

Challenges in the decision making of air emissions risk assessments of amines and degradation products from post-combustion carbon capture plants

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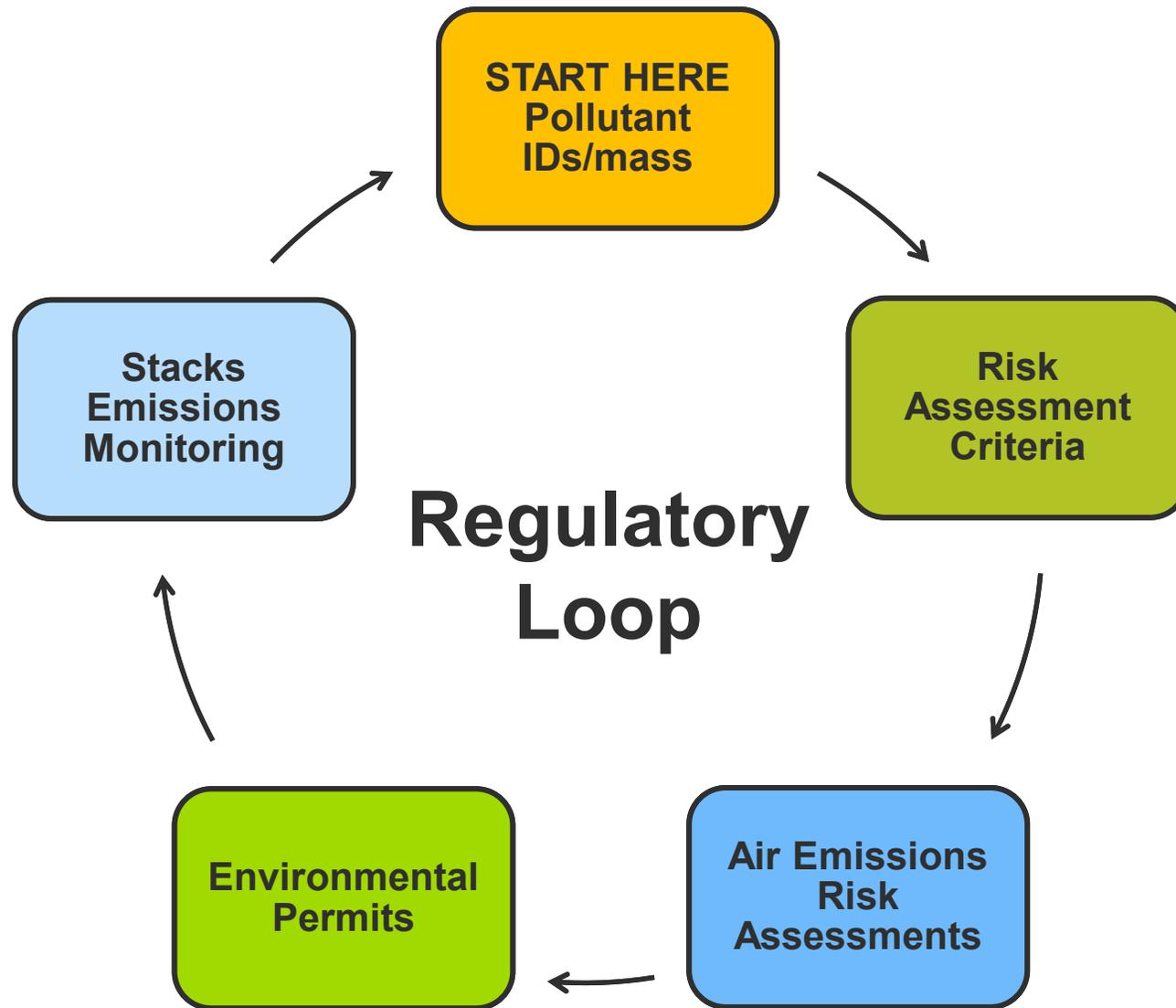
June 2023

Our role

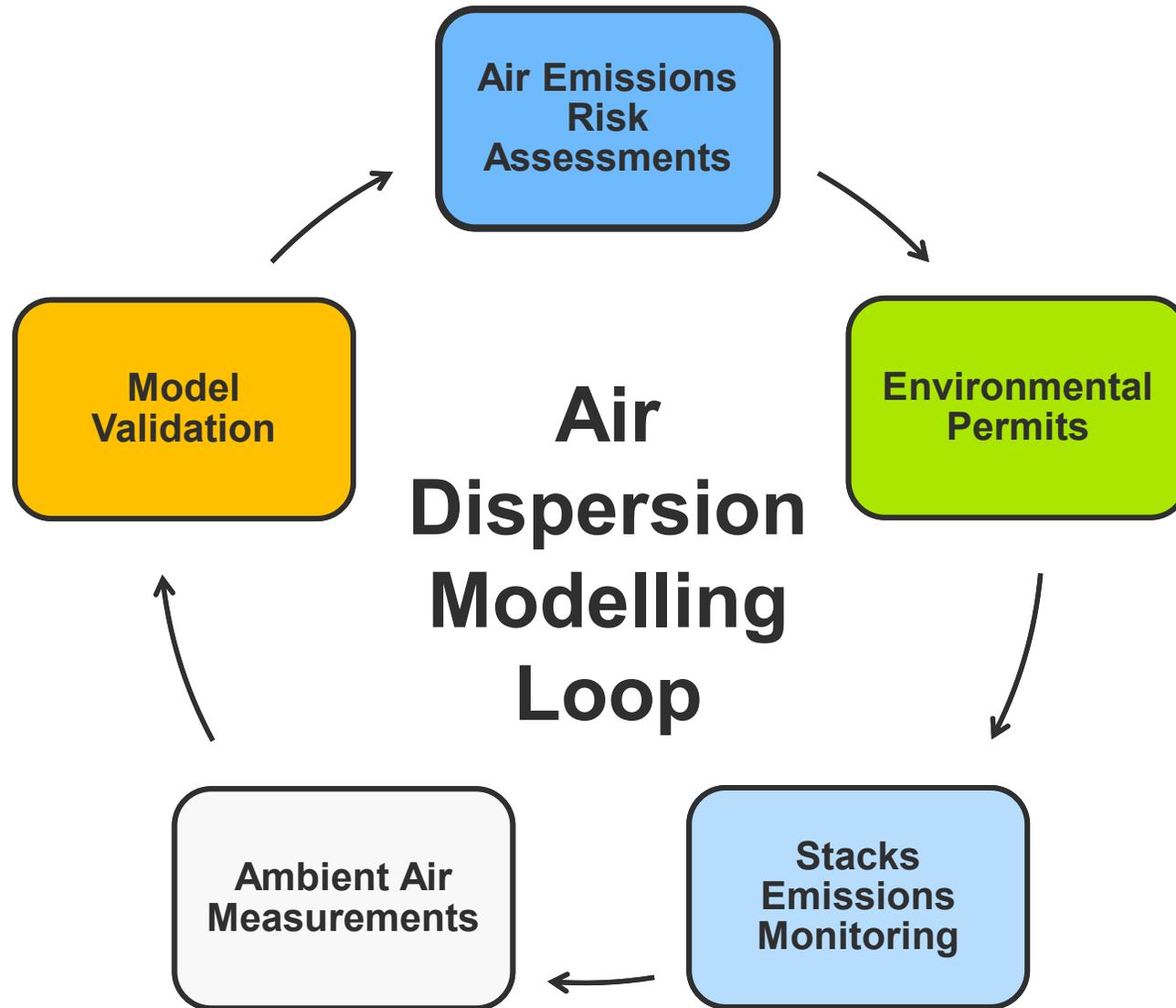


- **AQMAU: Air Quality Modelling and Assessment Unit**
 - We represent the Environment Agency's national focus of expertise on air quality modelling and assessment.
 - We advice permitting, compliance, incident and policy teams and carry out research, development and training.
 - We audit complex air dispersion and noise models submitted by applicants supporting their environmental permit applications.
 - We provide technical leadership and operational support across regulated sectors.
 - We focus on risk.
- **We aim to ensure that modelling-based assessments are consistent, of a high standard and based on sound science to establish whether:**
 - The applicant's risk assessment conclusion can be used for permitting decision-making.
 - The proposed facility does not contribute to an exceedance of any Environmental Standard (ES) set for the protection of human health and ecological sites.

Amines modelling: The issue



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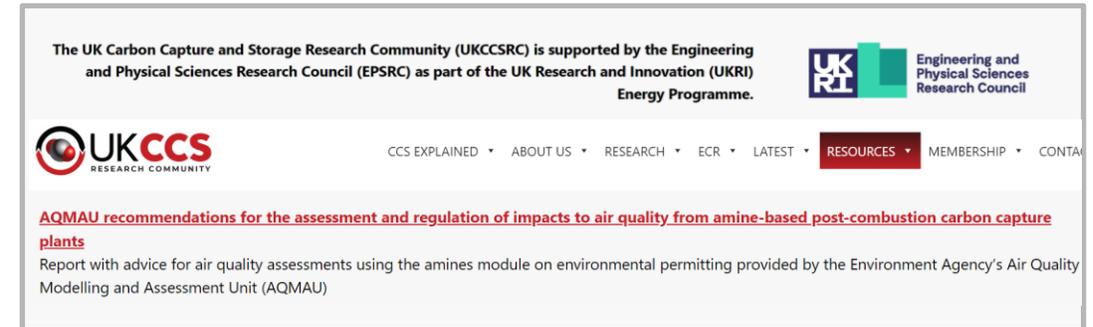
Amines modelling: Key AQMAU work

Key milestones

- Published **AQMAU guidelines** on risk assessments techniques to aid operators and regulators
- We concluded that the CERC ADMS amines module can be a useful tool to inform decisions, but **remain cautious due to the uncertainty.**

Ongoing and future key work

- AQMAU-led project to address uncertainty
- Support and tap into projects of relevance
- Goal: **Improved** modelling software/tools + risk assessments **strategies** → **Fit for engineering design decisions**



The UK Carbon Capture and Storage Research Community (UKCCSRC) is supported by the Engineering and Physical Sciences Research Council (EPSRC) as part of the UK Research and Innovation (UKRI) Energy Programme.

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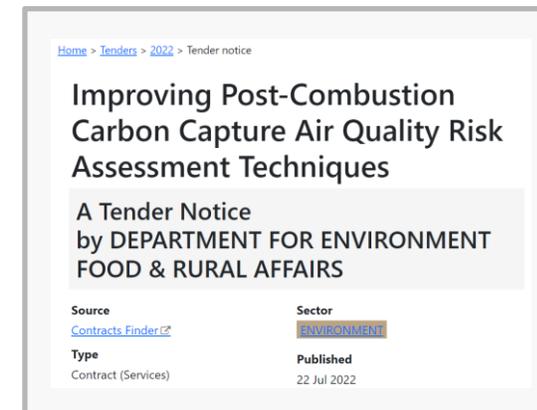
AQMAU recommendations for the assessment and regulation of impacts to air quality from amine-based post-combustion carbon capture plants

Report with advice for air quality assessments using the amines module on environmental permitting provided by the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU)

AQMAU guidelines on assessments using the amines module

(commented by internal and external stakeholders)

[Available at <https://ukccsrc.ac.uk/best-available-technology-bat-information-for-ccs/>]



Home > Tenders > 2022 > Tender notice

Improving Post-Combustion Carbon Capture Air Quality Risk Assessment Techniques

A Tender Notice
by DEPARTMENT FOR ENVIRONMENT
FOOD & RURAL AFFAIRS

Source	Sector
Contracts Finder	ENVIRONMENT
Type	Published
Contract (Services)	22 Jul 2022

AQMAU-led modelling project

CERC (developers of ADMS amines module) and Imperial College London won the open competition

Toxicological advice on air pollutants

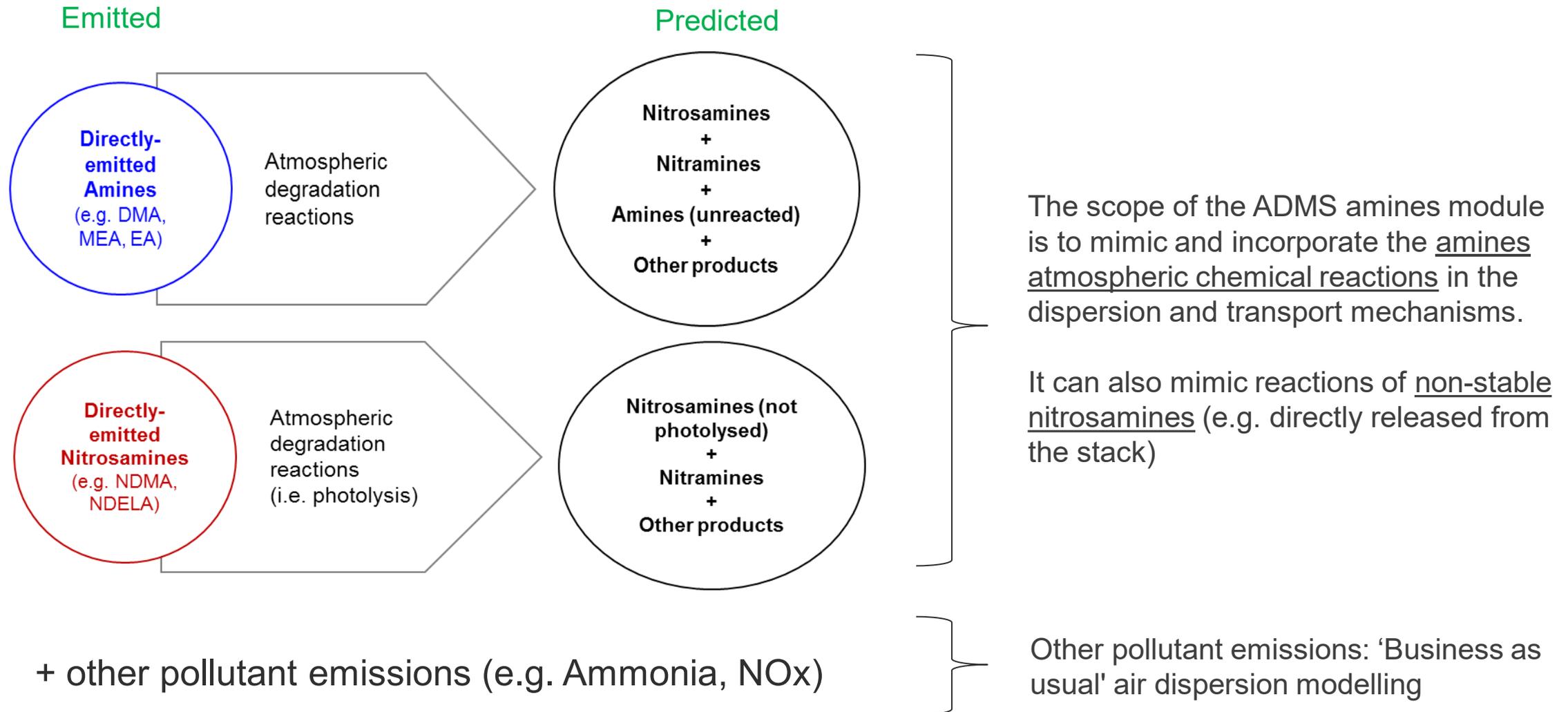
Hazard Ranking of Substances for Development of EALs for Substance Emissions to Air from Carbon Capture Technologies

November 2022

E&B-led EALs project

First results on prioritisation of substances for EALs
[Available at <https://ukccsrc.ac.uk/best-available-technology-bat-information-for-ccs/>]

Amines modelling: Scope of the amines module

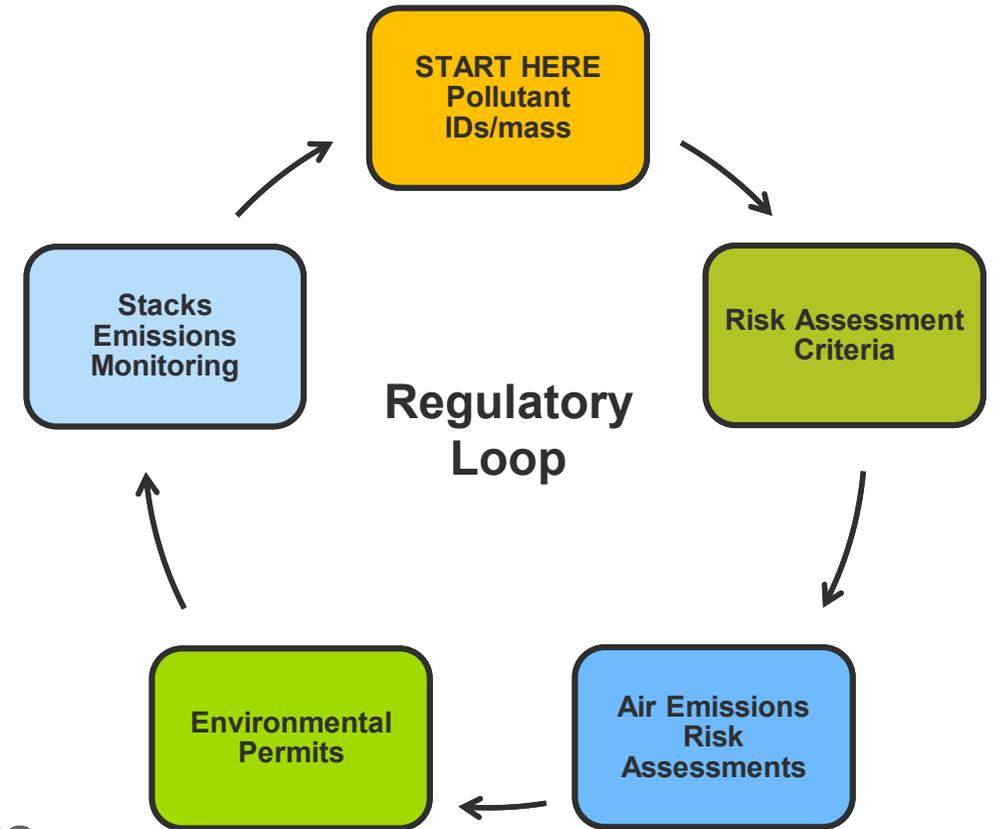


Amines modelling: Key challenges for risk-based decision-making

- Emissions IDs and quantities uncertainty (permits must limit uncertainty on a risk-basis)
- Substances without risk assessment criteria (ongoing projects)
- Atmospheric reaction parameters uncertainty (published research, ongoing projects)
- Amines modelling tool complex use, uncertainties, not validated (ongoing projects)

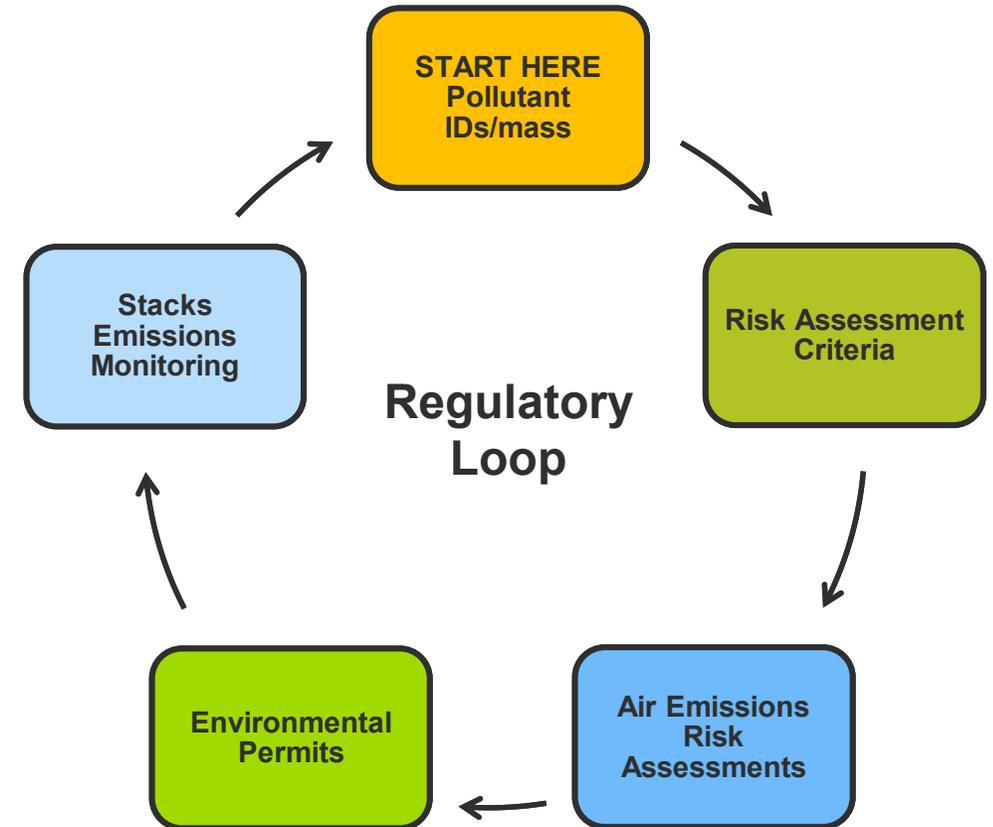


Sensitivity analysis and conservative assumptions to deal with uncertainty and knowledge gaps



Amines modelling: Key challenges for risk-based decision-making

- **Environment Agency guidance**
 - “The model you use must be fit for purpose, based on established science, and be validated and independently reviewed”.
 - “You must show that you have estimated the level of uncertainty in your predictions”.
- **We cannot endorse a modelling software**
 - AQMAU consider the ADMS amines module a useful tool to inform decisions. However, we acknowledge the level of uncertainty and remain cautious on its endorsement.
- **The site-specific assessment is applicant’s responsibility, but AQMAU can support**
 - Applicants must give (us and members of the public) confidence in their conclusions about the risk.
 - Pre-application advice with AQMAU is encouraged.



AQMAU audits within NPS

AQMAU
audit



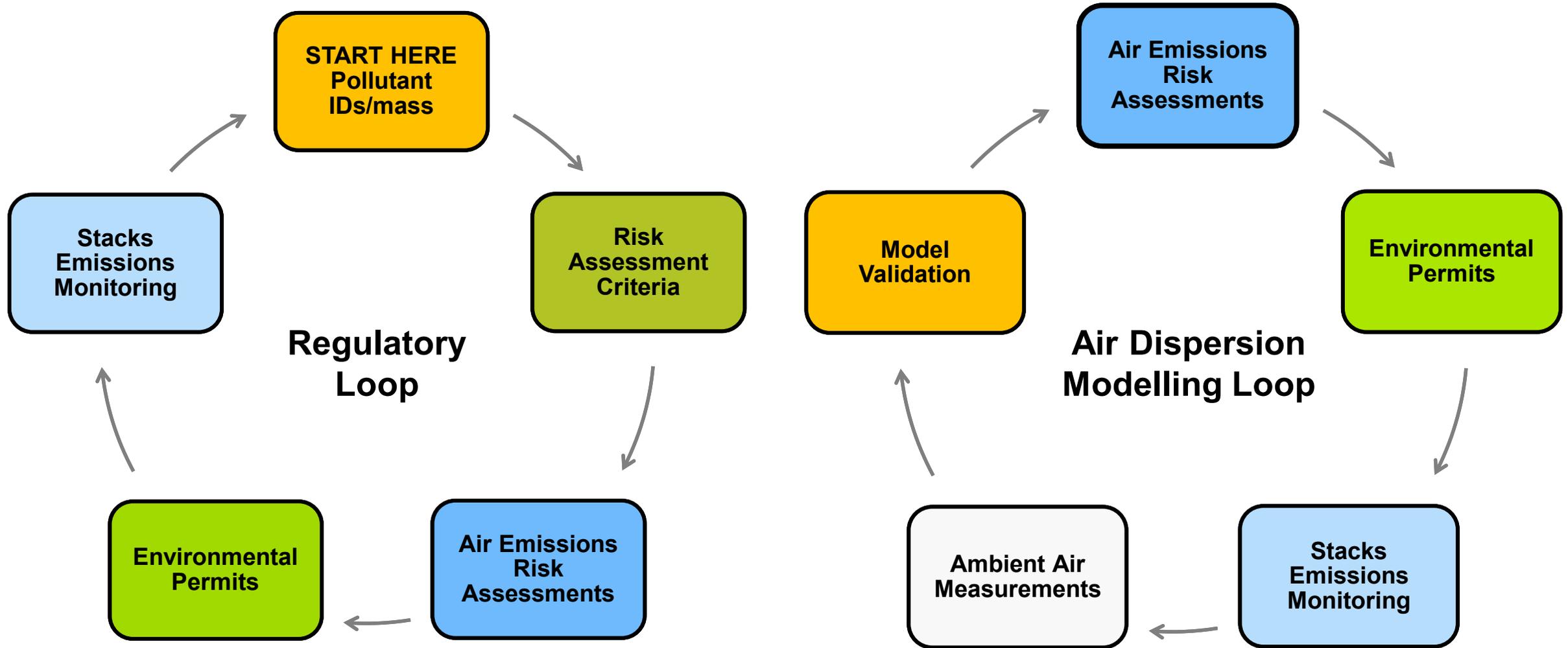
AQMAU risk-based (sample) recommendations

- Applicant's conclusions can be used for permit determination
- Clarify with the applicant (e.g., operational variables, controls)
- Consult with specialists habitats team
- The applicant must reassess the risk with mitigation of impacts



NPS

Summary



Available resources

Environment Agency external guidance

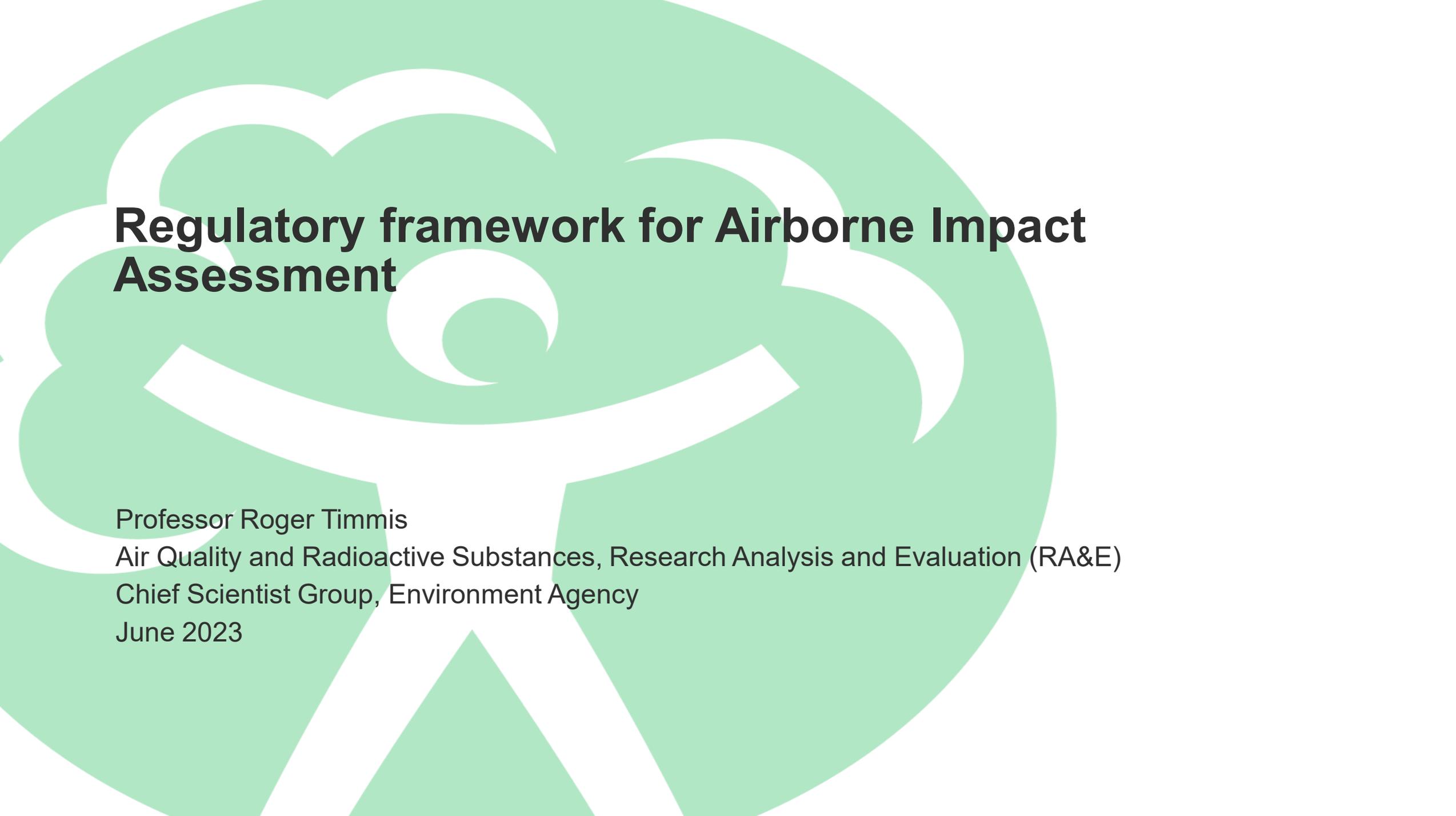
- [Air emissions risk assessment for your environmental permit - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit)
- [Environmental permitting: air dispersion modelling reports - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports)
- [Post-combustion carbon dioxide capture: best available techniques \(BAT\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/post-combustion-carbon-dioxide-capture-best-available-techniques-bat)
- [Derivation of new Environmental Assessment Levels to air - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/derivation-of-new-environmental-assessment-levels-to-air)

Other resources, guidelines and ongoing work

- AQMAU guidelines, available at: [AQMAU-C2025-RP01.pdf \(ukccsrc.ac.uk\)](https://www.ukccsrc.ac.uk/aqmau-c2025-rp01.pdf)
- Report on the prioritisation of Environmental Assessment Levels (EALs) for amines, available at: [Prioritisation-of-carbon-capture-chemicals-interim-report \(ukccsrc.ac.uk\)](https://www.ukccsrc.ac.uk/prioritisation-of-carbon-capture-chemicals-interim-report)
- Review of Emissions from Post-Combustion Carbon Capture Using Amine Based Technologies and Current Monitoring Techniques: [Review of emissions from PCCC \(ukccsrc.ac.uk\)](https://www.ukccsrc.ac.uk/review-of-emissions-from-pccc)
- BAT review: [UKCCSRC - Carbon Capture & Storage \(CCS\) Best Available Techniques \(BAT\) information for CCS](https://www.ukccsrc.ac.uk/carbon-capture-storage-ccs-best-available-techniques-bat)
- Enhanced pre-application advice service is encouraged and can be requested at [Get advice before you apply for an environmental permit - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/get-advice-before-you-apply-for-an-environmental-permit)

Thank you

Please send an [email](#) with any thoughts, feedback, views or reflection points



Regulatory framework for Airborne Impact Assessment

Professor Roger Timmis

Air Quality and Radioactive Substances, Research Analysis and Evaluation (RA&E)

Chief Scientist Group, Environment Agency

June 2023

Regulatory framework for airborne impact assessments

Source-Pathway-Receptor modelling of realistic scenarios; assess impacts with uncertainty

Scenarios

- Scenario development: location(s), process(es), utilisation(s); short + long-term impacts
- Emissions: after abatement; phase (particles, aqueous, gas); species; height, heat + momentum (plume rise)
- Meteorology: representative location and sample of weather/climate; short + long-term; seasonal variations

Modelling

- Dispersion modelling: atmospheric physics and chemistry to simulate reactions/phases/formation in plume
- Predicted incremental concentrations and depositions at receptors under plume footprint
- Receptors may be people or ecosystems; add background + combined impacts from multiple sites
- Evaluate exposure of sensitive receptors and critical groups; uptake and degradation
- Compare exposure with toxicity standards (e.g. ambient) and/or risk criteria (e.g. no-threshold pollutants)

Uncertainty/confidence

- Uncertainties: Scenario – emission – dispersion – chemistry – exposure – health/risk criteria – societal
- Base case + variants to scope uncertainties e.g. different emission abatement techniques/performance
- Monte Carlo analysis; probabilistic results
- Identify risks and knowledge gaps
- Model validation: Monitoring to validate performance at source (emissions) and receptor (ambient)
- Monitoring Certification Scheme; Reporting and feedback (e.g. updated dose/response, epidemiology)