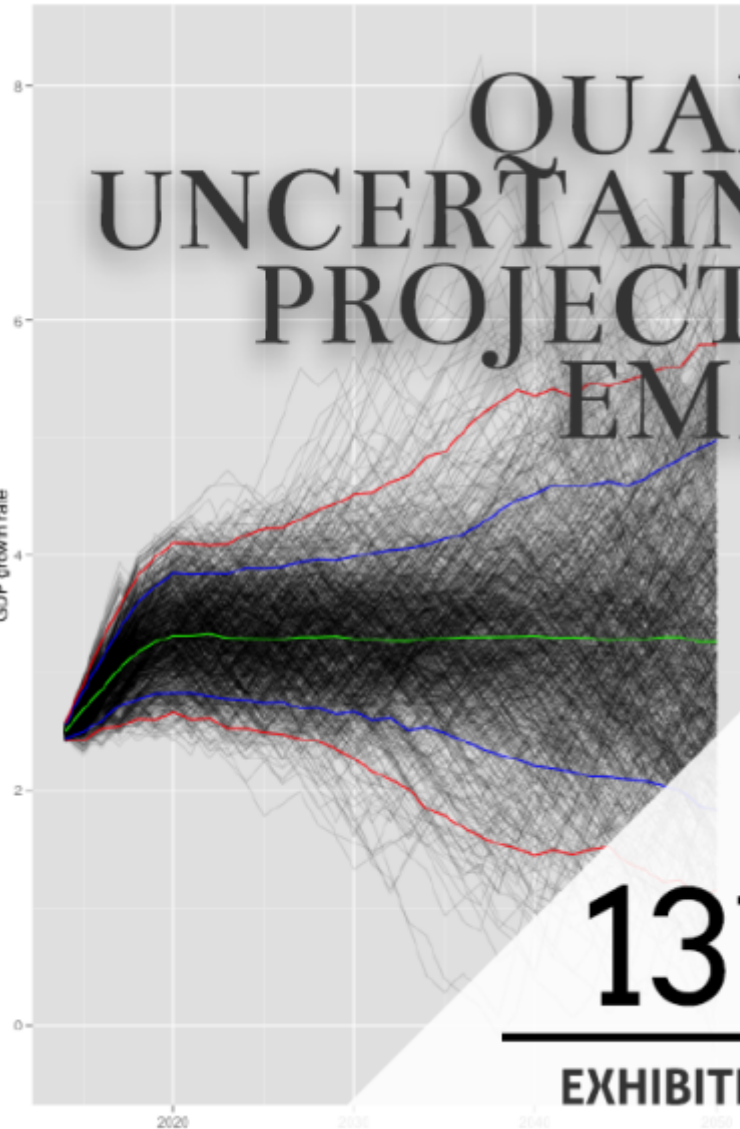
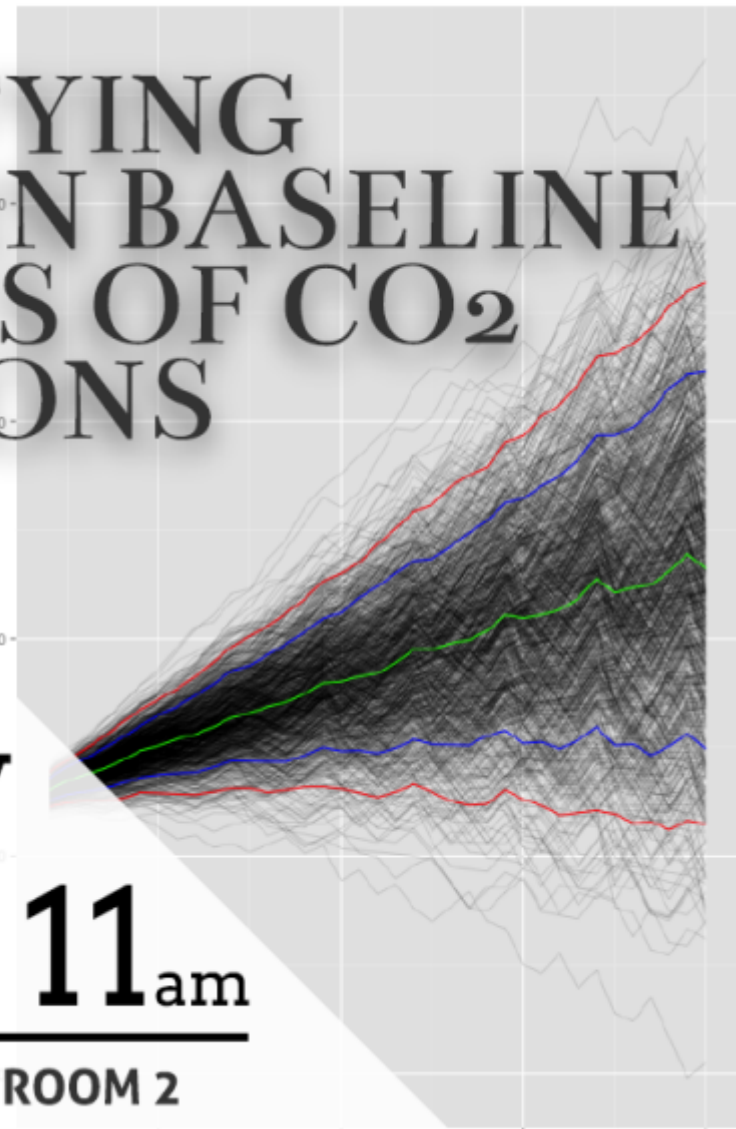


# QUANTIFYING UNCERTAINTY IN BASELINE PROJECTIONS OF CO<sub>2</sub> EMISSIONS

GDP growth rate



Population (million)



NOV  
13<sup>th</sup> @ 11<sub>am</sub>

EXHIBITION HALL 4, ROOM 2



**ERC**

ENERGY RESEARCH CENTRE  
University of Cape Town



UNEP

**FIRM**

Facilitating  
Implementation and  
Readiness for  
Mitigation

# Agenda

11:00: A few words of introduction by DEA (DEA: Thapelo Letete)

11:05: Introduction of Project by UNEP (UNEP: Cecilia Kinuthia-Njenga, Rahel Steinbach)

11:20: Introduction (ERC: Bruno Merven)

11:30: Approach (ERC: Ian Durbach)

11:45: The Model and Preliminary Results (ERC: Bruno Merven)

12:00: Presentation on what this could mean for Policy (ERC: Andrew Marquard)

12:15: Questions and discussion (chair: TBA)

13:00: Lunch

# **1. BASELINE PROJECTIONS**

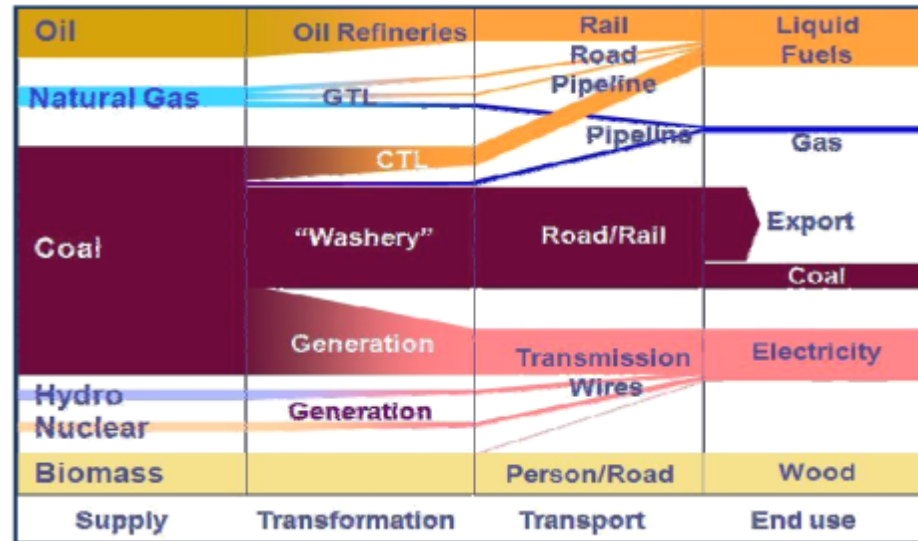
# Baselines and Climate Policy

- Reference against which mitigation potential and cost is assessed
- In most developed countries: set relative to emission level for a benchmark date [recent past]
- In developing countries: a percentage reduction from an emission level in a baseline trajectory at a specified future date [long into the future]
- Percentage reduction either relative to:
  - GHG trajectory (e.g. SA)
  - GHG intensity trajectory (e.g. China)

## Baseline: a can of worms!

- Baseline follows Business as Usual (BAU): How is BAU defined?
  - Are current NAMAs, LCDs and SD-PAMs efforts included?
  - % GT or % GT/\$?
- Growth projections are aspirational and politically sensitive
- For developing countries Development and Sustainable Development and not Climate is main driver (poverty, inequality, education)
- Countries' own analysis should still take precedence over analysis done outside

# Baseline for SA: How much Coal?



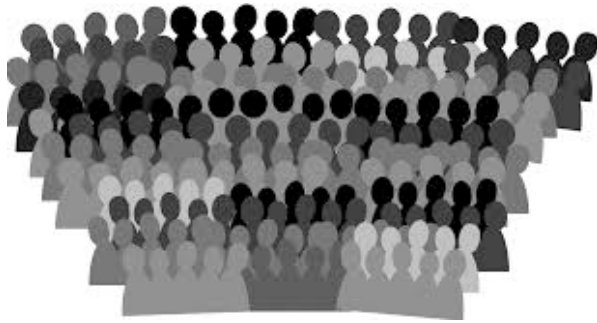
## Drivers in the absence of a climate policy:

- Growth in population
- Development of the economy (size and structure)
- Energy and Environmental regulation
- Domestic Price of coal relative to other competing energy carriers/technologies:
  - Global Coal Price and potential for trade
  - Price and availability of Shale Gas or Regional Gas for electricity, industry thermal, transport (oil price also a factor here)
  - Price of Renewable/Nuclear electricity
  - Price of more efficient/less carbon intensive end-use technologies
  - Price of Carbon (domestic and int. via border tax adjustments)
  - Price of scarce water

## **2. APPROACH**







Population growth



GDP growth



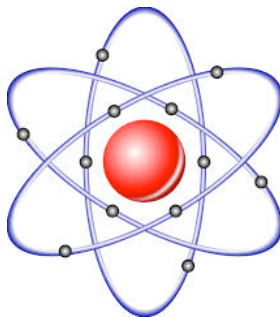
GDP distribution



Coal prices



Gas prices



Nuclear costs

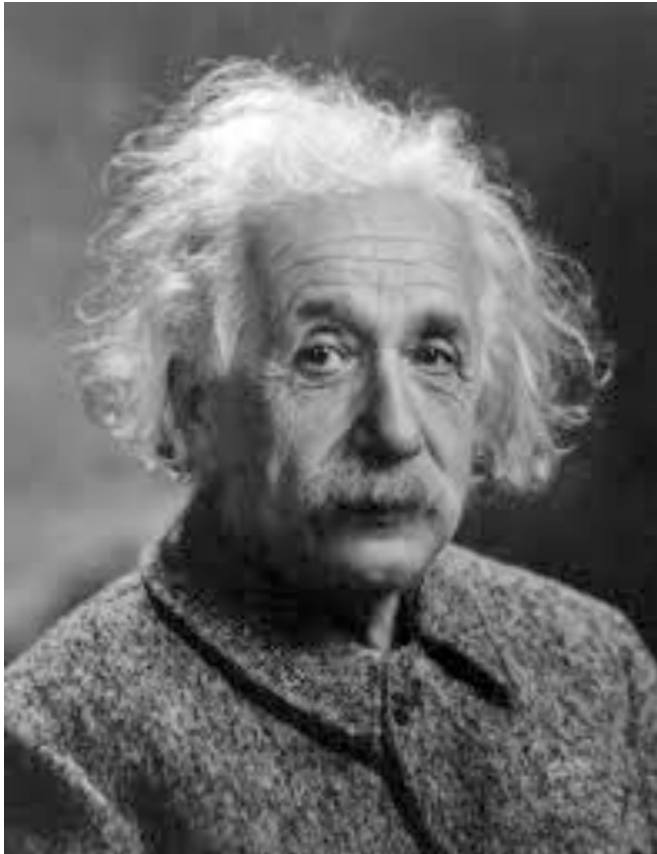


Renewables costs



# 2050?



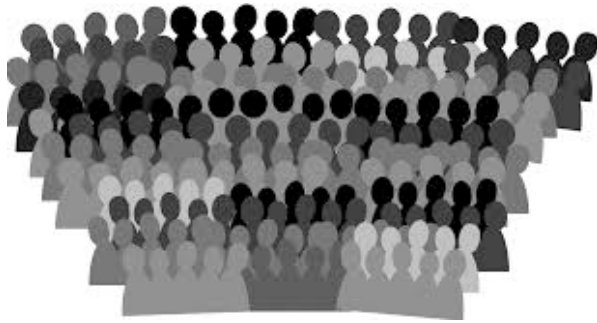


Local expert  
assessments



Literature and past  
research





UN probabilistic projections



2 expert interviews



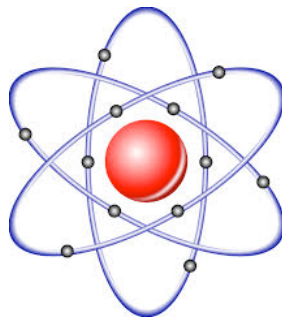
2 expert interviews



4 expert interviews



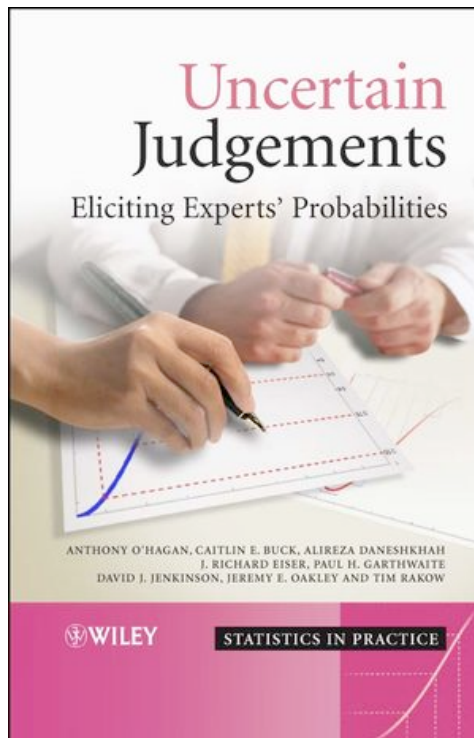
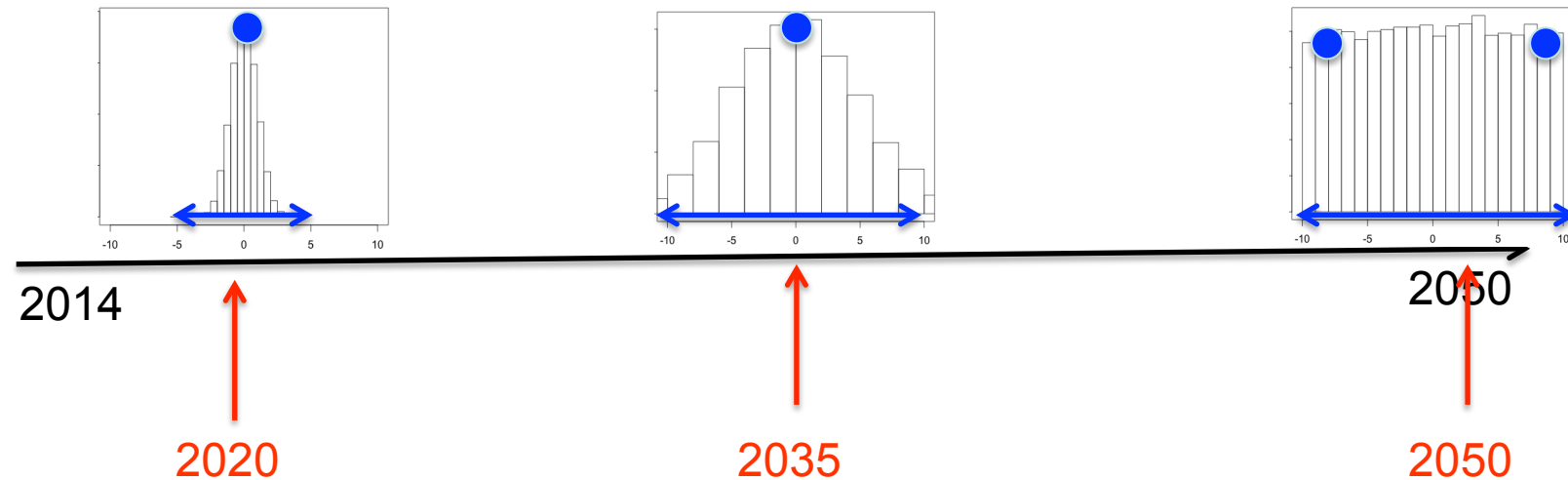
2 expert interviews



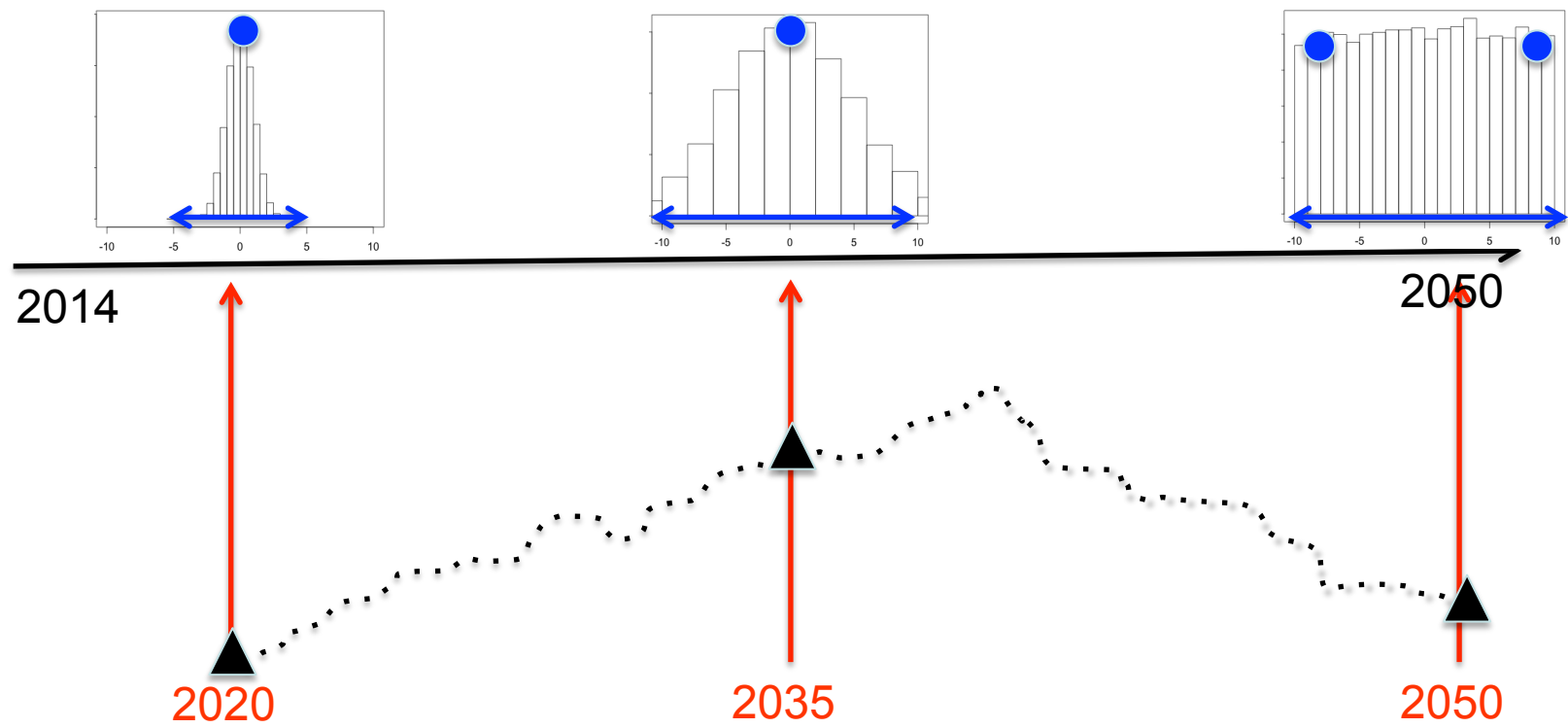
Literature and past work

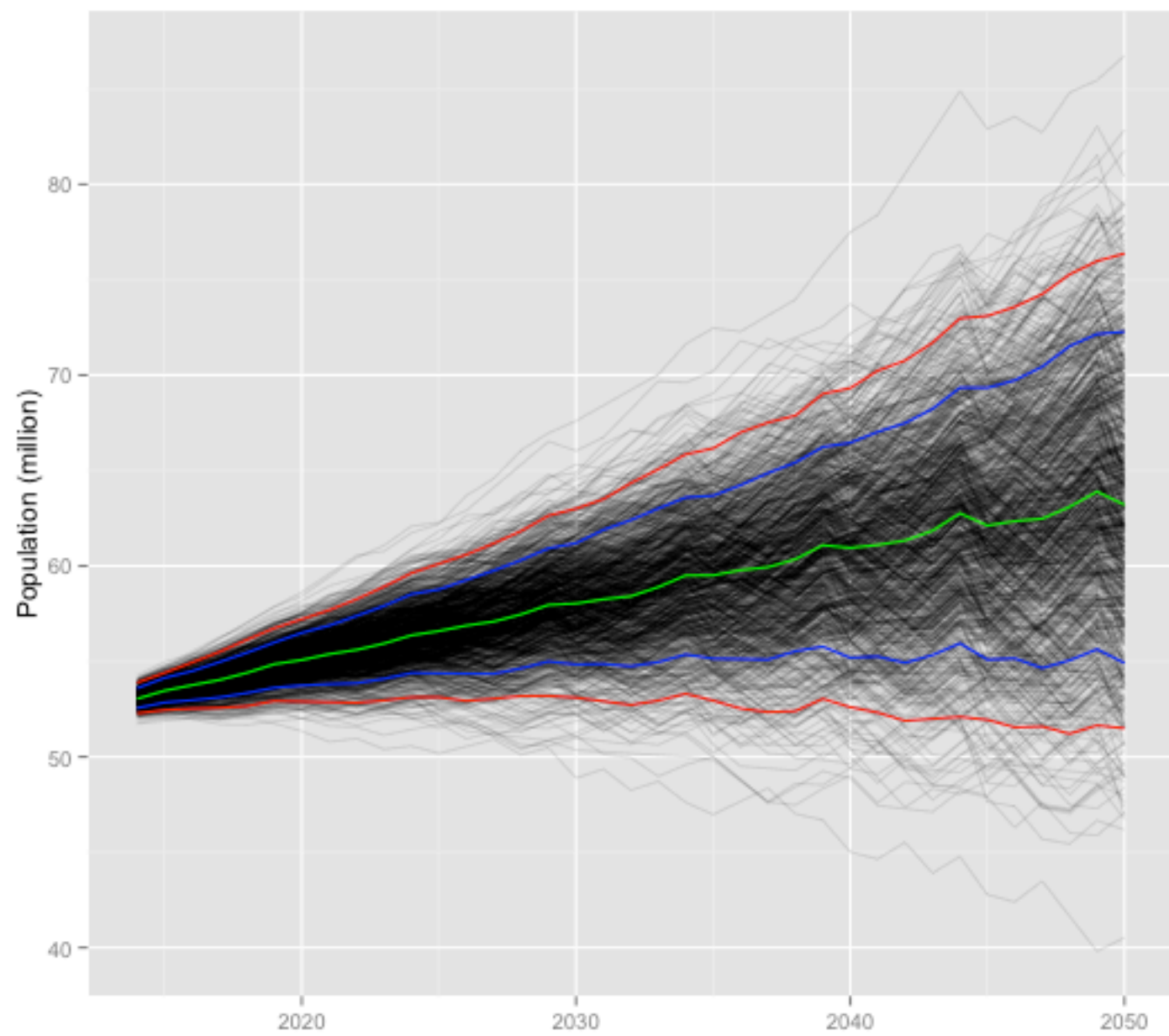


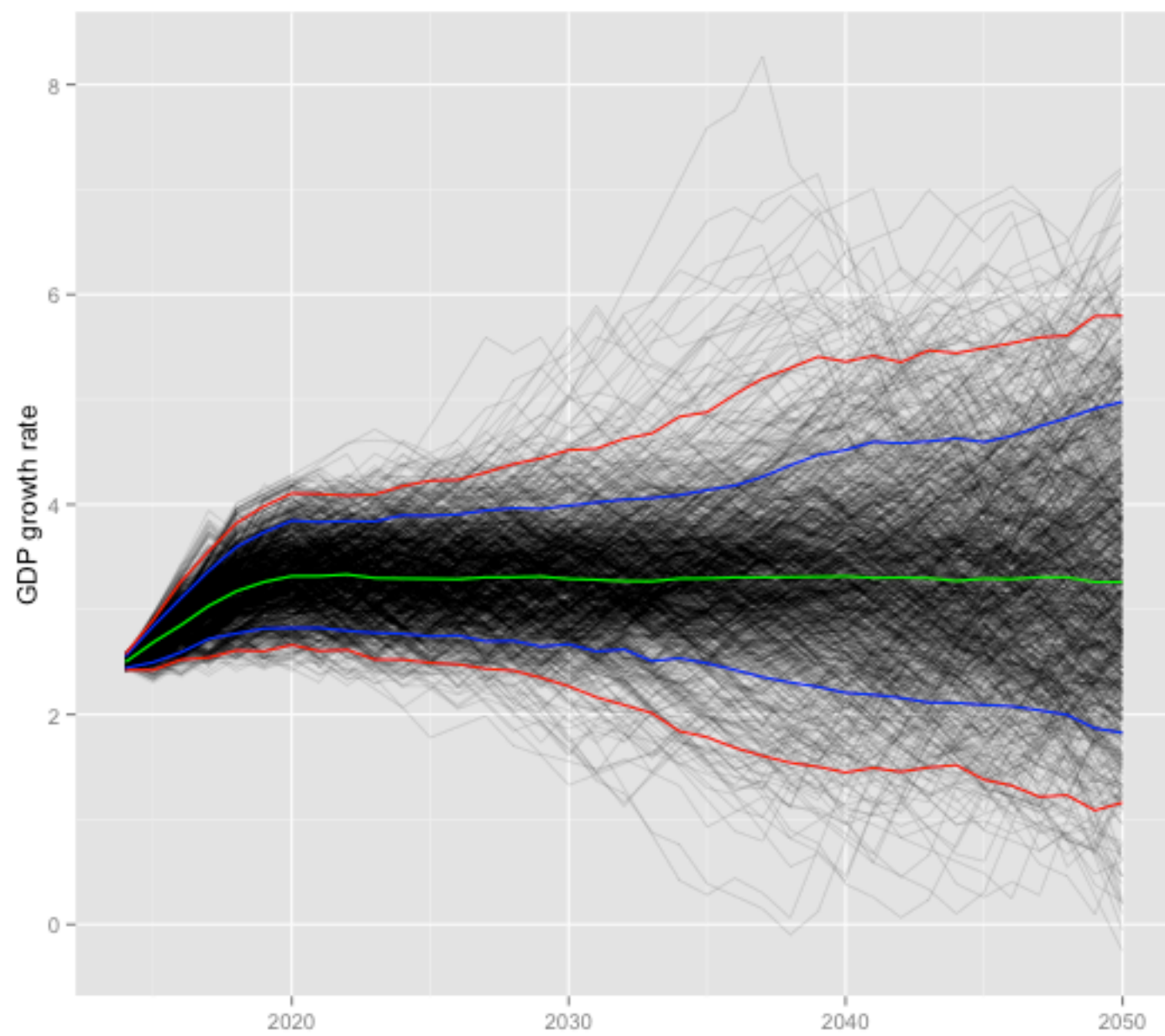
Literature and past work



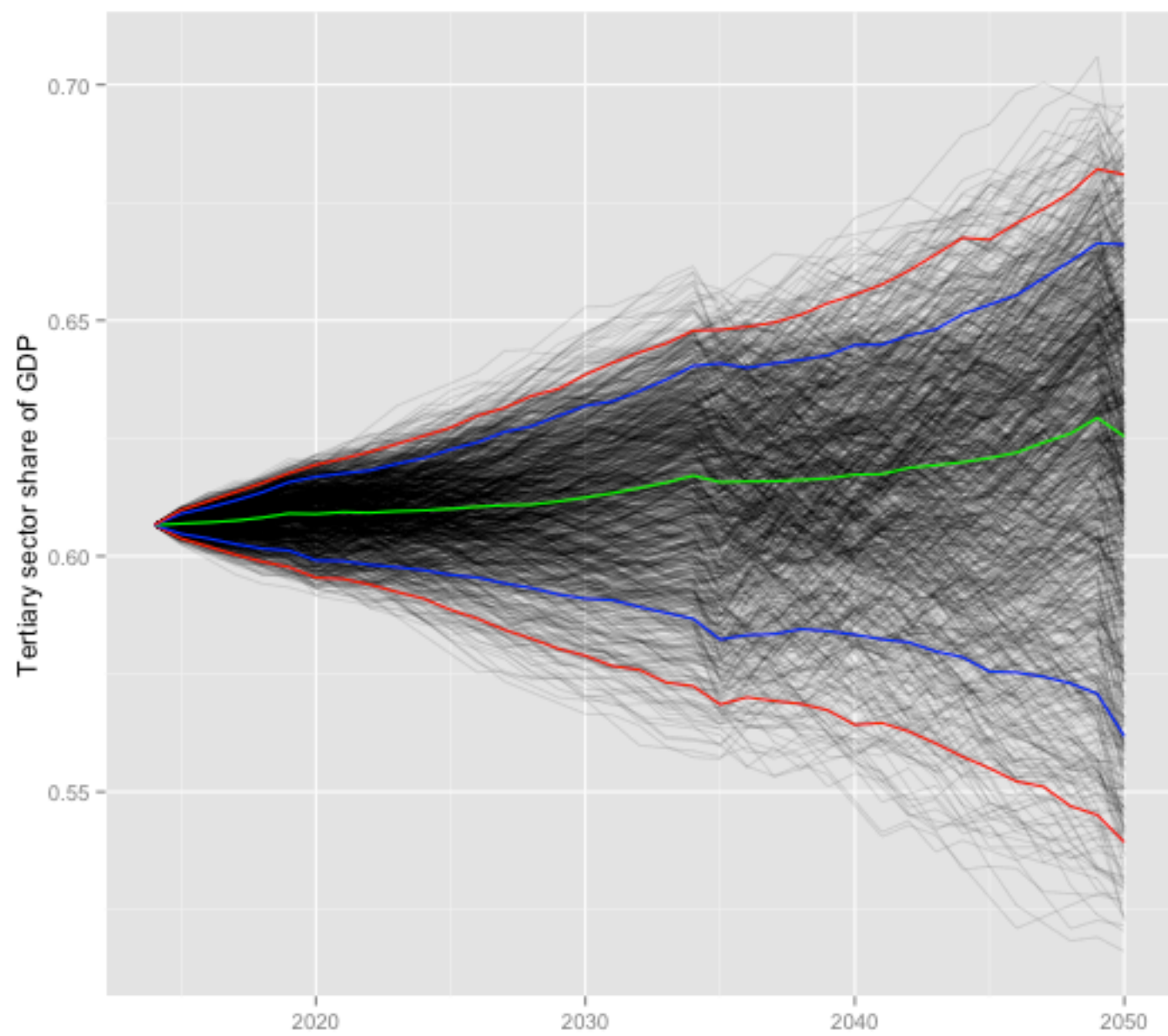
- Establishing rapport
- Acclimatizing the expert
- Eliciting probability judgments
- Cross-checking and validation

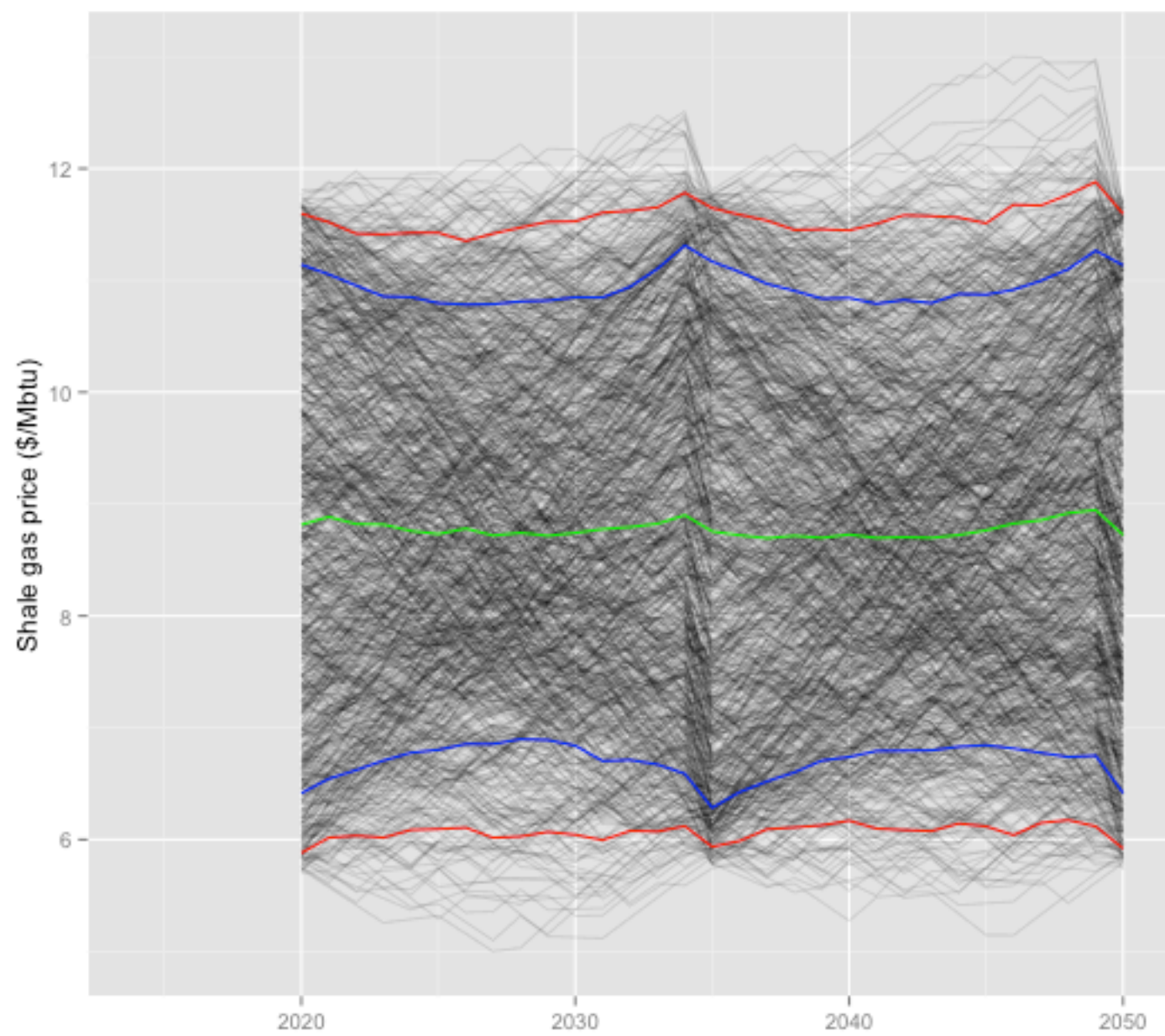


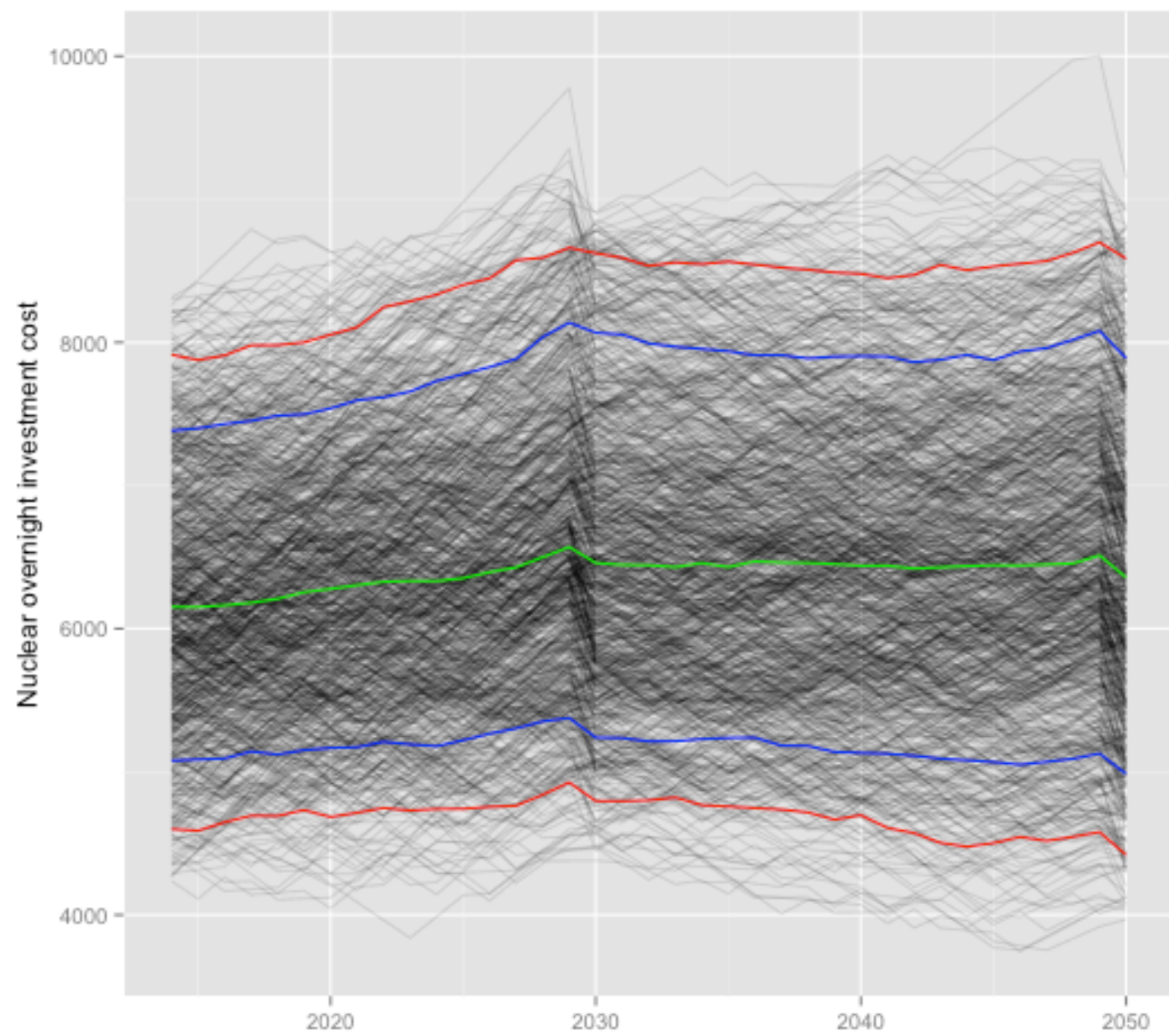


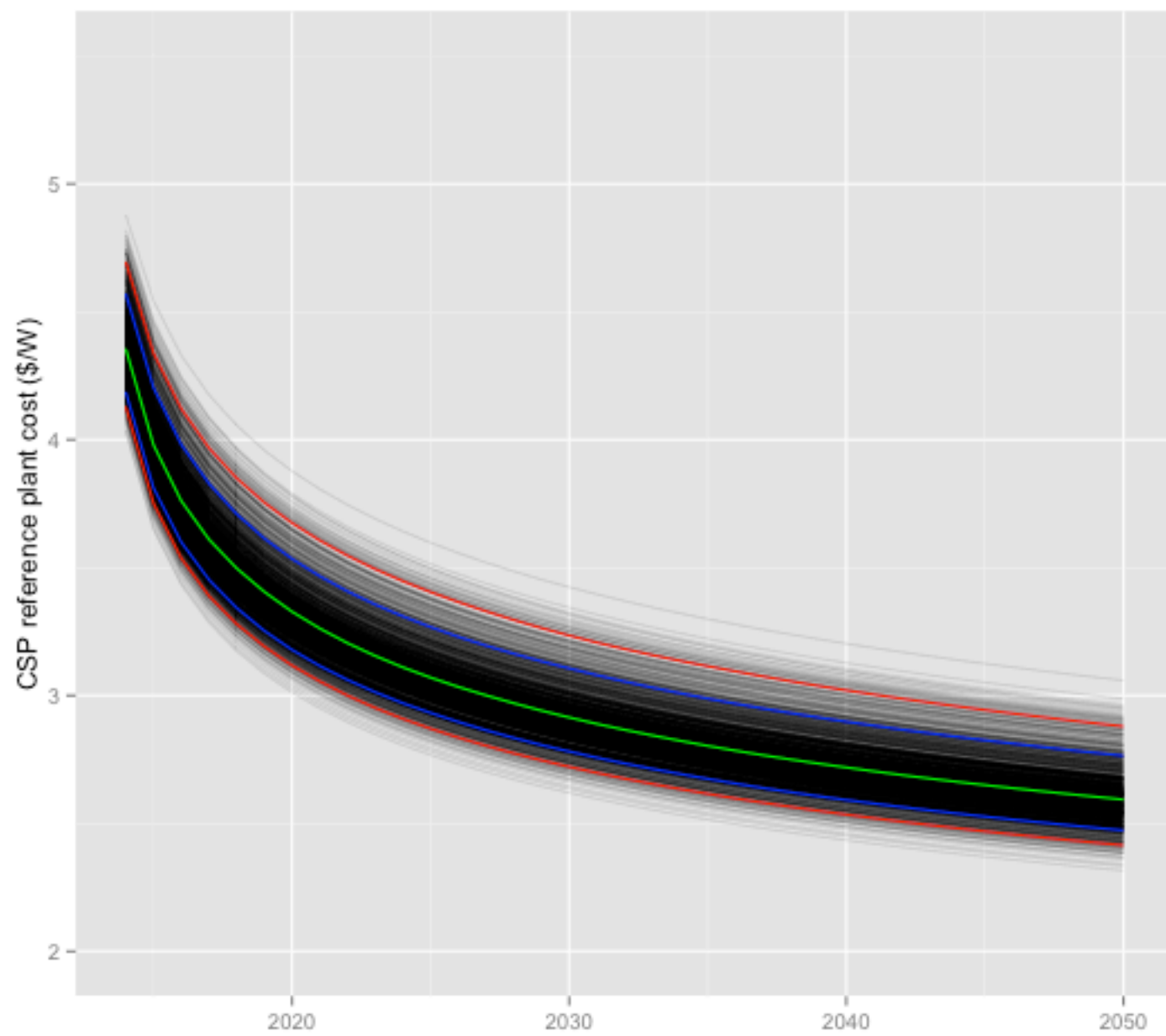




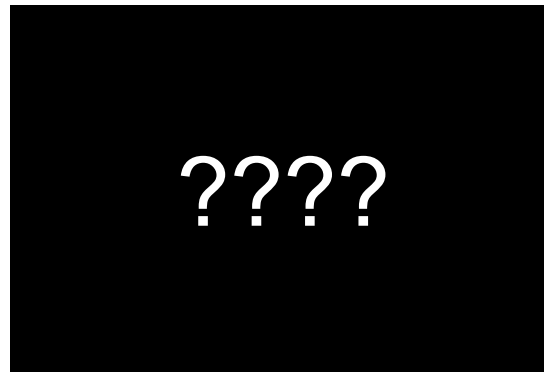








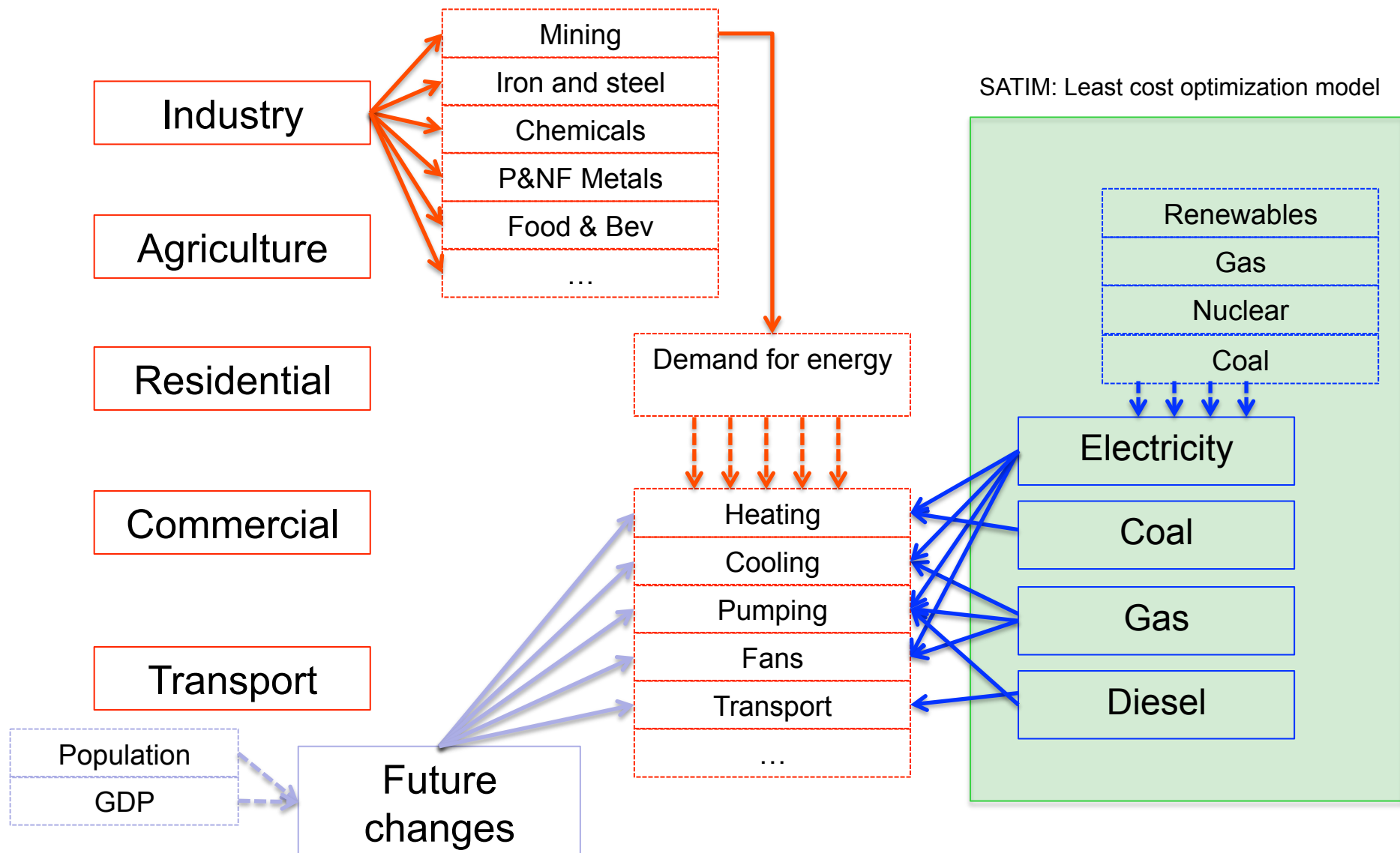
INPUTS



Output

### **3. THE MODEL**

# Energy modelling using SATIM-F



# SATIM-F: Main Features

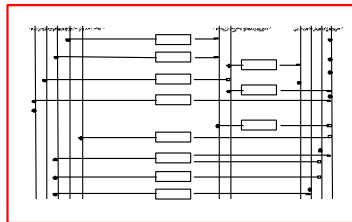
- Bottom-up Energy Systems Optimization Long-Range (>10 years) Planning Model (similar to the one used for the IEP)
- Full Sector: Includes and allows trade-off between demand and Supply
- End-use type model:
  - Gives a detailed description of how the energy is used.
  - Describes the types of equipment used and how much energy is used by each type of equipment to satisfy demand.
  - Can capture:
    - structural changes/ shocks
    - mode switching (transport)
    - fuel switching
    - Technical improvement/ improved efficiency
    - Intensity changes e.g. mines have to dig deeper



# Components of a TIMES model

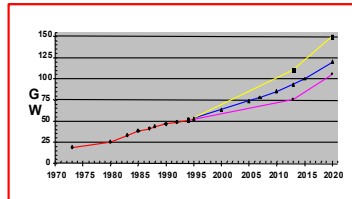
## Components of an Energy System Model

- \* Energy system topology & organization



RES

- \* Numerical data



Time Series

- \* Mathematical structure
  - œ transformation equations
  - œ bounds, constraints
  - œ user defined relations

$$\begin{aligned}P_{BHKW\_S} &= \eta_{BHKW} \cdot P_{Coal\_BHKW} \\ O_{BHKW\_CO_2} &= \varepsilon \cdot P_{Coal\_BHKW} \\ Q_{BHKW\_H} &= \eta_{2\_BHKW} \cdot P_{Coal\_BHKW}\end{aligned}$$

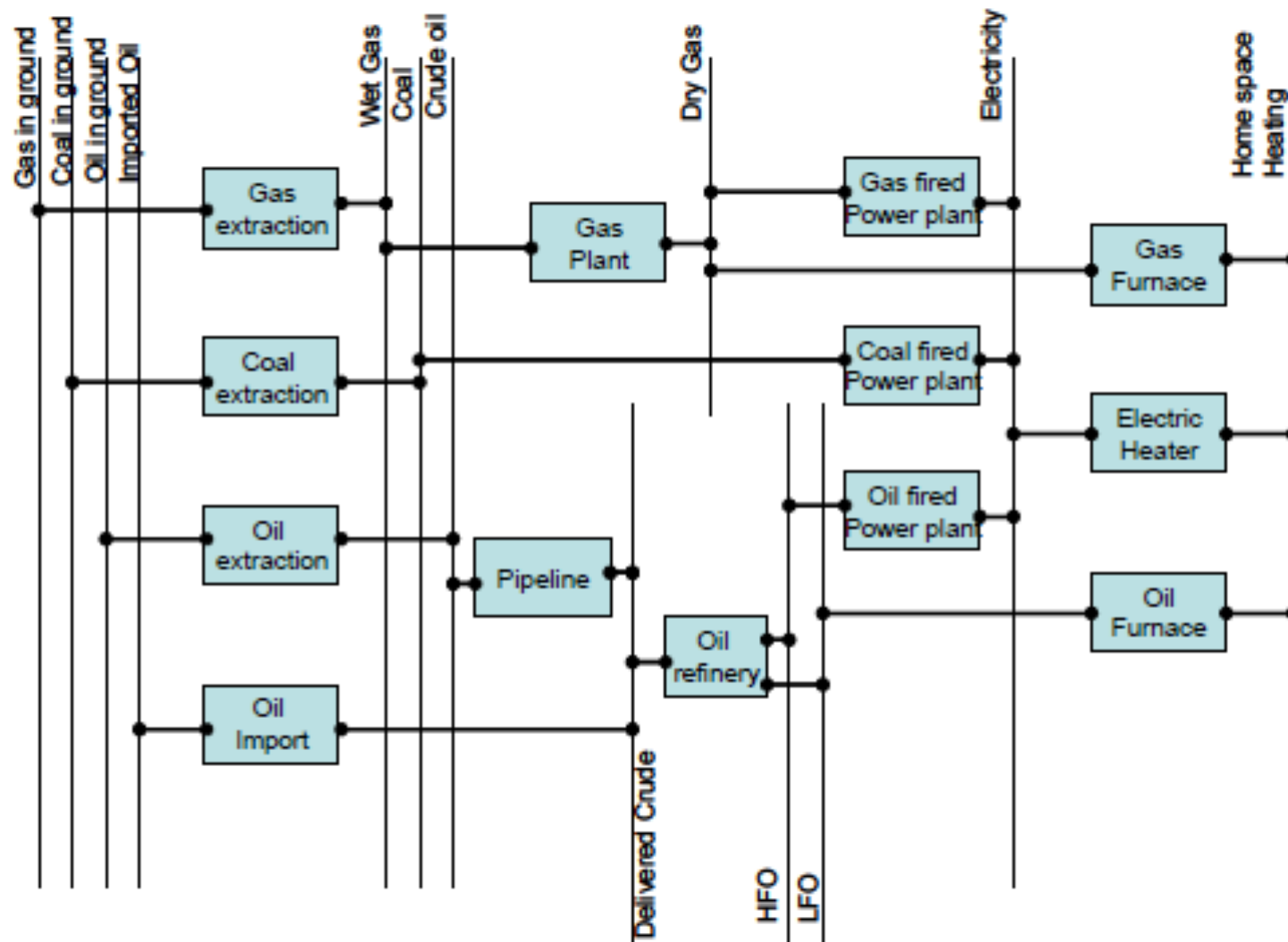
GAMS Model

- \* Scenarios and strategies



Cases

# Simple Reference Energy System



INPUTS



MODEL

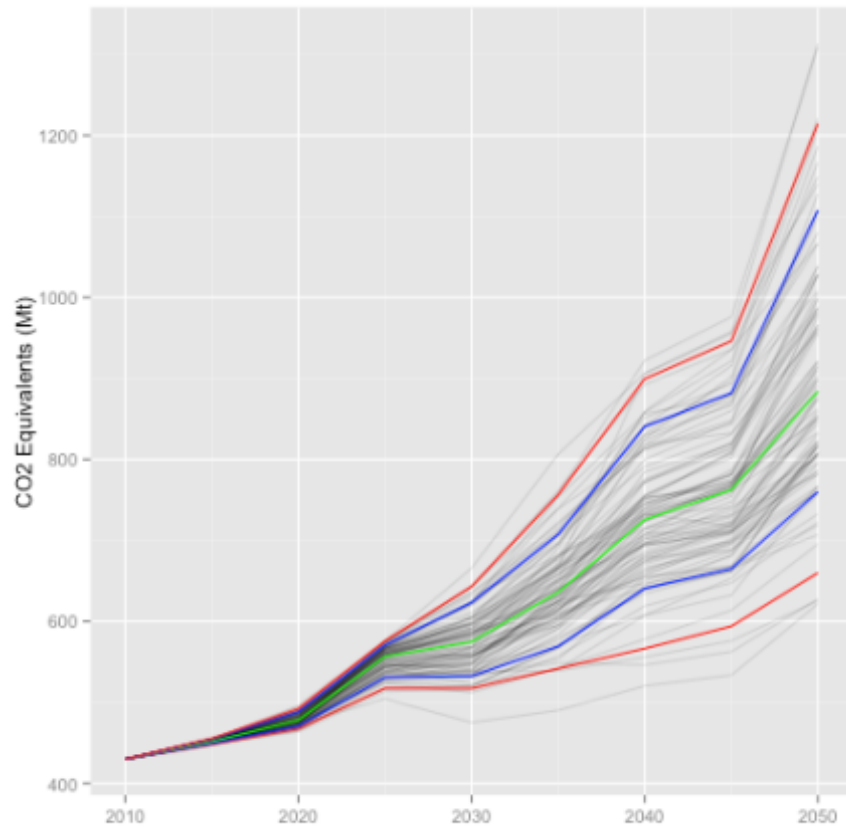


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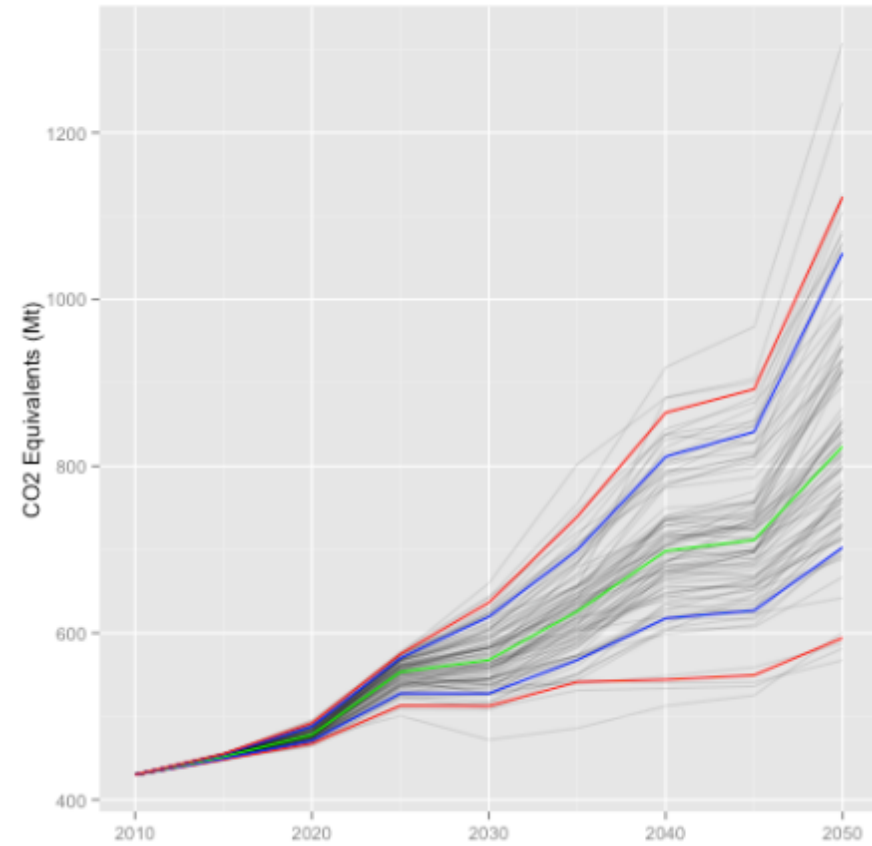
## **4. PRELIMINARY RESULTS**

# CO2-eq Emissions

No international mitigation

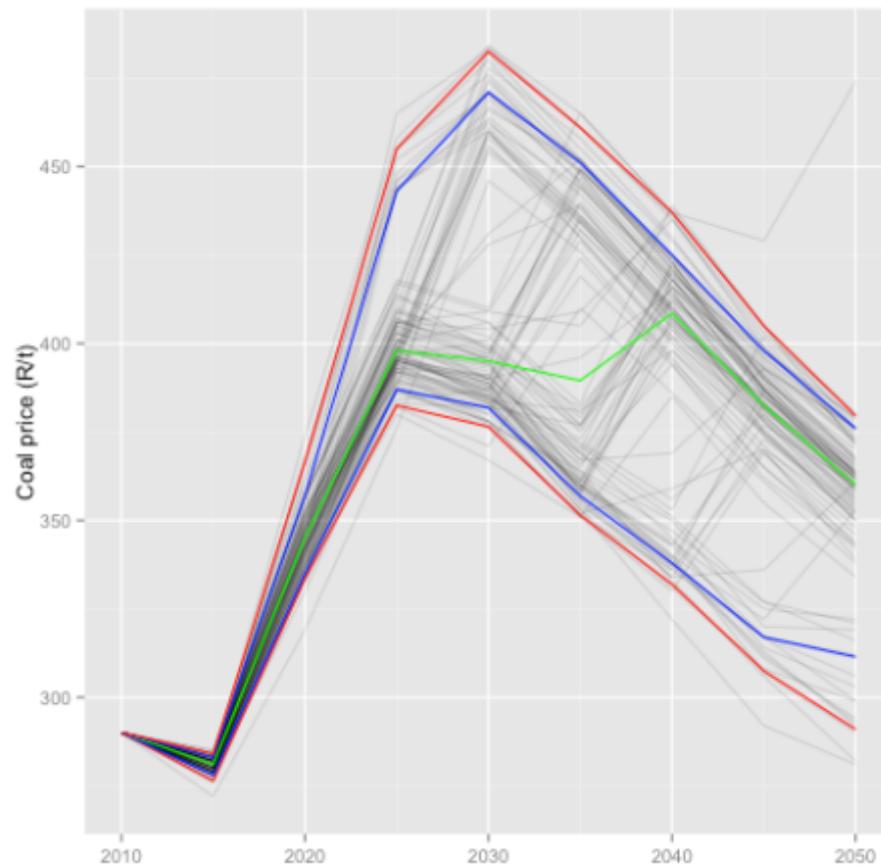


With international mitigation

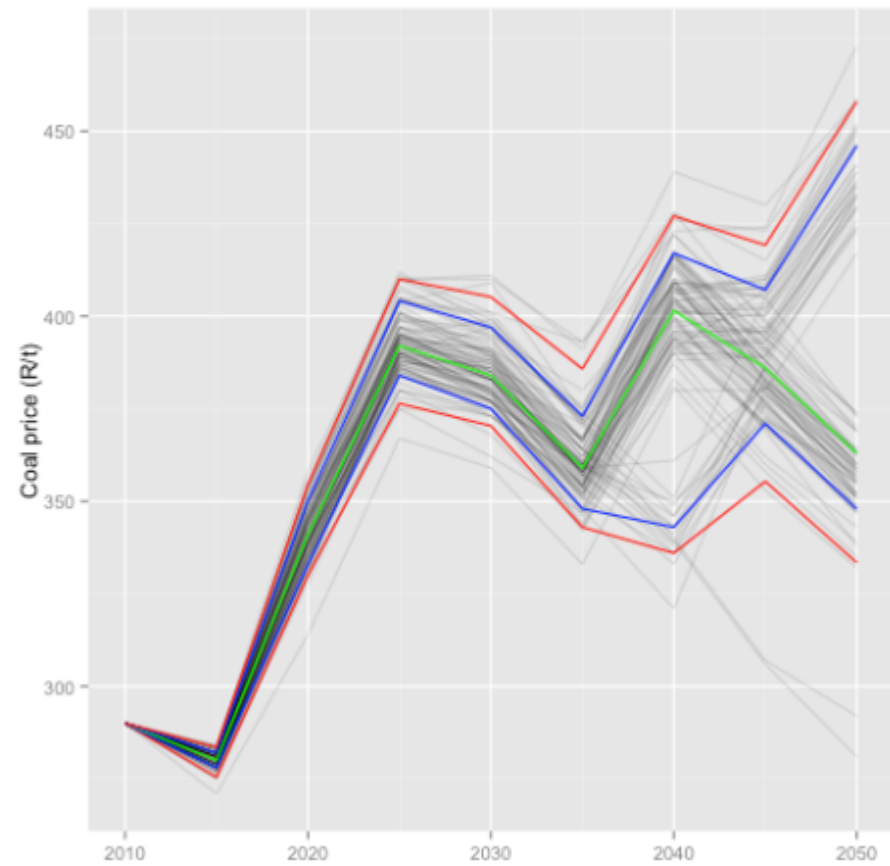


# Weighted average coal price to power plants

No international mitigation

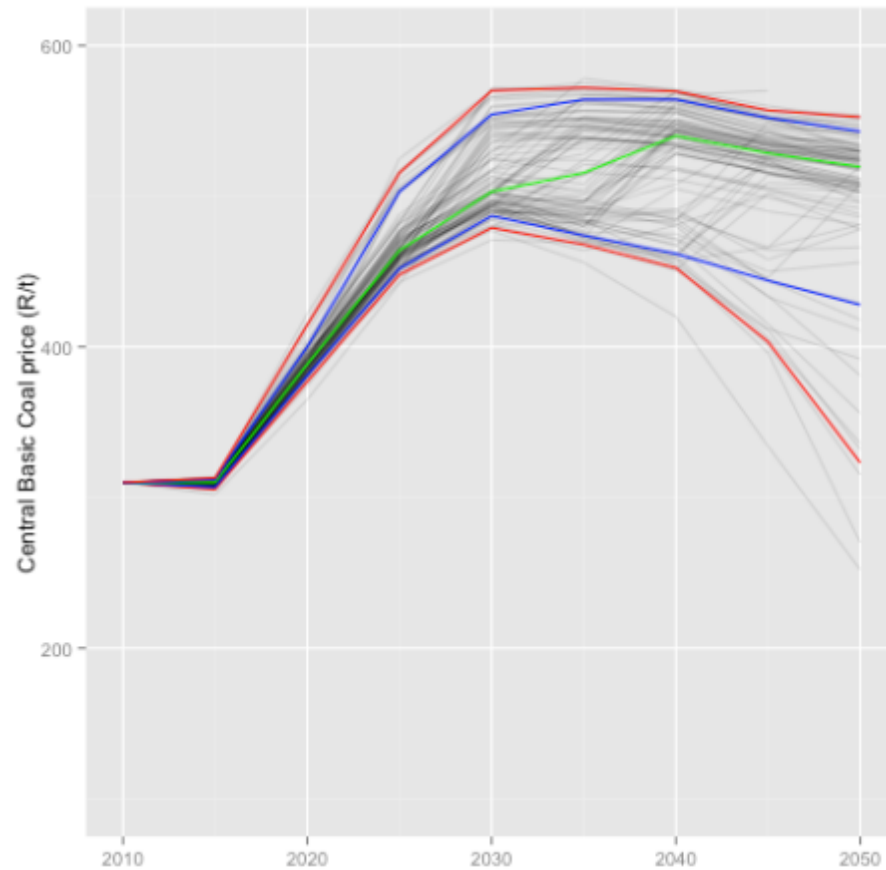


With international mitigation

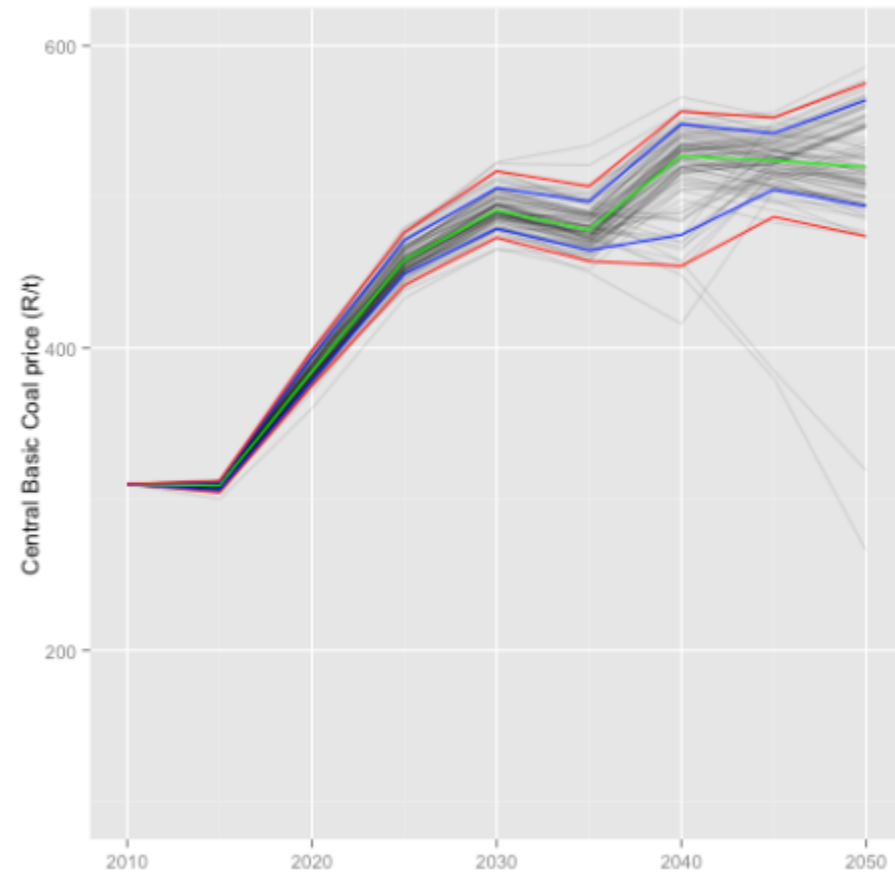


# Weighted average coal price to Central Basin Power plants

No international mitigation

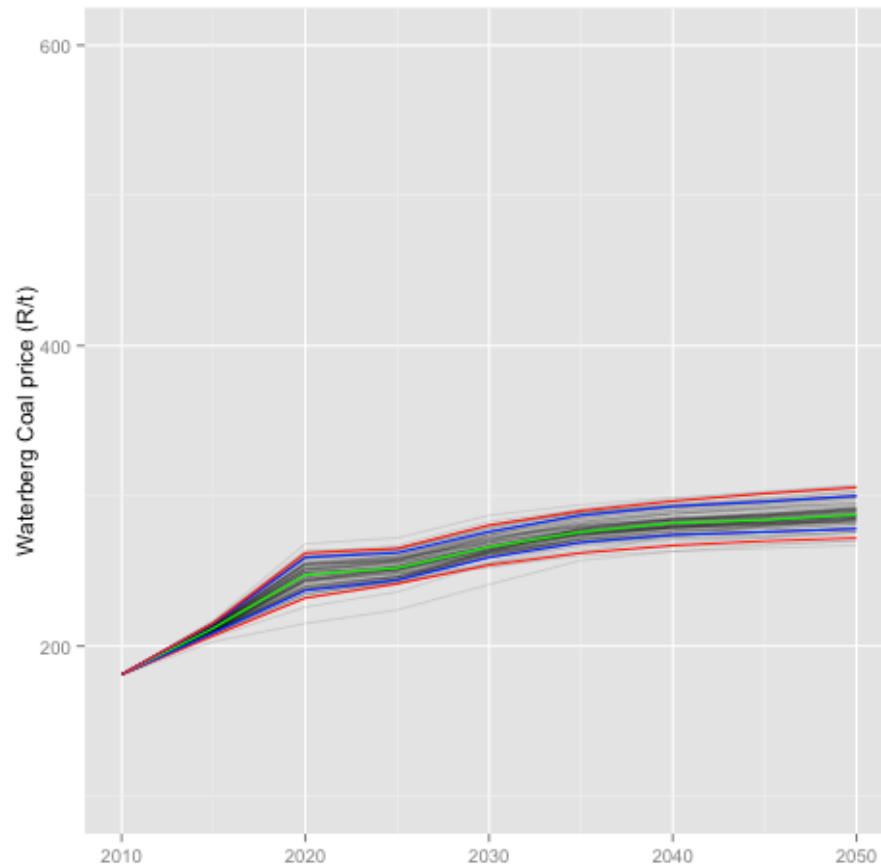


With international mitigation

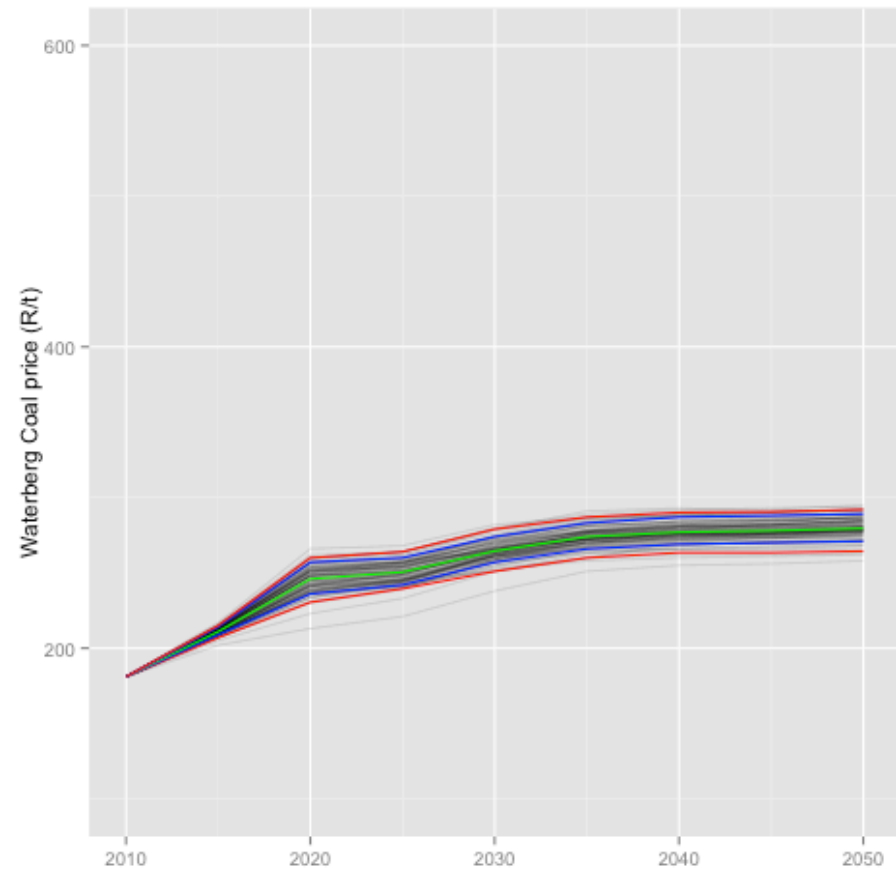


# Weighted average coal price to Waterberg Power plants

No international mitigation



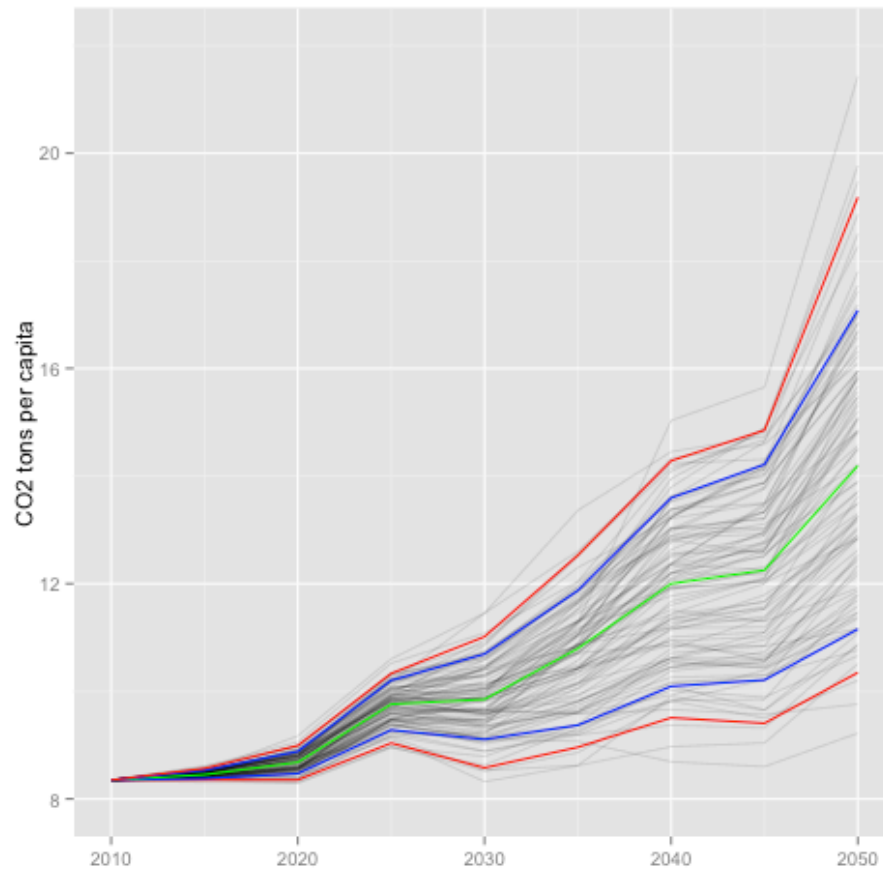
With international mitigation



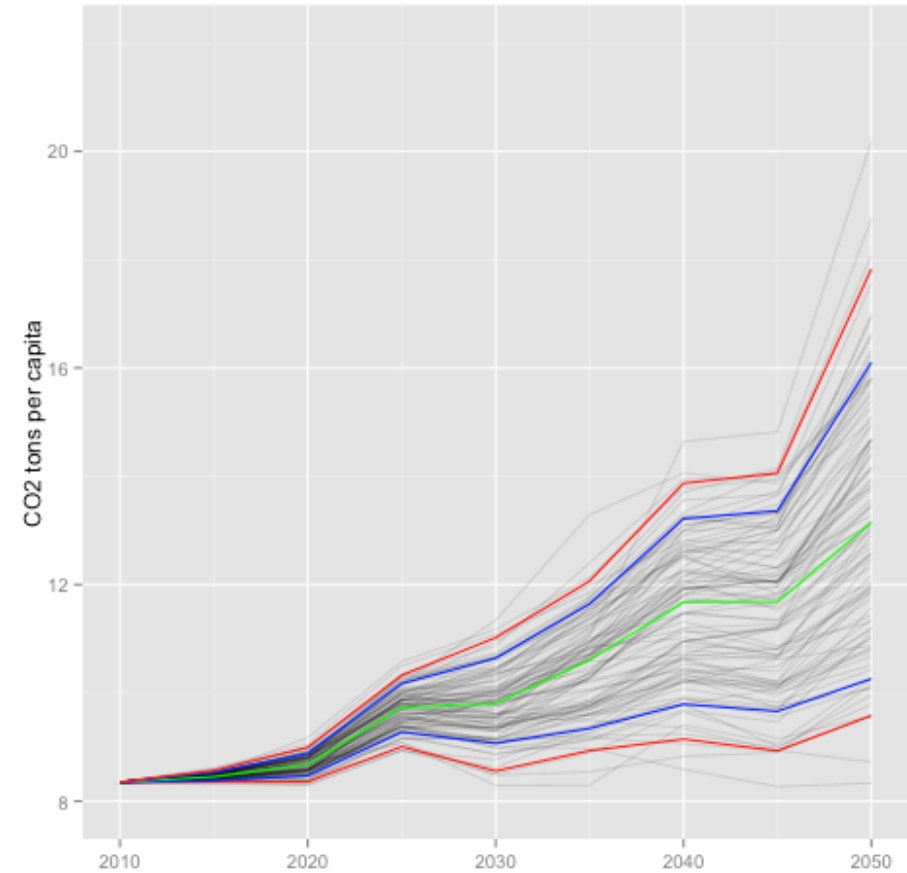


# CO2 per Capita

No international mitigation

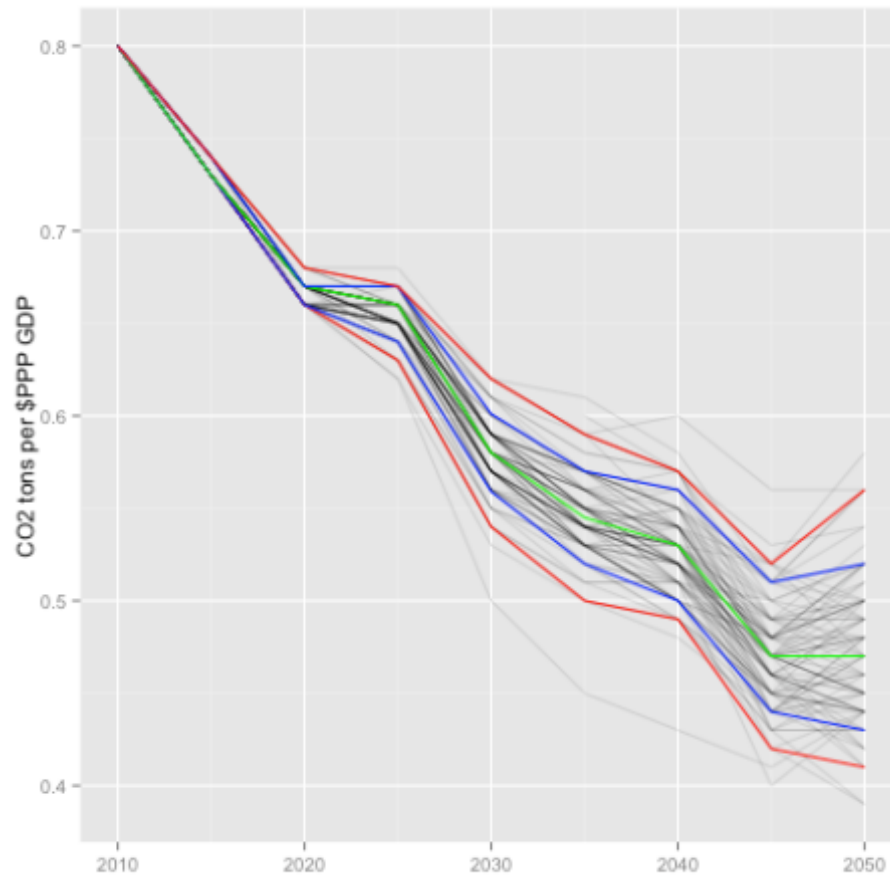


With international mitigation

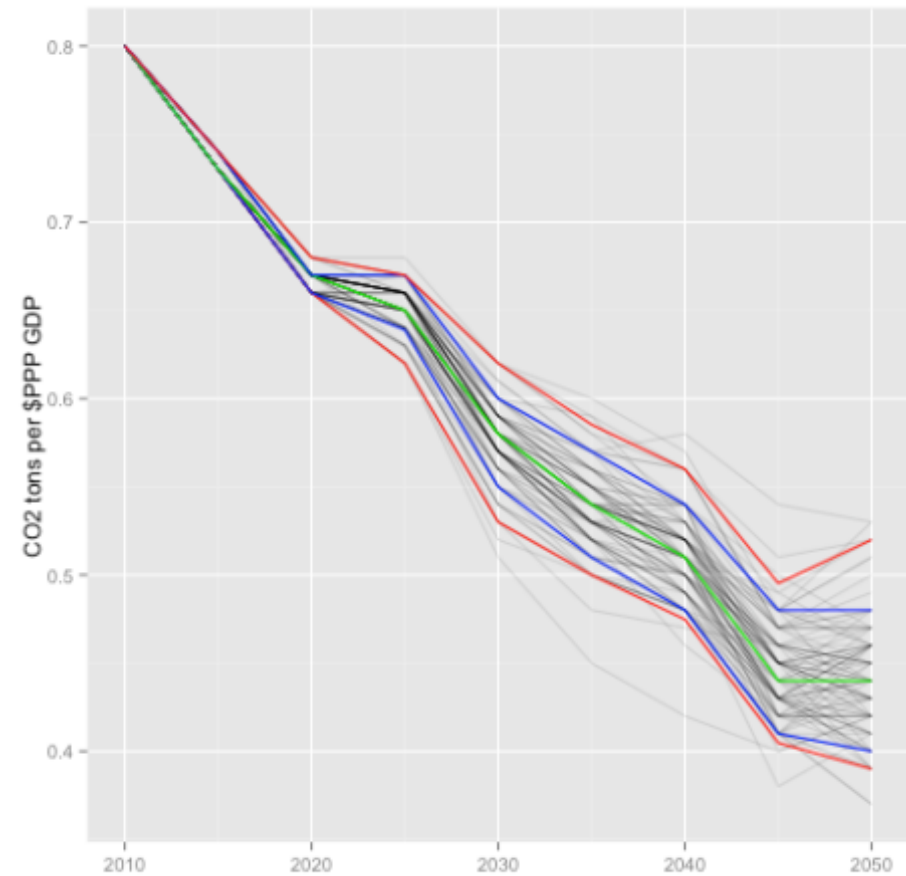


# CO2 per \$ PPP GDP

No international mitigation



With international mitigation



## **5. POLICY IMPLICATIONS**

How efforts to characterise the uncertainty in the baseline (and mitigation) scenarios are going to support the policy process

- Projections (if single lines) often misinterpreted as predictions
- Quantifying uncertainty makes explicit the implications of different assumptions
- Can reduce fear of 'gaming' of national baseline
- A central purpose of policy research and policy analysis is to help identify the important factors and the sources of disagreement in a problem, and to help anticipate the unexpected
- Decision making around climate and energy policy, and infrastructure planning that takes account of uncertainty is better than decision making that doesn't



THANK YOU

