Foresight in Science and Innovation
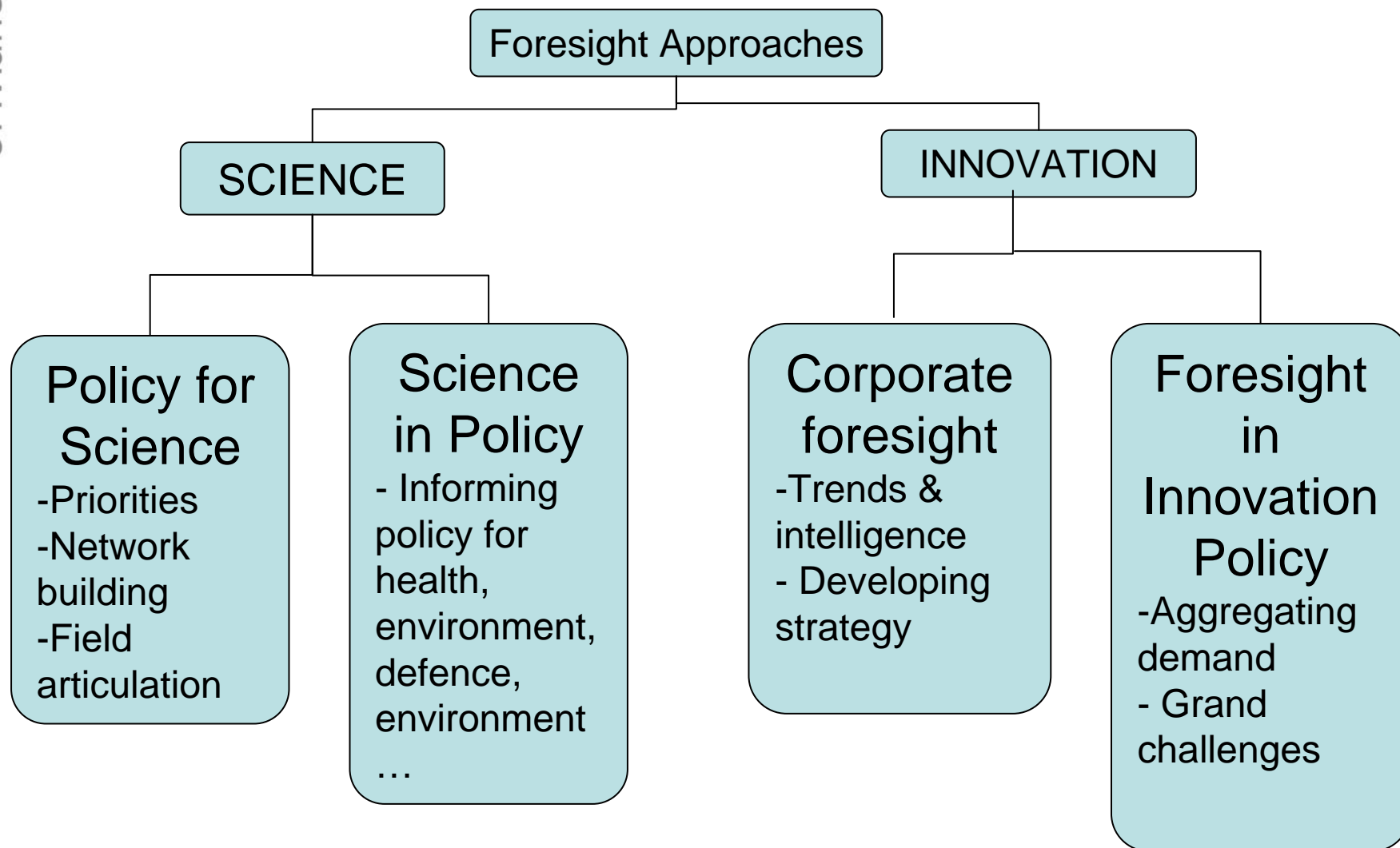
Luke Georghiou

MIoIR, Manchester Business School

University of Manchester

http://www.mbs.ac.uk/PREST

Foresight in Science and Innovation

```
                    ┌──────────────────────┐
                    │ Foresight Approaches │
                    └──────────┬───────────┘
              ┌────────────────┴─────────────────┐
        ┌──────────┐                        ┌──────────────┐
        │ SCIENCE  │                        │ INNOVATION   │
        └────┬─────┘                        └──────┬───────┘
      ┌──────┴──────┐                     ┌────────┴────────┐
```

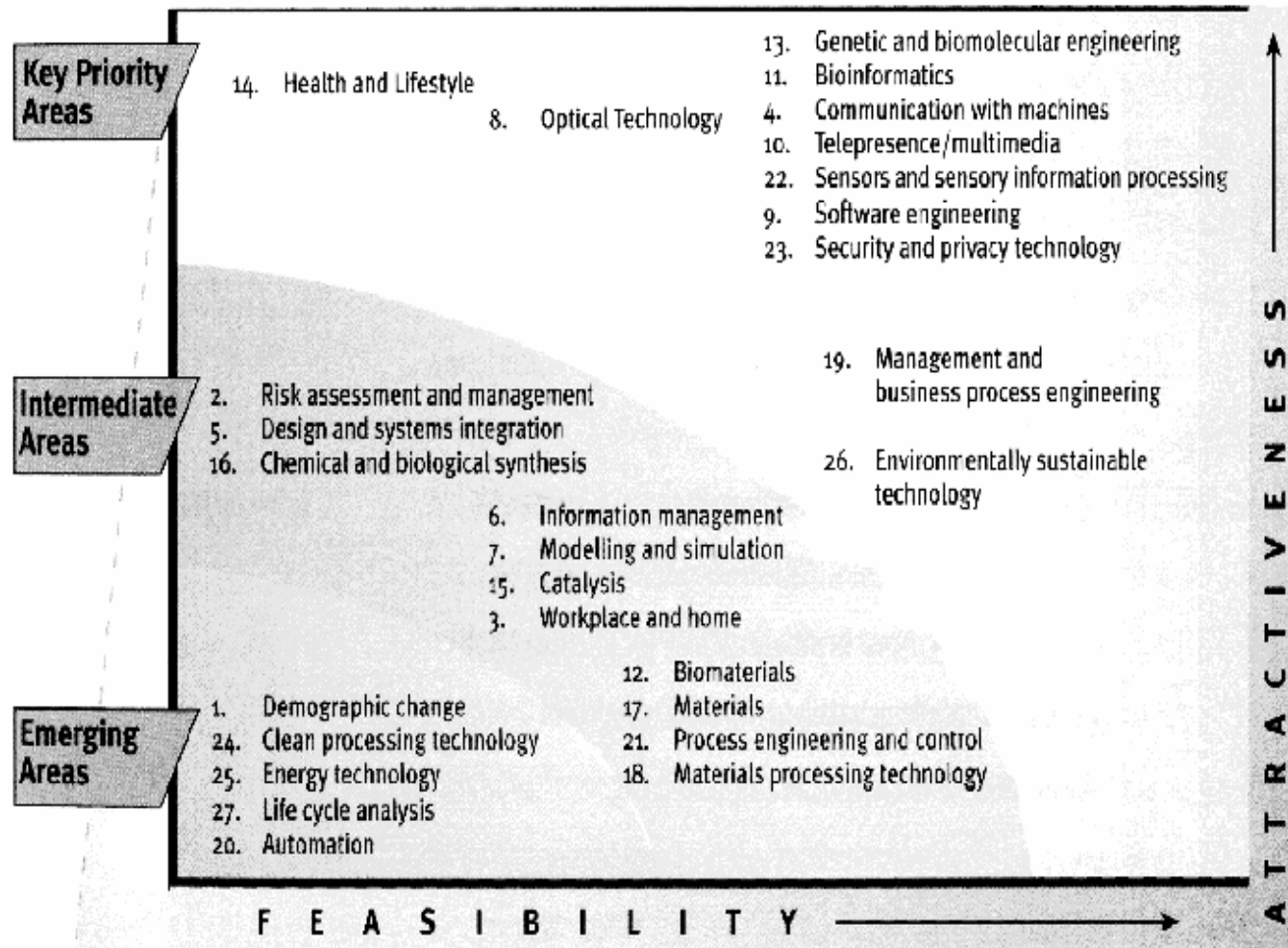| Policy for Science	Science in Policy	Corporate foresight	Foresight in Innovation Policy
-Priorities -Network building -Field articulation	- Informing policy for health, environment, defence, environment …	-Trends & intelligence - Developing strategy	-Aggregating demand - Grand challenges

Foresight for policy vs Foresight as policy

- For policy
  - Use as a tool to *inform and develop* policy in any area
  - Also for "joining up" policy across domains
  - In our domain normally areas of policy with a strong science/ research input

- As policy
  - Use as an instrument to *implement* budgetary, structural or cultural changes
  - In our domain as an instrument of research and/or innovation policy

UK Foresight shift from Policy for Science to Science for Policy

- **First Cycle 1994-1999**
  - Panel based
  - Aim to improve connection between science base & wealth creation + quality of life
  - Other goals to inform priorities & promote "Foresight culture" of forward and longer term thinking "beyond the business plan"

- **Second Cycle 1999-2002**
  - Largely unsuccessful attempt to shift to thematic focus and upgrade business presence

- **Third Cycle 2002 –**
  - Project based
  - Looks at key issues where science holds the promise of solutions; or, an area of cutting edge science where the potential applications and technologies have yet to be considered and articulated

Key Priority Areas

13. Genetic and biomolecular engineering
11. Bioinformatics
4. Communication with machines
10. Telepresence/multimedia
22. Sensors and sensory information processing
9. Software engineering
23. Security and privacy technology

14. Health and Lifestyle

8. Optical Technology

Intermediate Areas

2. Risk assessment and management
5. Design and systems integration
16. Chemical and biological synthesis

6. Information management
7. Modelling and simulation
15. Catalysis
3. Workplace and home

19. Management and business process engineering

26. Environmentally sustainable technology

Emerging Areas

1. Demographic change
24. Clean processing technology
25. Energy technology
27. Life cycle analysis
20. Automation

12. Biomaterials
17. Materials
21. Process engineering and control
18. Materials processing technology

F E A S I B I L I T Y

A T T R A C T I V E N E S S

Third Cycle

- Aim "to increase UK exploitation of science", inform but not direct public and private research funders
- Replaced broad set of standing panels with fluid rolling programme of projects looking at 3-4 areas at any one time
- Selected by brainstorming of "visionaries" to develop shortlist of projects
  - key issue where science holds the promise of solutions; or
  - area of cutting edge science where potential applications and technologies need to be considered and articulated.
- Wide consultation with business, the science base, government departments
- Each project must have senior sponsor, usually Minister from relevant government department

Criteria for topic selection

- Require looking ahead at least 10 years, in areas where the outcomes are uncertain. This typically occurs where the future direction of change is rapid, current trends are uncertain or different trends may converge;

- Have science and technology as the main drivers of change or are capable of impacting substantially on future scenarios;

- Have outcomes that can be influenced, to an extent that is significant for one or more of the economy, society and the environment;

- Are not covered by work carried on elsewhere. However, they must build from areas of active research;

- Require an inter-disciplinary approach to the science, and bring together groups from academia, business and government. They must not be capable of resolution by a single group; and

- Command the support of the groups most likely to be able to influence the future and be owned by a lead government department.

Completed projects

- 7 projects have launched their findings and action plans eg
  - Cognitive systems (DTI/OST lead launched November 2003)
  - Flood & coastal defence (DEFRA, April 2004)
  - Exploiting the Electromagnetic Spectrum (DTI, April 2004)
  - Cyber Trust & Crime Prevention (Home Office, June 2004)
  - Brain science, addiction and drugs (Dept of Health July 2005)
  - Intelligent Infrastructure Systems (Dept for Transport) December 2005
  - Detection and Identification of Infectious Diseases (DEFRA, December 2005)

Current projects

- Sustainable Energy Management and the Built Environment

- Mental Capital and Wellbeing

- Tackling Obesity: Future Choices

Method and output

- Projects based on initial seminar, literature and horizon scanning, in-house and external support with use of futures techniques to avoid extrapolation

- Delivery target: overview, vision of what success will look like, recommendations for action, networks keen to take recommendations forward

- Flood and coastal defence project
  - Produced a long term (2030-2100) and holistic vision for future risk of fluvial and coastal flooding taking account of climate change, land use and socio-economic change
  - Method was to produce range of risk-based scenarios and review possible responses to threats and implications
  - OST project team (4 people) + 60 experts, website consultation, workshops and commissioned work
  - Government Chief Scientific Adviser identified 2 key messages
    - continuing with existing policies not an option – in virtually every scenario considered, the risks grow to unacceptable levels.
    - risks need to be tackled across a broad front. Reductions in global emissions would reduce the risks substantially. However, insufficient in itself. Hard choices need to be taken – must either invest more in sustainable approaches to flood and coastal management or learn to live with increased flooding.
    - http://www.foresight.gov.uk/Previous_Projects/Flood_and _Coastal_Defence/index.html

Figure 1.1 The four scenarios used

The vertical axis shows the system of governance, ranging from autonomy, where power remains at the local and national level, to interdependence, where power increasingly moves to international institutions. The horizontal axis shows social values, ranging from consumerist to community-oriented.
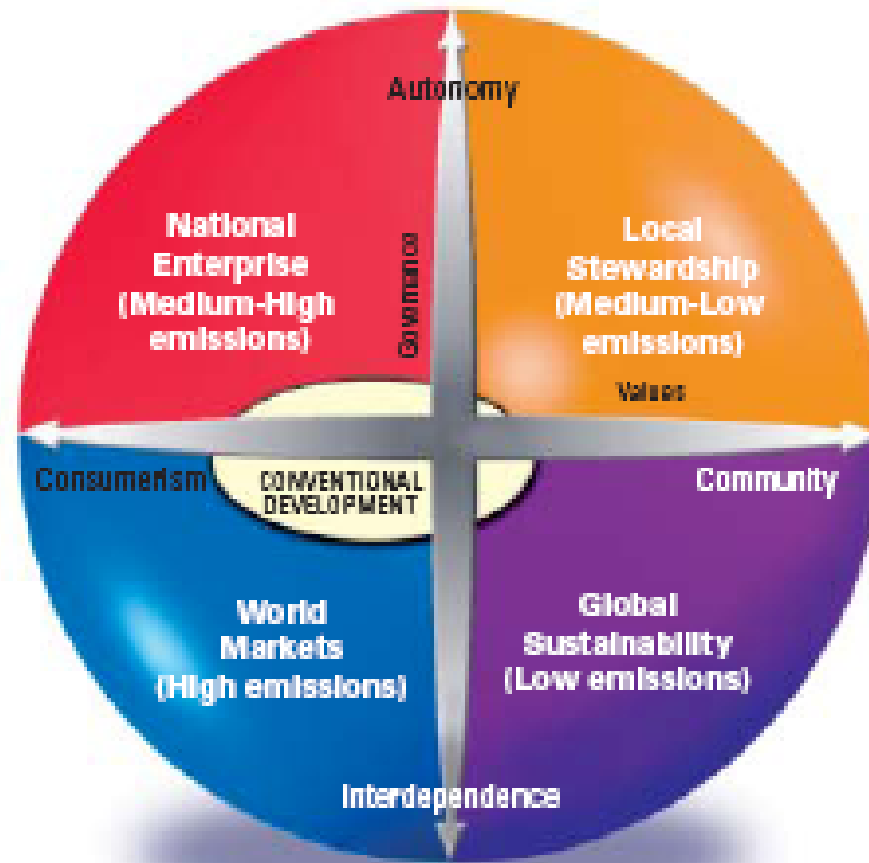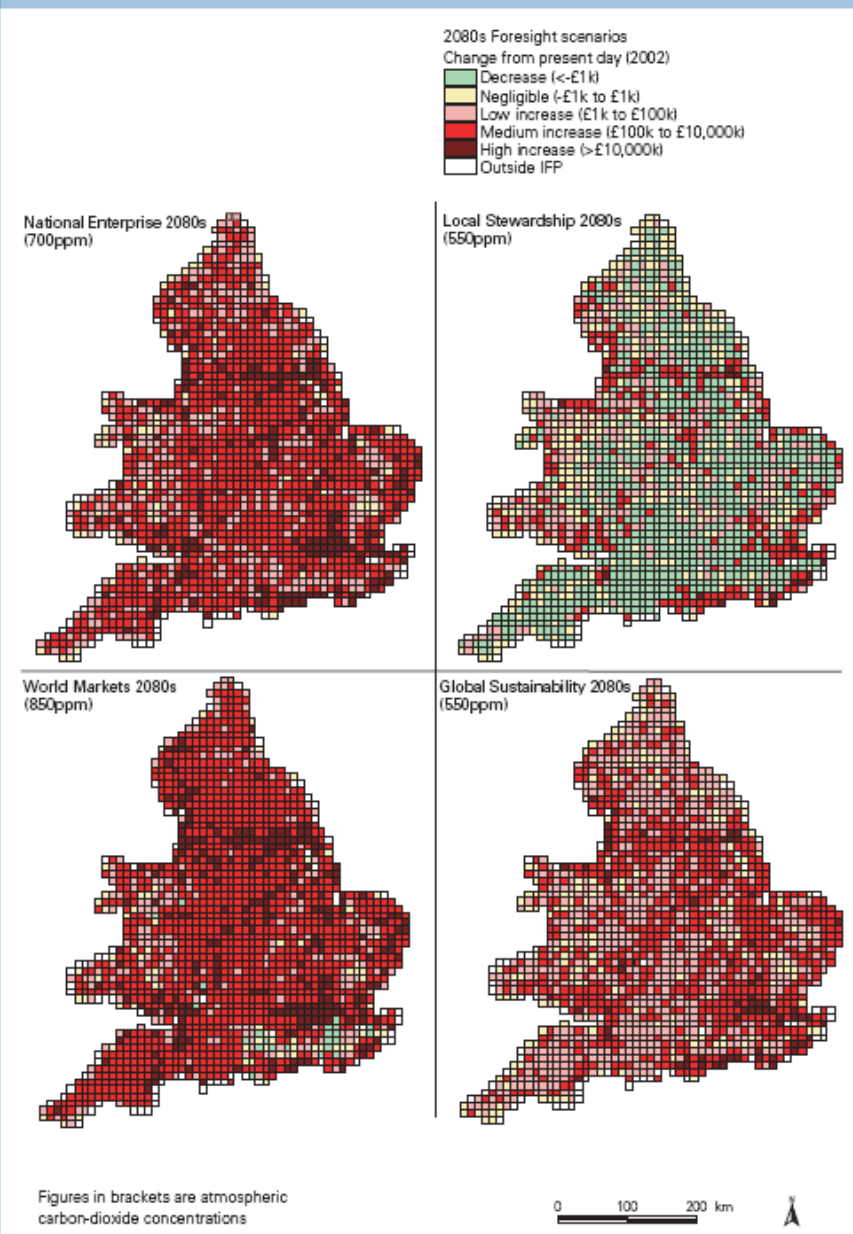
Figure 2.1 **The distribution of average annual damage from flooding across England and Wales in the 2080s. The maps represent changes in risk by the 2080s for the four future scenarios. Darker shades of red signify progressively greater increases in damage. Green signifies a reduction.**

PREST evaluation conclusion on key impacts

- Foresight has directly informed national policies and programmes
- Also influenced climate of thought in relevant policy making bodies and in emergent networks
- General effect to bring together key players and hence to allow a more "joined-up" approach
- Also bringing together disciplinary combinations, which in some cases changed ways of understanding an issue or demonstrated its significance
- Evidence that the Programme engaged senior policymakers with science and scientists, often for the first time
- Little engagement with national innovation agenda

Coordination across government

- 2004 Government established Horizon Scanning Centre as part of 10 year investment framework for S&T

- Horizon scanning is defined as the systematic examination of potential threats, opportunities and likely future developments, including (but not restricted to) those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues as well as persistent problems or trends.

- To feed directly into cross-government priority setting & strategy making

- **Delta Scan** analysis of emerging trends in science and technology

- **Sigma Scan** analysis of broad set of social, economic, political, environmental & S&T Trends

Some comments on Innovation Foresight - Context of move to open innovation

- Convergence of innovation and industrial policy in the context of knowledge economy

- Concept of innovation ecosystem

- Foresight role in creating shared strategic vision

- Emerging reorientation of innovation policy with new emphasis upon demand-side policies

  - Also an industrial policy based upon fostering clusters, platforms and supply chains

  - Key driver of development is linkage between local capabilities and effective demand

Existing experience - corporate

- Foresight in business vs Foresight for business
- Functions include anticipatory intelligence, direction setting, priority setting, strategy formulation and innovation catalysis
- Trend to "open foresight" in terms of participation, scope and delineation
- Close connection to proposed changes in innovation environment but also need specific actions
- Build corporate culture and capability to sustain foresight in enterprises that are locked into traditional thinking and markets and day-to-day survival
- Key lessons from major firms
  - Ensure engagement of principal stakeholders in company
  - Match open innovation with open foresight

Five generations of Foresight

The University

MANCHESTER
1824

FIRST GENERATION

Techno forecas

SECOND GENERATION

Tech and mark

THIRD GENERATION

Technolog markets and the s dimension

**FOURTH GENERATION**

Distributed Role in Innovation Sy

FIFTH GENERATION

Structural & broad policy focus

Extending the mandate to Innovation Foresight – structural focus
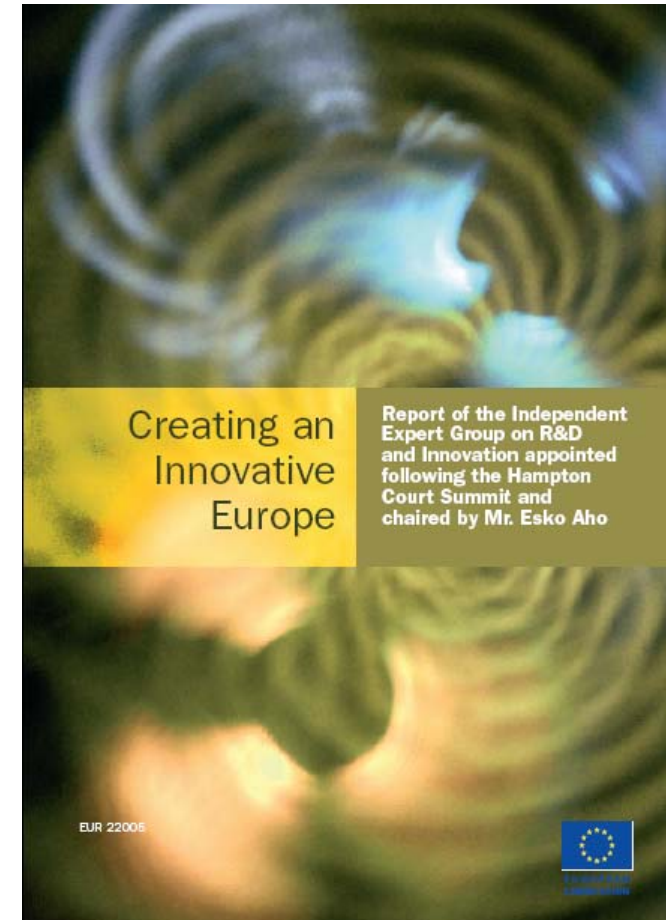
- Overcoming market and system failures
- Microeconomic climate for innovation
- Addressing deficiencies in firms
  - Resources
  - Incentives
  - Capabilities
  - Opportunities
- Also use foresight to address deficiencies in system capacity for strategic development
- Foresight as balancing and linking mechanism

A taxonomy of research and innovation policies

Source: Edler and Georghiou Research Policy September 2007
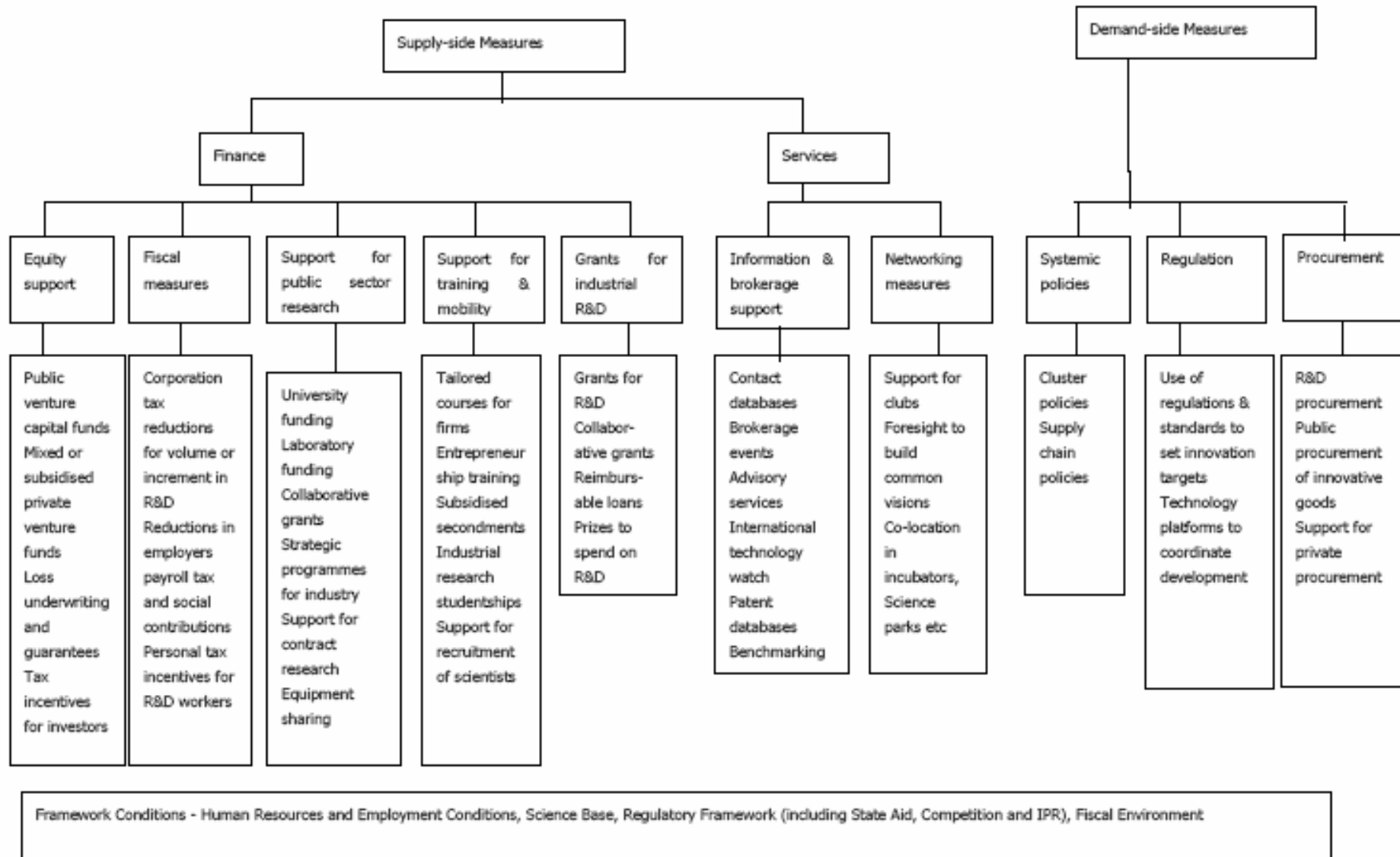
Innovation & Industrial Policy

- Emerging role for foresight in New Wave Demand-side innovation policy
- Need to understand foresight in context of range of tools for innovation policy and how it can interact with, strengthen and be strengthened by combinations with other policies
- Particular opportunities in demand-oriented innovation policies
  - Clusters and technology platforms built on base of common visions
  - Public procurement for innovative goods and services again driven by shared visions

Creating an Innovative Europe

Report of the Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit and chaired by Mr. Esko Aho

EUR 22005

Potential Shift Towards Mission-Oriented Research and Innovation POlicy

- Grand Challenge concept now being hotly debated in Europe
- Motivating innovation through large scale coordinated efforts involving partnership between government, business and societal groups
- Economic-orientation to some extent already being addressed through EU's Joint Technology Initiatives
  - Public- private partnerships of up to 1 billion funding eg Innovative Medicines, Embedded Systems, Clean Skies
  - Also national equivalents eg UK Innovation Platforms, France Programmes Mobilisateurs
- Further potential in addressing social and sustainability challenges arising from eg climate change, migration, security
- Role for foresight in aggregating the key actors in the research and innovation ecosystem and building the vision

Conclusions

- UK and EU Foresight extending from priority setting and broad network building roles which became common in 1990s

- In science domain UK has had largely successful experience of using foresight to illuminate cross-cutting policy challenges for government

- New challenge for foresight on the interface with innovation in a changing environment for research and innovation

- Foresight will continue to adapt and reinvent itself to keep pace with the changes which it helped to induce

Some links

- PREST Evaluation of Current UK Foresight Programme
  - http://www.foresight.gov.uk/Publications/Current_round_General_Publications/Foresight_Evaluation_2006/Foresight_Evaluation_Final_Report_June_2006.pdf

- UK Foresight reports
  - http://www.foresight.gov.uk/

- Grand Challenges
  - http://ec.europa.eu/research/conferences/2007/fst/pdf/discussionpaper_en.pdf

- Demand side innovation policy
  - http://ec.europa.eu/invest-in-research/action/2006_ahogroup_en.htm
  - http://www.nesta.org.uk/assets/pdf/demanding_innovation_provocation_NESTA.pdf