspace on public land. This should include
 - improving naturalness of green spaces and improving connectivity and the biodiversity of greenspaces.
 - The protection, enhancement and management of existing green spaces; planning new spaces; and protecting vulnerable spaces
- There should be a minimum 20% native tree canopy cover for towns and cities – there are many social justice reasons why this target should be disaggregated by wards with those wards that suffer multiple deprivation including health impacts targeted first. It's worth noting that tree canopy cover in Wales varies dramatically, from just 4.5% in Fochriw in Caerphilly to 34% in Trimsaran in Carmarthenshire⁵³.
- Welsh Government should produce statutory green infrastructure guidance for all public bodies and the private sector.
- All local authorities should create and implement a Green Infrastructure Action Plan as a matter of urgency. Local Authorities, under Planning Policy 10, are required to produce a Green Infrastructure Assessment – this must include an action plan that Local Authorities must follow to increase the amount of biodiverse green space in towns and cities.
- Welsh Government should create statutory “Accessible Natural Greenspace Standards” or ANGSt⁵⁴ which recommends that everyone, wherever they live, should have an accessible natural greenspace:
 - of at least 2 hectares in size, no more than 300 metres (5 minutes walk) from home;
 - at least one accessible 20 hectare site within two kilometres of home;
 - one accessible 100 hectare site within five kilometres of home; and
 - one accessible 500 hectare site within ten kilometres of home; plus
 - a minimum of one hectare of statutory Local Nature Reserves per thousand population

Agriculture

Transformative change and a sustainable approach to farming relies on changing farming systems, not just on using inputs more efficiently or substituting one for another⁵⁵. Tackling the negative environmental externalities in farming will not only deliver for the environment but will also benefit our farmers and positively differentiate Welsh food in the international marketplace.

General

1. Undertake all the recommendations within Plantlife Cymru “Lets talk about nitrogen - A call to protect Wales’ internationally important wild flora and fungi from air pollution”
2. Wales needs a vision, a framework and investment system that moves farming in Wales away from a high input model towards an agroecology⁵⁷ model. We must introduce a clear, quantitative target for significantly reducing the overall use of pesticides and artificial fertilizers in agriculture.

Education, advice and guidance -

3. **Achieving Behavioural Change: Communicating the Message** – Welsh Government, NFU, FUW and NRW should facilitate an awareness and communication campaign to educate all farmers on why agricultural air (and water) pollution is such an important issue. We suggest working with the UK Centre for Climate Change & Social Transformations (CAST) based at Cardiff University.
4. **Ensure that farmers have access to independent advice.** Welsh Government, NRW and farming unions should facilitate access for farmers, who are encountering difficulties in achieving air pollution reductions, to the appropriate **independent** experts on pollution mitigation options. All those providing advice to farmers need to be comprehensively trained to an accredited standard.

Planning, permitting monitoring and enforcement

5. **Extending environmental permitting** to the dairy and intensive beef sectors
6. Welsh Government or NRW should undertake calculations to ascertain the **amount of slurry** and animal waste (including from poultry sheds) that is

being produced per farm and whether Wales has capacity to sustainably use or dispose of it.

7. **Herd size** increases should require permission from Government or NRW so that they can check if there are the appropriate infrastructure in place i.e. appropriately sized and covered slurry pits. This happens in Denmark.
8. If farmers receive government assistance to increase or upgrade their slurry storage, landowners cannot increase their herd size for 5 years. This happens in Scotland where the financial is capped £30k.
9. **Managing perverse outcomes** - Welsh Government, NRW and planning authorities must eliminate the risk of perverse incentivisation of farmers to circumnavigate pollution mitigation obligations i.e. applications for 39,999 birds as opposed to 40,000 by requiring all intensive livestock units over 999 birds to incorporate appropriate anti-pollution measures.
10. All current Intensive Livestock Units (especially those under the current thresholds i.e. 40,000 birds) should be visited to assess whether they are currently adhering to planning and permit conditions, best practice etc - if not, advice and/or enforcement procedures should be undertaken.
11. **Temporary suspension of all planning** - There should be a temporary suspension of all new planning and permit applications for Intensive Livestock Units in Wales until
 - a new system is introduced for combat air and water pollution
 - the forthcoming TAN is published
 - all current Intensive Livestock Units (especially those under the current thresholds i.e. 40,000 birds) are visited to assess whether they are currently adhering to planning and permit conditions, best practice etc.
12. **Planning - Assessing Developments**- with significant areas at or above critical levels of air or water pollution, achieving planning approvals should be difficult, and almost impossible in some areas. NRW and planning authorities must refuse planning permissions when there will be an adverse impact upon the environment - currently it appears that they are reluctant to do so.
13. **Monitoring - Regulations will only be as good as the monitoring** - There needs to be **significant investment into air and water quality monitoring** throughout Wales to pick up incidents much earlier and allow for quick responses.
14. There needs to be an investment in NRW monitoring and enforcement teams.
15. **Enforcement - Regulations will only be as good as the monitoring.** A major obstacle to effective compliance with existing regulation is the lack of

funding for enforcement. Government should recognise the significant cost savings associated with investing in enforcement.

Thresholds and Regulation

16. Welsh Government should set an ambitious timetable for ammonia reductions as well as helping farmers to adopt the kind of technology and methods that would swiftly and drastically reduce today's emissions.
17. **Setting the Thresholds.** Welsh Government should establish statutory targets for reducing ammonia emissions and restoring protected wildlife sites in line with EU Directives and UNECE Gothenburg Protocol commitments.
18. **Strengthen regulation for agricultural businesses**, with adequate funding and support to enable compliance and enforcement. Tighter air quality screening thresholds were introduced in 2017 but further strengthening is required to:
 - Regulate wastes from intensive farming operations (currently exempt);
 - Lower the threshold for environmental permits for poultry units from 40,000 birds;
 - Require environmental permits for other emissions sources, particularly large and indoor cattle units;

New Regulations and Action Plans

19. **CoGAP should be made mandatory** - We support Welsh Government in publishing supplementary guidance to the Code of Good Agricultural Practice (CoGAP) to give up-to-date advice on how to reduce ammonia emissions. It explains the practical steps farmers, growers, land managers, advisors and contractors can all take.
20. **New agri- pollution regulations need to be strengthened to tackle air pollution.**
21. **A new Sustainable Land Management Act must include pollution control measures - they should be mandatory for all farms.** For example, banning splashplates and require more precision equipment such as umbilical, trailing shoe etc because of air quality regulations tackling nitrates and ammonia.
22. **Integrated Pollution Prevention and Control Regulations 2000 (IPPC).** The IPPC Regulations requires certain types of installations, including pig and poultry farms above a given size, to implement best available technologies

for a wide range of pollutants including NH₃. However, Schedule 1, (Section 6.9—Intensive Farming) thresholds near lowering and the scope widened.

23. The SSAFO regulations should be updated to include measures to prevent ammonia emissions and expand the requirements for slurry storage.
24. **General Binding Rules** - Like NRW, we believe that “General Binding Rules could assist in tackling diffuse agricultural pollution issues”. They have been very effective in Scotland in bringing 80% of farmers inspected into compliance. Evidence from the River Ayr Priority catchment demonstrates how 90% of farmers have taken action to rectify problems without any need for SEPA to take further action⁵⁸. Moreover, farmers and representative bodies viewed the Scottish approach favourably, regarding the process as balanced and fair^{59,60}. Farmers and farming unions were on board with the proposals as they felt all farmers in Scotland farmed in accordance with the code of practice. Instead of environmental benefits, GBRs are sold as money saving regulation.

Resources

25. **Introduce measures to support farmers to transition to whole farm agroecological systems**
26. **Increase support to the organic sector** to increase the area of land organically managed.
27. Provide resources and other support for NRW and PSBs to ensure effective enforcement of existing legislation, regulation and reporting mechanisms.
28. Create grant schemes for lagoon covers and slurry injecting and establish machinery rings or coops.

Rural Local Air Quality Management (RLAQM) or Ecological air quality management areas (eAQMA) -

29. We recommend that there should be **RLAQM or eAQMA**s in areas where designated sites are being adversely affected by airborne pollution. We recommend that the principles and procedures laid out in the consultation for Local Air Quality Management (LAQM) should apply in rural areas to target agricultural air pollution. Following the declaration of an RLAQM/ eAQMA, the Local Authority and NRW should work with other partner agencies and the public to draw up and implement an ecological local air quality action plan using recommendations from the Centre for Ecology & Hydrology (CEH)

(2015) – Report for DEFRA entitled the Identification of Potential “Remedies” for Air Pollution (nitrogen) Impacts on Designated Sites (RAPIDS)⁶¹.

On farm measures

- 30. Green Infrastructure** – is a cost effective measure to reduce the impacts of ammonia with tree belts are the most successful strategy for decreasing the impact of ammonia⁶². Therefore, there is a clear rationale for significant (60m+) tree plantations to be placed strategically around livestock units to capture and disperse ammonia away from nearby sensitive sites.
- 31. Better Methods of Slurry and Manure Spreading** – Scientific research has shown that applying slurry using low emission techniques will achieve significant ammonia reductions compared to splash plates with deep and shallow injects being by far the best methods. Promotion of these methods of slurry application must be a key priority for both government and the farming sector. There is a need to accelerate uptake of this “win-win” farming technique. Therefore, the uptake of these technologies must be increased with the use of splash plates banned or phased out as soon as possible.
- 32. Fertiliser Application** – We need to significantly reduce the fertilizer application. The application of chemical fertiliser to land produces ammonia emissions with 7% of agricultural ammonia coming from this source⁶³. There are also other reasons to reduce the chemical fertilizer, its carbon footprint is significant, and it creates substantial water pollution issues.
- 33. Timing of Slurry and Manure Spreading** - There is significant scope to reduce ammonia emissions by adjusting the timing of slurry and manure application. Scientific research⁶⁴ has found that moving the timing of slurry application from mid-year to early spring when conditions are less favourable for ammonia volatilisation can reduce emissions of ammonia and nitrous oxide.
- 34. Livestock Diets** - research shows that there is an 8 to 10% reduction in ammonia for every 1% reduction in the crude protein content of pig diets, there is also good evidence that similar relationships exist for other livestock diets⁶⁵.
- 35. Outdoor grazing**⁶⁶ - A key driver of ammonia emissions is the reaction between urine and faeces when these substances are mixed together. A first step in ammonia abatement is therefore to maximise the length of the grazing season.
- 36. Covered slurry stores** - The provision of covers on slurry stores may provide up to an 80% reduction in ammonia emissions⁶⁷.

- 37. Livestock Housing Systems** - Livestock housing and hard standings are one of the greatest sources of ammonia from agriculture. Key to minimising ammonia emissions from livestock housing is the separation of urine and faeces through the flooring and storage system. There are a number of actions that can be taken to reduce the volume of ammonia emissions. For example, slatted floors are estimated to reduce ammonia emissions by 36% compared to solid floors while grooved floor systems with tooth scrapers can provide 46% ammonia abatement compared to conventional slatted floors⁶⁸. The introduction of appropriate technologies to all intensive livestock units such as air scrubbers⁶⁹ and dry air heating in poultry houses⁷⁰ can have significant impacts.
- 38. Adding strong acids to slurry** (e.g. sulfuric acid or hydrogen chloride), in the storage tank or before field application has been proven to lower emissions.

Highways

If Wales is to be truly sustainable and implement integrated and innovative solutions to multiple problems, we recommend the following:

1. Areas of high pollution should look at how to reduce the number of polluting vehicles on the road. Acceleration may be possible through legislation (e.g. **Congestion Charge** and **low emission zones**).
2. **Ban diesel and petrol cars vehicles**. Paris, Madrid, Athens and Mexico City will ban the most polluting cars and vans by 2025 to tackle air pollution⁷¹. Norway will 'completely ban petrol powered cars by 2025⁷².
3. Welsh Government need to undertake an urgent review of all new road building in Wales.
4. They need to set up a Commission with a similar remit to the SE Wales Transport
5. Commission for anywhere they are considering new road schemes including Deeside
6. **Sustainable transport solutions** - fully fund sustainable transport solutions as a matter of urgency rather than locking us into new major infrastructure that will add to Wales' pollution problems e.g. Deeside Corridor dual carriageway
7. **Do not fund environmentally damaging road schemes** such as the Deeside Corridor dual carriageway.
8. Look at green infrastructure solutions.

References

- ¹ Bauer, Susanne E., Kostas Tsigaridis, and Ron Miller. "Significant atmospheric aerosol pollution caused by world food cultivation." *Geophysical Research Letters* 43.10 (2016): 5394-5400.
- ² <https://www.theguardian.com/environment/2016/may/17/farming-is-single-biggest-cause-of-worst-air-pollution-in-europe>
- ³ <https://www.channel4.com/news/cutting-ammonia-emissions-from-farming-could-save-thousands-of-lives>
- ⁴ Janhäll S - Review on urban vegetation and particle air pollution – Deposition and dispersion Atmospheric Environment
Volume 105, March 2015, Pages 130–137 <http://www.sciencedirect.com/science/article/pii/S1352231015000758>
- ⁵ Fullar et al (2009) Practical mitigation measures for diesel particulate matter: near-road vegetation barriers contract AQ-04-01: developing effective and quantifiable air quality mitigation measures Department of Civil & Environmental Engineering.

University of California http://www.dot.ca.gov/hq/env/air/research/ucd_aqp/Documents/Mitigation-Measures-Package-Report-5-Micah-v3.pdf

- ⁶ Pugh *et al* (2012) Effectiveness of Green Infrastructure for Improvement of Air Quality in Urban Street Canyons Lancaster Environment Centre, Lancaster University, Environ. Sci. Technol., 2012, 46 (14), pp 7692–7699 <http://pubs.acs.org/doi/abs/10.1021/es300826w>
- ⁷ Freer-Smith, P. H., K. P. Beckett, and Gail Taylor. "Deposition velocities to *Sorbus aria*, *Acer campestre*, *Populus deltoides*× *trichocarpa* 'Beaupré', *Pinus nigra* and× *Cupressocyparis leylandii* for coarse, fine and ultra-fine particles in the urban environment." *Environmental Pollution* 133.1 (2005): 157-167. <https://www.sciencedirect.com/science/article/pii/S0269749104001228>
- ⁸ Räsänen, Janne V., et al. "Effects of species-specific leaf characteristics and reduced water availability on fine particle capture efficiency of trees." *Environmental pollution* 183 (2013): 64-70. <https://www.sciencedirect.com/science/article/pii/S0269749113002625>
- ⁹ Beckett, K. Paul, P. H. Freer-Smith, and Gail Taylor. "Particulate pollution capture by urban trees: effect of species and windspeed." *Global change biology* 6.8 (2000): 995-1003. <https://onlinelibrary.wiley.com/doi/abs/10.1046/j.13652486.2000.00376.x>
- ¹⁰ The Centre for Ecology and Hydrology alongside the University of Lancaster - Trees and Sustainable Urban Air Quality – Using Trees to improve Air Quality in Cities <http://www.es.lancs.ac.uk/people/cnh/UrbanTreesBrochure.pdf>
- ¹¹ Maher *et al* Impact of Roadside Tree Lines on Indoor Concentrations of Traffic-Derived Particulate Matter - Centre for Environmental Magnetism & Palaeomagnetism, Lancaster Environment Centre, Lancaster University, Lancaster LA1 4YQ, United Kingdom Environ. Sci. Technol., 2013, 47 (23), pp 13737–13744 <http://pubs.acs.org/doi/abs/10.1021/es404363m?source=cen> ¹² McDonald - Planting Healthy Air, A global analysis of the role of urban trees in addressing particulate matter pollution and extreme heat – the Nature Conservancy Council
- ¹³ Pugh *et al* (2012) Effectiveness of Green Infrastructure for Improvement of Air Quality in Urban Street Canyons Lancaster Environment Centre, Lancaster University, Environ. Sci. Technol., 2012, 46 (14), pp 7692–7699 <http://pubs.acs.org/doi/abs/10.1021/es300826w>
- ¹⁴ The Centre for Ecology and Hydrology alongside the University of Lancaster - Trees and Sustainable Urban Air Quality – Using Trees to improve Air Quality in Cities <http://www.es.lancs.ac.uk/people/cnh/UrbanTreesBrochure.pdf>

- ¹⁵ Edgware Road Tube Station, Marylebone <http://www.biotechure.uk.com/portfolio/edgware-road-tube-station-marylebone/>
- ¹⁶ www.ciht.org.uk/download.cfm/docid/8931E4C8-098A-47D2-A0FICEBF719152B0 ¹⁷ Green Infrastructure: A Catalyst for the Well-being of Future Generations in Wales
http://www.wtwales.org/sites/default/files/green_infrastructure.pdf
- ¹⁸ University of Leeds - Brief Guide To The Benefits Of Urban Green Spaces – a joint publication from the Leeds Ecosystem, Atmosphere and Forest (LEAF) centre, the United Bank of Carbon (UBoC), and the Sustainable Cities Group at the University of Leeds,
- ¹⁹ McDonald - Planting Healthy Air, A global analysis of the role of urban trees in addressing particulate matter pollution and extreme heat – the Nature Conservancy Council
- ²⁰ NRW - Swansea and the Tawe Valley Trees- an amazing resource benefiting us all
<https://naturalresources.wales/media/679646/engtawe-i-tree-infographic-v2.pdf>
- ²¹ NRW Wrexham's Urban Trees- an amazing resource benefiting us all
<https://naturalresources.wales/media/679641/engwrecsam-i-tree-infographicv2.pdf>
- ²² NRW Bridgend's Urban Trees- an amazing resource benefiting us all
<https://naturalresources.wales/media/679644/engpenarbontarogwr-bridgend-i-tree-infographicv2.pdf>
- ²³ Valuing London's urban forest. The results of the London i-tree eco project <http://www.forestry.gov.uk/pdf/LONDONI-TREEECOSUMMARY160331.pdf/%24FILE/LONDONI-TREEECOSUMMARY160331.pdf>
- ²⁴ Bauer, Susanne E., Kostas Tsigaridis, and Ron Miller. "Significant atmospheric aerosol pollution caused by world food cultivation." *Geophysical Research Letters* 43.10 (2016): 5394-5400.
- ²⁵ <https://www.thebureauinvestigates.com/stories/2019-06-13/how-ammonia-is-killing-off-the-countryside>
- ²⁶ ibid
- ²⁷ Plantlife Cymru "Lets talk about nitrogen - A call to protect Wales' internationally important wild flora and fungi from air pollution" https://www.plantlife.org.uk/application/files/4715/2950/3384/Welsh_nitrogen_report_-_Plantlife.pdf https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1810160958_DA_Air_Pollutant_Inventories_19902016_Issue1.pdf
- ²⁹ Mark Sutton, environmental physicist at the Centre for Ecology and Hydrology
<https://www.theguardian.com/environment/2019/jun/13/testing-reveals-ammonia-pollutant-hotspots-farms-uk>
- ³⁰ <https://www.thebureauinvestigates.com/stories/2019-06-13/deadly-gas-ammonia-cutting-farm-emissions-could-save-3000lives-a-year>
- ³¹ <https://www.fwi.co.uk/machinery/trailing-shoe-application-strikes-a-good-balance>

- ³² <https://www.thebureauinvestigates.com/stories/2019-06-13/how-ammonia-is-killing-off-the-countryside>
- ³³ Plantlife Cymru “Lets talk about nitrogen - A call to protect Wales’ internationally important wild flora and fungi from air pollution” https://www.plantlife.org.uk/application/files/4715/2950/3384/Welsh_nitrogen_report_-_Plantlife.pdf
- ³⁴ <https://www.thebureauinvestigates.com/stories/2019-06-13/deadly-gas-ammonia-cutting-farm-emissions-could-save-3000lives-a-year>
- ³⁵ <https://www.thebureauinvestigates.com/stories/2017-08-21/farming-pollution-fish-uk>
- ³⁶ Plantlife Cymru “Lets talk about nitrogen - A call to protect Wales’ internationally important wild flora and fungi from air pollution” https://www.plantlife.org.uk/application/files/4715/2950/3384/Welsh_nitrogen_report_-_Plantlife.pdf
- ³⁷ <https://www.thebureauinvestigates.com/stories/2019-06-13/how-ammonia-is-killing-off-the-countryside>
- ³⁸ Maria Cambra-Lo´pez., Andre´ J.A. Aarnink, Yang Zhao, Salvador Calvet, Antonio G. Torres. (2010). Airborne particulate matter from livestock production systems: A review of an air pollution problem Environmental Pollution 158, 1–17
- ³⁹ NRW (2015a) Powys Pilot Study: Assessment of cumulative atmospheric releases: Evidence Report No: 218, Khalid V. Aazem and Simon A. Bareham, National Resources Wales, July 2015
- ⁴⁰ <https://www.thebureauinvestigates.com/stories/2019-06-13/how-ammonia-is-killing-off-the-countryside>
- ⁴¹ Trends Report 2018: Trends in critical load and critical level exceedances in the UK Report to Defra under Contract AQ0843 CEH Project: NEC05708 https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1905230854_Trends_Report_2018.pdf ⁴² Hall, J. et al (2017) Trends Report 2017: Trends in critical load and critical level exceedances in the UK: <https://ukair.defra.gov.uk>
- ⁴³ ibid
- ⁴⁴ NRW (2015b) Natura 2000 Thematic Action Plan – Air Pollution: Nitrogen Deposition, Natural Resources Wales, LIFE Nat11/UK/385, October 2015 (supported by LIFE, a financial instrument of the European Community), available at:
<http://naturalresourceswales.gov.uk>
- ⁴⁵ NRW Evidence Report no.298: Lichen surveys to investigate ammonia impacts, Sam Bosanquet, Natural Resources Wales, June 2019 <https://cdn.naturalresources.wales/media/689184/nrw-evidence-report-no-298-lichen-surveys-to-investigateammonia-impacts.pdf>
- ⁴⁶ <https://www.thebureauinvestigates.com/stories/2019-06-13/how-ammonia-is-killing-off-the-countryside>
- ⁴⁷ <https://www.theguardian.com/environment/2018/jan/04/oceans-suffocating-dead-zones-oxygen-starved>
- ⁴⁸ <https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/>

- ⁴⁹http://www.who.int/gho/publications/world_health_statistics/2016/whs2016_AnnexA_AmbientAirPollution.pdf ⁵⁰ <http://theconversation.com/air-pollution-from-brake-dust-may-be-as-harmful-as-diesel-exhaust-on-immune-cells-newstudy-129594>
- ⁵¹ <https://inews.co.uk/news/environment/brake-dust-major-source-air-pollution-study-finds-1359299>
- ⁵² <https://record.assembly.wales/Plenary/5662#A51504>
- ⁵³ <https://www.itv.com/news/wales/update/2015-07-07/call-for-welsh-towns-to-have-20-canopy-cover/>
- ⁵⁴ http://www.ukmaburbanforum.co.uk/documents/other/nature_nearby.pdf
- ⁵⁵ For example, see: Pretty et al (2018) Global Assessment of Agricultural System Redesign for Sustainable Intensification. Nature Sustainability. [Online] Available at: www.nature.com/articles/s41893-018-0114-0#ref-CR25
- ⁵⁶ https://www.plantlife.org.uk/application/files/4715/2950/3384/Welsh_nitrogen_report_-_Plantlife.pdf
- ⁵⁷ The Food and Agricultural Organisation of the UN's definition of agroecology as "*an integrated approach that applies ecological and social principles to the design and management of food and agricultural systems. It seeks to optimise the interactions between plants, animals, humans and the environment and the social aspects that need to be addressed for a sustainable and fair food system.*" It applies the principles of the regenerative economy to agriculture.
- ⁵⁸ Mind the Gap Conference - November 2013. Lucy Filby, SEPA Catchment Coordinator - The River Ayr Priority Catchment ⁵⁹ WWF (2014) Ensuring Company Operations and Suppliers are Compliant with Existing Water Protection Legislation and Regulations – see http://assets.wwf.org.uk/downloads/ensuring_company_operations_and_suppliers_are_compliant_with_existing_water_protection.pdf
- ⁶⁰ Stephen Field, SEPA Land Unit Manager, pers.comm
- ⁶¹ Centre for Ecology & Hydrology (CEH) (2015) – Report for DEFRA Identification of Potential "Remedies" for Air Pollution (nitrogen) Impacts on Designated Sites (RAPIDS) <http://nora.nerc.ac.uk/512980/1/N512980CR.pdf>
- ⁶² Dragosits U. et al. (2006) "The potential for spatial planning at the landscape level to mitigate the effects of atmospheric ammonia deposition", Environmental Science and Policy 9: 626-638 https://ec.europa.eu/environment/integration/research/newsalert/pdf/47na2_en.pdf
- ⁶³ Making Ammonia Visible - An Annex to "Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland" Produced by the Expert Working Group on Sustainable Agricultural Land Management for N. Ireland December 2017 <https://www.daerani.gov.uk/sites/default/files/publications/daera/Ammonia%20Annex-%20Expert%20Working%20Group%20%28final%29.pdf> ⁶⁴ Making Ammonia Visible An Annex to "Delivering Our

Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland” Produced by the Expert Working Group on Sustainable Agricultural Land Management for N

⁶⁵ Making Ammonia Visible An Annex to “Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management

Strategy for Northern Ireland” Produced by the Expert Working Group on Sustainable Agricultural Land Management for N.

Ireland December 2017 <https://www.daera-ni.gov.uk/sites/default/files/publications/daera/Ammonia%20Annex-%20Expert%20Working%20Group%20%28final%29.pdf>

⁶⁶ Making Ammonia Visible An Annex to “Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland” Produced by the Expert Working Group on Sustainable Agricultural Land Management for N.

Ireland December 2017 <https://www.daera-ni.gov.uk/sites/default/files/publications/daera/Ammonia%20Annex%20Expert%20Working%20Group%20%28final%29.pdf>

⁶⁷

<https://www.daera-ni.gov.uk/sites/default/files/publications/daera/17.18.088%20EU%20Farm%20Structure%20Survey%202016%20V2.pdf>

⁶⁸ Swiersta et al. (2001) <http://edepot.wur.nl/198524>

⁶⁹ De Vries, Jerke W., and Roland W. Melse. "Comparing environmental impact of air scrubbers for ammonia abatement at pig houses: A life cycle assessment." *Biosystems engineering* 161 (2017): 53-61. <https://www.sciencedirect.com/science/article/pii/S1537511017300788>

⁷⁰ Making Ammonia Visible An Annex to “Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland” Produced by the Expert Working Group on Sustainable Agricultural Land Management for N.

Ireland December 2017 <https://www.daera-ni.gov.uk/sites/default/files/publications/daera/Ammonia%20Annex-%20Expert%20Working%20Group%20%28final%29.pdf>

⁷¹ Four of world's biggest cities to ban diesel cars from their centres -

<https://www.theguardian.com/environment/2016/dec/02/four-of-worlds-biggest-cities-to-ban-diesel-cars-from-their-centres> Norway to 'completely ban petrol powered cars by 2025 -

<http://www.independent.co.uk/environment/climatechange/norway-to-ban-the-sale-of-all-fossil-fuel-based-cars-by-2025-and-replace-with-electric-vehicles-a7065616.html>

