UK Scenarios Development Method

Dr Neil Strachan

Senior Research Fellow, Policy Studies Institute

strachan@psi.org.uk

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Outline

- Scenarios typology
  - Descriptive, normative
- Recent UK energy scenarios
  - Royal Commission on Environmental Pollution (RCEP)
  - Cabinet Office-DTI
  - Tyndall Centre
- Key issues in quantifying UK scenarios
  - Modelling Cabinet Office-DTI scenarios with the UK MARKAL model

Descriptive Scenarios

- Forecasting
  - Extrapolation from existing energy system
  - Historical trends, expert opinion
  - Shorter-term focus
- Exploratory scenarios
  - Illuminating key drivers (landscape level)
  - Can encompass surprises (often do not)
  - Focus on technological change
  - Longer-term focus
- Technological scenarios
  - Focus on static representation of technologies
  - Less detail on social drivers

Normative Scenarios

- Visions
  - Specific viewpoints of desirable energy futures
  - Encompass surprises and social change
- Back-casting
  - Pathways to reach a desired end-point
  - Stakeholder consultation
- Roadmaps
  - Stakeholder consultation
  - Identification of key barriers and opportunities
  - Identification of key timing of actions

Recent UK Energy Scenarios

- RCEP (2000)
  - Basis for UK Energy White paper (including 60% CO_2 reduction target by 2050)
  - Technological scenarios
- Cabinet Office-DTI (1999 – 2006)
  - UK government quantification of 60% CO_2 target
  - Quantification using MARKAL dynamic optimisation model
  - Exploratory scenarios
- Tyndall Centre (2005)
  - Scenario generation
  - Inclusion of additional sectors
  - Backcasting approach

RCEP: 60% CO_2 reduction scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Demand % reduction				
Low-grade heat	0	50	50	66
High grade heat	0	25	25	33
Electricity	0	25	25	33
Transport	0	25	25	33
TOTAL	0	36	36	47
Supply (PJ)				
Fossil fuels (no CCS)	3,339	3,339	3,339	3,339
Intermittent renewables	1,071	819	504	504
Other renewables	598	598	283	126
Nuclear or CCS	1,638	0	598	0

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	Red	Blue	Turquoise	Purple	Pink
GDP growth	3.3%	1.6%	2.6%	3.9%	3.9%
Final energy	90 Mtoe	130 Mtoe	200 Mtoe	330 Mtoe	330 Mtoe
Households	27.5 M	25 M	30 M	27.5 M	27.5 M
House energy reduction	Large	Very large	Small	None	None
Key electricity technologies	Central coal	coal CCS, CHP	Gas, nuclear	Renewable, nuclear	Coal, gas (CCS)
Private ground transport	Reduction	Small growth	No growth	Large growth	Large growth
Public ground transport	Very large growth	Large growth	Small growth	Large growth	Large growth
Aviation	Low growth	Medium growth	High growth	Very high growth	Very high growth
Decarbonisation policies	innovation	Collective demand	Supply side	Market focused	Market focused

Cabinet Office-DTI Scenarios

- Two axis approach
  - Governance (autonomous - independence)
  - Social values (consumer – community)
- **Storylines included: GDP, sustainable development goals, regulation, EU/global policies, international trade, energy markets, energy prices**
- ***World Markets***
  - *a world defined by an emphasis on private consumption with a highly developed and integrated world trading system.*
- ***Provincial Enterprise***
  - *a world of private consumption values coupled with policy making reflecting local, regional and national concerns and priorities.*
- ***Global Sustainability***
  - *social and ecological values are more pronounced and there is greater effectiveness of global institutions, including stronger collective action in dealing with environmental problems.*
- ***Local Stewardship***
  - *stronger local and regional governance allow social and ecological values to be demonstrated to a greater degree*

Modelling the Cabinet Office-DTI Scenarios

- Three scenarios (carbon constrained and unconstrained)
  - Baseline
  - World Markets
  - Global Sustainability
- Practical implementation
  - Energy prices (oil, gas, coal)
  - Energy demand projections (by sector)
  - Sensitivity runs on innovation / diffusion
    - Technology class and energy efficiency
- Dynamic supply side optimization modelling

Annual abatement costs (£Bn) for selected runs

		2030	2040	2050
Baseline (BL)		1	5	10
World Markets (WM)		2	6	13
Global Sustainability (GS)		0.3	2	7
Limited Energy Efficiency (2.1% historic rate and no negative cost options)	BL	3	5	12
	WM	3	8	18
	GS	8	17	38
Limited natural gas supplies (year 2000 levels)	BL	0	4	10
	WM	1	5	15
	GS	0	1	7
No innovation (frozen at 2010 levels)	BL	6	19	42
Nuclear electricity increased by 0.5p/kWhr	BL	6	4	9
No nuclear or carbon sequestration	BL	1	5	10

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Scenario quantification issues 1

- Focus on: scale of task to reach target
  - What do future (unconstrained carbon) worlds look like?
  - Population, GDP, energy demands, global energy prices
- Focus on: differentiation of pathways
  - For a state of the world, what can policy makers influence?
  - Technology costs, efficiency uptake, local energy prices
- Ensuring a valid comparison between base and carbon policy cases
  - Environmentally progressive in both ?
  - Energy price developments in both ?
  - Technology development *only* in the policy case ?

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Scenario quantification issues 2

- Are scenarios different enough?
  - Categorizing the range of uncertainties
  - Capturing the interactions between uncertainties
- A central scenario ?
- Which modelling outputs?
  - GDP impacts, fuel use, technology uptake and costs, security implications etc
- And hence which modelling tools?
  - MARKAL: great technological detail
  - Can add: elastic demands, Macro, learning curves
  - What to account for or endogenize in the model?

Thank you

Neil Strachan; strachan@psi.org.uk

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