Omega

Aviation in a sustainable world

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ESRC Research Seminar 3
Complexity – a framework for Policy and Decision Support
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Aviation environmental challenge

- Sustainability gap: 5% annual growth but 1-2% technology and operational response
- Local pressures and global threats – hardening scientific evidence
- Small evolutionary changes but need revolutionary steps
- Overcoming institutional and commercial barriers
- Uncertainty over impacts and international action

What is Omega?

- Independent, multi-sectoral academic network of aviation sustainability expertise.
- Forum for exchange of ideas / expertise and building consensus of the challenges and potential solutions.
- ‘One-stop shop’ platform for advice, analysis, research and KT.
- Reduce impacts to enable sustainable growth

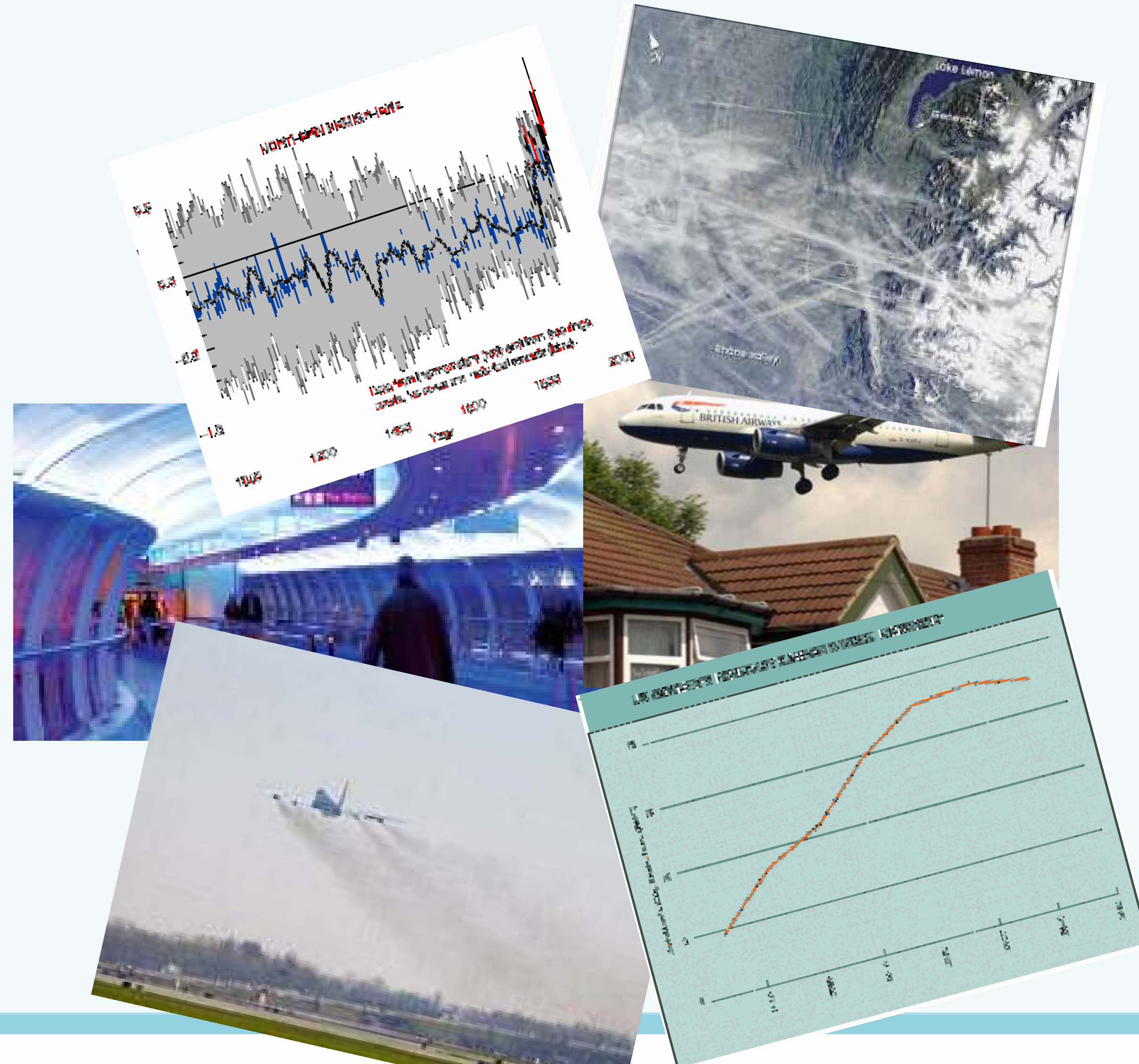
Research role: Omega role

- Complement and support work by Governments and industry
- Provide a longer term view – look out to 2030 – 2050
- Context and facilitation for those who deliver change – the right information to help strategise
- Forum for debate, innovation and ideas testing
- Stimulate and challenge

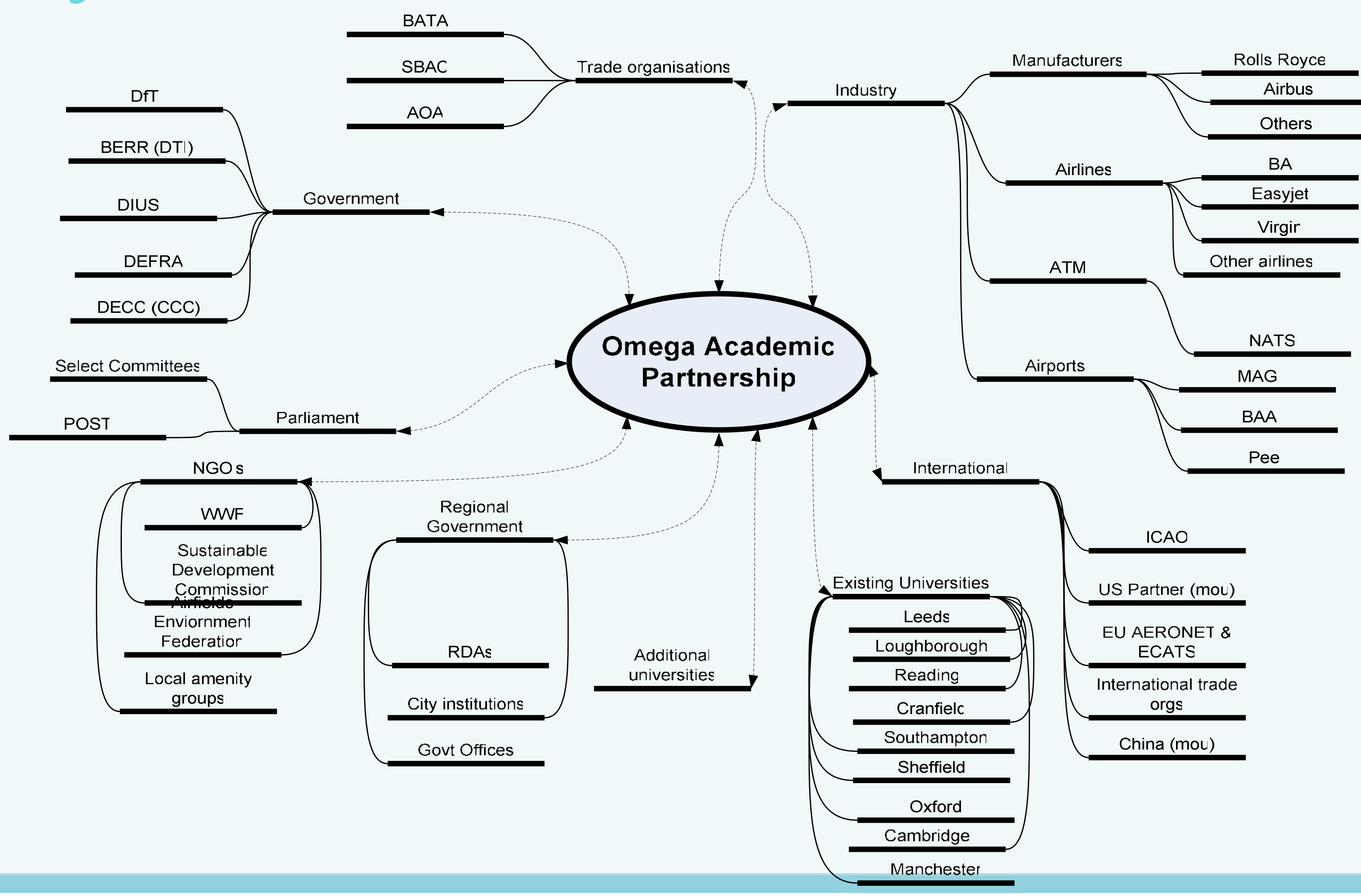
Omega scope

Topic areas

- Climate change
- Local air quality
- Noise
- Aircraft systems
- Aircraft operations
- Alternative Fuels
- Demand
- Mitigation policy

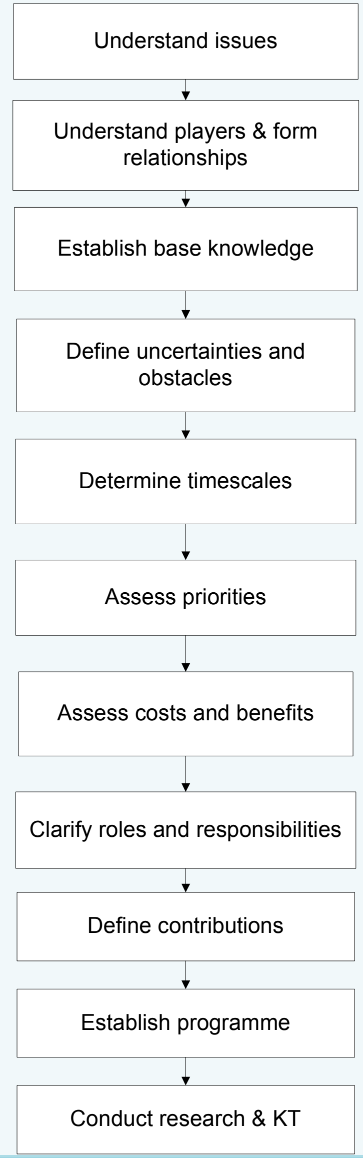


Players in debate



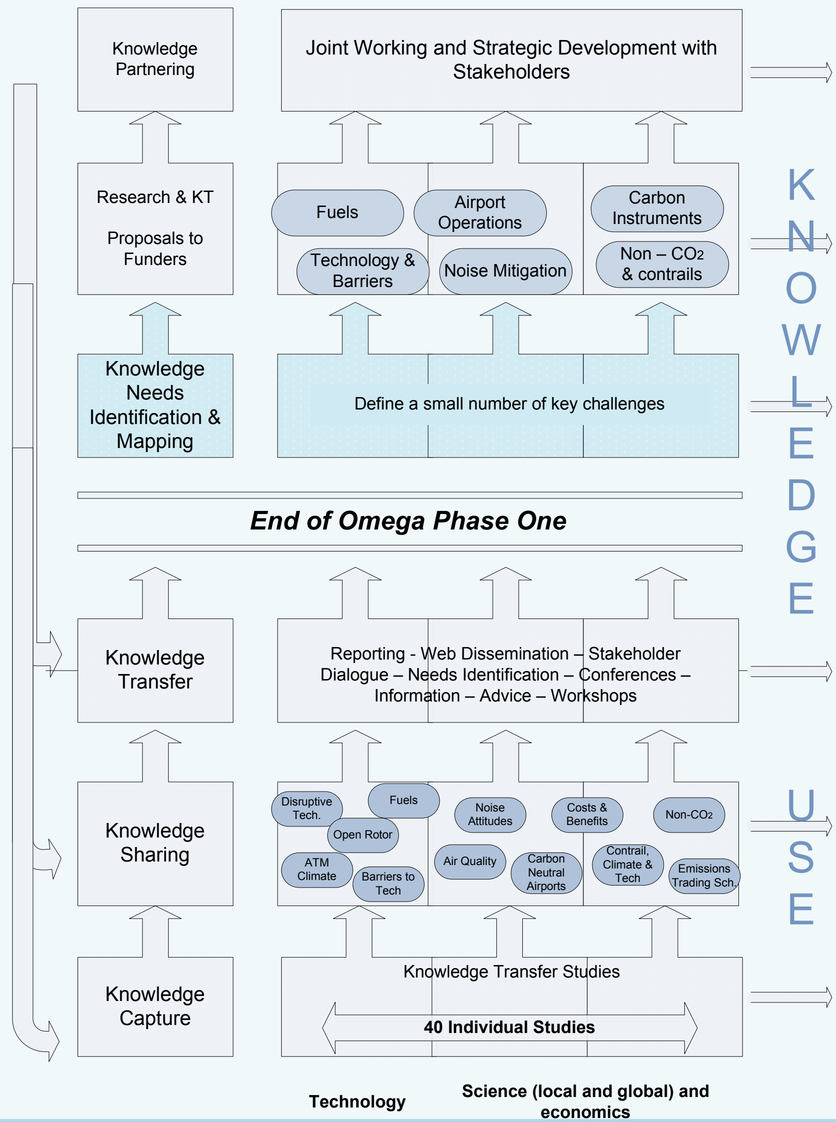
Omega process

- Making sense of the status quo
- The role of academia
- Plugging knowledge gaps & exploring solutions
- Working with the 'delivery agents'

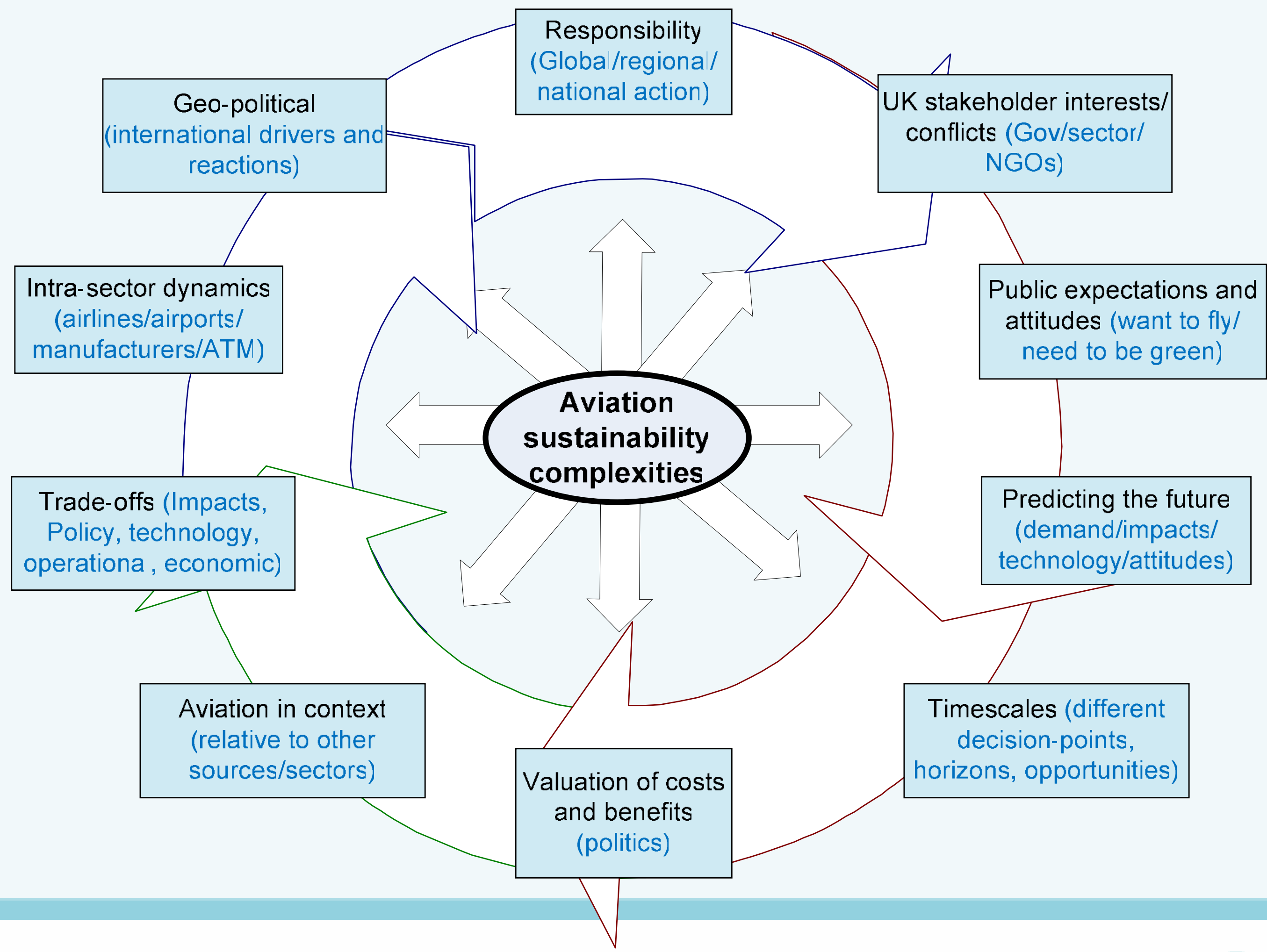


Omega status

- Extracting messages from phase 1 and gap analysis
- Dialogue on priorities
- Define knowledge needs addressing key obstacles
- New programme with stakeholder engagement



Aviation sustainability complexities

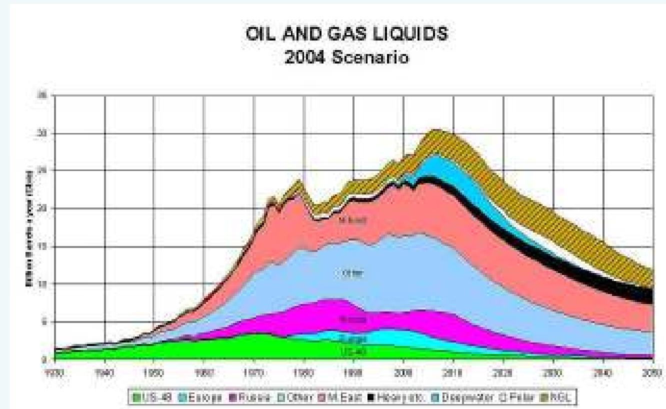


Aviation demand, climate change and Socio-Economic Development

An Example of Complexity

CC Challenge   Aviation challenge

- Targets for CO_2 reduction by 2050.
  UK   80%



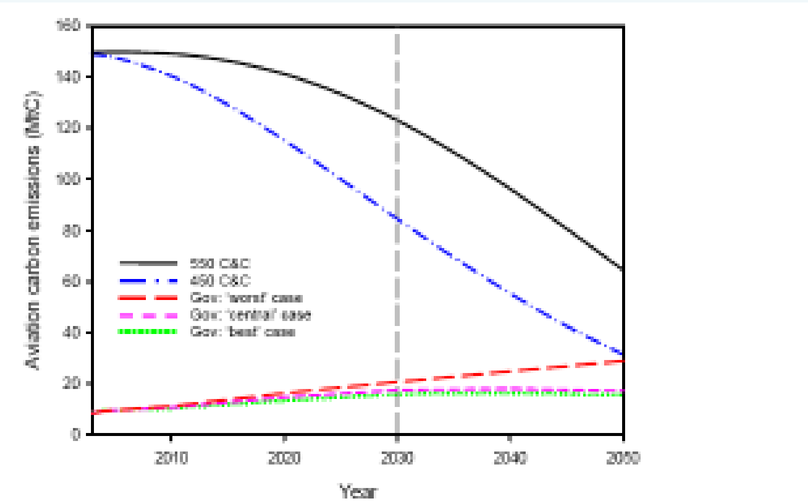


Figure 9: DfT aviation forecasts in terms of carbon emissions for the UK in relation to contraction and convergence profiles for 450ppmv and 550ppmv, each with a convergence date of 2050. The contraction and convergence profiles were generated using a version of *CCOptions* consistent with the UK Government's 60% carbon reduction target.

- Aviation small contribution to CC but it is increasing - 1200% increase in demand for aviation fuel by 2050-60?

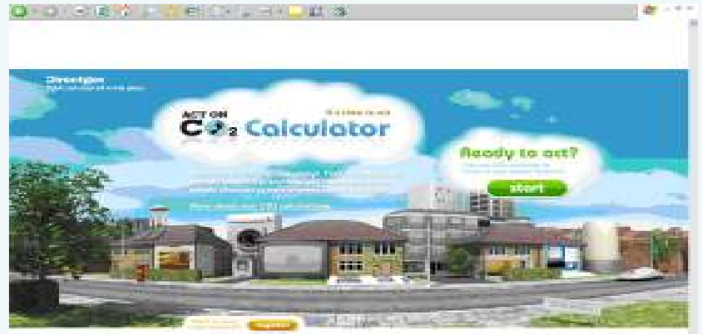
- Legacy user of carbon fuels and emitter of CO_2.

C.C. Public Attitude and growth

- Aviation products very attractive to public but:
  - Evidence of CC happening
  - Government pressures building

- Calls being made to restrict further airport infrastructure growth.

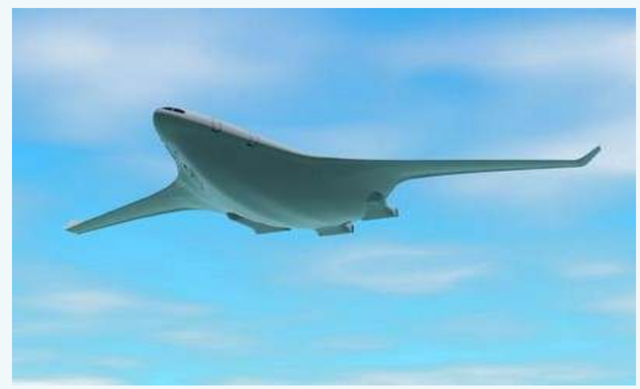
- Will impact upon demand and regulation



Industry Responses will increase the cost of air travel

- Aircraft technology
- Alternative fuels
- Emissions trading
- Fleet replacement
- Operations
- Business practices
- Carbon offsetting

- Step change to carbon free flight



CC will affect Pattern of Demand

- Ticket prices more closely linked to distance.
- Some tourism destinations become too hot others more attractive.
- Traditional holiday seasons could change to adapt.

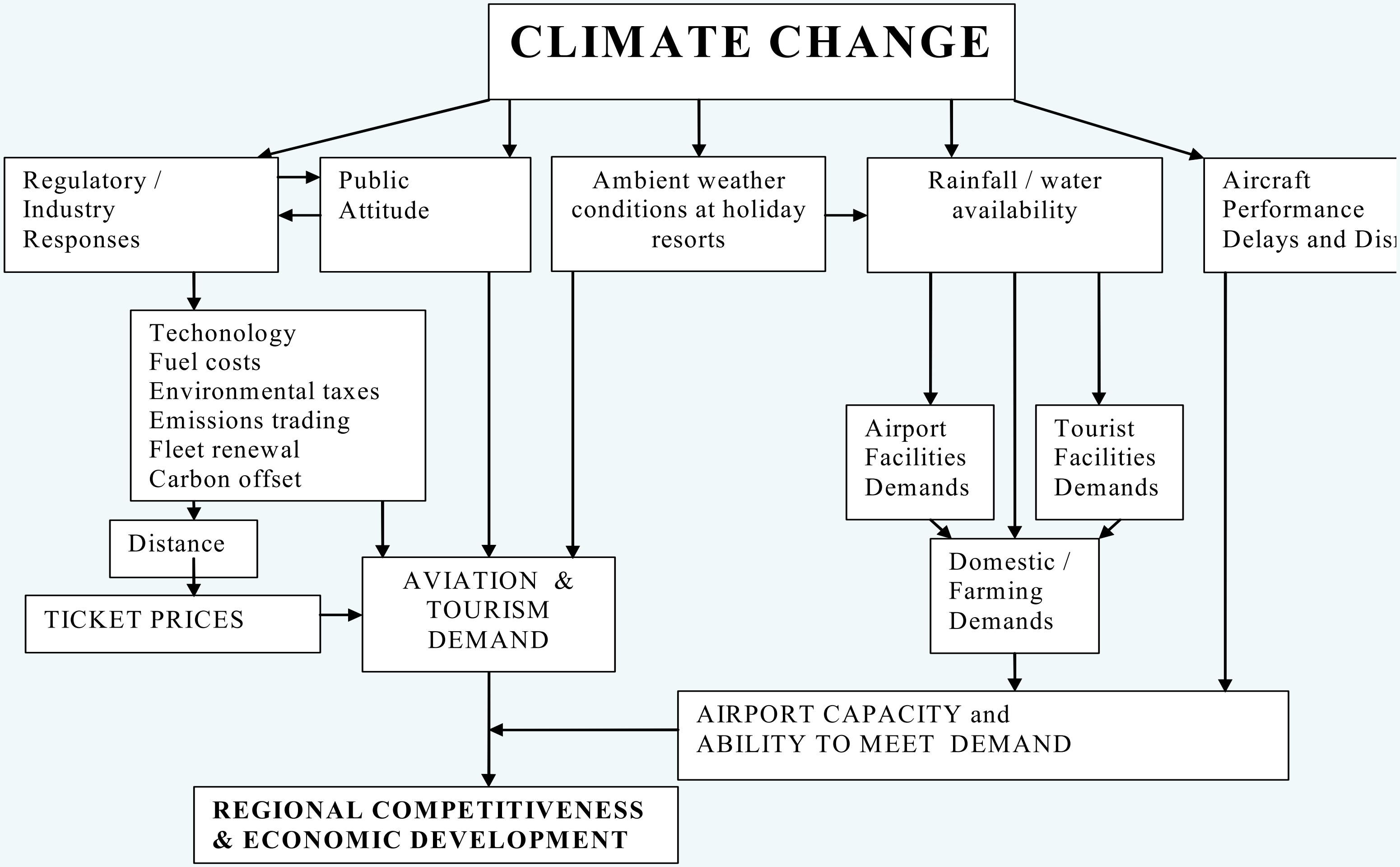
CC will affect Airport Capacity

- Operations affected by rain, fog, high winds, heat
- Infrastructure design – adaptation /new developments
- Competition for energy and water from domestic, agriculture, tourism and airports.
- Adequate secure, sustainable supply e.g. Mediterranean islands, LHR?

CC Impacts on ATM

- Disruption, delays, a/c performance.
  - Rain, fog, winds, heat.
  - Changes in jet stream
- SESAR - system flexibility and weather forecasting critical.
- Aircraft technological development a critical issue.

Climate effects on aviation



It is difficult to accurately forecast the speed or the extent to which climate change will impact on aviation development. But change is happening quickly and the future will be very different.

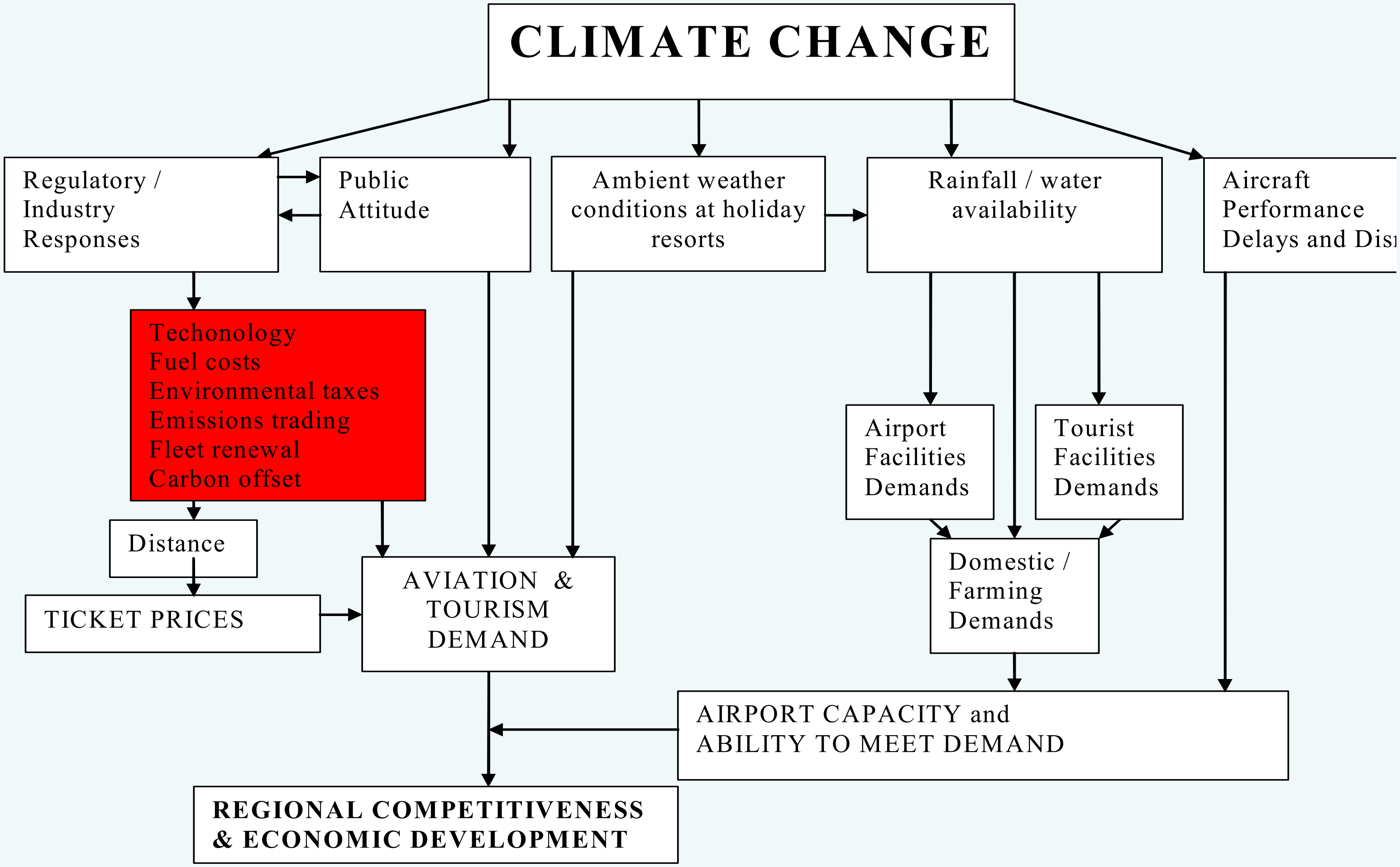
We are entering ‘uncharted territory’.

IAN POLL

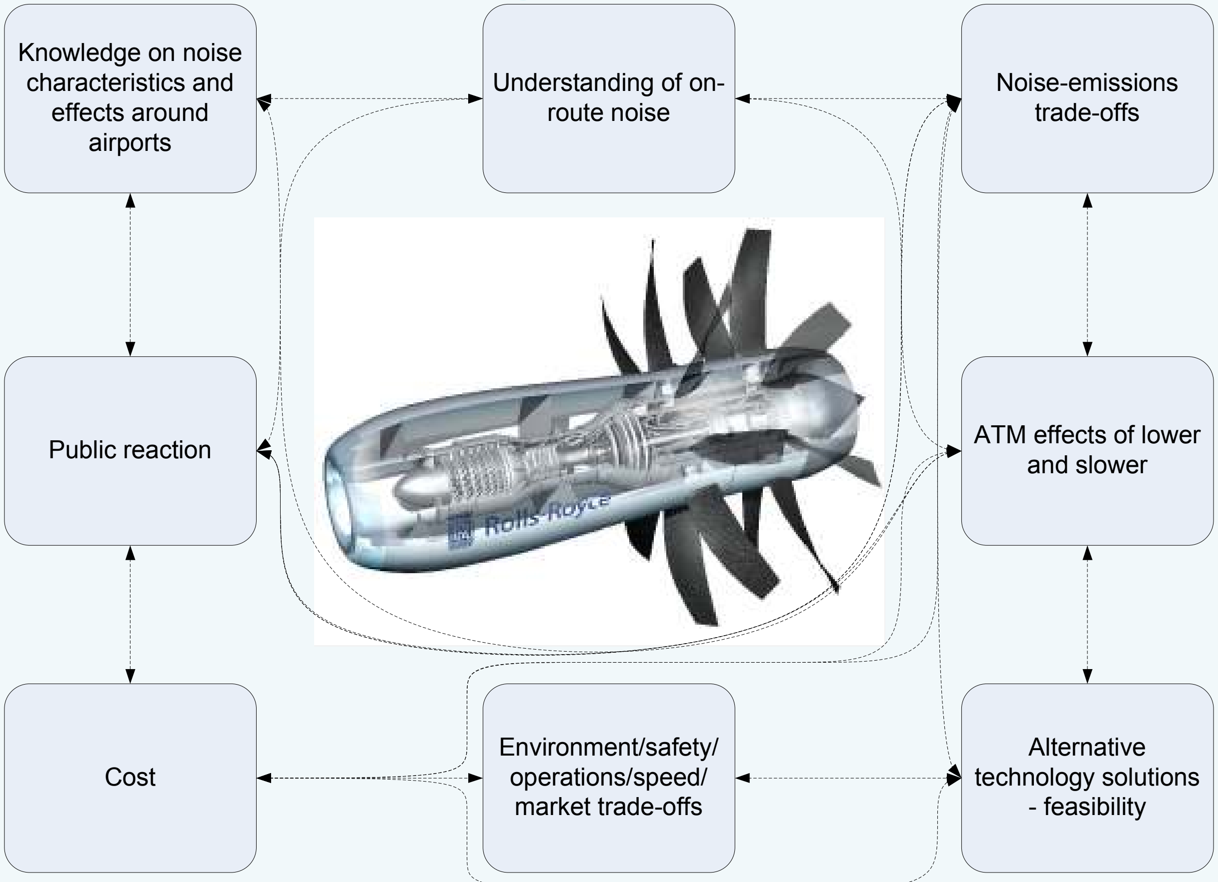
Technology solutions to noise and emissions

Micro-level Complexity

Technology solutions to noise and emissions - Micro-level Complexity



Open rotor engine example



Drivers and conflicts – reduce CO2 –v- lower noise.

Aviation and the EU ETS

Understanding the effects of including aviation in complex European market system

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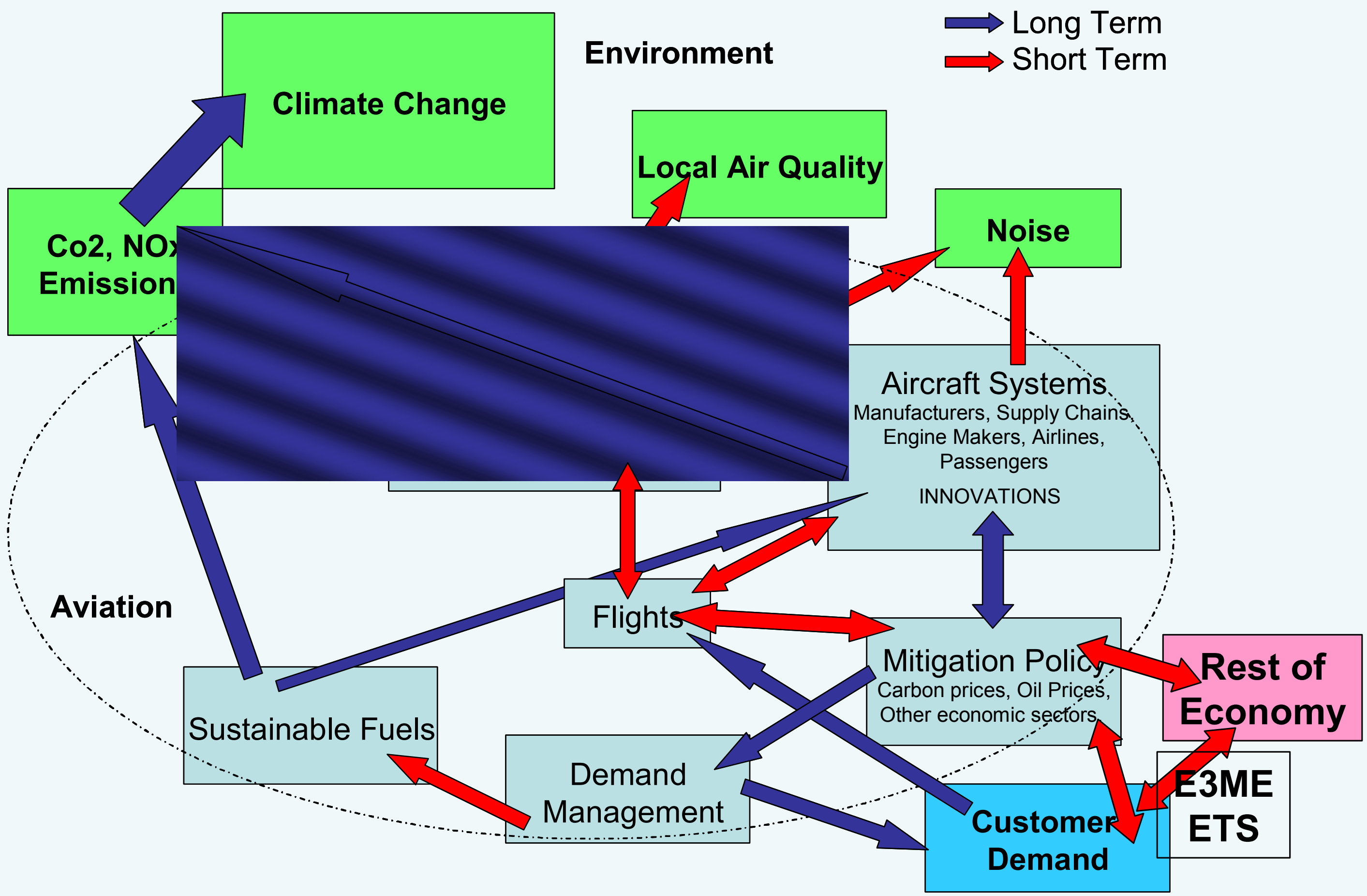
Omega complexity



Omega ETS study

- Study the possible impacts on the European aviation industry and general economic activity of including the aviation sector in the EU ETS: effects on the sector (CO2, demand) and economy (CO2, GDP).
- Examine a wide range of scenarios to determine the conditions under which the inclusion of aviation in the EU ETS would either lead to technological change in the aviation industry towards higher energy and emissions efficiencies.

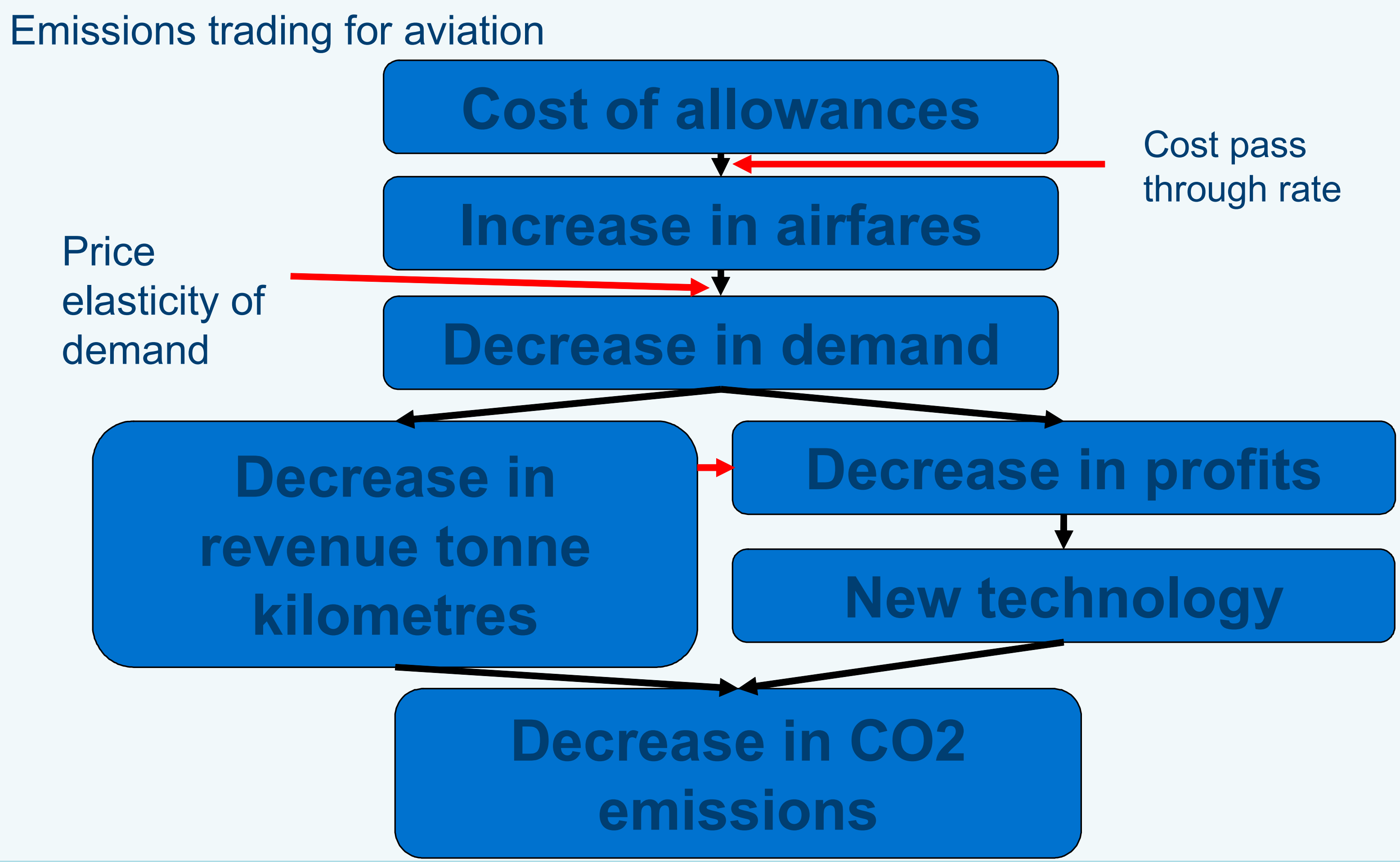
E3ME model

- used **E3ME – an *Energy-Environment-Economy Model at the European level*** *of Cambridge Econometrics* - E3ME is developed from a quantitative systems approach:
- comprehensive (whole E3 system, all sectors, many policy instruments)
- open as regards economic policy, i.e. no assumptions of full employment, budget balance, or balance of payments equilibrium
- "scenario" approach: computation of many scenarios with comparisons of policy packages and provides quantified explanation of results
- treatment of uncertainty
  - in parameter estimates (econometric estimation of error distribution)
  - in assumptions and policies (by scenario analysis)
- modular, so that research can be decentralised e.g. emissions trading submodel

E3ME model (2)

- **E3ME:** a medium- to long-run E3 model, runs 1970-2020
- **Use of cointegration techniques to identify long-run trends from panel data**
- **Disaggregated** *27 European regions, 19 energy users, 12 energy carriers, 42 industries, 14 atmospheric emissions*
- **Focussed on fiscal instruments for mitigation and diffusion of technology**
- **Emissions trading in E3ME -** Six of the 19 fuel users are included
  - power generation
  - other transformation
  - iron and steel
  - non-metallic mineral products
  - paper and pulp
  - **air transport**

ETS notional aviation effects



ETS study fundamentals & findings

- The air transport industry does not exist in isolation. It is a part of wider EU economy and therefore is affected by changes in other industries and also by changes in consumer behaviour.
- Exploring the air transport **in interaction** with the other 41 industries allows:
- To make explicit the effects of constraints from other sectors through intermediate demand
- Through changes in consumers behaviour, money that does not get spent on air transport is spent on products from other industries which may then spend more on air transport
- GDP impacts the air transport industry and the air transport industry affects GDP and these changes in income are also taken into account
- **The impacts of including aviation in the EU ETS from 2012 were estimated to be small. For example: 7.4% reduction in CO_2 emissions from the EU air transport industry (below business as usual) and no change GDP in 2020 (€20 per tonne of CO_2)**

Summary: the Omega Process

- Knowledge transfer concept
- Engage collaborative partners
- Gap analysis and scenarios
- High impact studies
- Knowledge transfer and mapping
- Boosting intellectual capacity for accelerated gain