



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

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Republic of Ireland

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The UCL Energy Institute Team

- Professor Paul Ekins
- Dr. Neil Strachan - Reader
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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

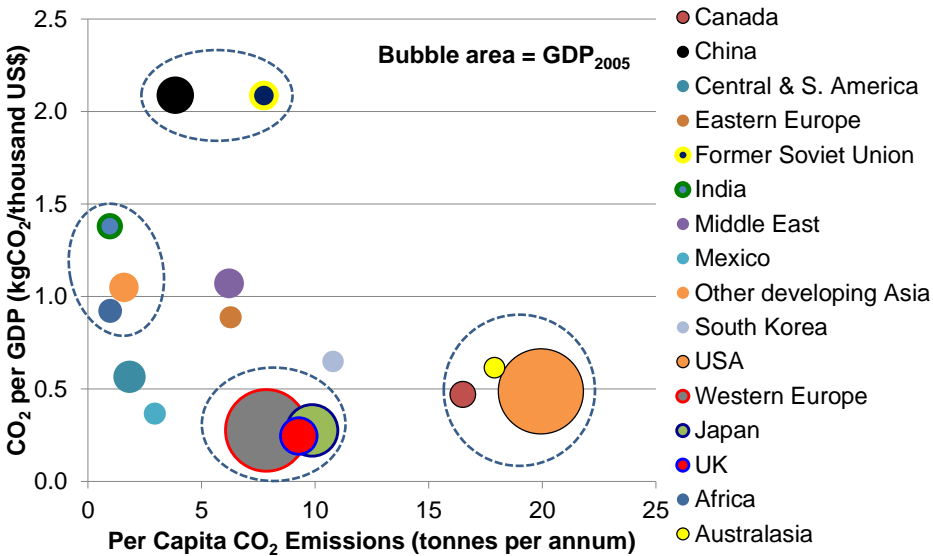
- UK Government
 - Department of Energy and Climate Change - Long term CO₂ prices
- Academic research
 - Role of demand management in global decarbonisation
 - Burden sharing agreements
 - Oil and gas resources
 - Endogenous technological learning
 - Focussing on hydrogen, and extended to counter-factual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



Burden Sharing Agreements – the UK under global decarbonisation trajectories



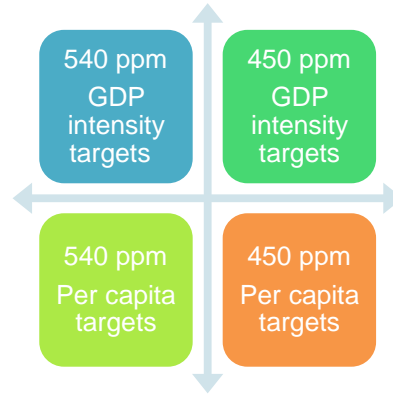
Reference scenario – position of regions in 2005



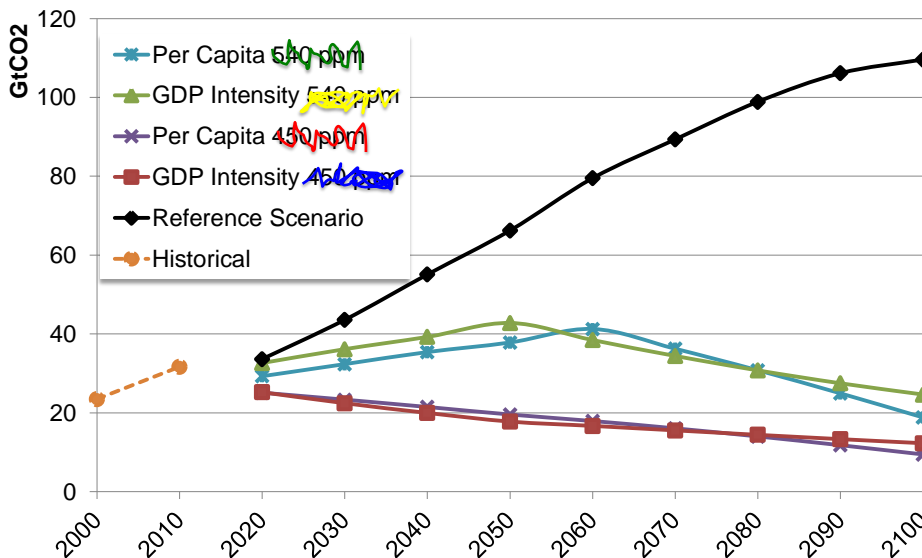
One way to investigate the problem:

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

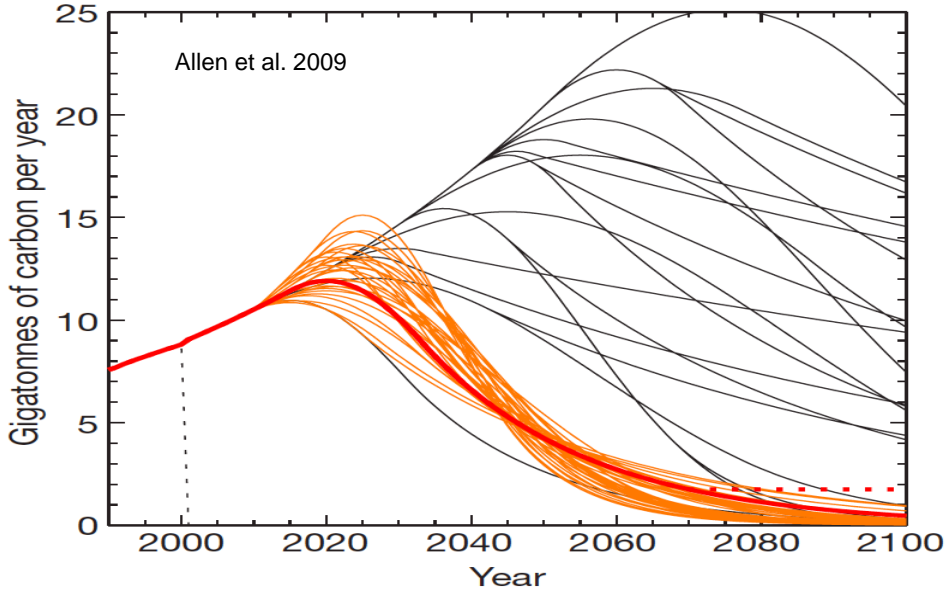


Global net CO₂ emissions





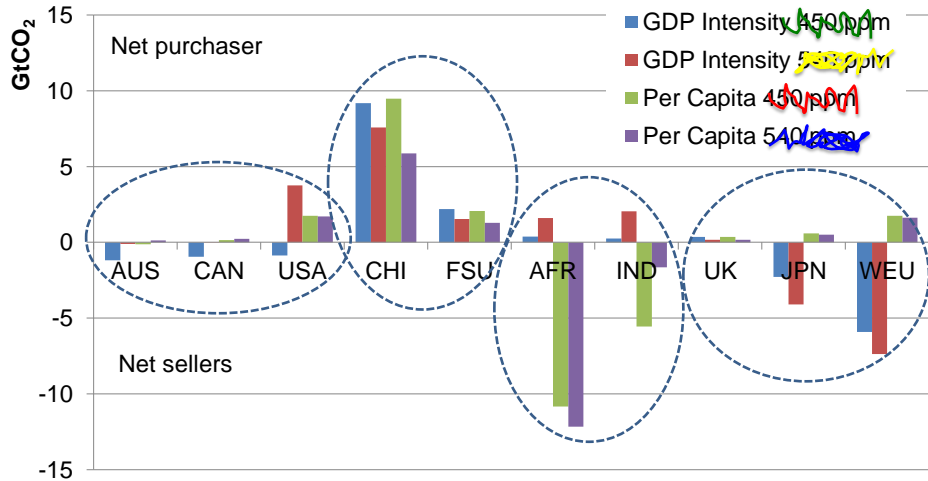
Idealised Emissions Pathways



Results - Global trade in emissions

Region behaviour under scenarios follow:

- starting conditions
- projections for GDP or population growth



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 CO₂ 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 CO₂ 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

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References

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- Vaninsky, Alexander. 2010. *Prospective national and regional environmental performance: Boundary estimations using a combined data envelopment stochastic frontier analysis approach*. Energy 35, no. 9 (September): 3657-3665. doi:10.1016/j.energy.2010.05.010. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0360544210002732>

List of Regions and Countries

Region	Countries
AFRICA (AFR)	Algeria, Angola, Benin, Cameroon, Congo, Congo Republic, Egypt, Ethiopia, Gabon, Ghana, Ivory Coast, Kenya, Libya, Morocco, Mozambique, Nigeria, Other Africa, Senegal, South Africa, Sudan, Tanzania, Tunisia, Zambia, Zimbabwe
AUSTRALIA (AUS)	(AUS)Australia and New Zealand
CANADA (CAN)	Canada
CENTRAL and SOUTH AMERICA (CSA)	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
CHINA (CHI)	China
EASTERN EUROPE (EEU)	Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Slovenia, Yugoslavia
FORMER SOVIET UNION (FSU)	Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
INDIA (IND)	India
JAPAN (JAP)	Japan
MXICO (MEX)	Mexico
MIDDLE-EAST (MEA)	Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen
OTHER DEVELOPING ASIA (ODA)	Bangladesh, Brunei, Chinese Taipei, Indonesia, North Korea, Malaysia, Myanmar, Nepal, Other Asia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam
SOUTH KOREA (SKO)	South Korea
UNITED KINGDOM (UK)	United Kingdom
UNITED STATES OF AMERICA (USA)	United States of America
WESTERN EUROPE (WEU)	Austria, Belgium, Denmark, Finland, France, Germany, Gibraltar, Greece, Greenland, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom

16R TIAM-UCL Model Development (as of June 2010)

- Fully calibrated 16 Region TIAM-UCL global model (**Version 1.00**)
 - 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**)
 - The TIAM-UCL Global Energy Systems Model: Critical Comparison of UK and Global Climate Decarbonisation Trajectories (**BIEE, Oxford, September 2010**)