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Emerging science challenges for integrated assessment

Energy Modelling Forum:
Rapid Systems Transitions to Low GHG Futures

Snowmass, 22 July 2019

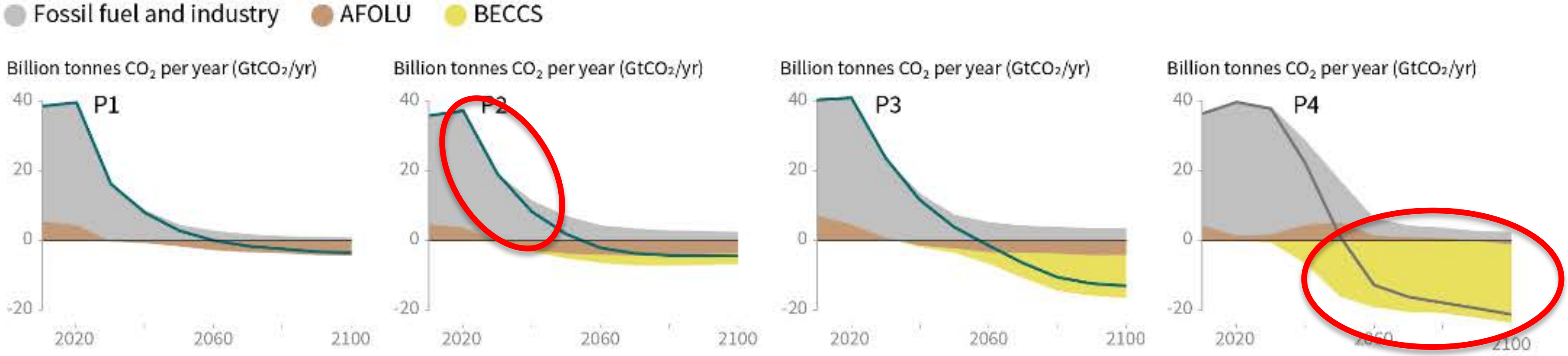
Jim Skea
Professor of Sustainable Energy

Imperial College London

SPM3b|

The feasibility questions: rapid transition and large-scale CO_2 removal

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

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Feasibility: a bottom-up approach in SR1.5

System	Mitigation Option	Evidence	Agreement	Ec	Tec	Inst	Soc	Env	Geo	Context
Energy System Transitions	Wind energy (on-shore & off-shore)	Robust	Medium							Wind regime, economic status, space for wind farms, and the existence of a legal framework for independent power producers affect uptake; cost-effectiveness affected by incentive regime
	Solar PV	Robust	High							Cost-effectiveness affected by solar irradiation and incentive regime. Also enhanced by legal framework for independent power producers, which affects uptake
	Bioenergy	Robust	Medium							Depends on availability of biomass and land and the capability to manage sustainable land use. Distributional effects depend on the agrarian (or other) system used to produce feedstock
	Electricity storage	Robust	High							Batteries universal, but grid-flexible resources vary with area's level of development
	Power sector carbon dioxide capture and storage	Robust	High							Varies with local CO_2 storage capacity, presence of legal framework, level of development and quality of public engagement
	Nuclear energy	Robust	High							Electricity market organization, legal framework, standardization & know-how, country's 'democratic fabric', institutional and technical capacity, and safety culture of public and private institutions

"dark shading signifying the absence of barriers in the feasibility dimension, moderate shading that on average, the dimension does not have a positive, nor a negative effect on the feasibility of the option, and faint shading the presence of potentially blocking barriers"

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Not infeasible?

OPINION

Limiting Climate Change to 1.5 C is not Impossible, Says IPCC Chair

By Lee Hoesung

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__Lee Hoesung__ was appointed Chair of the Intergovernmental Panel on Climate Change (IPCC) in 2015. He is also the Endowed Chair Professor of economics of climate change, energy and sustainable development in the Republic of Korea.*

UNITED NATIONS, Dec 3 2018 (IPS) - When governments set a target in December 2015 of limiting global warming to well below 2°C above pre-industrial levels while pursuing efforts to hold it at 1.5°C, they invited the IPCC to prepare a report to provide information on this Goal.

Lee Hoesung

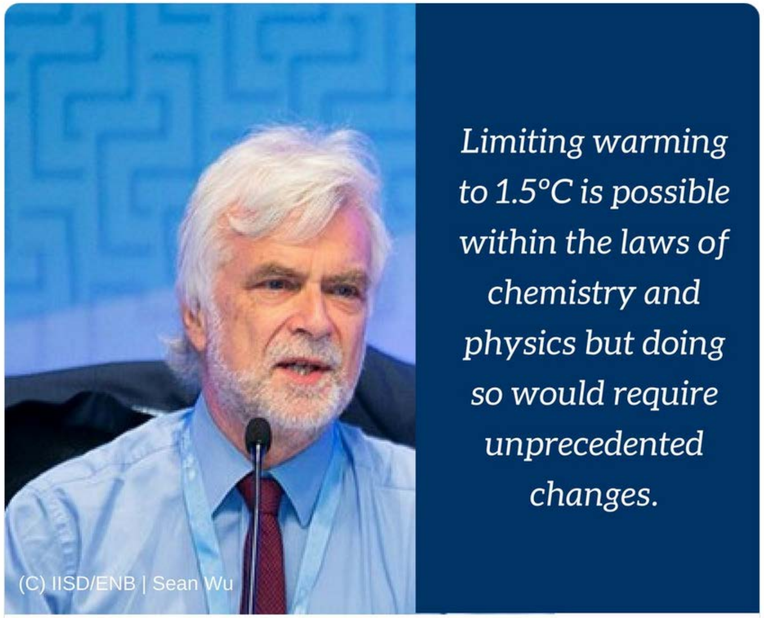
They asked the IPCC to assess the impacts of warming of 1.5°C, the related emissions pathways of greenhouse gases like carbon dioxide that would result in warming of that amount, and the differences between warming of 1.5 and 2°C or higher.

The new IPCC Special Report on *Global Warming* of 1.5°C shows that it is not impossible to limit warming to 1.5°C but that doing so will require unprecedented transformations in all aspects of society.

The report shows that this is a worthwhile goal as the impacts of warming of 2°C on lives, livelihoods and natural ecosystems are much more severe than from warming of 1.5°C.

The global temperature has already risen about 1°C from pre-industrial levels. The report shows that because of past emissions up to the present it will continue to warm. But these emissions alone are not enough to take the temperature to 1.5°C: it is still possible to hold it at that level.

This requires very strong cuts in emissions of greenhouse gases by 2030, for instance by decarbonization of electricity production, and further cuts after that so that emissions fall to net zero by 2050.



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CARBON NEUTRALITY COALITION

The net zero aspiration is taking hold

"We will develop long-term low-greenhouse gases emission climate resilient development strategies, in line with the agreed long-term temperature increase limit. We will do so well ahead of 2020, and if possible by 2018."

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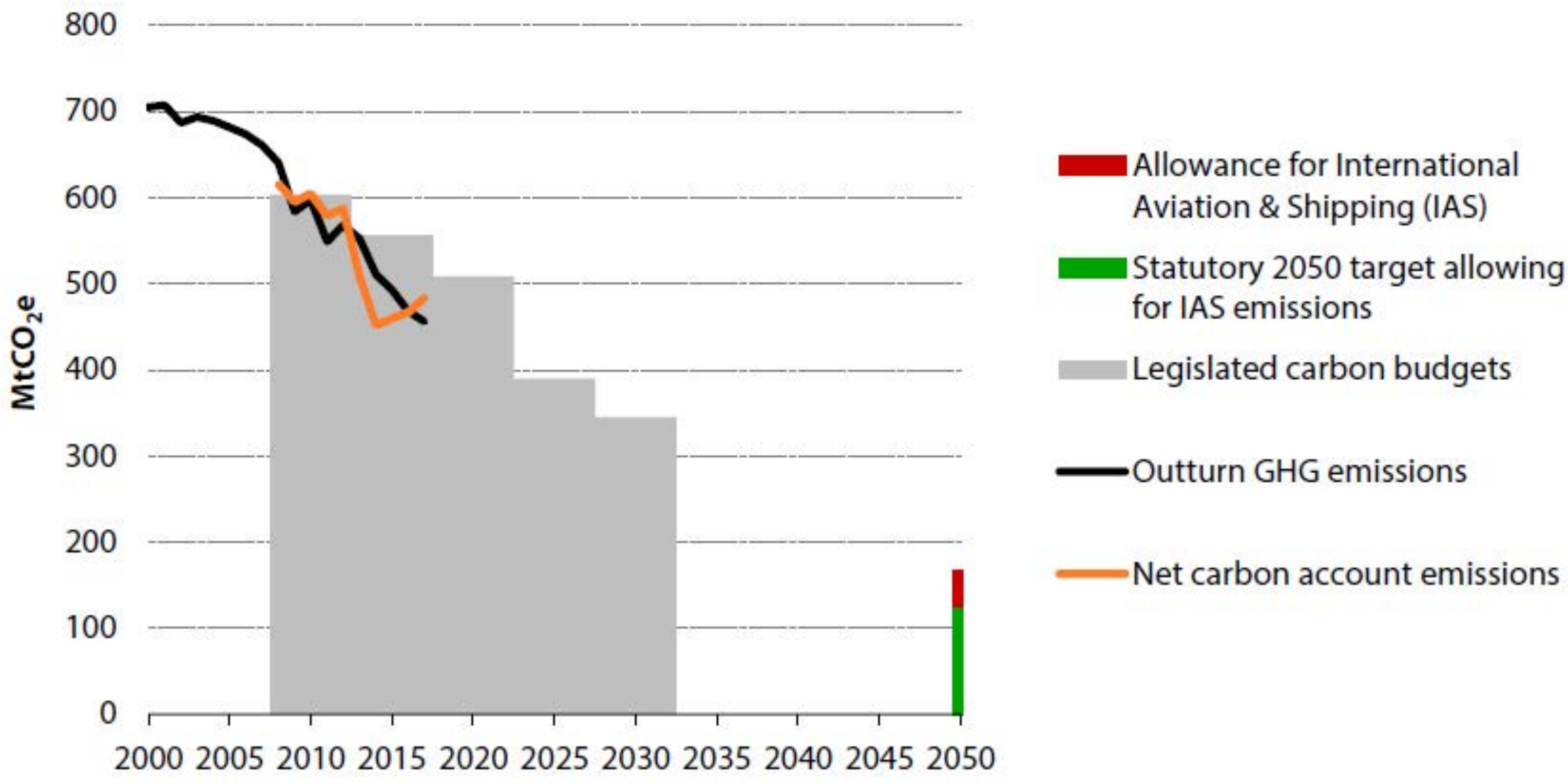
The UK's legally binding commitments pre-Paris




Net Zero
The UK's contribution to stopping global warming
Committee on Climate Change
May 2019


Net Zero
Technical report
Committee on Climate Change
May 2019

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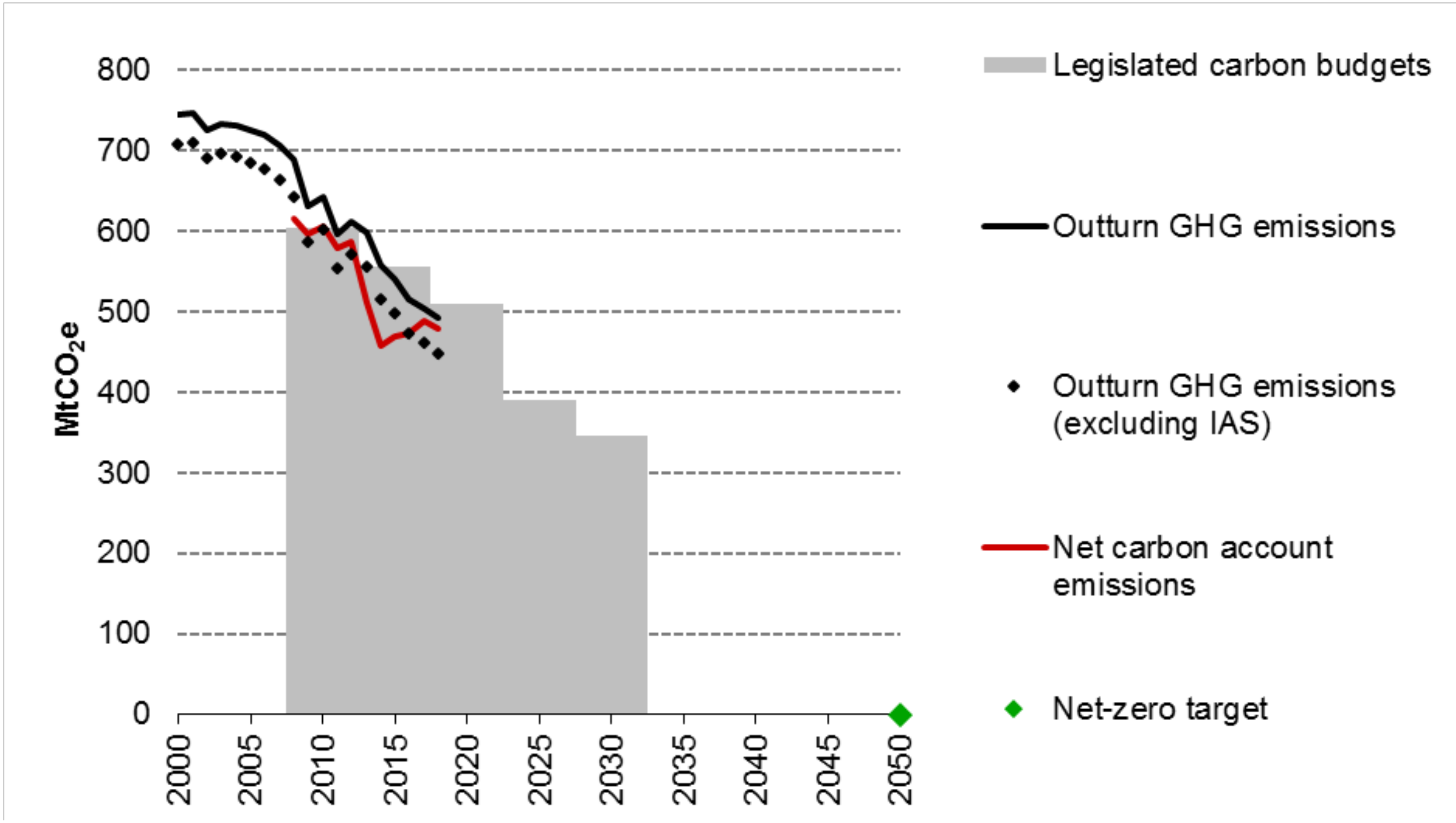
The UK's legally binding commitments post -Paris and SR1.5



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Analytical underpinning: UK in a global context

ENERGY INSTITUTE

UCL

RESEARCH REPORT

Modelling 'leadership-driven' scenarios of the global mitigation effort

New TIAM model runs

Secondary analysis of SR1.5 database

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The UK's contribution to a Paris-consistent global emissions reduction pathway

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Analytical underpinning: Net zero in the UK

- Internal Committee analysis using sectoral models previously developed in-house or through consultancy assignments
  - Power and Hydrogen
  - Buildings
  - Industry
  - Surface Transport
  - Aviation and Shipping
  - Agriculture & LULUCF
  - Waste
  - F-gas emissions
  - Greenhouse gas removals
- No system-level modelling
- Comparative statics – now and 2050, no pathways

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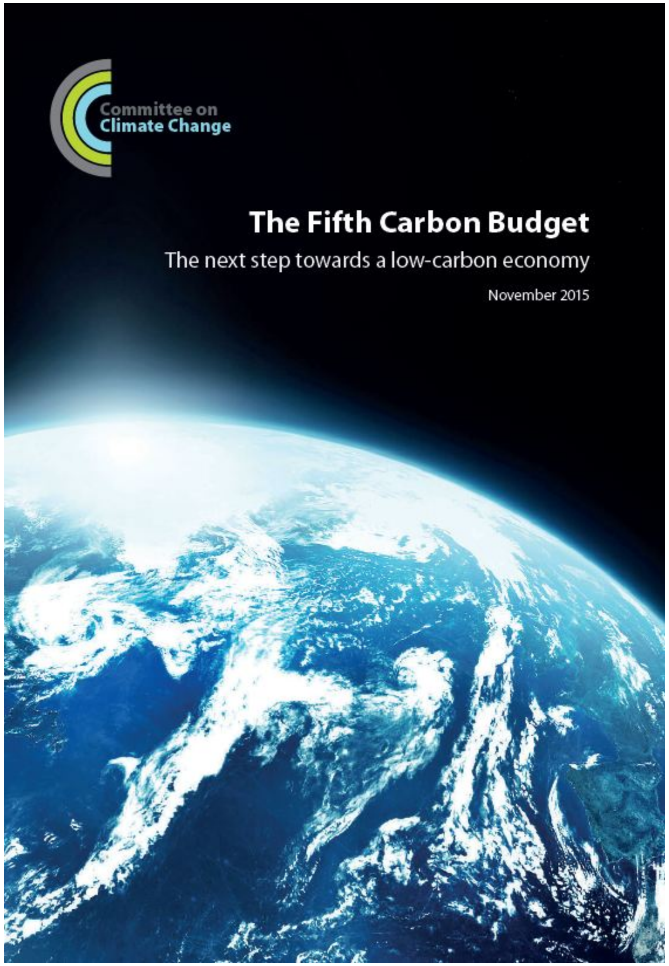
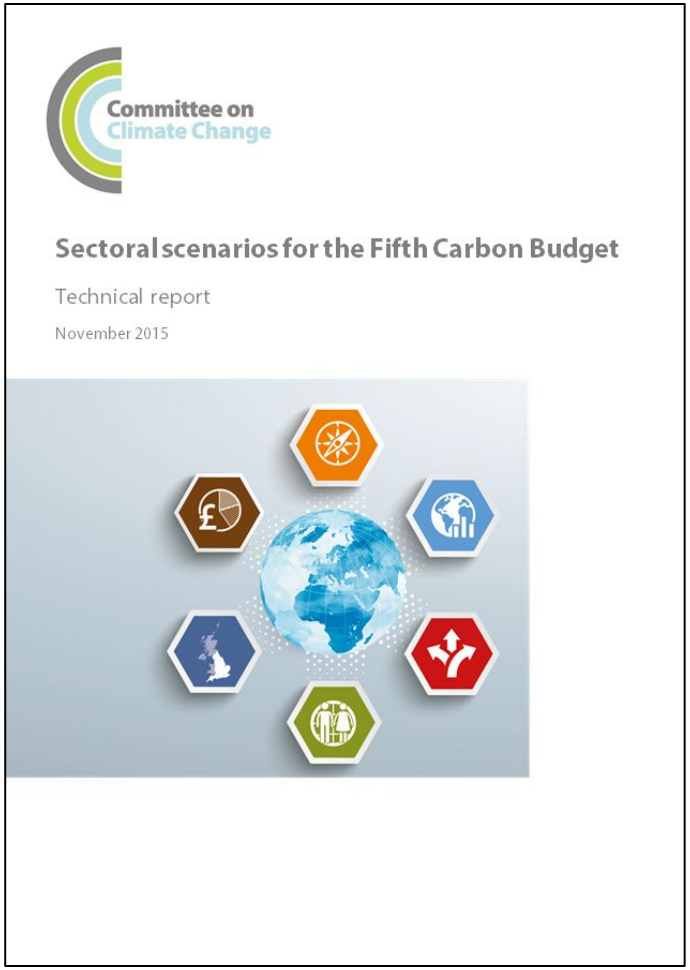
Thinking 15 years ahead: the UK's carbon budgets





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Analytical underpinning: UK in a global context

- Sectoral models previously developed in-house or through consultancy assignments *plus bespoke commissioned work*
  - Power
  - Buildings
  - Industry
  - Transport
  - Agriculture, land use and forestry
  - Waste and fluorinated gases
- *Use of UK TIMES-MARKAL systems model tried and abandoned*
- Scenarios on an *annual* basis, not 5/10 year steps.

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Commissioned work: vehicles; grid; hydrogen; heat; agriculture

- The potential for demand-side fuel savings in the HGV sector
- Light duty vehicle cost
- Value of flexibility in a decarbonised grid and system externalities of low-carbon generation technologies
- System integration costs for alternative low carbon generation technologies
- Scenarios for deployment of hydrogen in meeting carbon budgets
- Research on district heating and local approaches to heat decarbonisation
- Quantifying uncertainty in baseline emissions projections
- Review and update of the UK agriculture marginal abatement cost curves

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Back to IPCC

IPCC WG III AR6: the scenario framework

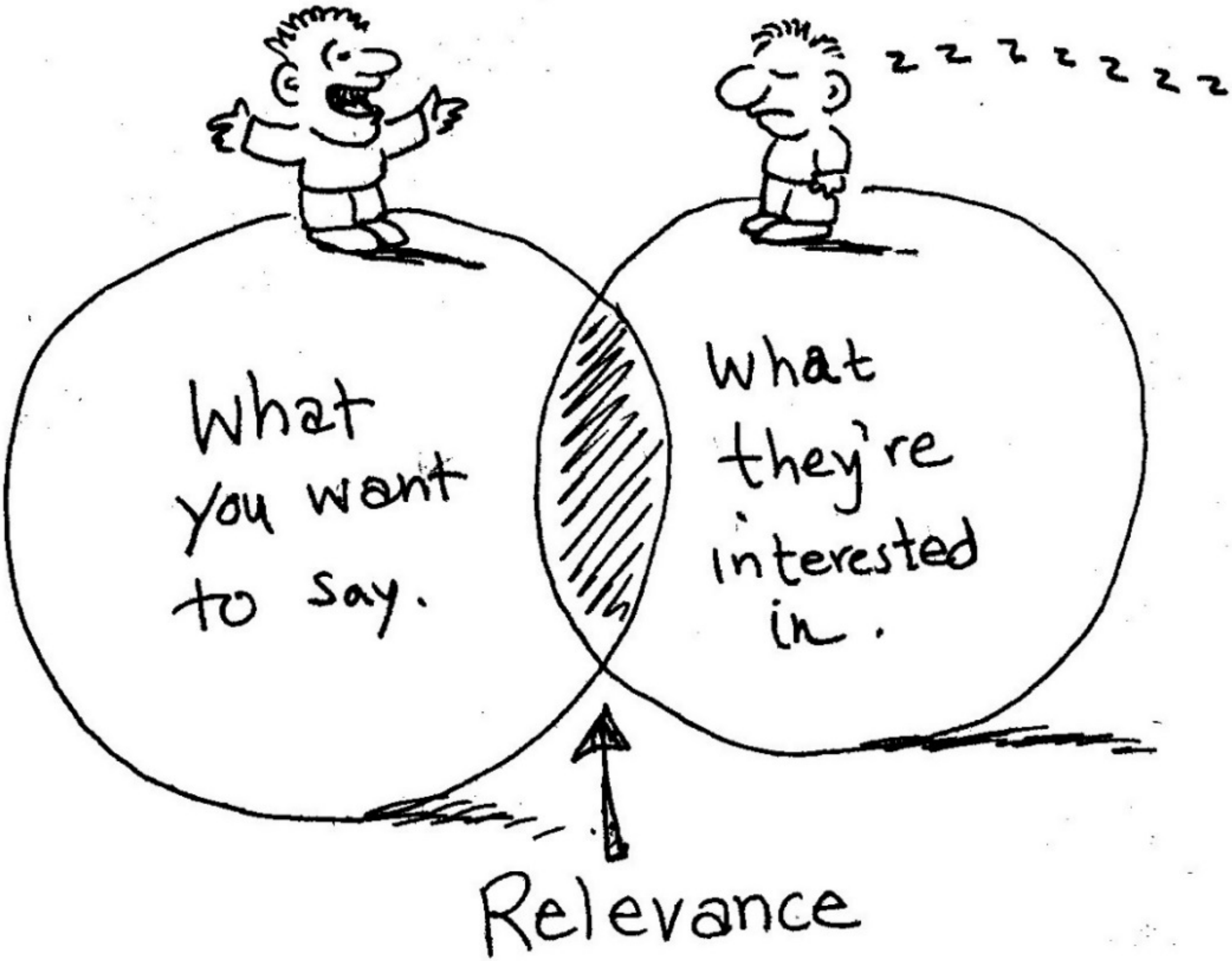
Chapter 3

- Socio-cultural-techno-economic assumptions and projections, including regional differences (referring to baseline and mitigation scenarios, Shared Socio-economic Pathways (SSPs)
- Modelled emission pathways compatible with the Paris Agreement, including the long-term temperature goal, and higher warming levels (including peaking, rates of change, balancing sources and sinks, and cumulative emissions)
- System transitions and/or transformation compatible with mitigation pathways, including supply and demand and integrating sectoral information
- Economics of mitigation and development pathways, including mitigation costs, investment needs, employment effects, etc.
- Technological and behavioural aspects of mitigation pathways and socio-technical transitions
- Interaction between near to mid-term action, and long-term mitigation pathways

Chapter 4

- Projections of socio-economic and demographic drivers (e.g. GDP, population)
- Aggregate effects of climate action including NDCs and other mitigation efforts relative to long-term mitigation pathways, including methodologies and gap analysis
- Mitigation efforts in the context of national and, where appropriate, subnational action plans and policies
- National, regional and global modelling of mitigation and development pathways in relation to mid-century strategies
- Implications of mitigation for national development objectives, including: employment, competitiveness, GDP, poverty, etc., and contributions of sustainable development pathways to mitigation
- Enabling conditions for mitigation, including technology development and transfer, capacity building, finance, and private and public sector participation

+ Annex C: Scenarios and modelling methods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What you want to say.
What they're interested in.
Relevance

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Questions for myself

- Where does Integrated Assessment Modelling stop; where do other types of models start?
- How much granularity do you need for decision-makers thinking 15-20 years ahead?
- Shorter time slices for near-term analysis to better capture transition issues?
- "Just transition" social and economic considerations: employment; supply-chains; skills needs; industrial infrastructure
- How do we link long-term and short/medium-term scenario horizons to provide actionable messages for decision-makers?