# Competition for biomass trade to meet global and national emission targets for below 2 °C trajectories

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## Research question

**Has the potential for bioenergy been underestimated in some countries because governments are too pessimistic about biomass trade opportunities?**

We use an integrated assessment model (IAM) to explore potential future trade in biocommodities and consider the implications for the development of bioenergy.

## Method

TIAM-UCL is a global IAM with 16 regions and a detailed representation of current and potential future energy resources and technologies in each region. TIAM-UCL identifies *least-cost* transitions to low-carbon energy systems, across the world, to meet climate change targets.[1]

- The representation of bioenergy in each modelled region includes all processes from resources to conversion to end-use technologies.

- Biomass can be used in the model to produce biofuels and other bioproducts, or to generate electricity, heat, or hydrogen, with carbon capture and storage (CCS) available where appropriate for negative emissions (BECCS).

- Regions can trade energy crops, solid biomass, bio-diesel, and other biofuels, in addition to fossil fuels.  We assume that biomass trade in the future will mostly occur between nations in which there is already a nascent bioenergy or biofuels trade.

We reflect the uncertainty in the resource base by examining two long-term scenarios with high and low resource availability.  In each scenario, greenhouse gas emissions are restricted to keep the global temperature rise below 2 °C.
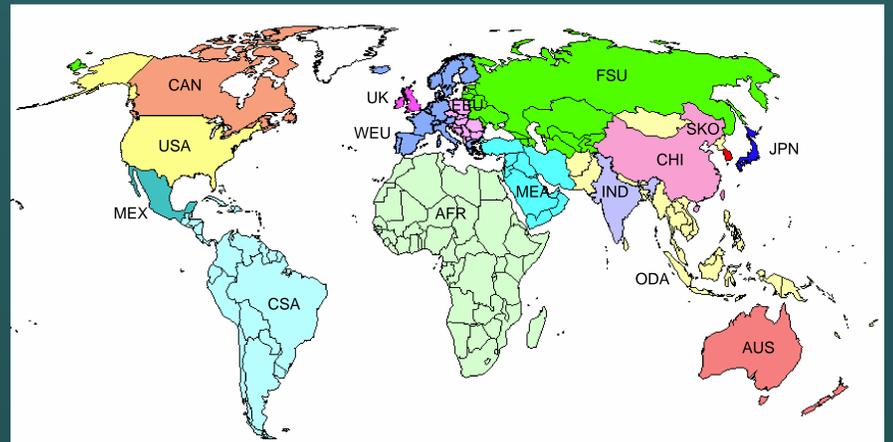
| CAN | Canada | UK | UK & Ireland | FSU | Former Soviet Union | SKO | South Korea |
|-----|--------|-----|-----|-----|-----|-----|-----|
| USA | USA | WEU | Western European Union | MEA | Middle East | JPN | Japan |
| MEX | Mexico | EEU | Eastern European Union | IND | India | ODA | Other Developing Asia |
| CSA | Central and South America | AFR | Africa | CHI | China | AUS | Australia & NZ |

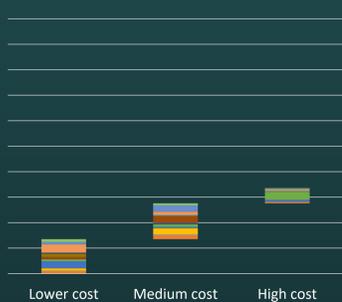Define regions and trade links in TIAM-UCL
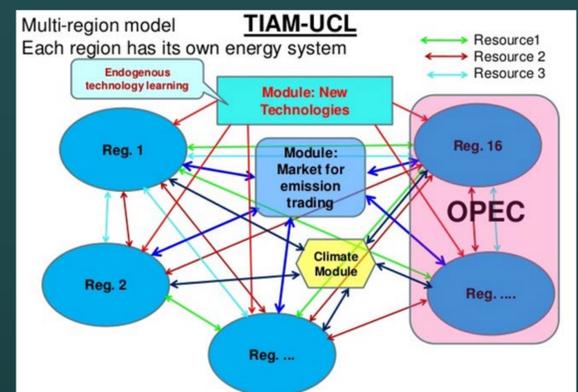
Biomass resource availability and cost are model inputs

### High availability / Low availability

Domestic resource cost curves in 2050 for *tradable* biomass (excluding waste)
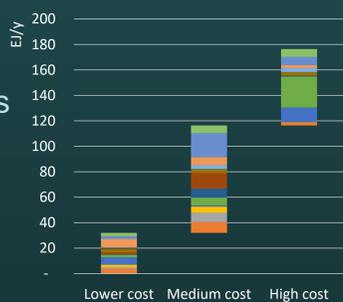
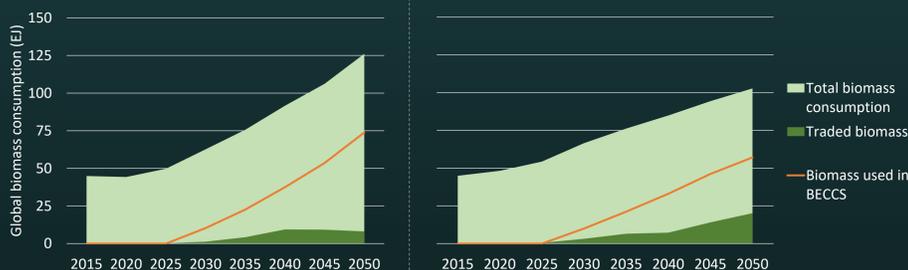## Insights

Biomass and waste consumption

Higher-cost resources are only economical in the low-availability scenario, reflecting the important role of bioenergy in meeting the 2 °C target even if biomass is expensive.  BECCS accounts for more than 50% of all biomass consumption in both cases.  Most biomass is used within the region in which it is harvested. Competition and trade are higher when the resource is more limited.

Biocommodity trading in 2050

- Bio-naphtha
- Bio-kerosene jet fuel
- Ethanol
- Bio-diesel
- Solid biomass
- Energy crops

In both scenarios, the USA, China, Africa, Japan and the UK are importers, while Russia, Canada and South-East Asia are exporters. Yet the proportions of imports and exports varies greatly between scenarios, and trade is higher when domestic biomass availability is more limited.  Biomass trade is far higher than biofuel trade.

## Case study: UK trade

The UK Government assumes that the availability of biomass imports to the UK will reduce over time, as shown in the graph below.  Yet in both scenarios in this study, net imports are much higher than even the sum of the Government's projections of maximum domestic resources and imports, as shown below.

This is important because BECCS is the optimal destination in a limited-resource scenario, while the much higher imports modelled here would enable a biofuel industry to also flourish, with bioenergy having a much greater role in the wider energy system.

Resource underestimate

- Range of net imports
- Government domestic resources
- Government maximum imports
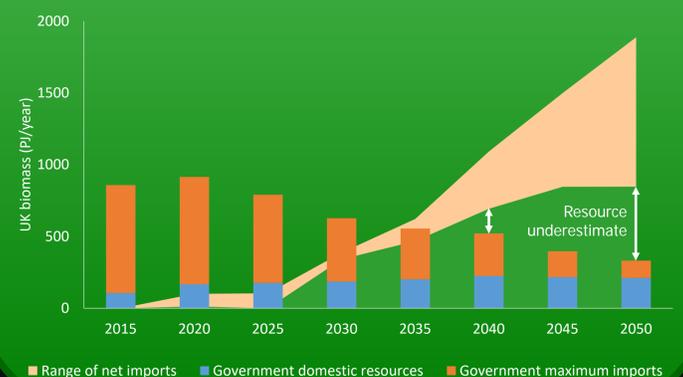
[1] Anandarajah, G., S. Pye, W. Usher, F. Kesicki and C. McGlade (2011). TIAM-UCL Global Model Documentation. London, UK. Available at: http://www.ucl.ac.uk/energy-models/models/tiam-ucl.

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