

# **A Bridge to a Low-Carbon Future? Modelling the Long-Term Global Potential of Natural Gas**

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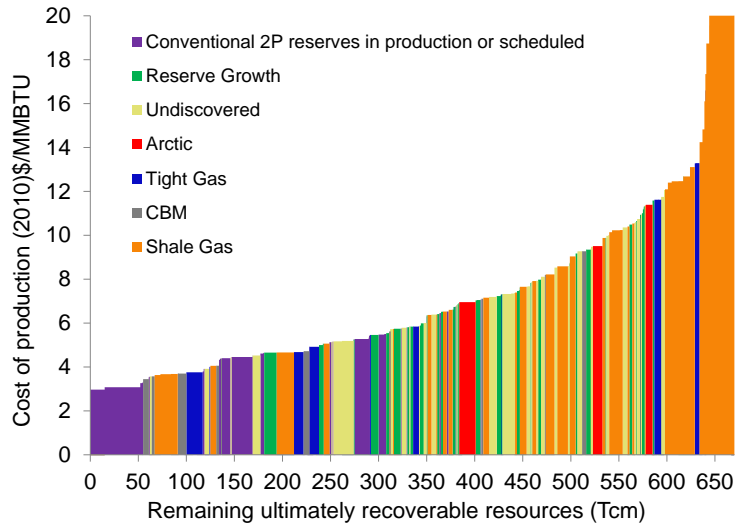
## Interaction between natural gas consumption and its effects on the climate is hotly debated

- Intergovernmental Panel on Climate Change (IPCC):
  - *“Greenhouse gas emissions...can be reduced significantly by replacing current world average coal-fired power plants with modern, highly efficient natural gas combined-cycle power plants.”*
- McJeon et al. (2014):
  - *“Market-driven increases in global supplies of unconventional natural gas do not discernibly reduce the trajectory of greenhouse gas emissions or climate forcing.”*
- Role of natural gas as a ‘bridging fuel’ thus remains unclear
- The report seeks to shed some light on this issue (as well as some others) using the integrated assessment model TIAM-UCL

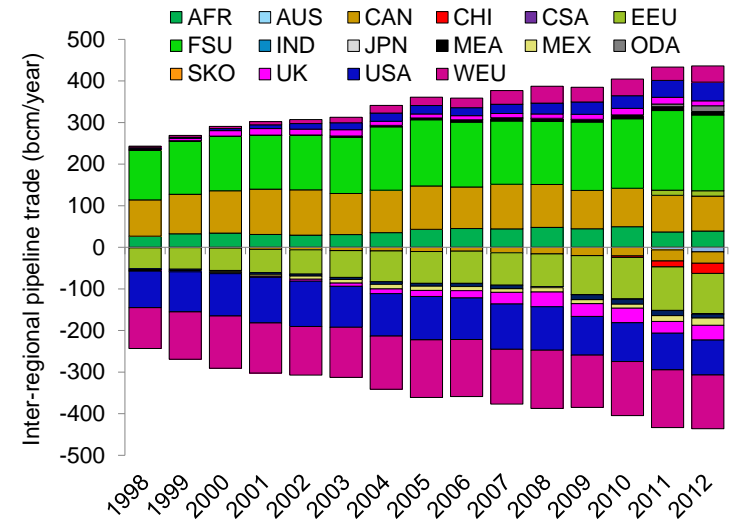


# Modifications to upstream and midstream

## Natural gas resources and costs



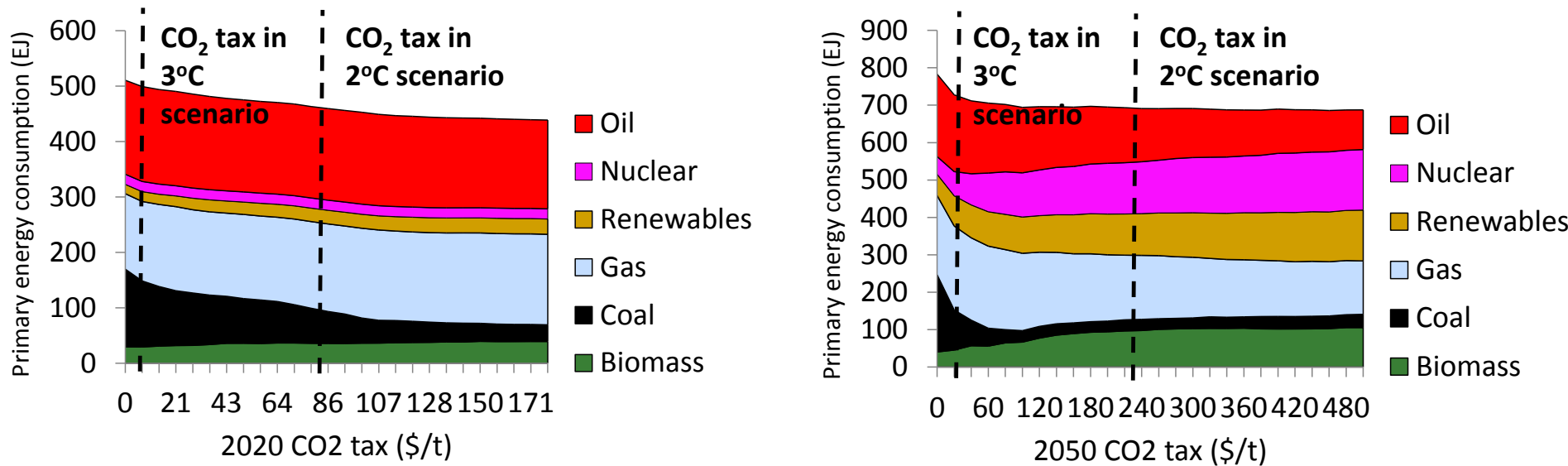
## Pipeline infrastructure and constraints



## LNG assumptions

|                |        | AFR     | AUS     | CAN      | CHI    | CSA               | EEU         | FSU      | IND   | JPN       | MEA         | MEX      | ODA         | SKO    | UK            | USA    | WEU     |           |
|----------------|--------|---------|---------|----------|--------|-------------------|-------------|----------|-------|-----------|-------------|----------|-------------|--------|---------------|--------|---------|-----------|
| <b>Country</b> | Liq    | Algeria |         |          |        | Trinidad & Tobago | Poland      | Russia   |       | Japan     | Qatar       |          | Malaysia    |        |               |        | Norway  |           |
|                | Re-gas | Algeria |         |          |        | Argentina         | Poland      | Russia   |       | Japan     | Kuwait      |          | Thailand    |        |               |        | Belgium |           |
| <b>Port</b>    | Liq    | Skikda  | Dampier | Kitimat  | Fujian | Point Fortin      | Swinoujscie | Sakhalin | Dahej |           | Ras Laffan  | Ensenada | Bintulu     |        |               |        | Sabine  | Melkoya   |
|                | Re-gas | Skikda  | Dampier | Canaport | Fujian | Bahia Blanca      | Swinoujscie | Sakhalin | Dahej | Sodegaura | Mina Ahmadi | Ensenada | Map Ta Phut | Inchon | Milford Haven | Sabine |         | Zeebrugge |

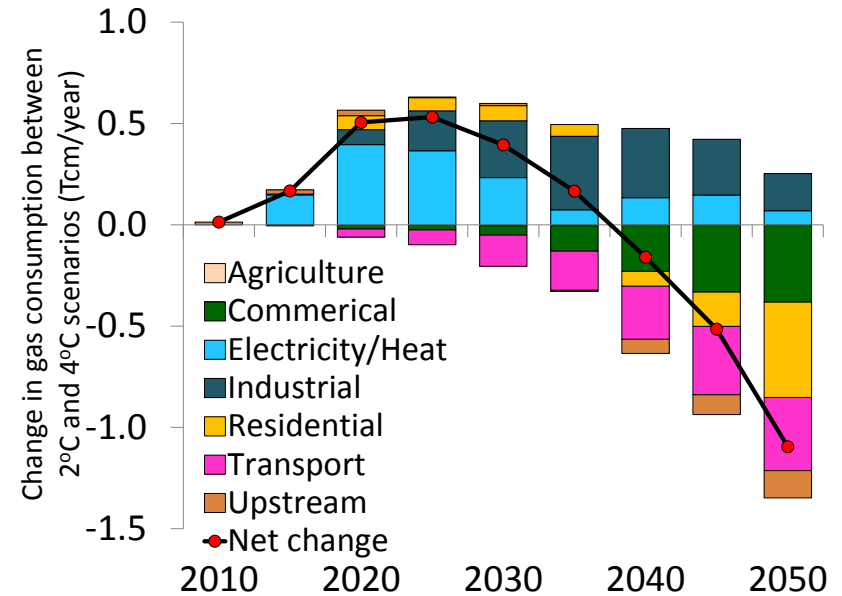
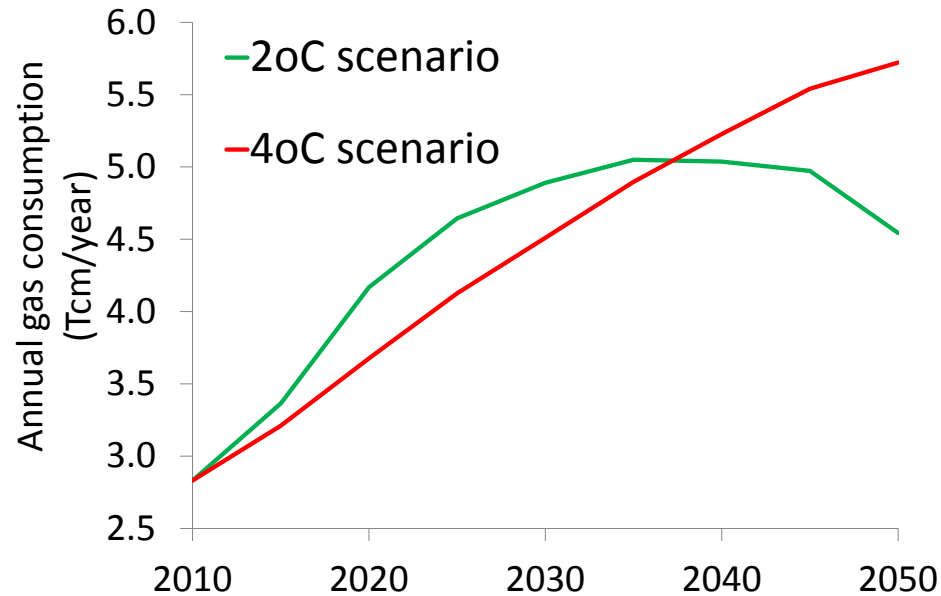
## Stringent climate policies lead to increase in near-term consumption but lower longer-term consumption



- Implemented lots of scenarios with varying degrees of effort to mitigate emissions by running scenarios with different CO<sub>2</sub> tax levels
- In early periods: the higher the tax, the more gas is consumed
- In later periods:
  - Low taxes - gas forces out coal
  - High taxes - renewables, nuclear and bioenergy force out gas



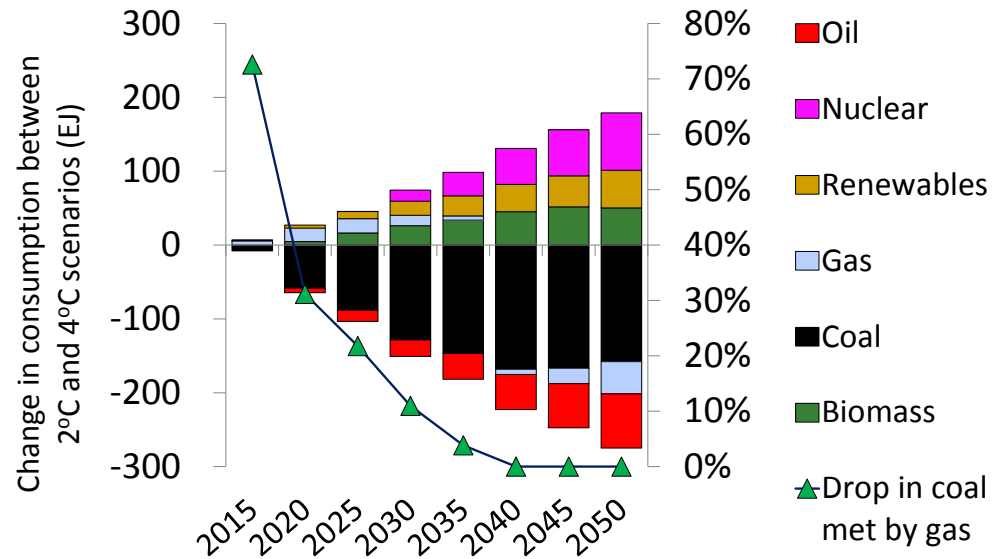
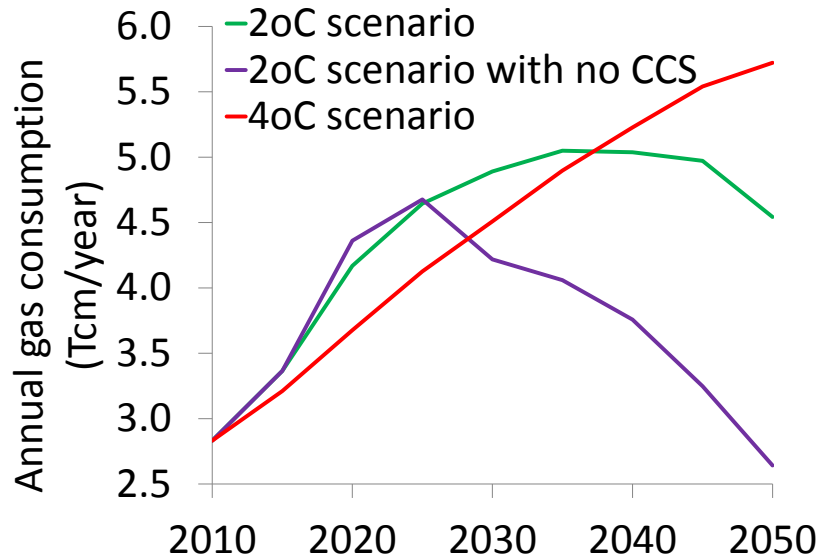
# Natural gas can act as a transition fuel globally



- Under our definition, on a global level gas acts as a bridging fuel to a low-carbon future in both an absolute and relative sense out to around 2035
- Consumption in 2°C scenario is greater than 4°C scenario in the electricity and industrial sectors in all years, however the commercial, transport and upstream sectors all require less gas in all periods.
- But multiple caveats to this...



# Relies on CCS being available, and gas-for-coal substitution alone is not sufficient



- If carbon capture and storage (CCS) is not available, global gas consumption peaks much earlier
- Classifying gas as a transition fuel needs a convincing description of how global coal consumption will be curtailed, or emissions from the increased use of gas will be additional to those from coal
- Gas only 'displaces' coal in early periods (up to 2015), afterwards efficiency and low-carbon fuels are more important than gas in replacing the drop in coal consumption



## Significant regional variation exists

| Region  | Potential role to act as a transition fuel <b>with</b> CCS | Potential role to act as a transition fuel <b>without</b> CCS |
|---------|--|---|
| AFR     | Limited  | Good  |
| AUS     | Good   | Good  |
| CAN     | Limited  | Limited   |
| CHI     | Strong   | Strong  |
| CSA     | Limited  | Limited   |
| EUR     | Strong   | Good  |
| FSU     | Limited  | Limited   |
| IND     | Strong   | Good  |
| JPN&SKO | Strong   | Good  |
| MEA     | Limited  | Limited   |
| MEX     | Limited  | Limited   |
| ODA     | Good   | Good  |
| USA     | Good   | Good  |
| Global  | Good   | Good  |



# Conclusions

- Have made multiple modifications to modelling of natural gas in TIAM-UCL
- Found that there is a good potential for gas to act as a transition fuel globally to a low-carbon future up to 2035, but important conditions exist:
  - The bridging period is strictly time-limited
  - The near-term increase in gas consumption must occur alongside a much greater reduction in coal consumption
  - The availability of carbon capture and storage (CCS) is key
  - This global pattern is not exhibited by all regions





# Thank you!

Link to report:

[http://www.ukerc.ac.uk/support/tiki-download\\_file.php?fileId=3716](http://www.ukerc.ac.uk/support/tiki-download_file.php?fileId=3716)

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