

# Quantifying Energy Scenarios of a Low Carbon Society

The Annual Energy Modelling Conference (AEMC) of the UK Energy Research Centre (UKERC)

## SUMMARY

### Background

The 2006 Annual Energy Modelling Conference (AEMC) of the UK Energy Research Centre (UKERC) was held in Oxford UK from 5-7 December 2006. The conference theme was *Quantifying Scenarios of a Low Carbon Society*. The conference structure consisted of an open symposium with UK energy policy stakeholders followed by a technical modelling workshop. A particular emphasis was on developing country participation. A key output of the workshop was to define comparative modelling runs which will be a direct research output to the UK-Japan research project *Developing Visions for a Low-Carbon Society (LCS) through Sustainable Development*.<sup>1</sup>

*Note 1: A full workshop report produced by PSI, is also available on the UKERC website, at <http://www.ukerc.ac.uk/content/view/364/463>*

### Aims

#### Open Symposium

- Presentation and discussion of research regarding UK and international scenarios of low carbon societies (LCS)

#### Closed expert workshop

- Technical discussion of state-of-the-art energy modelling
- Introduction to developing country energy modelling teams and capacities
- Definition of collaborative modelling run: to agree a set of scenarios each with common inputs for comparable runs of the various models

### Organisation

Jane Palmer (JP), UKERC Meeting Place  
Kerry LaJoie (KL), Neil Strachan (NS) PSI

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<sup>1</sup> Further information on the 1<sup>st</sup> UK-Japan LCS workshop is at: [http://2050.nies.go.jp/index\\_e.html](http://2050.nies.go.jp/index_e.html)

## Expert Participants

Country	Model	Institute	Name
UK	MARKAL	Policy Studies Institute	Neil Strachan
UK	MARKAL	Policy Studies Institute	Ramachandran Kannan
UK	E3MG	4CMR, Cambridge University	Terry Barker
UK	E3MG	4CMR, Cambridge University	Tim Foxon
UK	E3MG	4CMR, Cambridge University	Jonathan Koehler
UK	E3MG	4CMR, Cambridge University	Serban Scricieiu
Japan	AIM	NIES	Junichi Fujino
Japan	AIM	NIES	Toshihiko Masui
Japan	DNE21	RITE	Keigo Akimoto
Thailand	AIM	Asian Institute of Technology	Janak Shrestha
India	AIM	IIM Ahmedabad	Subash Dhar
China	AIM	BEEC	Li Bin
South Africa	LEAP	University of Cape Town	Kate Louw
Germany / IEA	TIMES	University of Stuttgart	Uwe Remme
Canada	CIMS	Simon Fraser University	Chris Bataille
UK	-	UKERC	Jim Skea
UK	-	Imperial College	Sophie Jablonski
UK	-	SPRU	Tao Wang

## Key Themes from Presentations

*Note 2: All presentations are available on the UKERC website at <http://www.ukerc.ac.uk/content/view/364/463>*

### **Session 1: International scenarios of low carbon societies (LCS)**

***Chair and discussant: Dr Neil Strachan, PSI***

*Overview of Japan low carbon society (LCS) modelling study, and results of the first Japan-UK 2050 LCS workshop*

Dr Junichi Fujino, National Institute for Environmental Studies

*Energy Technology Perspectives - scenarios & strategies to 2050*

Dr Uwe Remme, IER Stuttgart

Session 1 on International scenarios of low carbon societies (LCS) focused on presentations by Junichi Fujino (NIES) and Uwe Remme (IER Stuttgart). Both

presentations focused heavily on the value of models in defining and quantifying LCS scenarios, in this case using the Asia Pacific Integrated Model (AIM) and the International Energy Agency's global MARKAL/TIMES model, as used in the Energy Technology Perspectives project. Model quantification can involve back-casting with a defined low carbon target, and identification of key mitigation options. An alternative is a forecasting function of different energy futures, and the impact of differing technology assumptions or CO<sub>2</sub> shadow prices.

## **Session 2: UK scenarios of low carbon societies (LCS)**

***Chair and discussant: Dr Brenda Boardman, University of Oxford***

*Overview of UK energy and carbon scenarios*

Mr Nick Hughes, Policy Studies Institute

*Exploring the UK's 60% carbon target: a scenario approach*

Dr Sarah Mander, University of Manchester

*Achieving 60% CO<sub>2</sub> reductions within the UK energy system: discussions on implications for the electricity generation sector*

Dr Filip Johnsson, Chalmers University

Session 2 on UK scenarios of low carbon societies (LCS) consisted of three presentations. "Overview of UK energy and carbon scenarios" by Nick Hughes (PSI) set the context and history for defining energy scenarios, notably in thinking through future uncertainty. "Exploring the UK's 60% carbon target: a scenario approach" by Sarah Mander (University of Manchester) discussed the Tyndall Centre's scenarios work with a particular emphasis on the 'true' carbon target and the importance of all emission sources including international aviation. Lastly "Achieving 60% CO<sub>2</sub> reductions within the UK energy system: discussions on implications for the electricity generation sector" by Filip Johnsson (Chalmers University) focused on quantification of the RCEP scenarios which underpinned the UK 60% CO<sub>2</sub> reduction target and focused on optimization modelling of electricity sector evolution.

## **Session 3: Open discussion: Technological vs. behavioural change in LCS scenarios**

***Chair: Prof Paul Ekins, Policy Studies Institute***

*Introduction: Thoughts on incorporating behaviour in LCS scenarios*

Dr Brenda Boardman, University of Oxford

## **Keynote address: Thoughts on the Stern Review on the Economics of Climate Change**

Prof Dennis Anderson, Professor of Energy & Environmental Studies, Imperial College

The conference keynote speech was delivered by Professor Dennis Anderson of Imperial College. Building on his input as a major contributor into the *Stern Review of the Economic of Climate Change*, Professor Anderson delivered an integrated and thorough critique of the costs and benefits of climate change mitigation policies.

#### **Session 4: Types of models – technical discussion**

*Opportunity to share and discuss experiences and learn about other models*

**Chair: Dr Tim Foxon, University of Cambridge**

Energy-economic modelling using AIM

*Dr Toshihiko Masui, National Institute for Environmental Studies, Japan*

Emissions and energy policy analysis from nation to factory floor: The uses of CIMS, a technology simulation model with behaviourally realistic micro- and macro-economic feedbacks

*Dr Chris Bataille, Simon Fraser University, Canada*

Energy-economic modelling using the MDM-E3 - E3MG suite of models

*Dr Terry Barker, University of Cambridge*

Transition to LCS: effects of technology diffusions in both energy supply side and demand side

*Dr Keigo Akimoto, Research Institute of Innovative Technology for the Earth, Japan*

Moving into the closed expert workshop, Session 4 was a technical discussion on state-of-the-art energy modelling. This was designed to inform participants of the methodological underpinning, input sources and assumptions, model structure, and key outputs from the various E4 models.

#### **Session 5: Possibilities and limitations of the different models**

**Facilitator: Jane Palmer, UKERC Meeting Place**

*Small group discussion on the strengths and limitations of the different model types as tools for analysing the scenarios, followed by feedback and discussion in the full group*

Sessions 5, 7, 8 and 9 were structured to discuss and define LCS scenarios for the ongoing LCS comparative modelling project. This included the strengths and weaknesses of different models, key metrics and drivers of LCS scenarios, definition of model parameters, and agreement on the process of this innovative comparative modelling exercise. These parameters were set up by the expert modellers as goals and concerns to work with for the rest of the workshop.

#### **Session 6: Introduction to energy modelling in developing countries**

**Chair: Dr Junichi Fujino, National Institute for Environmental Studies, Japan**

*Mr Janak Shrestha, Asian Institute of Technology, Thailand*

*Mr Subash Dhar, Indian Institute of Management Ahmedabad, India*

*Mr Li Bin, Beijing Energy Conservation & Environment Protection Centre, China*

*Ms Kate Louw, University of Cape Town*

Session 6 introduced workshop participants to the energy challenges facing developing countries and their modelling capabilities.

#### **Session 7: Scenarios – key metrics and drivers**

**Facilitator: Jane Palmer, UKERC Meeting Place**

*Small group work to define the scenarios, developing a broad storyline and rationale and identifying the key metrics and drivers, followed by feedback to the full group*

### **Session 8: Definition of model parameters**

**Facilitator: Jane Palmer, UKERC Meeting Place**

*Combination of small group and plenary work to review the scenarios proposed and identify the necessary parameters, bearing in mind the range of model types*

### **Session 9: Enabling the scenarios**

**Facilitator: Jane Palmer, UKERC Meeting Place**

*Feedback on parameters to the main group and discussion of any outstanding issues*

### **Session 10: Next steps**

**Chair: Dr Neil Strachan, Policy Studies Institute**

## Key Points and Steps Forward

A key output of the workshop was to define comparative modelling runs which will be a direct research output to the UK-Japan research project *Developing Visions for a Low-Carbon Society (LCS) through Sustainable Development*.

Up to twelve international teams constitute this collaborative energy modelling project on low carbon societies. The goal is to use model of different scale and typologies to investigate the economic costs of restructuring energy systems under long-term low carbon scenarios (LCS). This process is similar to earlier collaborative modelling projects (e.g., IMCP<sup>2</sup>, EMF<sup>3</sup>) but with a number of key differences:

- An emphasis on long-term deep reductions in CO<sub>2</sub> (and other GHGs)
- An emphasis on developing country participation, including institutes previously less integrated into modelling networks
- A mixture of country vs. global and top-down vs. bottom-up models
  - Global models assisting to define a common dataset of input parameters
  - Common scenarios (see below)
  - Individual scenarios (see below)

The initial set of agreed scenarios for all country teams to undertake are:

1. Base case
  - Extrapolation of current trends based on a consistent set of input parameters
2. Carbon price: \$10 in 2013 rising exponentially to \$100 in 2050
  - A run to ascertain the impact of a relatively modest carbon price signal
3. "Carbon plus": Carbon price plus additional measures to achieve LCS
  - Based on particular strengths of model: e.g. environmental target, technological change, behaviour and societal change, energy security, international trade, economic development, oil prices etc

A major goal of this LCS modelling comparison project is to provide input into the G8 Gleneagles dialogue on climate change mitigation when Japan holds the G8 presidency in 2008. Academic publication of this modelling exercise will be forthcoming in a special issue of *Climate Policy*.

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<sup>2</sup> Innovation Modelling Comparison Project

<sup>3</sup> Energy Modelling Forum