Systems science and engineering for responding to global change

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Responding to the perfect storm

Regenerative medicine

The big data revolution

The transition to new energy sources

Satellites and commercial use of space

Advanced materials

Agricultural technology - the next green revolution

Robotics

Synthetic biology
1. Using the language and methodologies of risk to link systems science with decision making

2. Providing tools for thinking rationally about the long term and severe uncertainties
Droughts

Floods

Ecosystem degradation

Harmful water quality

Deteriorating infrastructure

Salinization

Water conflicts
Embedding risk in decision making:

UK flood risk management
Water resources planning:
From deterministic margins to risk-based decision making

Source: Hall and Borgomeo
Multi-scale risk management

Dependence on water imports

Globally correlated drought

Trade in virtual water

Note: Only the biggest water savings (> 5 Gm³ per year) are shown. Source: Mekonnen and Hoekstra (2011, p. 24).

Source: WATCH

Source: Chapagain and Hoekstra (2008)
1. Using the language and methodologies of **risk** to link systems science with decision making

2. Providing tools for thinking about the **long term** and severe **uncertainties**
### National Infrastructure Plan 2011

#### IT03 - UK INFRASTRUCTURE TIMELINES

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#### Timelines

**Waste**
- Law requires reduction in waste through current legislation: Landfill Tax and increased recycling

**Energy**
- Capacity Mechanism
- Carbon Price
- Feed In Tariff for Difference
- RO CHP to generation

**BPR**
- Electricity
- EV Infrastructure
- Smart Meters
- Smart Grid
- District Heating
- Gas
- Offshore Grid Interconnection
- Nuclear
- Storage
- CCS
- Large Scale Renewables
- Offshore Wind
- Onshore Renewables
- Biomass
- Offshore Renewable

**Nuclear**
- Capacity Mechanism
- Carbon Price
- Feed In Tariff for Difference
- RO CHP to generation

**BPR**
- Energy & Environmental End Use
- Insulation and Building
- Performance of existing buildings
- Heating and Community Energy
- Gas
- Electricity/Applications
- Lighting
- Fuel
- Petroleum refining
- Gas
- Refinery manufacture and distribution

** intents**
- Policy
- Legislation
- Standards

**HM Treasury**

**Infrastructure UK**

**November 2011**
The UK Infrastructure Transitions Research Consortium: Providing the tools for strategic analysis of infrastructure systems

- High resolution demographic projections
- Regional multi-sectoral economic model
- National infrastructure database and analysis archive

Module for:
1. Sampling scenarios & uncertainties
2. Specifying options & strategies for infrastructure provisions
3. Specifying CDAM model runs
4. Post-processing & visualising results

Water demand projections and capacity implications from climate change
Evidence-based validation

Analysis of scenarios and policy options

Multi-scale modelling

Visualisation and decision support
Tools for decision making under uncertainty

Adaptation pathways

Robust decision making

Real options

Figure B4.3: Water resourcing investment decision tree for London, 2020s to 2080s

Adaptation pathways
1. Multi-scale analysis of coupled human and natural systems

2. Connects directly with decision making through the analysis of risks and of options for responding to risk.

3. Is explicit about uncertainties but does not regard them as an insurmountable obstacle to decision making