Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

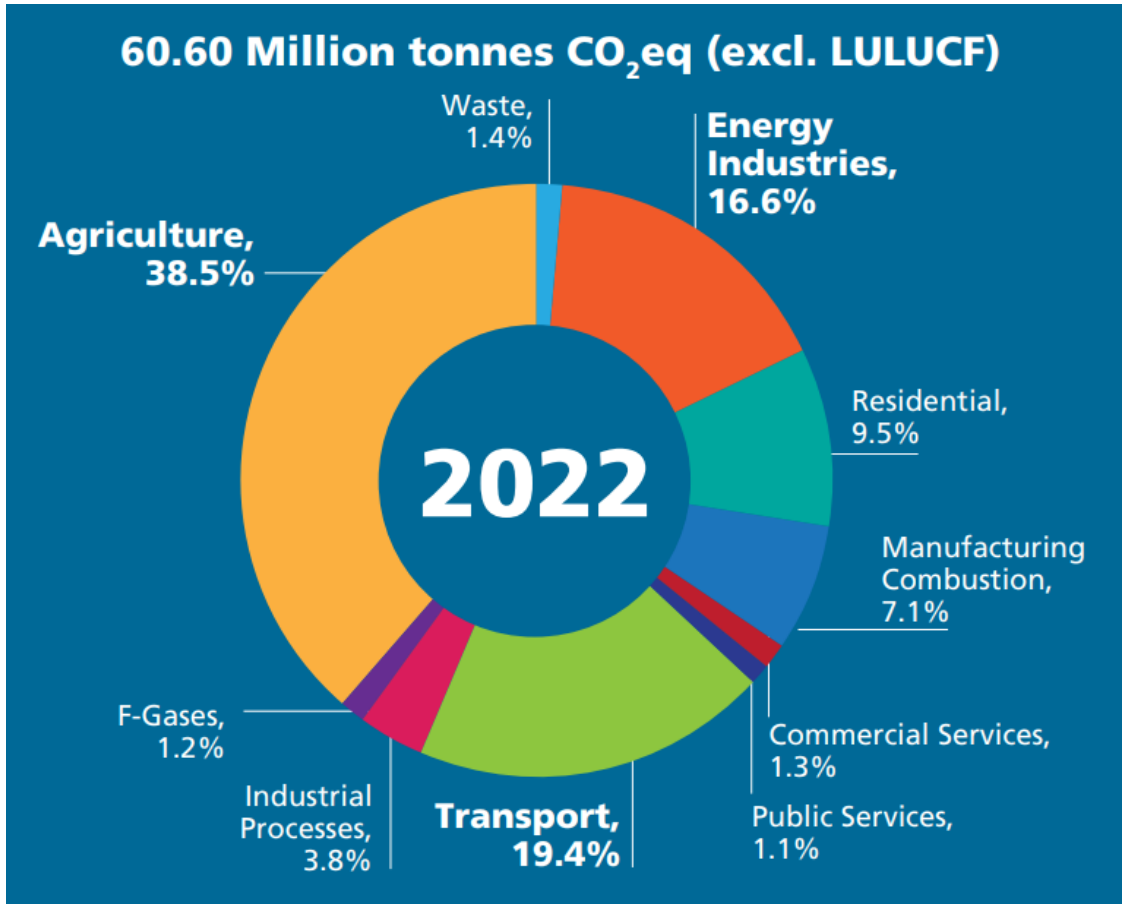
National GHG and air pollutant inventories – the role of nitrogen fertiliser and lime

EPA & Fertiliser Association of Ireland meeting 29th November 2024

Role of EPA Emissions Inventories and Projections

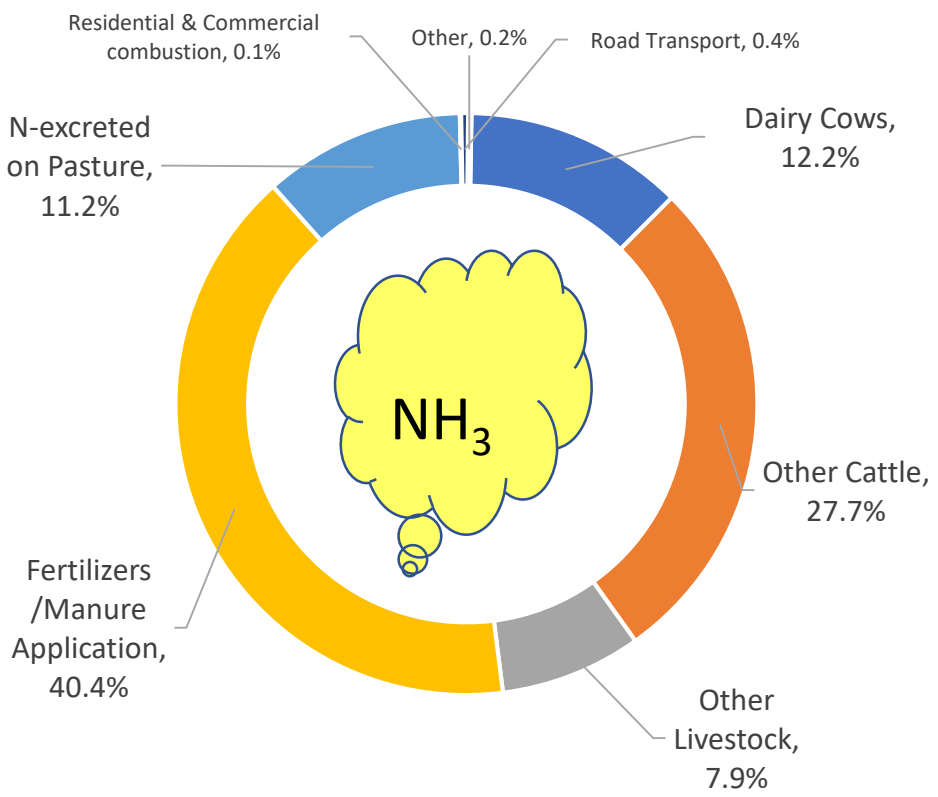
- EPA compiles National Inventories and Projections of Ireland's Greenhouse Gas and Air Pollutant Emissions
  - International: Reporting to EU and United Nations Framework Convention on Climate Change
  - National: Climate Action and Low Carbon Development (Amendment) Act 2021; Carbon Budgets
- Reportable GHG -Carbon Dioxide, Methane, Nitrous Oxide, F-Gases - HFCs, PFCs, SF6, NF3
- Reportable Air Pollutants – NECD & CLRTAP
  - Nitrogen Oxides, Sulphur Dioxide, Ammonia, Volatile Organic Compounds, Particulate Matter (2.5 microns); (Other Pollutants – CO, PM_{10}, TSP, BC, Heavy Metals and Persistent Organic Pollutants)
- Reported by sector and by Gas
  - GHG – Jan 15th and Mar 15th incl. National Inventory Report, Projections; July 31st provisional inventory (Y-1)
  - Air Pollutants – Feb 15th, Informative Inventory Report and Projections Mar 15th

Greenhouse Gas Emissions 2022



- Total GHG 2022: 60.6 Million tonnes CO_2eq
-
- Agriculture GHG emissions
  - CO_2eq – 38.5 % of national total
  - Agricultural CH_4 ~ 94 % of national CH_4
  - Agricultural N_2O ~ 91 % of national N_2O

Air Pollutant Emissions 2022



- Total NH_3 2022: 128.64 kt
  - Agriculture 99.4 %

- Also responsible for:
  - 36.4 % of NO_x,
  - 39.1 % of NMVOC's
  - 7.9 % of $PM_{2.5}$

Projections Scenarios WEM and WAM

With Existing Measures

Measures **committed** to by Government. Measure must be in place before the end of the latest Inventory year (2022).

Certainty = Law, Agreement, Financial/Human Resources Committed or Official Gov Decision

With Additional Measures

Assumes implementation of the WEM in addition to measures in **Government Plans including CAP 2024**

Plans with an implementation pathway that can be modelled.

Climate Action Plan sectoral target assessment

Sectors	Projected Reduction 2030 vs 2018	Target Reduction 2030 vs 2018
Electricity	-66%	~-75%
Transport	-29%	~-50%
Buildings (Residential)	-40%	~-40%
Buildings (Comm and Public)	-60%	~-45%
Industry	-24%	~-35%
Agriculture	-18%	~-25%
Other*	-25%	~-50%
LULUCF (no ceiling currently)	17%	- 626 kt (EU)
Total with LULUCF	**-29%**	**-51%**

*Waste, F-gases and Petroleum Refining

Air pollutant targets -NECD

- Targets in place for 2020 and 2030 with a linear trajectory between target years
- Targets are based on percentage reduction on 2005 level

	2020	2030
Sulphur Dioxide (SO_2)	-65%	-85%
Nitrogen Oxides (NOx)	-49%	-69%
Ammonia (NH_3)	-1%	-5%
Non-Methane Volatile Organic Compounds (NMVOCs)	-25%	-32%
Particulate Matter < 2.5 µm (PM2.5)	-18%	-41%

Progress to targets under NECD

Pollutant	Emissions (kilotonnes)			2020-2029 and 2030 Reduction Commitments (% reduction compared with 2005 levels) based on latest inventory estimates	
	2022	2025	2030	2020-2029	2030
Total SO_2 WEM	9.45	8.24	7.11	25.99	11.14
Total SO_2 WAM	9.45	8.24	6.78	-65%	-85%
Total NOx WEM*	59.02	42.93	33.94	68.20	41.45
Total NOx WAM*	59.02	42.93	30.65	-49%	-69%
Total NMVOC WEM*	66.75	70.59	**76.29**	57.54	52.17
Total NMVOC WAM*	66.75	70.57	**74.63**	-25%	-32%
Adjusted NMVOC WEM*	42.02	42.91	42.91	51.25	46.47
Adjusted NMVOC WAM*	42.02	42.89	41.25	-25%	-32%
Total NH_3 WEM	128.64	124.07	**121.19**	123.63	118.64
Total NH_3 WAM	128.64	119.12	112.56	-1%	-5%
Total $PM_{2.5}$ WEM	10.70	10.33	10.10	15.29	11.00
Total $PM_{2.5}$ WAM	10.70	10.32	9.62	-18%	-41%

•Article 4 (3) of the National Emission reduction Commitments Directive provides that emissions of NOx and NMVOC from categories 3B (manure management) and 3D (agricultural soils) are not accounted for the purpose of complying with 2020 and 2030 emission reduction commitments.

Inventory (& Projections) Compilation

- Emissions = Activity data * Emission Factor

- Based on internationally agreed guidelines – Intergovernmental Panel on Climate Change and EMEP/EEA

- Follow the principles of **TACCC**
  - **Transparent**: clearly explained methods and assumptions
  - **Accurate**: measure of exactness – neither over or under estimated as far as that can be ascertained
  - **Consistent**: Internally consistent across the time series
  - **Comparable**: between counties, follow compilation & reporting guidelines
  - **Complete**: cover all emissions that take place in Ireland

- Reviewed/audited annually: UNFCCC and EU (ESR and NECD)

Determining National Emissions

Emissions = Activity data * Emission Factor

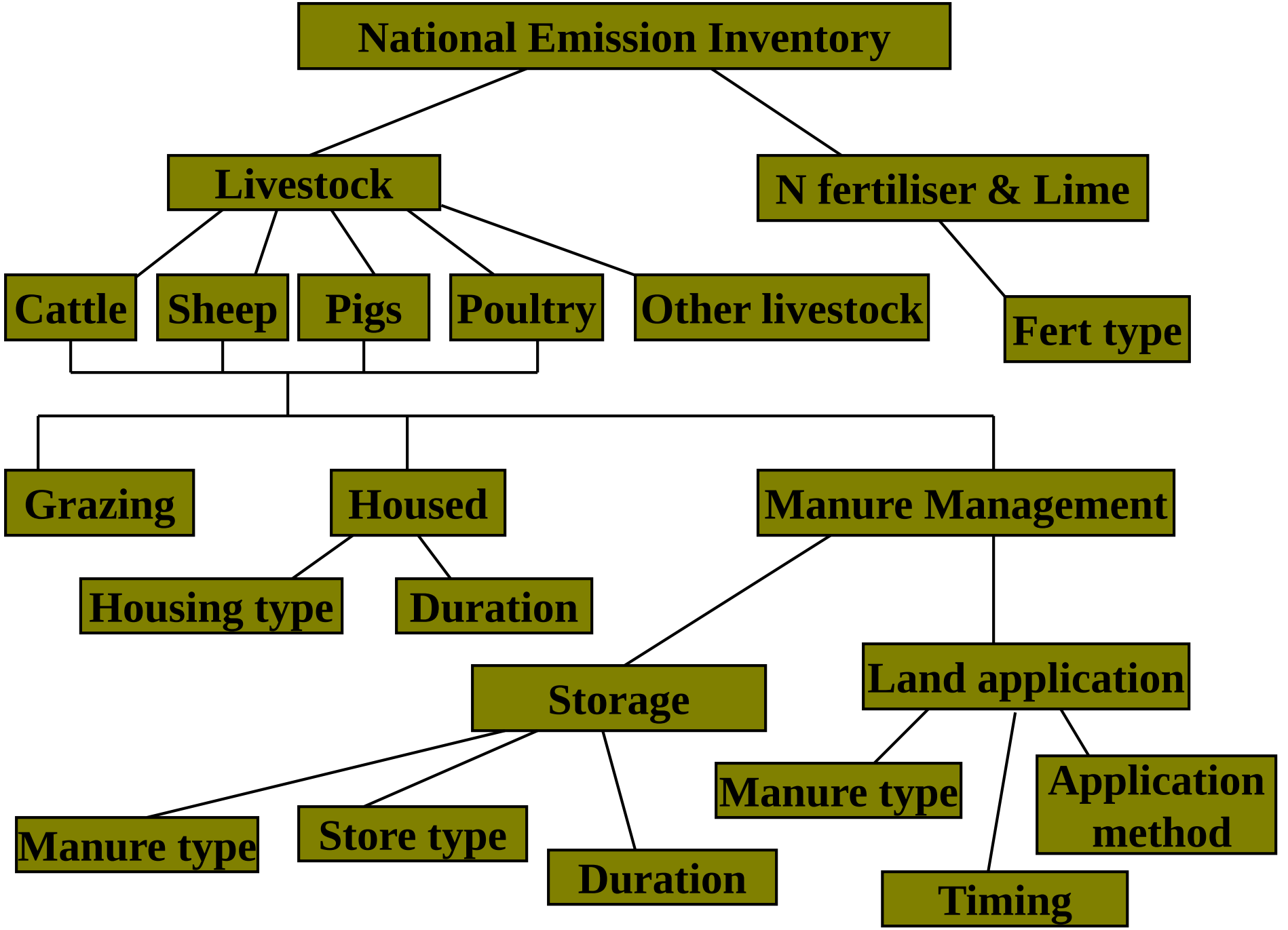
Methodological tiered approach:

- **Tier 1**
  - Simplest method
  - Largely using emission factors available in the IPCC guidelines
- **Tier 2**
  - Country specific parameters (based on research)
  - In agriculture this includes disaggregated livestock population statistics, detailed characterisation of manure management
- **Tier 3**
  - Country specific methodologies, measurement based approaches, detailed modelling

For non-key categories a Tier 1 method is appropriate

For key sources use a higher tier method

Inventory Compilation: Data sources


National Emission Inventory
Livestock
N fertiliser & Lime
Cattle
Sheep
Pigs
Poultry
Other livestock
Fert type
Grazing
Housed
Manure Management
Housing type
Duration
Storage
Land application
Manure type
Store type
Duration
Manure type
Application method
Timing

Agriculture sector - GHG emission sources 2022

- Enteric Fermentation (CH_4)
- Manure Management (CH_4 & N_2O) – direct and indirect (NH_3 & leaching)
- Agricultural soils (N_2O)
- Liming (CO_2)
- Urea application (CO_2)

Contribution
65.0 %
12.1 %
19.5%
2.8 %
0.6 %

Agricultural soils (N_2O) overview

- Seven sub categories
  - Inorganic fertilisers
  - Organic fertilisers (manure, sewage sludge and other applied to soils)
  - Dung and urine from grazing
  - Crop residues
  - Mineralisation/immobilisation with loss/gain in soil organic matter
  - Cultivation of organic soils
  - Indirect N_2O from
    - Atmospheric deposition of NH_3
    - Nitrogen leaching and run-off

Contribution in 2022
36.9%
10.6 %
24.9 %
2.4 %
0.2%
8.1 %
16.8 %

Inorganic fertilisers (N_2O)

- Fertiliser sales statistics – quarterly – DAFM
- Sales stats provide quantity per product ~ 80 diff products on the market
- Separate N_2O emission factors (Tier 2 -Teagasc research) for
  - Urea
  - Inhibited urea
  - CAN (and other compounds)
- Research direction is towards further disaggregation of products

  e.g. new EF's for fertiliser compounds: 18:6:12, 10:10:20 etc

Inorganic fertilisers (NH_3)

- Fertiliser sales statistics – quarterly – DAFM
- Sales stats provide quantity per product ~ 80 diff products on the market
- Separate NH_3 emission factors (Tier 2 -Teagasc research) for
  - Inhibited urea
  - All other emission factors based on EMEP/EEA emission inventory guidance
- Fertiliser Register may provide additional information going forward at a national level
  - Initial discussions with DAFM re data

Liming (CO_2) & Urea application (CO_2)

- Liming
  - Lime sales statistics supplied by DAFM
  - Default carbon content (emission factor) of lime used from IPCC
  - Development of country specific emission factor (LABMACC project – DAFM funded)

- Urea application
  - Urea and inhibited urea sales (DAFM fertiliser sales)
  - Based on carbon content

Projections and PaMs

- Future livestock population, crop areas, crop yield provided by Teagasc FAPRI model)
- Effect of PaM's estimated by EPA
- Two scenarios – With Measures and With Additional Measures
- With Measures Scenario
  - LESS-bovine (As per Ag-Climatise), Lime (N-fert replacement & increased CO_2) (AgClimatise), LESS-pig slurry (as per NAP)
- With Additional Measures Scenario
  - Fertiliser N target (CAP), Inhibited urea replacement of CAN (CAP), Dairy conc CP% (NAPCP), Reduced Slaughter age (CAP), Reduced age first calving (CAP), Cover slurry stores (Ag Climatise), Slurry amendments CH_4 - pigs and cattle (CAP), Reduce pig conc CP% (Ag Climatise), Drying of poultry manure (AgClimatise), Cap on urea sales (NAPCP), Dairy EBI (CAP), 3NOP (CAP)

Fertiliser related policies and measures

- With Measures Scenario
  - LESS-bovine (As per Ag-Climatise), Lime (N-fert replacement & increased CO_2) (AgClimatise), LESS-pig slurry (as per NAP)
- With Additional Measures Scenario
  - Fertiliser N target (CAP), Inhibited urea replacement of CAN (CAP), Cap on urea sales (NAPCP)
- LESS and lime have an N replacement value therefore form part of fert N target for early years i.e. not an additional reduction
  - Lime = 2 Mt by 2030 – in line with MACC and AgClimatise
- Fert N target – 325 kt by 2025 & 300 kt by 2030, within which CAN is replaced with IU (85% in 2025 up to 95% in 2030).
- After which cap on urea sales (20 kt vs approx. 45/50 kt) is applied replaced with IU
- Note that CO_2 increases with increased lime and urea/IU fert

Fertiliser related policies and measures

- For GHG's fertiliser related measures ~ 30% of emission savings p.a., with contribution lowering as effect of animal based PaMs increases
  - E.g. feed additives

- For NH_3 fertiliser related measures ~ 50% of emission savings p.a. with contribution lowering as effect of animal based and manure based PaMs increases
  - E.g. Manure amendments, LESS, CP% reduction

Emission Inventories – data collection/new science

- Good practice principles
  - Use national published, peer –reviewed official data where possible
  - For KC it is good practice to use peer-reviewed published literature relevant to their national circumstances
  - If not available use international databases, but should reflect national circumstances as far as is possible
  - Focus more efforts on key categories
  - Consider whether input data meets TACCC
  - Use data quality objectives to prioritise improvement
  - Review data collection and methodologies on a regular basis
  - Select those methods, emission factors and activity data that are most representative
  - Where new measurements are undertaken – reliable and comparable results are achieved through well designed measurement campaigns

Inventory Refinement

- Normal part of the inventory process as data and scientific knowledge develops
  - Ongoing need for updates and improvement as science and knowledge progresses
  - Continuous engagement with Teagasc, DAFM and other stakeholders

- Refinement is dependent on national research and national activity data
  - **Measurable, Reportable, Verifiable**
- There is a clear approach for data inclusion in the inventory:
  - National reports e.g. through rigorous survey findings
  - Peer reviewed scientific publications
  - Must be **representative of national circumstances**

Stands up to scrutiny in UNFCCC, ESR and NECD annual review/audits

Guidebook updates – how ? (N fert as example)

- Bouwman et al. (2002), Aarhus lit review 2012, Pan et al. (2016) etc
  - Other criteria included
    - Omission with chemical composition not identified
    - Omission if emissions expressed relative to urea for e.g.
    - Incomplete experimental design

- Emissions recorded and expressed as proportion of fert N applied, totalled for whole measurement period

- Most data reported as the means of two or more replicates

- Basis of emission factor development for main fertilisers is well established
- Basis of reduction/abatement factor for some inhibitors is well established
- Focus on core scientific principles of soil science for new product assessment
  - Agriculture and Nature | TFEIP
  - Revision of UNECE Ammonia Guidance Document

Conclusion

- GHG and air pollutant inventory estimates are detailed and comprehensive
  - Based on available activity data and national research
- Inventories meet the required international standards and undergo multiple reviews annually
- Aim to reflect actual practice
- Significant collaboration with other agencies
- Significant research ongoing which will lead to further refinements as results become available
- Inclusion of planned emission reduction measures requires a ramp up in monitoring, reporting and verification of actions
  - Reflect on farm practices in national emission estimates
  - Requires scientific analysis following core soil/emission science principles

Key resources

- National Inventory Report – GHG's
- Informative Inventory Report – Air Pollutants
- IPCC Guidelines & 2019 Refinement
- EMEP/EEA Emission Inventory Guidebook
- Agriculture and Nature | TFEIP
- Revision of UNECE Ammonia Guidance Document