TIAM-UCL – Latest work using TIAM-UCL: Demand, burden sharing, resources

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William Usher, UCL Energy Institute, University College London, United Kingdom

The UCL Energy Institute Team

- Professor Paul Ekins
- Dr. Neil Strachan - Reader
- Dr. Gabrial Anandarajah – Senior RA
- Steve Pye – Senior RA (pt)
- William Usher - RA
- Fabian Kesicki – PhD/TIAM expert
A brief history

- TIAM-UCL evolved from a (2009) version of TIAM-ETSAP
  - UK broken out of Western Europe region
  - All region base year templates fully recalibrated to latest 2005 IEA data (2009 version)
  - Updates to drivers, resources, climate module, etc.
- Funded by UKERC – UK Energy Research Centre

Aims are to:
1. Explore role of the UK under global decarbonisation pathways
2. Integrate work on global oil and gas resources into TIAM-UCL
3. Investigate energy system uncertainties – through UK MARKAL

Current and future projects with TIAM-UCL

- UK Government
  - Department of Energy and Climate Change - Long term CO₂ prices
- Academic research
  - Role of demand management in global decarbonisation
  - Burden sharing agreements
  - Oil and gas resources
  - Endogenous technological learning
    - Focussing on hydrogen, and extended to counter-factual technologies
Burden Sharing Agreements – the UK under global decarbonisation trajectories

Reference scenario – position of regions in 2005

- Bubble area = GDP$_{2005}$
- CO$_2$ per GDP (kgCO$_2$/thousand US$) vs. Per Capita CO$_2$ Emissions (tonnes per annum)
One way to investigate the problem:

Experiment:
- **Converging** per capita greenhouse gas emissions
- **Converging** greenhouse gas intensity of GDP

- Differentiate **developed** and **developing** countries

- **Limited purchase** of greenhouse gas permits to 10% of gross emissions

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**Global net CO₂ emissions**

- **Per Capita 540 ppm**
- **GDP Intensity 540 ppm**
- **Per Capita 450 ppm**
- **GDP Intensity 450 ppm**
- **Reference Scenario**
- **Historical**
Idealised Emissions Pathways

Allen et al. 2009

Results - Global trade in emissions

Region behaviour under scenarios follow:
- starting conditions
- projections for GDP or population growth

Net purchaser

Net sellers
Results

• Level of global effort is key
• Small increase in global welfare cost from GDP intensity to per capita emissions allocation
• UK is largely isolated from global sensitivities due to:
  – More ambitious policy, higher cost
  – Decrease in UK cumulative discounted total welfare ~10% under all scenarios over base case, against ~2-7% global average decrease
  – Scenario restrictions on CO$_2$ permit purchase (10% gross emissions)
• CHINA!

Results (2)

Net purchasers:
China, Former Soviet Union, Eastern Europe, Middle East, UK, (USA)

UK ~$5bn per year on CO$_2$ permits in 2050

Switchers (net sellers under per capita):
Africa, India, Developing Asia

Switchers (net sellers under GDP intensity):
Western Europe, South Korea, Mexico, Japan, Central & South America
Future Work

• Develop a realistic global decarbonisation trajectory under differentiated policies
• Link CO₂ targets to ‘environmental performance’ of regions (Vaninsky, A., 2009)

Thank You

William Usher
Research Associate in Energy and Modelling
UCL Energy Institute
w.usher@ucl.ac.uk
www.ucl.ac.uk/energy
www.ukerc.ac.uk
References


APPENDICES

TIAM-UCL – regional aggregation, recent developments
### List of Regions and Countries

<table>
<thead>
<tr>
<th>Region</th>
<th>Countries</th>
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<tbody>
<tr>
<td>AUSTRALIA (AUS)</td>
<td>Australia and New Zealand</td>
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<tr>
<td>CANADA (CAN)</td>
<td>Canada</td>
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<tr>
<td>CENTRAL and SOUTH AMERICA (CSA)</td>
<td>Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Other Latin America, Panama, Paraguay, Peru, Trinidad-Tobago, Uruguay, Venezuela</td>
</tr>
<tr>
<td>CHINA (CHI)</td>
<td>China</td>
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<tr>
<td>EASTERN EUROPE (EEU)</td>
<td>Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, Yugoslavia</td>
</tr>
<tr>
<td>FORMER SOVIET UNION (FSU)</td>
<td>Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan</td>
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<tr>
<td>INDIA (IND)</td>
<td>India</td>
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<tr>
<td>JAPAN (JAP)</td>
<td>Japan</td>
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<tr>
<td>MIDDLE EAST (MEA)</td>
<td>Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen</td>
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<tr>
<td>OTHER DEVELOPING ASIA (ODA)</td>
<td>Bangladesh, Brunei, Chinese Taipei, Indonesia, North Korea, Malaysia, Myanmar, Nepal, Other Asia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam</td>
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<tr>
<td>SOUTH KOREA (SKO)</td>
<td>South Korea</td>
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<td>UNITED KINGDOM (UK)</td>
<td>United Kingdom</td>
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<tr>
<td>UNITED STATES OF AMERICA (USA)</td>
<td>United States of America</td>
</tr>
<tr>
<td>WESTERN EUROPE (WEU)</td>
<td>Austria, Belgium, Denmark, Finland, France, Germany, Gibraltar, Greece, Greenland, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom</td>
</tr>
</tbody>
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### 16R TIAM-UCL Model Development (as of June 2010)

- Fully calibrated 16 Region TIAM-UCL global model *(Version1.00)*
  - IEA data (base year is 2005)
  - UK is an explicit region
- Revised/new drivers, Updated technologies and scenario files
- Implementation of climate change mitigation policies
  - Carbon tax, cap-and-trade
- Elastic demand version enabled
- A results sheet template has been developed
- Model documentation (started)
- Conference presentations:
  - Carbon Tax vs. Cap-and-Trade: Implications on Developing Countries Emissions *(IAEE-International, Rio, June 2010)*
  - The UK energy system in an uncertain world: Insights from different modelling scales *(IEW2010, Stockholm, June 2010)*
  - Global Climate Change Mitigation: What is the role of demand reduction? *(IAEE-Europe, Vilnius, August 2010)*