



**The University of the West of England,  
Bristol**

Presentation by

**Professor Jim Longhurst**

**Air Quality Management Centre**

**Met Office**

**Strategic Priorities Fund**

**Clean Air Project**

**Engagement Event**

6th February 2019

# *The need for a systems perspective to devise new solutions for contemporary and emergent air pollutants.*

Jim Longhurst and Enda Hayes

# A Challenge to Conventional Thinking

- The easy wins with air quality policy have been taken.
  - Low hanging fruit has been picked
  - The remaining challenges are deeply entrenched and resistant to change.
  - Policy implementation becoming tougher.
  - The direct costs, financial and political of air quality improvements rising.
- 
- How to respond?
  - Need to think systematically
  - Integrate the science and human dimensions
  - Recognise that air quality is a multifaceted, emergent problem.
  - Encourage more integrated thinking.

# Structure of Presentation

1. Diagnosing the problem of anthropogenic air pollution
2. A brief comment on the Strategic Priorities Fund Clean Air Programme
3. The value of a systems perspective to address the issues, clarify the ambiguities and offer a way forward
4. A brief note on the importance of learning the lessons from history
5. Some concluding remarks on the next steps

# Part 1 The Air Quality Problem

- To illustrate the problem of anthropogenic air pollution I will use examples from local air quality management.
- My focus will be on AQMAs in municipalities.
- I will consider the mismatch between national emission reductions and concentrations measured at the local scale using AQMAs as the proxy.
- I will note governmental and societal responses.

# Fresh Air from the Potteries



<http://www.staffspastrack.org.uk/exhibit/coal/historical%20overview/pottery.htm>

# A Starting Perspective

- Anthropogenic air pollution is not an accident.
- It results from the decision others take to shape land use, develop transport infrastructure and to develop the economy.
- Air pollution results from the interactions of these processes and the way citizens practices are conditions by the systems in which they live their lives.
- The consequence is an impact on public health and the environment.
- Different groups in society have different experiences of pollution.
- In general, the richest in society emit the most pollution and are exposed the least.
- In general, the poorest in society emit the least pollution and are exposed the most.

# Times have changed

- Things have got better.
- We know from past experience that air pollution can be managed when there is a political will to act.
- Air pollution is a societal choice – we could reduce concentrations if we choose to do so.
- The perspective on air pollution will differ when considered at the national scale or the local scale.
- A challenge is how to connect.
- See Longhurst et al (2006) Environment International 32(8) 934-947.





# The Long Term Solution

- Land Use Planning including Agriculture
- Transport Infrastructure Planning
- Industrial and Economic Planning
- The problem is that the beneficial air quality impacts arising from systematic planning processes are long term whilst the problems of air pollution and the impact of policy change are immediate and near term.
- There is a disconnect in time between the resource inputs and the benefits.

— See Longhurst et al (2016) Sustainable Development & Planning 11 (4) 491–499

See Longhurst et al (1996) Atmospheric Environment. 30 (23) 3975-3985

# Policy, Targets and Actions for Public Health and the Environment

- Aim to reduce concentrations below regulatory compliance values.
- At the local scale policy intentions and implementation actions seek to identify the largest contributors and to manage their impact on local air quality.
- Managing local hot spots
- Local concentrations are stubbornly resistant to change particularly in areas of public exposure.

# National v Local

- Improving national position in terms of emissions – emission totals have fallen and in some cases continue to fall.
- Worsening or static local position in terms of concentrations expressed as AQMA designations

See Barnes, J. *et al* (2013) *Environmental Planning and Management* 57 (5). pp. 660-681.

Brunt, H. *et al* (2016) *Environmental Science and Policy* 58 52-60.

Barnes, J. *et al* (2018) *Environmental Science & Policy* 85, pp 28–39

# Catastrophe drives action.

- Catastrophe creates a political willingness to act because the public demands action.
- Good policy intentions often fall foul of vested interests in the policy development process.
- Intended policy action and actual implementation often differ quite significantly.
- See Longhurst et al (2006) Environment International 32(8) 934-947.



# The World's Biggest Environmental Health Risk.

- The scale, complexity and impact of the global problem of air pollution is enormous.
- The WHO estimates that 4.2 million people die prematurely each year as a result of exposure to ambient air pollution and that 91% of the world's population lives in places where air quality exceeds WHO guidelines.
- These guideline are evolving as new evidence emerges and it is likely that future guidelines will be tougher than the current iteration.
- The WHO describes air pollution as "*the world's biggest environmental health risk*".

# “Air Pollution is the Biggest Environmental Risk to Health in the European Union”

- So said the European Court of Auditors who reported in September 2018 that “air pollution causes about 400 000 premature deaths in the EU and hundreds of billions of euros in health-related external costs.”
- This really isn’t good enough!

[Special Report No 23/2018 , “Air pollution: Our health still insufficiently protected”, JOUE C 324 of 13 September 2018](#)

[https://www.eca.europa.eu/lists/ecadocuments/insr18\\_23/insr\\_air\\_quality\\_en.pdf](https://www.eca.europa.eu/lists/ecadocuments/insr18_23/insr_air_quality_en.pdf)



EUROPEAN  
COURT  
OF AUDITORS

# The Air Quality Strategy, 2000

- *Clean air is an essential ingredient of a good quality of life. People have the right to expect that the air they breathe will not harm them”.*

# An Annual Toll of Death and Ill Health

- In the UK estimates vary as to the annual death toll associated with exposure to air pollution with the most recent data suggesting that between 28 000 and 36 000 people die prematurely each year, principally associated with exposure to fine particles and nitrogen dioxide.
- Public Health England estimate the 2017 costs of air pollution to the NHS and social care in England as about £157 million.



# Managing UK Air Quality

- Three regimes – mostly disconnected although seeking similar outcomes in terms of managing air quality
- International law – the UNECE Convention on LRTAP - UK and EU are parties
- European legislation on emissions and concentrations – applies to the whole of the UK
- Local Air Quality Management – a devolved responsibility for governments in the UK who set policy and technical guidance for implementation by local authorities.
- Specifics differ across the UK space dependent upon the requirements of devolved administrations in Scotland, Wales, Northern Ireland as well as the Mayor of London and Secretary of State for Defra.
- See Longhurst et al (2009) Atmospheric Environment 43 (1) 64-78

# It's Not for the Want of Legislation

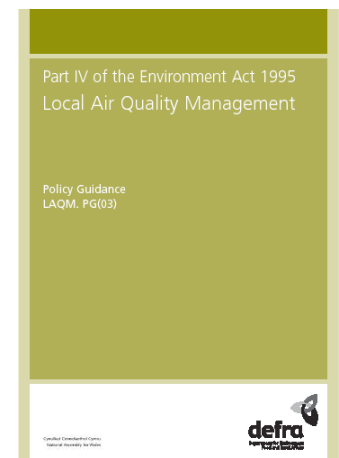
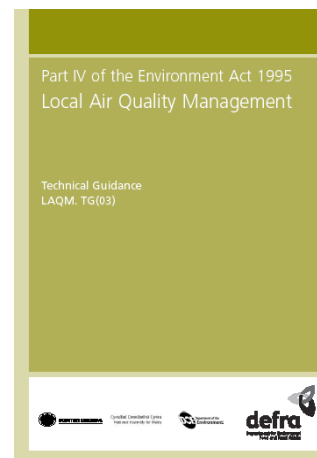
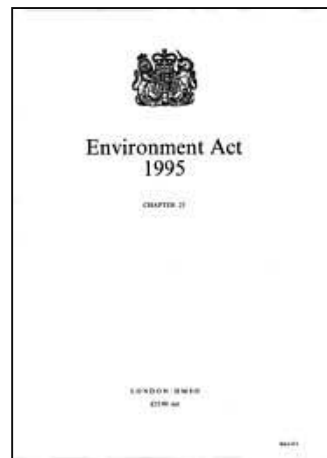
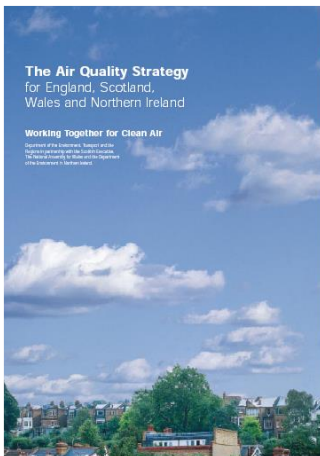
- We have had plenty in the UK.
- In the 61 years since the 1956 Clean Air Act we have many, many acts that directly or indirectly relate to air pollution.
- Perhaps not always as effective and hard hitting as we might want
- Often the intent has been watered down by special interest lobbying
- Always at risk from the anti-regulation red tape cutter
- Often the enforcement has been under resourced, weak or ineffectual

# Regulation and Enforcement

- To conceive and execute environmental protection responsibilities National and Local Authorities require an effective regulatory framework and a well trained and efficient enforcement capability.
- Both must be present to deliver effective environmental protection.

# Environment Act 1995

- **This really was avoidable if we were serious about managing local air quality!**
- The Environment Act 1995, Part 4, introduced the concept of the Air Quality Management Area (AQMA). These new, spatially referenced, management areas were identified on the basis of exceedance of an objective for a specified pollutant.
- See <http://www.legislation.gov.uk/ukpga/1995/25/part/IV>



# The Increasing Evidence of Policy Failure

- 1995 Environment Act and UK Air Quality Strategy set domestic annual mean AQ Objective for NO<sub>2</sub> of 40µg/m<sup>3</sup> **to be achieved by 2005**
  - It was expected that there would be "*a handful of AQMAs in large cities and metropolitan areas*"
  - By 2004 over one hundred local authorities had one or more AQMA declarations for NO<sub>2</sub> at the start of the year. The 2005 deadline was not going to be met.
- 
- See Longhurst et al (1996) Atmospheric Environment. 30 (23) 3975-3985
  - Longhurst et al (2009) Atmospheric Environment 43 (1) 64-78
  - Barnes, J. et al (2013) Environmental Planning and Management 57 (5). pp. 660-681.
  - Barnes, J. et al (2018) Environmental Science & Policy 85, pp 28–39

# The Solutions do not Match the Problem

- **By 2008: 225 LAs (52%) had AQMAs ( $\approx$ 500 AQMAs in total)**
- **2016: 259 /389 LAs with AQMAs (613 AQMAs in total)**
- **July 2018, 264/391 Local Authorities – 68% of those in the UK**  
– have one or more AQMAs. Some AQMAs are for more than one pollutant.
- These are not 'localised hotspots' they are local manifestations of a systemic national problem
- A problem that is strongly resistant to the current policy prescriptions for management

**Table 2-1 Current UK-wide status of Air Quality Management Areas (AQMAs) and Action Plans (as of July 2018.)**

Region	Total LAs	LAs with AQMAs	AQMAs for NO <sub>2</sub>	AQMAs for PM <sub>10</sub>	AQMAs for SO <sub>2</sub>
England (outside London)	293	197	513	41	6
London	33	33	34	29	0
Scotland	32	14	29	25	1
Wales	22	11	39	1	0
Northern Ireland	11	9	18	6	0
<b>TOTAL</b>	<b>391</b>	<b>264</b>	<b>633</b>	<b>102</b>	<b>7</b>

# Air Quality Management Areas

- Most Air Quality Management Areas in the UK are in urban areas and have been declared because of traffic emissions of nitrogen dioxide or PM10.
- Road transport is the main source in 96% of the AQMAs declared for NO<sub>2</sub>.
- 2% of NO<sub>2</sub> AQMAs result from road transport mixed with either domestic or industrial sources, with the remaining 2% made up of non-traffic and unspecified sources.
- Source <https://uk-air.defra.gov.uk/aqma/>
- An AQMA declaration requires a local authority to develop an Action Plan to improve air quality.
- The requirement is to prepare a plan not to improve air quality!
- See also Longhurst et al (2009) Atmospheric Environment 43 (1) 64-78
- Longhurst et al (2016) Sustainable Development & Planning 11 (4) 491-499



# Failure of Local Air Quality Action Plans

- Very hard to identify clear cases where AQAPs have been effective and improved air quality to the extent that and AQMA has been revoked
  - Little political priority within Local Authorities
  - Keeping traffic flowing a bigger priority!
  - Even if taken seriously by LA, actions are within the context of national policies designed to facilitate ever larger traffic flows
  - Implementation under resourced
  - Capacity and capability to act not always present.
- 
- See Longhurst et al (2016) Sustainable Development & Planning 11 (4) 491–499

# EU non-compliance not LAQM failure catalyses change.

- Failure of the UK properly to respond to the EU requirements has catalysed public opinion and led to vocal campaigns for change.
- National enforcement actions was ultimately mandated by the High Court! The Clean Air Zone
- Interestingly, the wide spread exceedance of the UK's own air quality objectives has not resulted in a similar campaign.
- But we are seeing a reaction to the Local Authority proposals for Clean Air Zones.

# Reaction to Clean Air Zone Proposals

**Bath businesses are going to be 'bludgeoned' by 'catastrophic' clean air zone plan**

"None of this makes sense to anyone – it is terrifying"

Somerset Live 28/10/18

<https://www.somersetlive.co.uk/in-your-area/clean-air-zone-bath-businesses-2146342>

# Reaction to Clean Air Plans Drives Retraction

- **Oxford drop plans to ban private vehicles in new clean air proposals**
- <https://airqualitynews.com/2019/01/17/no-ban-for-private-vehicles-in-updated-oxford-clean-air-plans/>
- **Clean air plan for Manchester but Burnham rules out charges for private vehicles**
- <https://airqualitynews.com/2019/01/10/clean-air-plan-for-manchester-but-burnham-rules-out-charges-for-private-vehicles/>
- **Southampton scraps plan for emissions charging zone**
- <https://airqualitynews.com/2019/01/09/southampton-scraps-plan-for-emissions-charging-zone/>

# Planning Decisions

- Air Quality appears to have a low importance in Planning Decisions
- **Air quality appeal over 4000-home development thrown out**
- The Communities Secretary did not have a duty to call in a planning application for a major housing development that would potentially affect air quality in Canterbury, the Court Of Appeal has ruled.
- Appeal lodged on basis that development will affect an Air Quality Management Area in Canterbury.
- <https://airqualitynews.com/2019/01/31/air-quality-appeal-thrown-out-over-4000-home-development/>

# Reaction to ULEZ

- **London's ULEZ will damage small businesses, logistics body claims**
- <https://airqualitynews.com/2019/01/17/londons-ulez-will-damage-small-businesses-freight-body-claims/>



# Clean Air Strategy 2019 – A New Start for the Management of Air Quality?

- The Clean Air Plan highlights new legislation, local and national, as part of the Environment Bill.
- Proposes changes to the Local Air Quality Management framework and the Smoke Control regulations.
- A new National Air Pollution Control Programme is proposed to meet the National Emissions Ceiling Directive.
- Ambitious target of reducing PM<sub>2.5</sub> concentrations by 50% in areas exceeding the WHO guideline.
- New nitrogen deposition target of protecting an additional 200,000 hectares of natural habitat from excessive nitrogen deposition
- 17% cut planned in nitrogen emissions.
- See <https://www.gov.uk/government/publications/clean-air-strategy-2019> New permitting regime to manage NH<sub>3</sub> emissions from farming.

# Clean Air Strategy – A New Start for the Management of Air Quality?

- Control programme for industrial plants of 500kW to 1MW thermal input.
- Sector roadmaps for clean technology and emission reductions.
- Unconventional emission sources such as non-road mobile machinery in agriculture and construction have become a matter of policy concern.
- Biomass combustion is signalled as a concern for both industrial combustion in power plants and residential wood combustion for domestic heating.
- Air quality strategies for major ports required.
- These initiatives need good science and social science to inform policy and to avoid unintended consequences.
- This will need good systems thinking to derive robust policies and implementation plans that are not watered down by vested interests.
- See <https://www.gov.uk/government/publications/clean-air-strategy-2019> New permitting regime to manage NH<sub>3</sub> emissions from farming.



# How do we Deal with Special Interest Pleading?

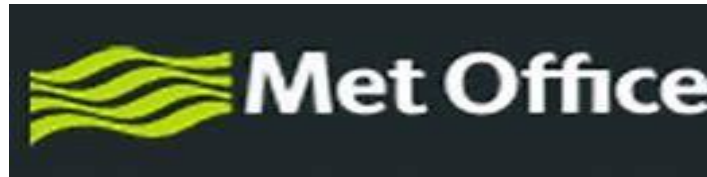
- **Clean Air Strategy: NFU warns farmers will need financial support**
- <https://airqualitynews.com/2019/01/15/clean-air-strategy-nfu-warns-farmers-will-need-financial-support/>



Image from Defra (2019) Clean Air Strategy Chapter 7

# Part 2 SPF Clean Air Programme

## UK Research and Innovation



# SPF Clean Air Programme

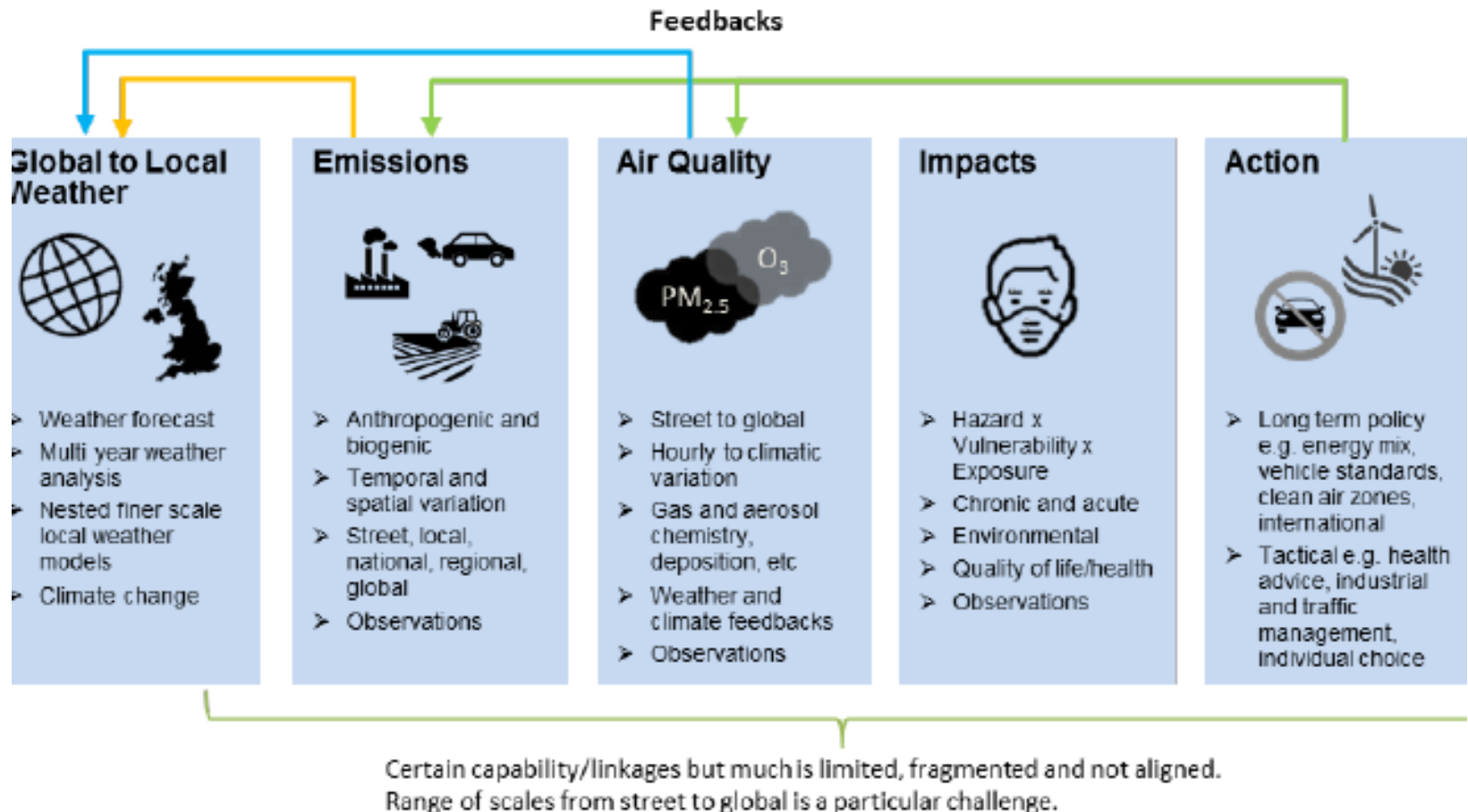
- The programme will support multidisciplinary research and innovation to stimulate solutions for clean air through predictive understanding of future air quality challenges, a systems approach to analysis, new technologies and innovative policy and practical interventions to benefit vulnerable groups, improve public health and support clean growth.
- To achieve these goals the programme must learn from the policy failures and successes of the past and adopt an integrated approach to devising solutions.
- It cannot be more of the same silo based thinking that generates tools and processes as intended solutions but for which public acceptance and policy makers ability to implement are poorly understood.
- A systematic approach integrating science and social science perspectives is required.

# SPF Clean Air Programme

The objectives of the SPF Clean Air programme are to:

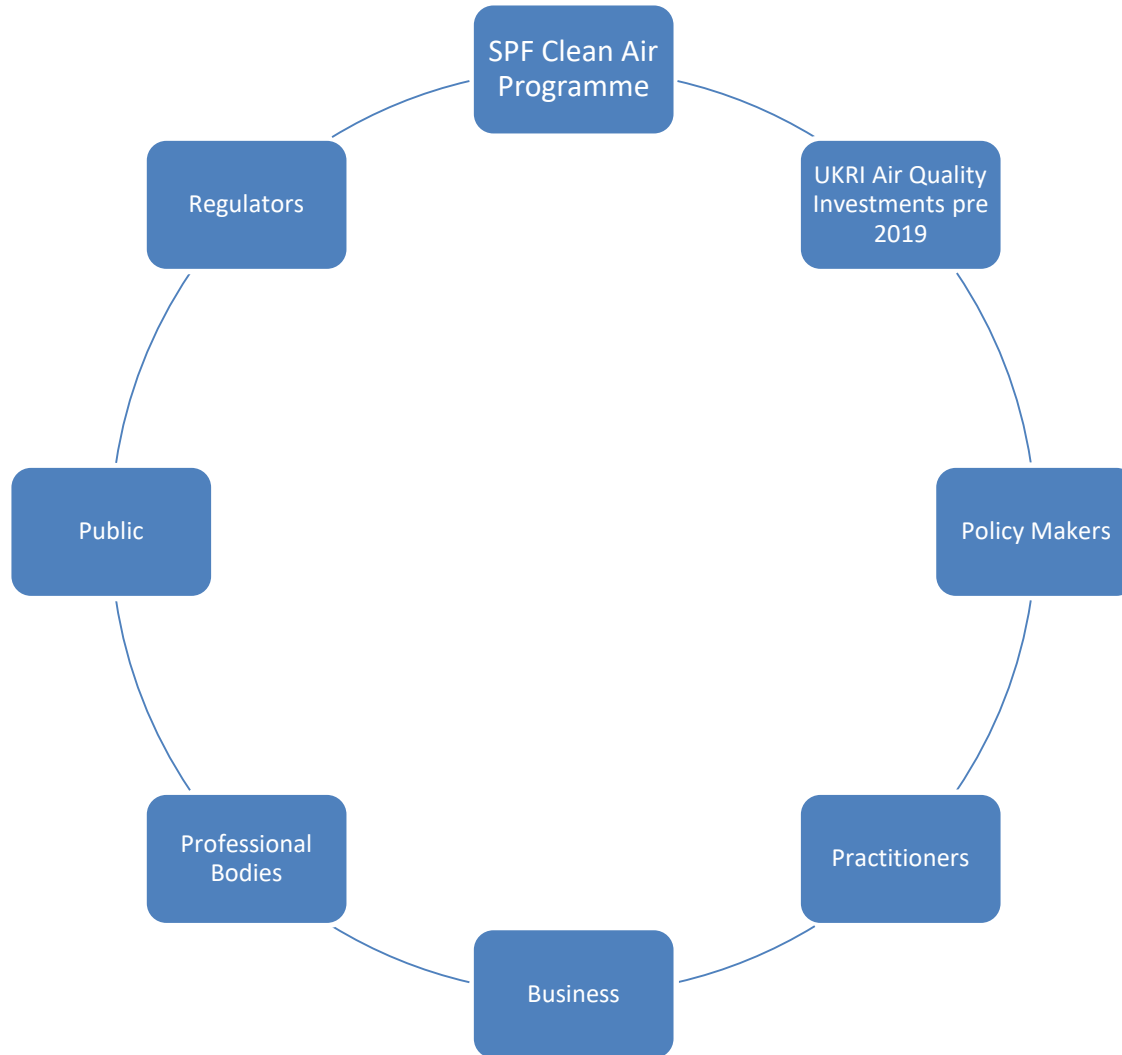
1. drive forward new multidisciplinary research and innovation;
2. leverage existing UK investments and enable a challenge-focussed multidisciplinary community to work together;
3. inform implementation of the UK Government's Clean Air Strategy;
4. develop new solutions to reduce emissions of atmospheric pollution and protect public health, whilst avoiding perverse consequences and
5. present information to stakeholders and public in an accessible way.

Figure 1. Air quality dependencies and basis for Clean Air systems analysis framework



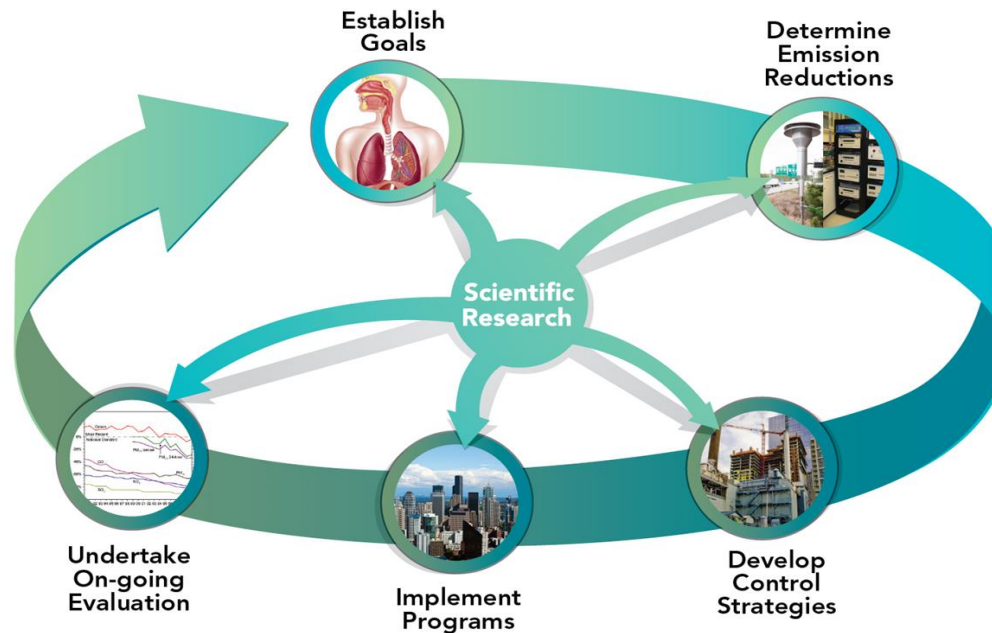
From UKRI Clean Air Programme Wave 1

# SPF System Engagement Map



# Part 3. Systems Thinking for Air Quality

## AIR QUALITY MANAGEMENT CYCLE



# Systems Approach to Air Quality

A definition of the Air Quality Management System

***"the application of a systematic approach to the control of air quality issues in which all the factors determining air quality are considered in an integrated, proportionate and cost-effective manner based upon sound science and by reference to health-effects based air quality criteria."***

**I think now we need to add people to this definition.**

After Laxen D. (1993), Clean Air, 23 p. 12

Longhurst, J.W.S. et al (1996) Atmospheric Environment. 30 (23) 3975-3985.



# Air Pollution – an emergent property

Anthropogenic air quality must be seen as an emergent property of a system, resulting from policy decisions from differing governmental spheres, often disconnected and asynchronous

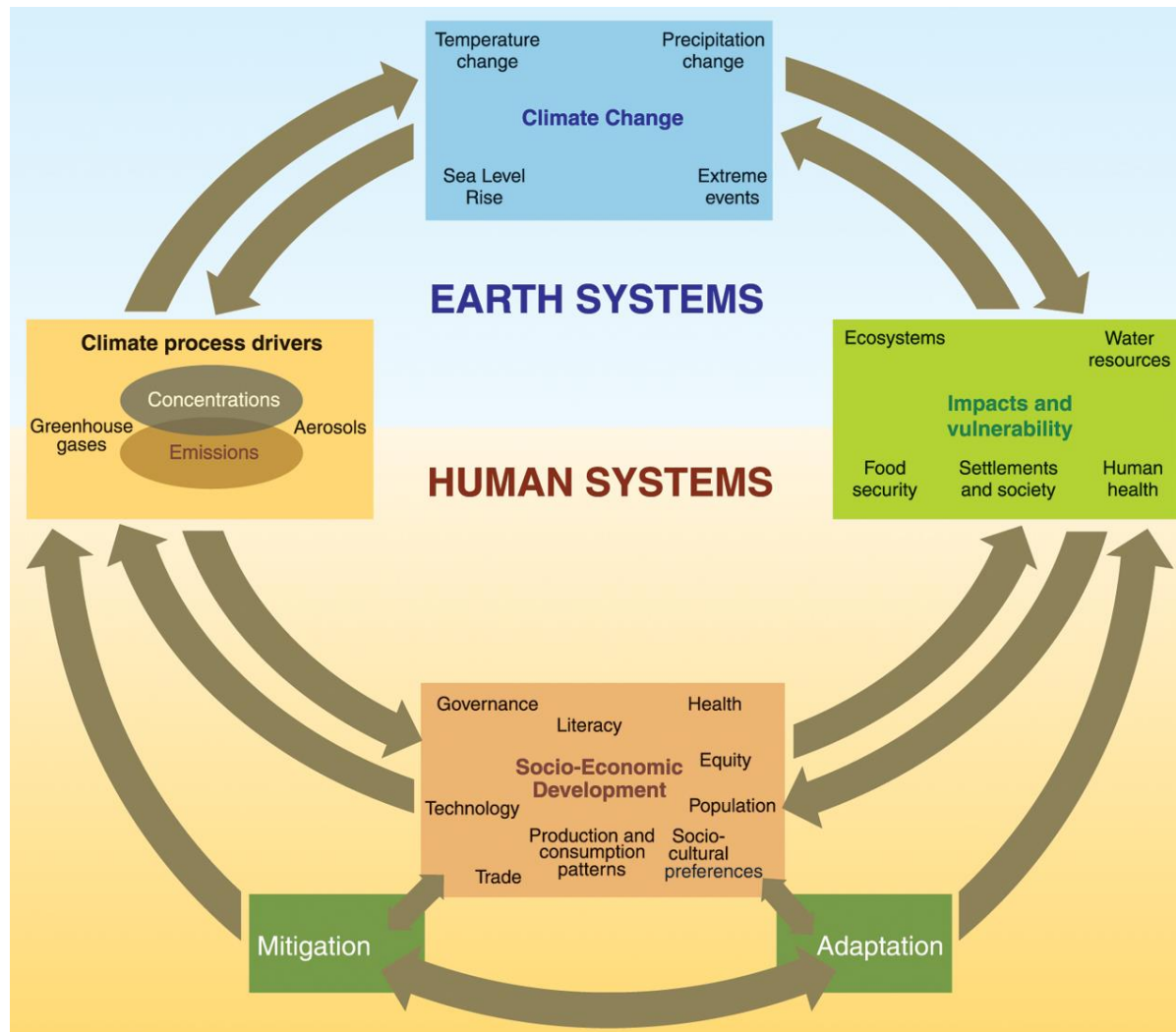
True management of anthropogenic air pollution can be only be achieved through a systematic understanding of the often multiple causes, feedback loops and impacts.

# Systems Thinking

- Systems thinking can aid policymakers in developing policies that anticipate and avoid unintended consequences.
- Systems thinking integrates multiple perspectives into a framework that describes and predicts the various ways in which a system might react to policy change.
- Systems thinking can help explain complex real world problems.

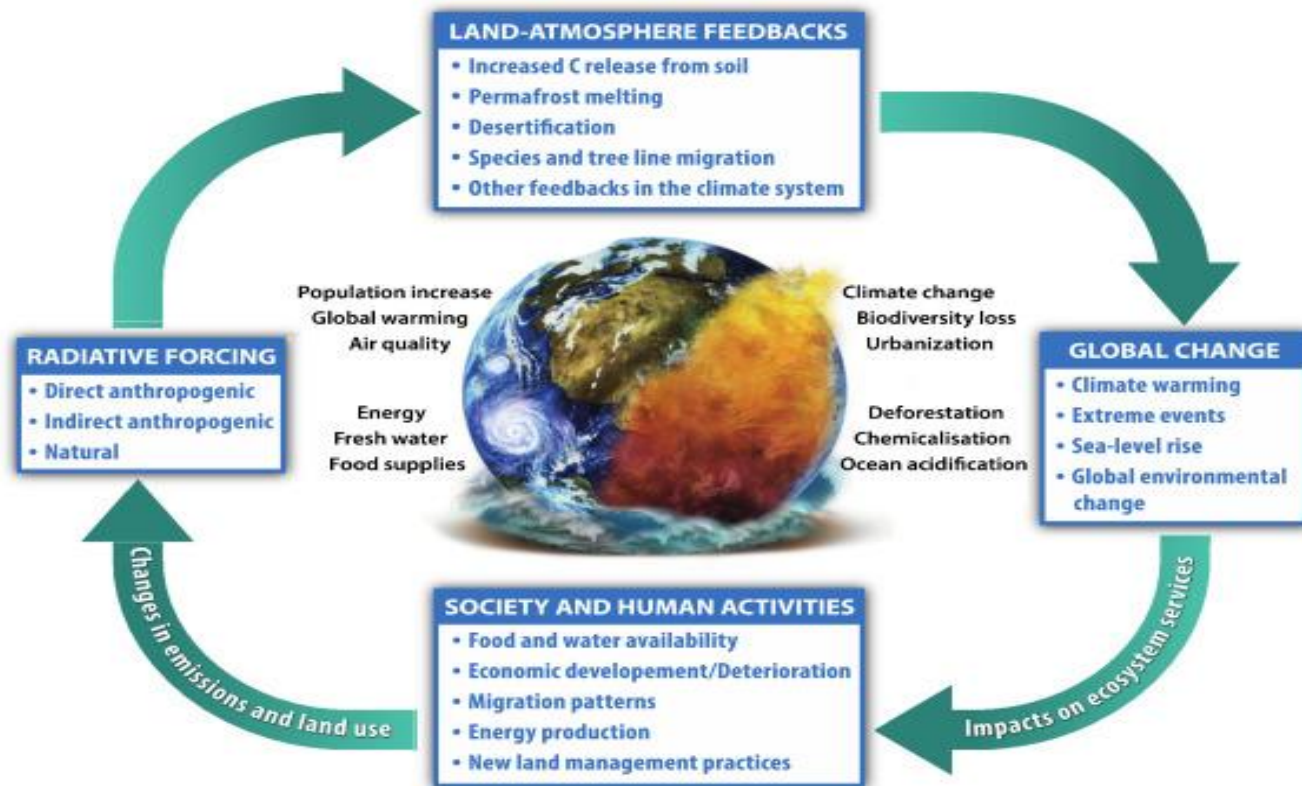
# System Conditions

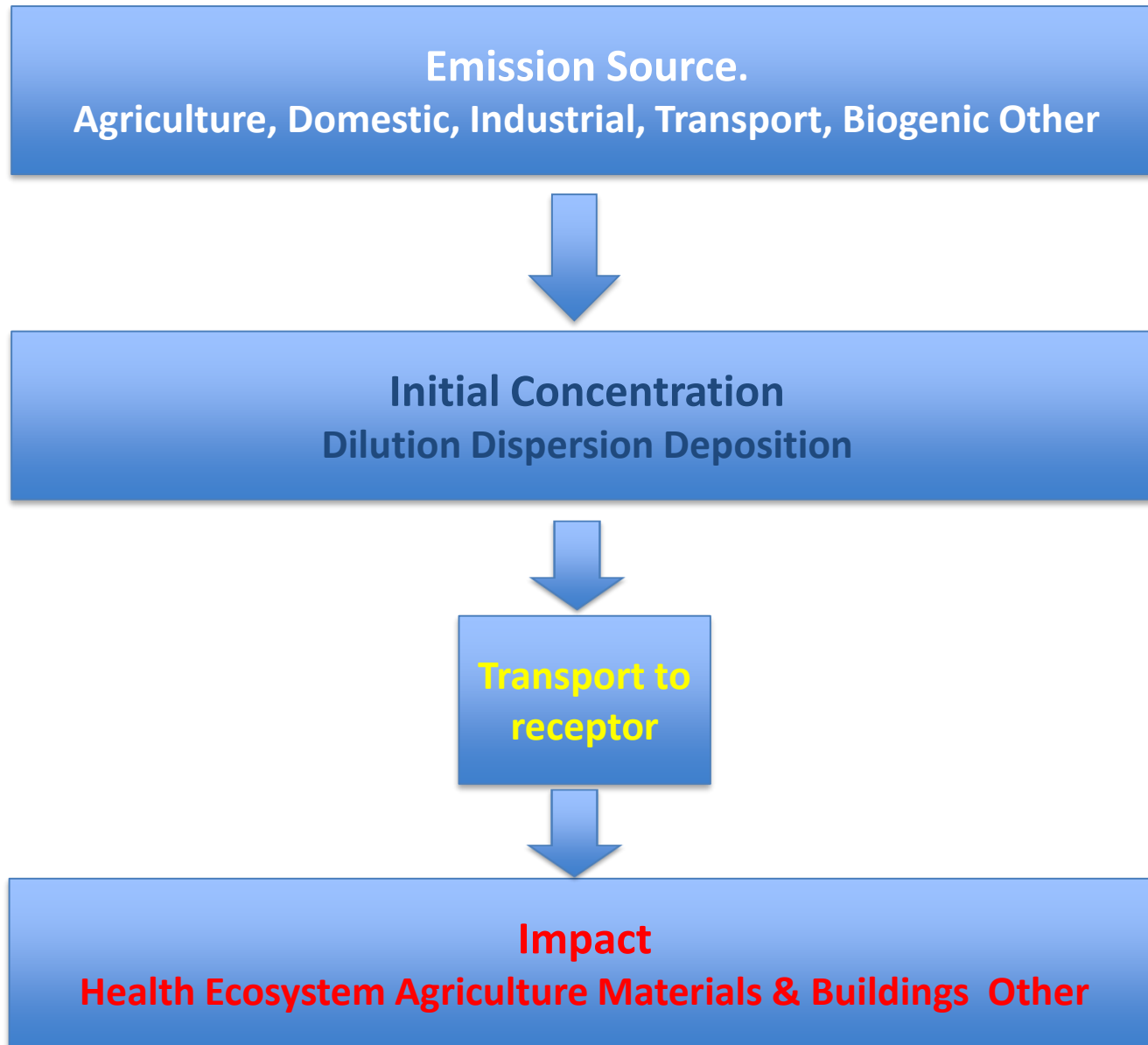
1. Many types of system including the Whole Earth System.
2. Need to consider the range of different systems and the interaction each has with other systems For example the atmospheric system with the terrestrial system.
3. However the flows, interactions and feedback mechanisms with the systems are mediated by interactions with human systems.
4. In order to understand operations and predict changes it is necessary to consider the various ways in which human policies, processes and actions interact and change the system conditions.
5. Critical to effective environmental protection is an integrated perspective of the system recognising both physical and human determinants of the system conditions.



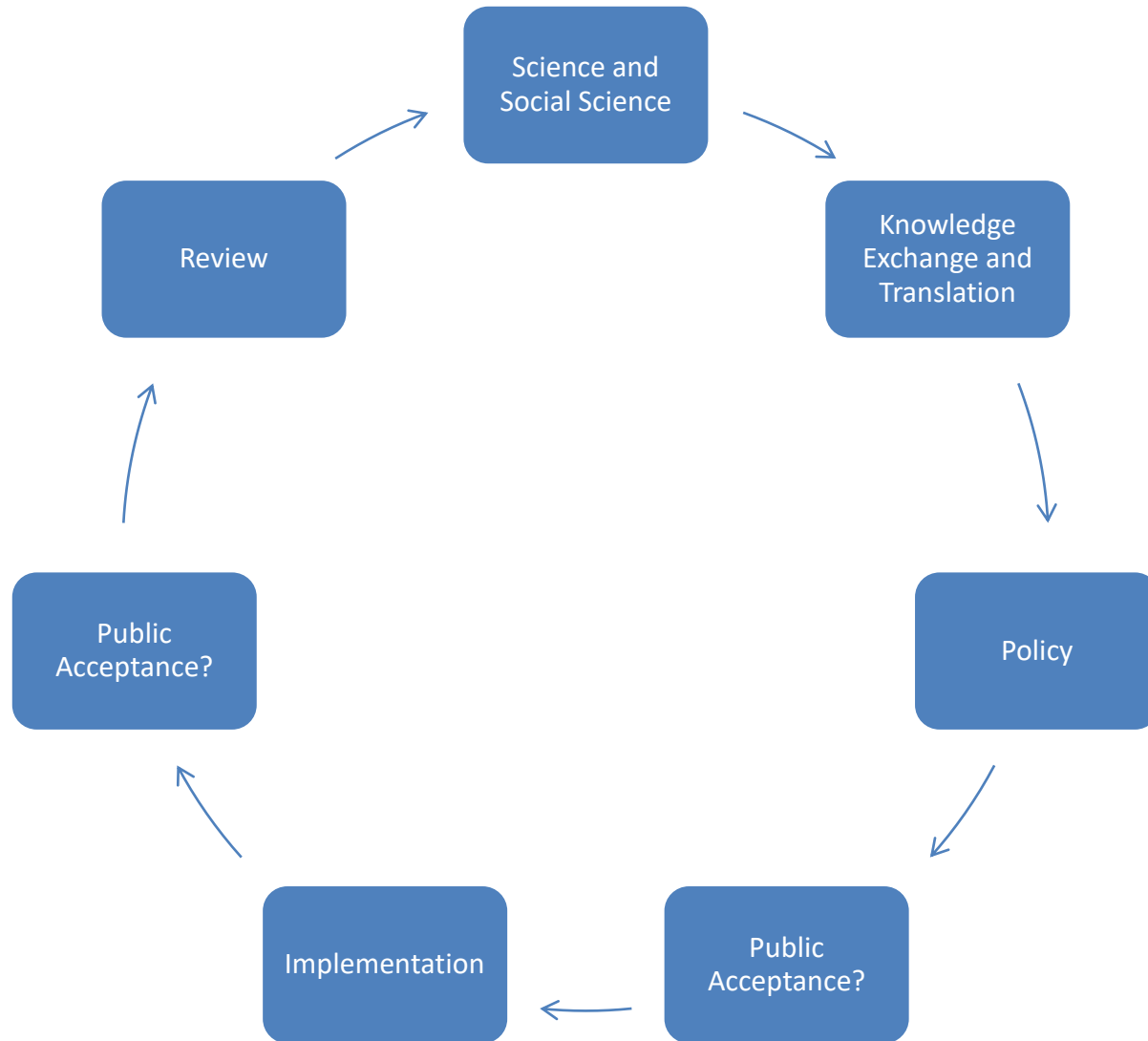
IPCC AR4 Synthesis Report (2007). Simplified representation of systems components and interactions

# Land Atmosphere Interactions





# Simple Schema of Air Quality Policy Process

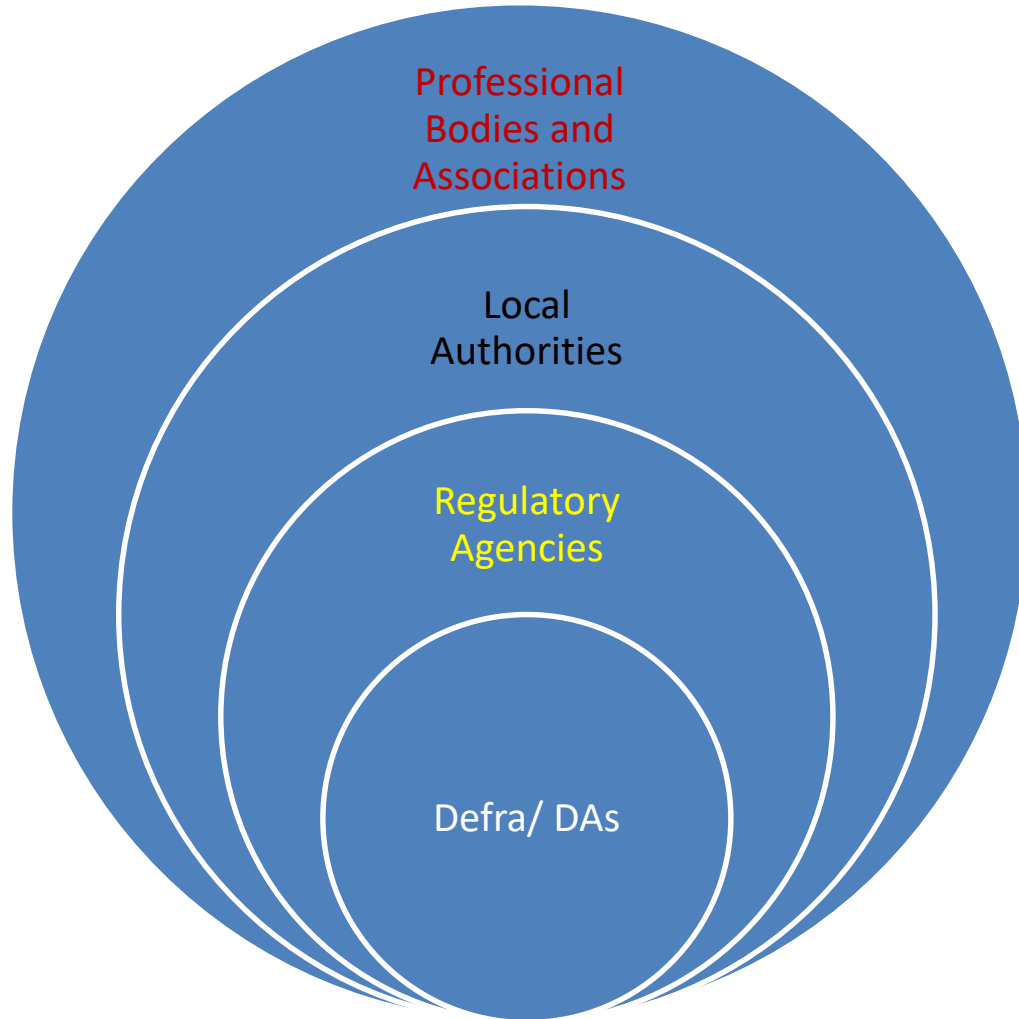


# Simple Flow Diagram of Control Programme





# Governance and Regulation

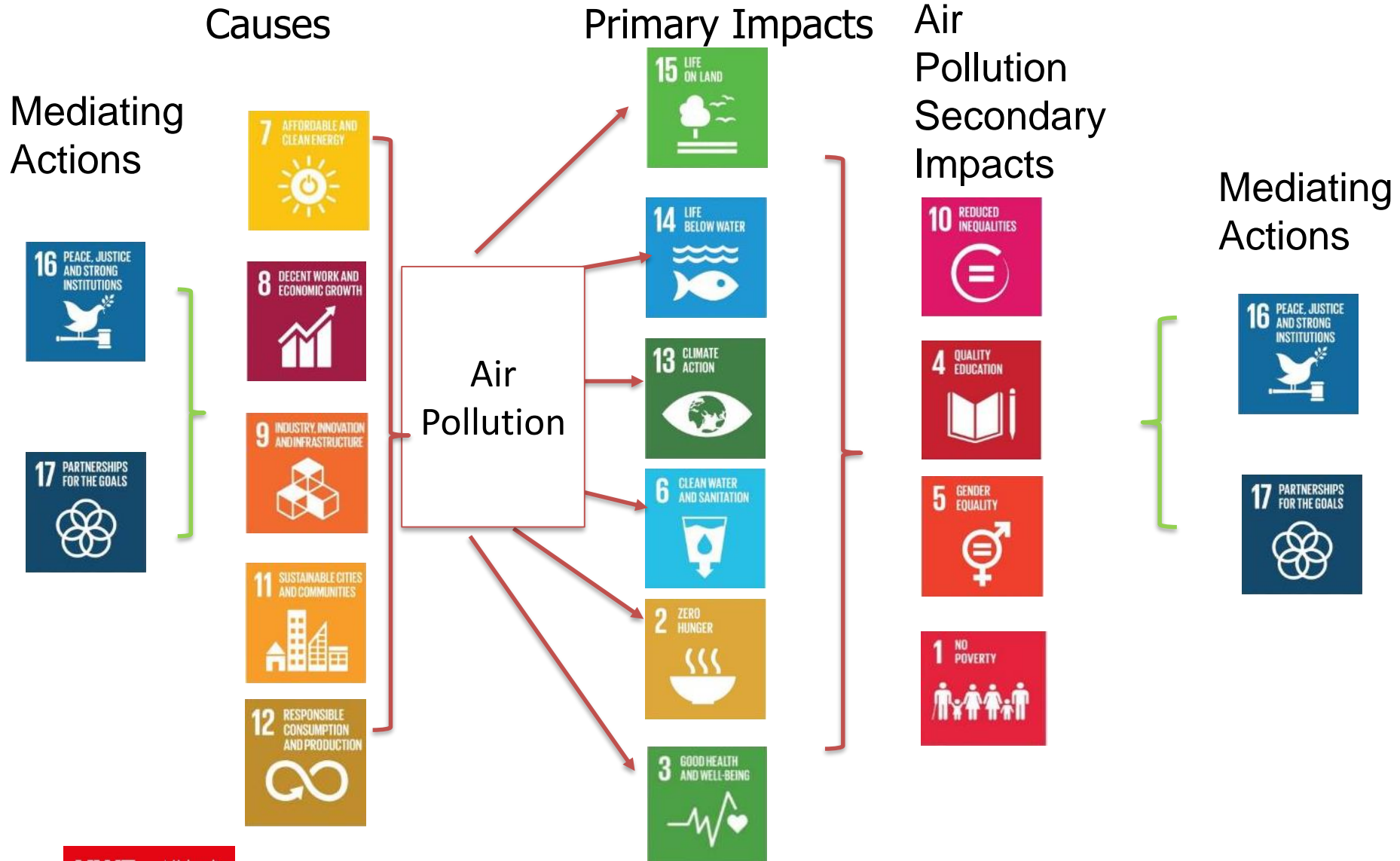




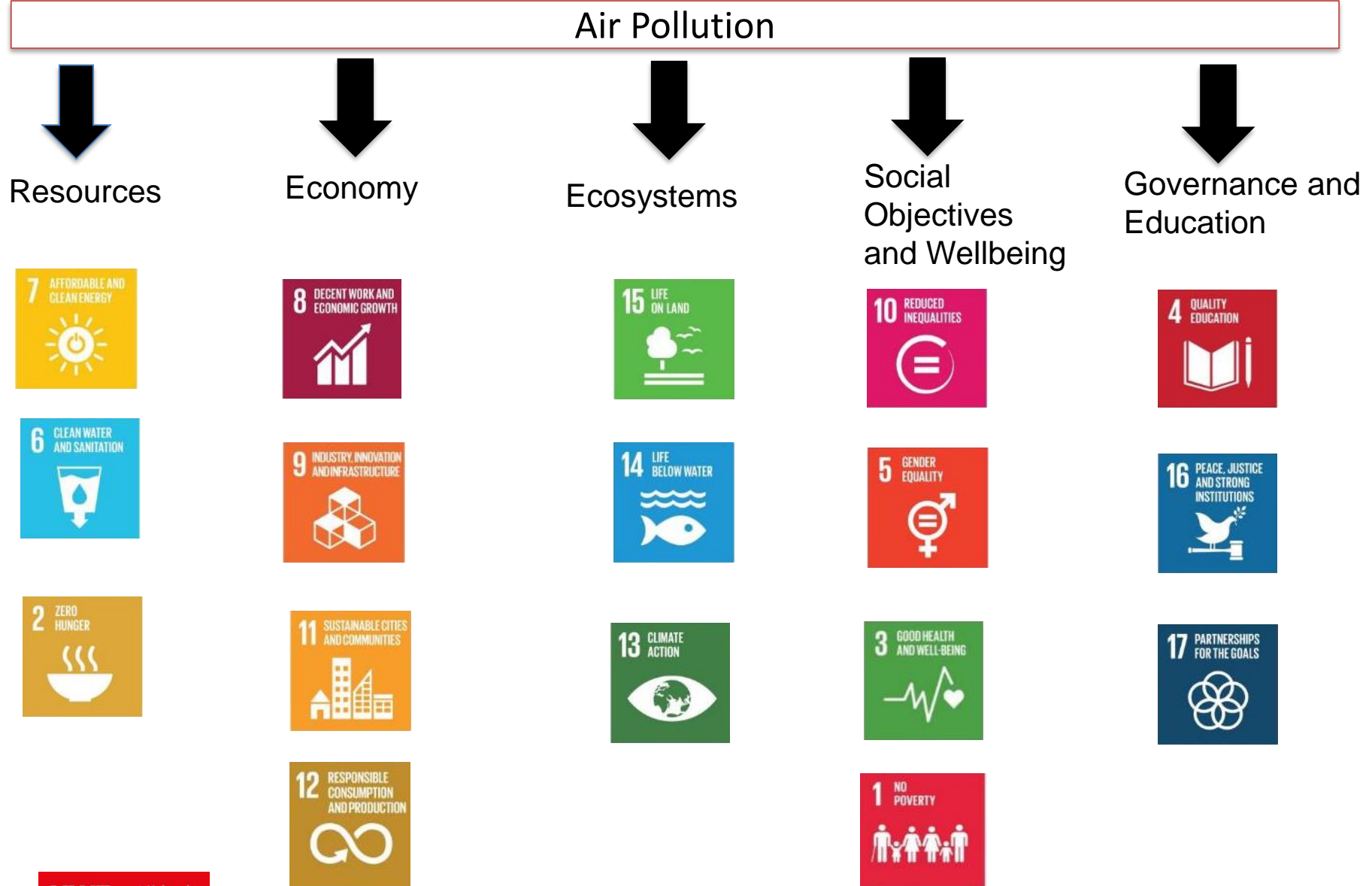
# The UN Sustainable Development Goals



# Conceptualising AQ and the SDGs



# Conceptualising AQ and the SDGs



# Late Lessons from Early Warnings

- **Late lessons from early warnings: the precautionary principle 1896-2000**, EEA 2002
- Case studies of environmental, occupational and consumer hazards, identifying the dates of early warnings, analysing how this information was used, or not used, in reducing hazards, and describing the resulting costs, benefits and lessons for the future.
- [https://www.eea.europa.eu/publications/environmental\\_issue\\_report\\_2001\\_22](https://www.eea.europa.eu/publications/environmental_issue_report_2001_22)
- **Late lessons from early warnings: science, precaution, innovation**, EEA 2013
- The case studies cover a diverse range of chemical and technological innovations, and highlight a number of systemic problems. The 'Late Lessons Project' illustrates how damaging and costly the misuse or neglect of the precautionary principle can be, using case studies and a synthesis of the lessons to be learned and applied to maximising innovations whilst minimising harms.
- <https://www.eea.europa.eu/publications/late-lessons-2>

# The Air Quality Problem

- In the two decades since the Environment Act 1995 there has been lots of activity, especially at the local authority level, but very little success in achieving cleaner air!
- The good intentions have been overwhelmed by societal changes.
- New thinking is required
- Recognise the social AND the techno centric causes and solutions to air pollution
- Address the social and structural inequalities related to both the cause of air pollution and its impacts
- Enable widespread emission reductions - not just hotspot management

# Conclusions

- Air quality in the UK and across the EU continues to pose a public health risk to much of the population.
- Efforts to control emissions and to manage and reduce exposure continue but are often under resourced, lack sufficient political support and public understanding and engagement is often absent.
- Ultimately air pollution is a choice society makes through its collective and individual behaviours and social practices.



# Conclusions

- However the consequences of those behaviours and choices will play out in many different ways with those who are least able to exercise choice having air pollution concentrations imposed upon them.
- History shows that concerted, collective and sustained action can lead to dramatic improvements in air quality.
- Society can choose to minimise the effects of air pollution.
- New ways of thinking and acting are required.
- The SPF Clean Air programme will be able to provide new science and social science knowledge to support effective and efficient solutions and to explore their acceptability.
- A commitment to true cross-disciplinary working and systems thinking is required in order to deliver the ambition and potential of this programme.

**Professor James Longhurst**

**University of the West of England,  
Bristol,  
BS16 1QY  
UK**

**Email [James.Longhurst@uwe.ac.uk](mailto:James.Longhurst@uwe.ac.uk)**

**Public profile**

**<http://people.uwe.ac.uk/Pages/person.aspx?accountname=CAMPUS\j-longhurst>**

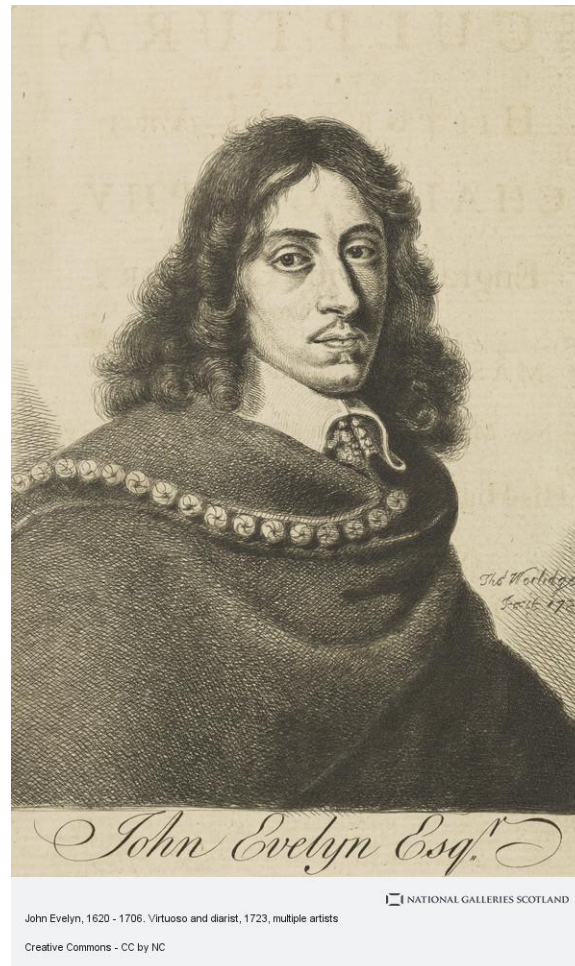


# Bonus slides

A little More on the Lessons of History and a couple of different systems slides

# John Evelyn 1620 – 1706

## Late Lesson1



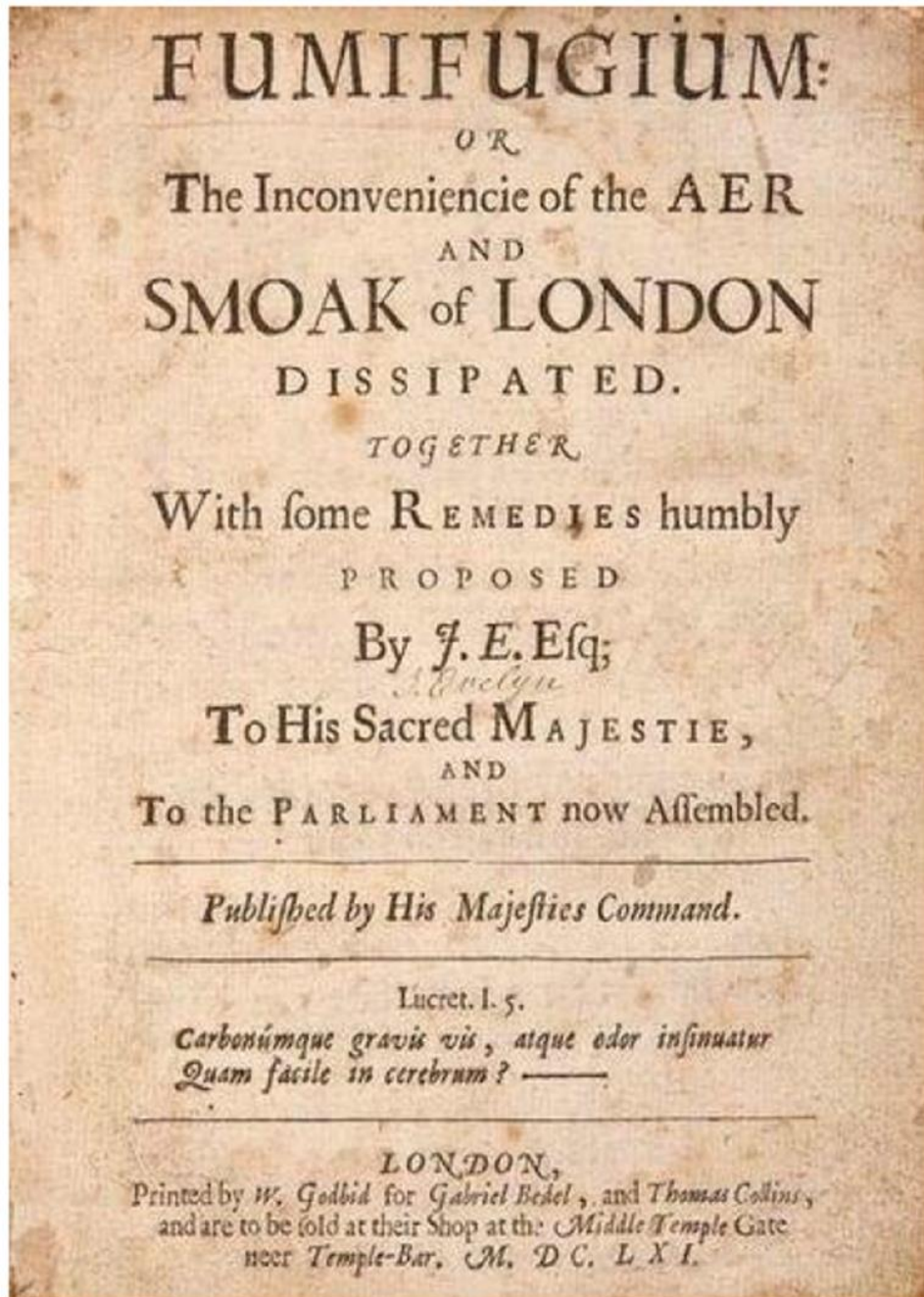
<https://www.nationalgalleries.org/art-and-artists/30011/john-evelyn-1620-1706-virtuoso-and-diarist>

# John Evelyn 1661



*"That this Glorious and Antient City, should wrap her stately head in Clouds of Smoake and Sulphur, so full of Stink and Darknesse, I deplore with just Indignation."*

[http://www.environmental-protection.org.uk/assets/library/documents/Fumifugium\\_MMXI.pdf](http://www.environmental-protection.org.uk/assets/library/documents/Fumifugium_MMXI.pdf)



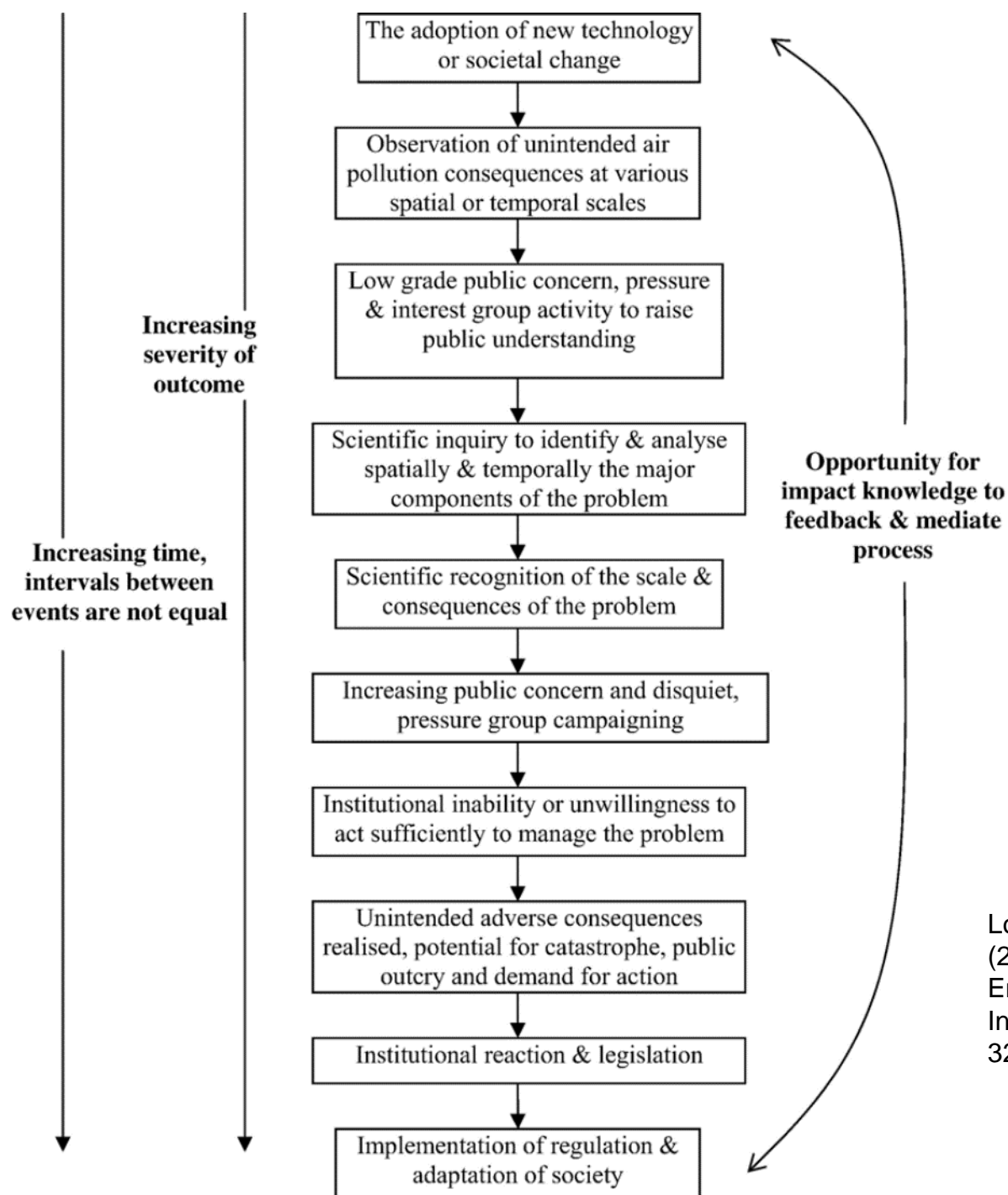
# RA Smith 1817-1884

## Late Lesson 2

- First chief inspector of the Alkali Inspectorate, 'father of acid rain'
- Author of Air and Rain. The Beginnings of a Chemical Climatology, Longmans, Green & Co. 1872
- See <https://archive.org/details/airrainbeginning00smitia/page/n6>



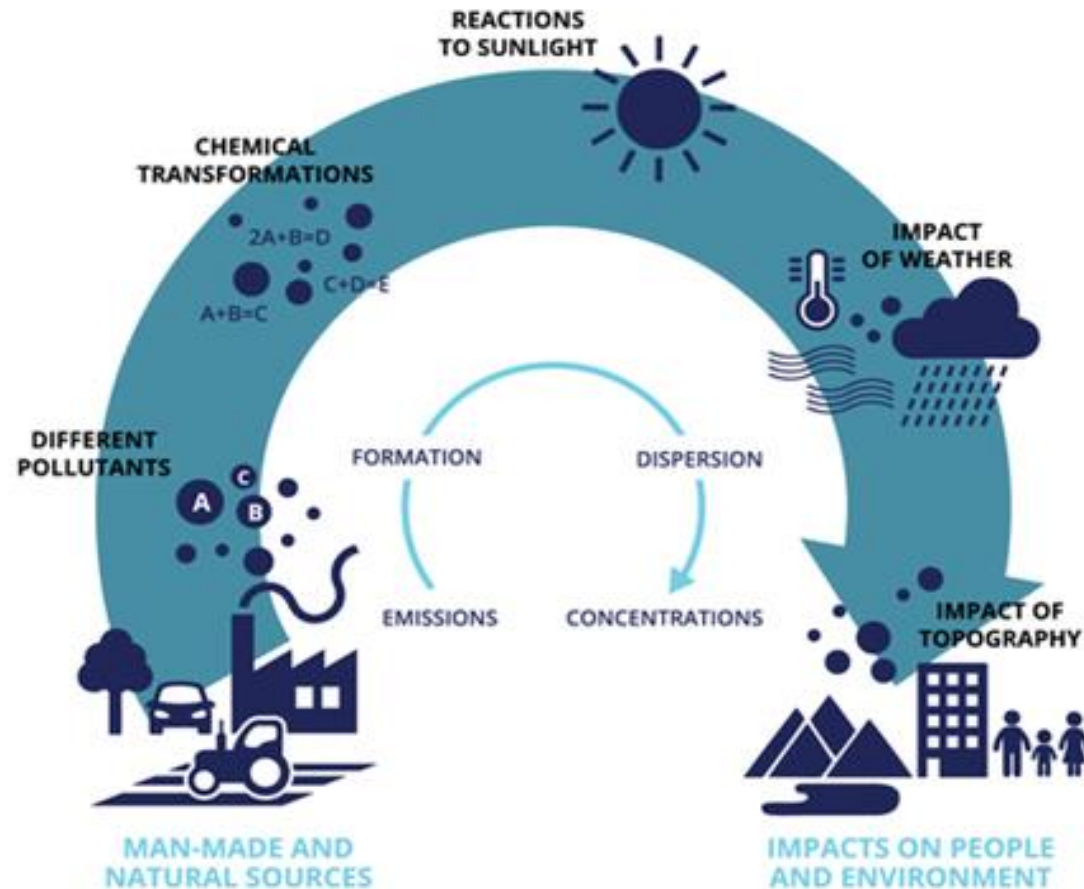
A conceptual model of air pollution in a risk management framework.



Longhurst *et al*  
(2006)  
Environment  
International  
32(8) 934-947.



## Simple Pollutant Pathway from EEA



Where are the views of people taken into account in this schema?