Quantifying Uncertainty in Baseline Projections of CO2 Emissions for South Africa

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FIRM

Facilitating Implementation and Readiness for Mitigation

1. BASELINE PROJECTIONS AND SA CONTEXT

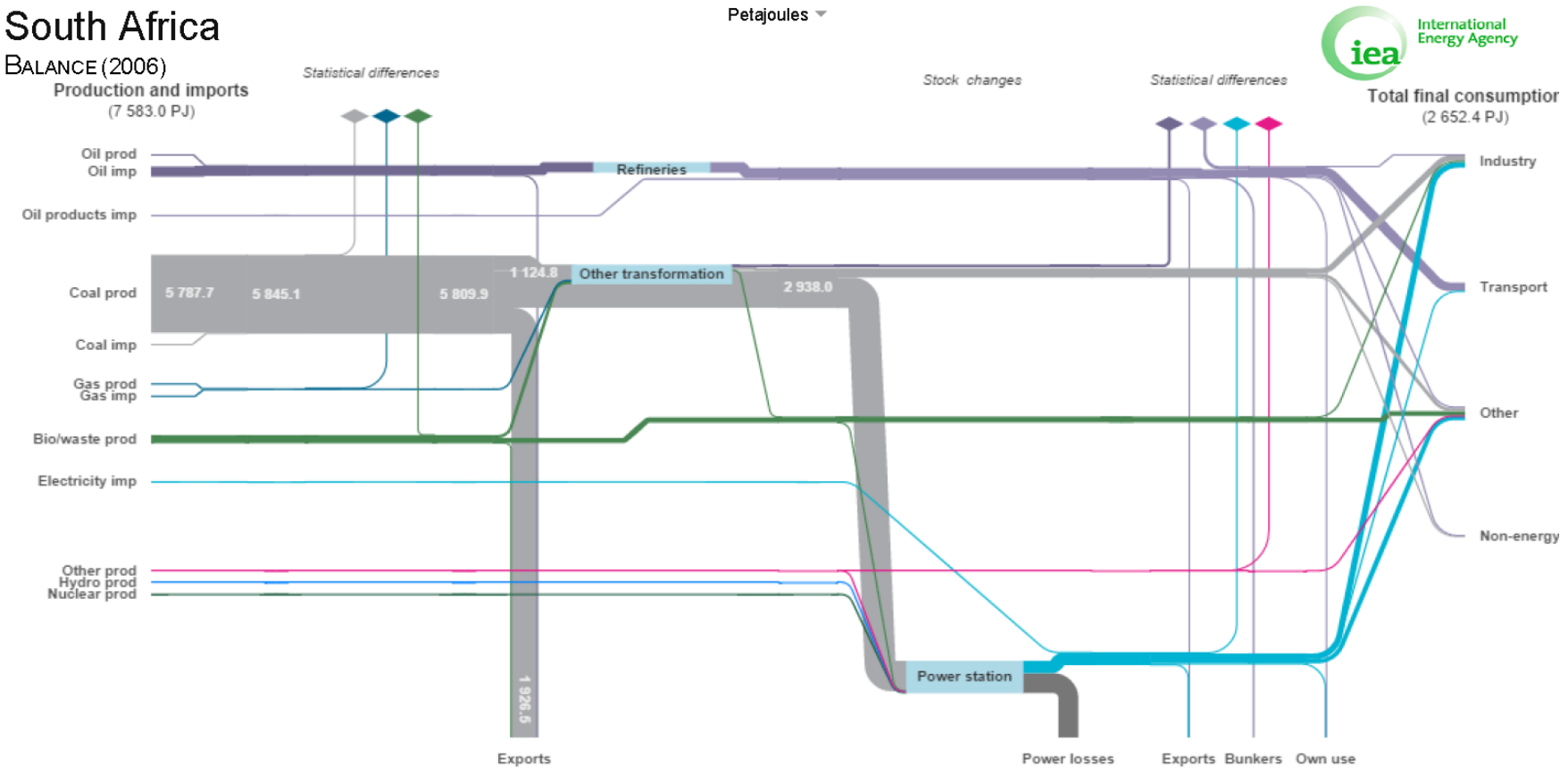
Baselines and Climate Policy

- 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!

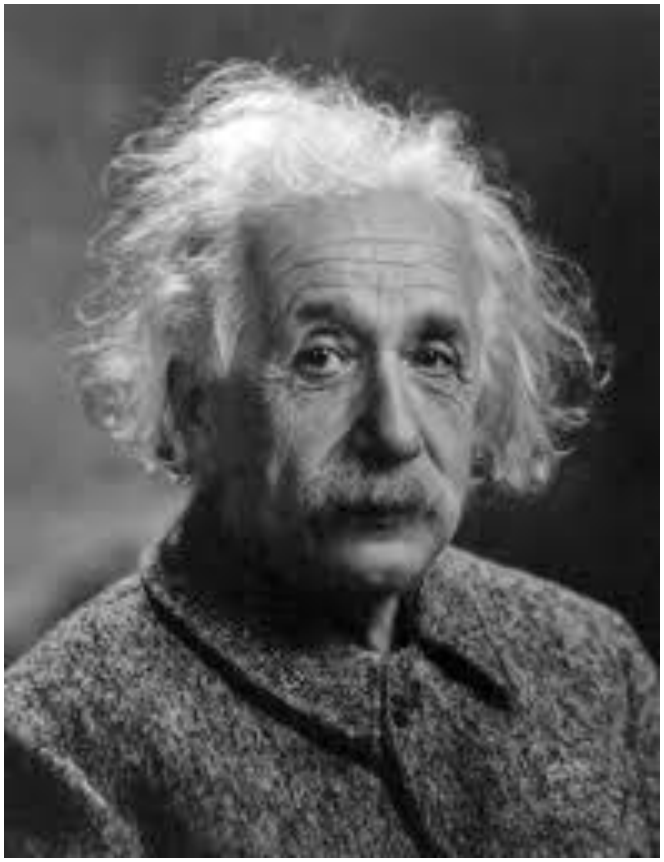
- For developing countries Development and Sustainable Development and not Climate on its own is main driver (i.e. other SD indicators: poverty, inequality, education, health etc.. Must also be addressed)
- Baseline follows Business as Usual (BAU): How is BAU defined?
  - Does it include or not the other efforts to improve on the broader SD goals
  - Externalities factored in?
  - What do we assume the other countries are doing in our baseline? (if they are doing nothing then – should the Climate damage costs be factored it?)
- CO2 reduction: % Gton CO2 or % GtCO2/$GDP?

Baseline for SA:
How much Coal?



2. APPROACH

2050?



Local expert assessments

Literature and past research

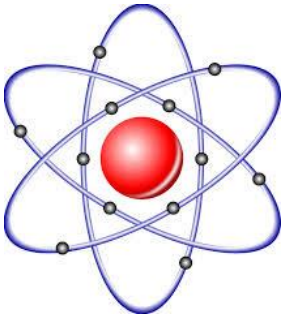
UN probabilistic projections

2 expert interviews

2 expert interviews

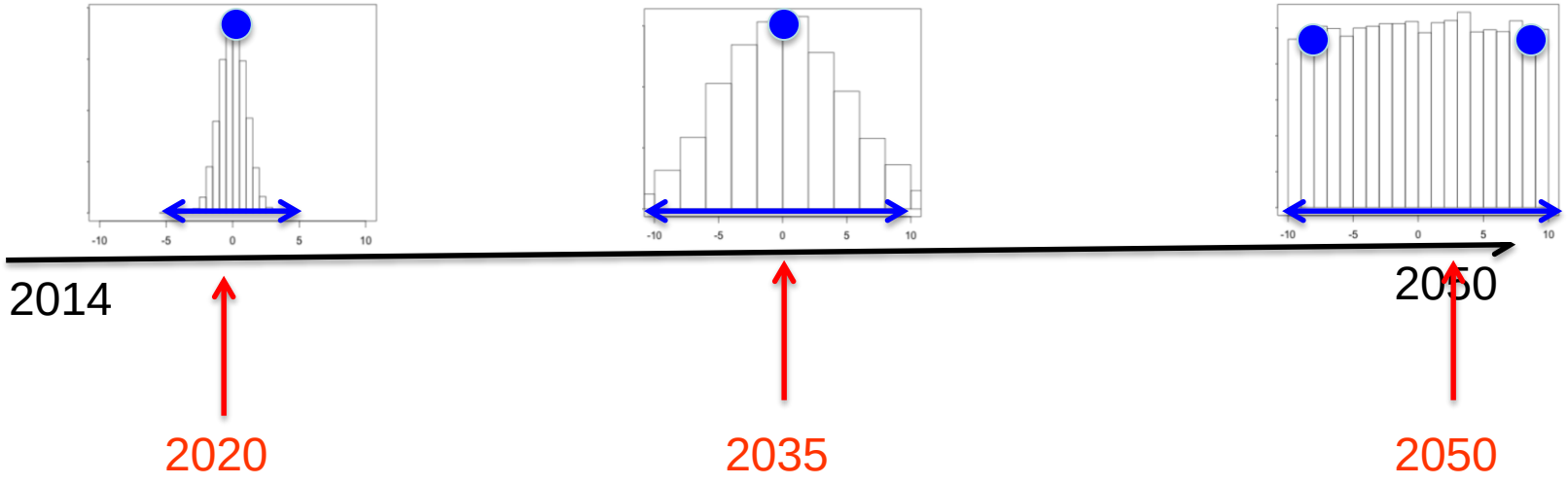
4 expert interviews

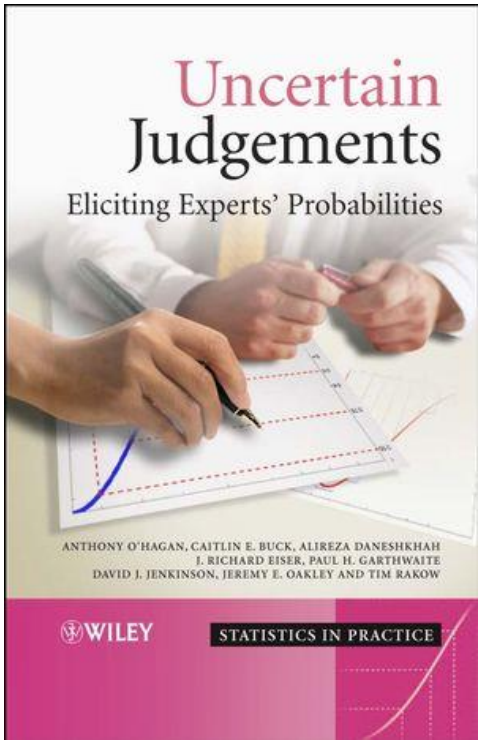
2 expert interviews



Literature and past work

Literature and past work





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

In Summary

The Model:

GDP & Population

Fuels Prices

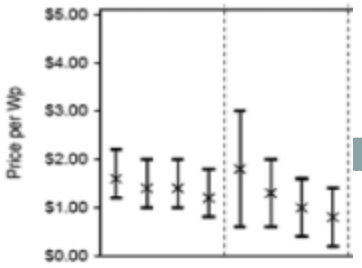
Technology Costs

SA TIMES energy model

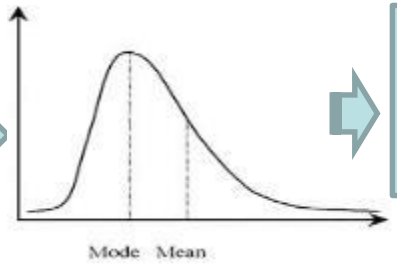
Least cost energy mix

GHG Emissions Projection

UNCERTAINTY



Expert Elicitation

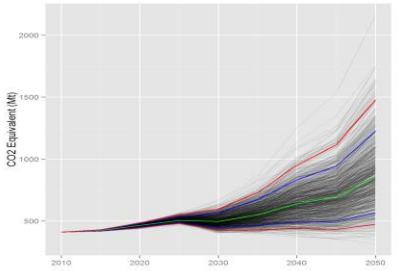


Combined Elicited Distributions

Monte Carlo algorithm

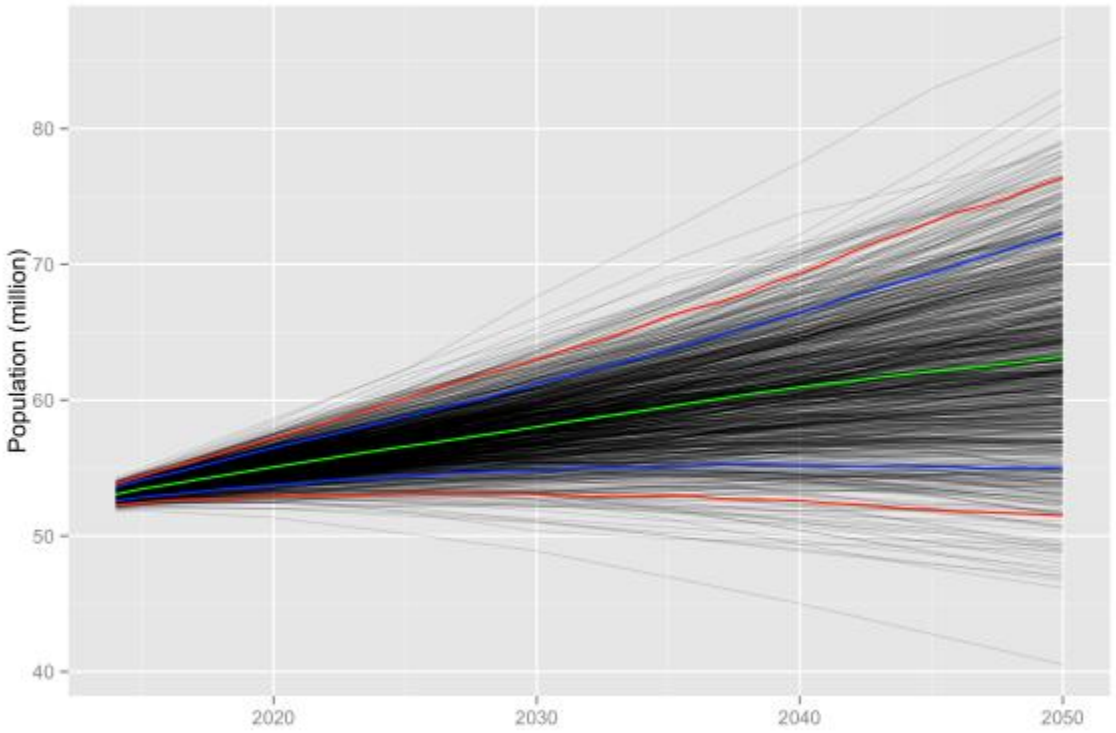
SA TIMES Model

(SATIM)



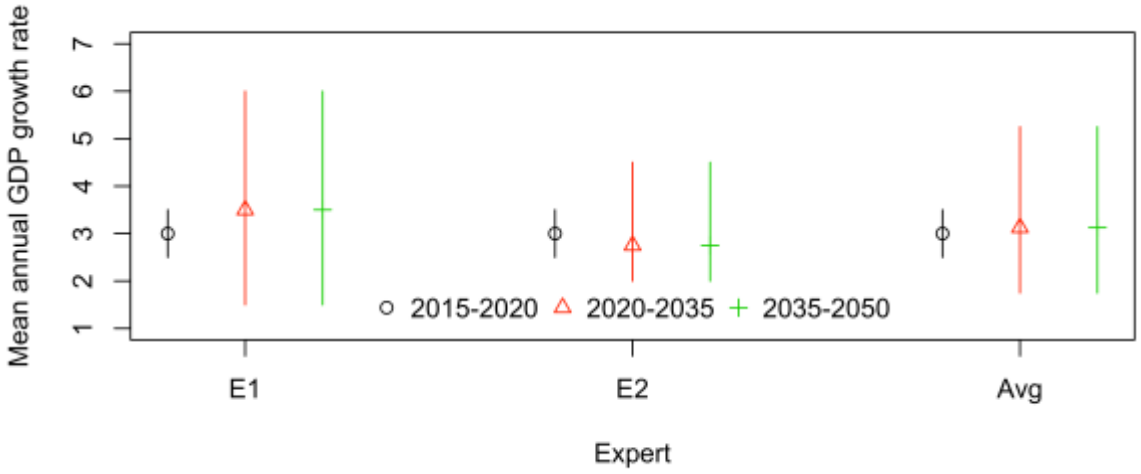
4. DESCRIPTION OF THE UNCERTAINTY

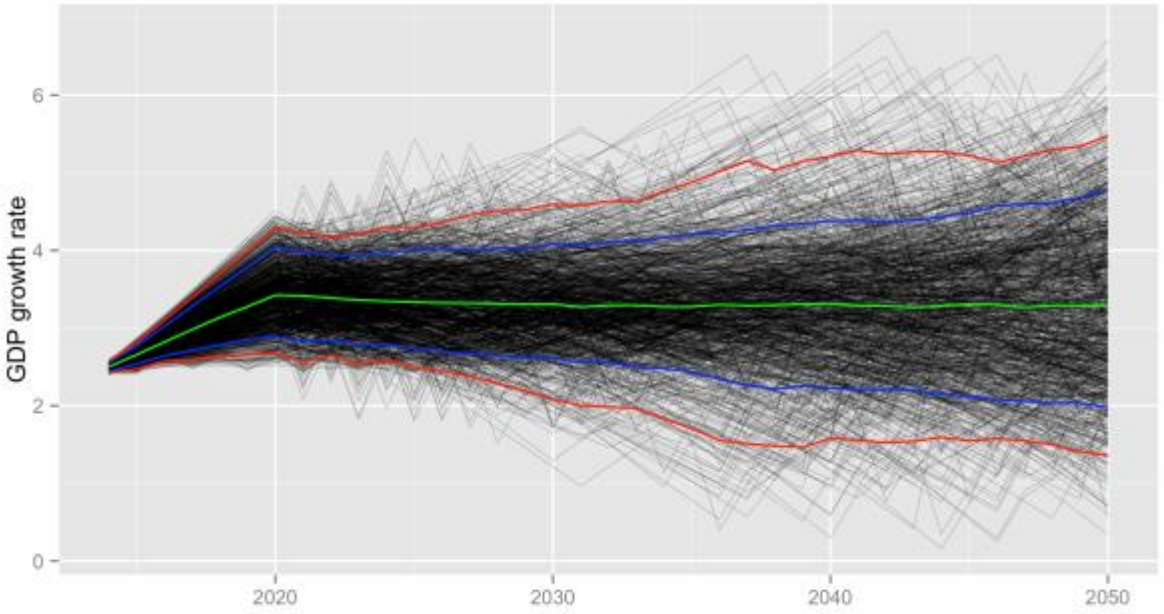
Population [UN Model]



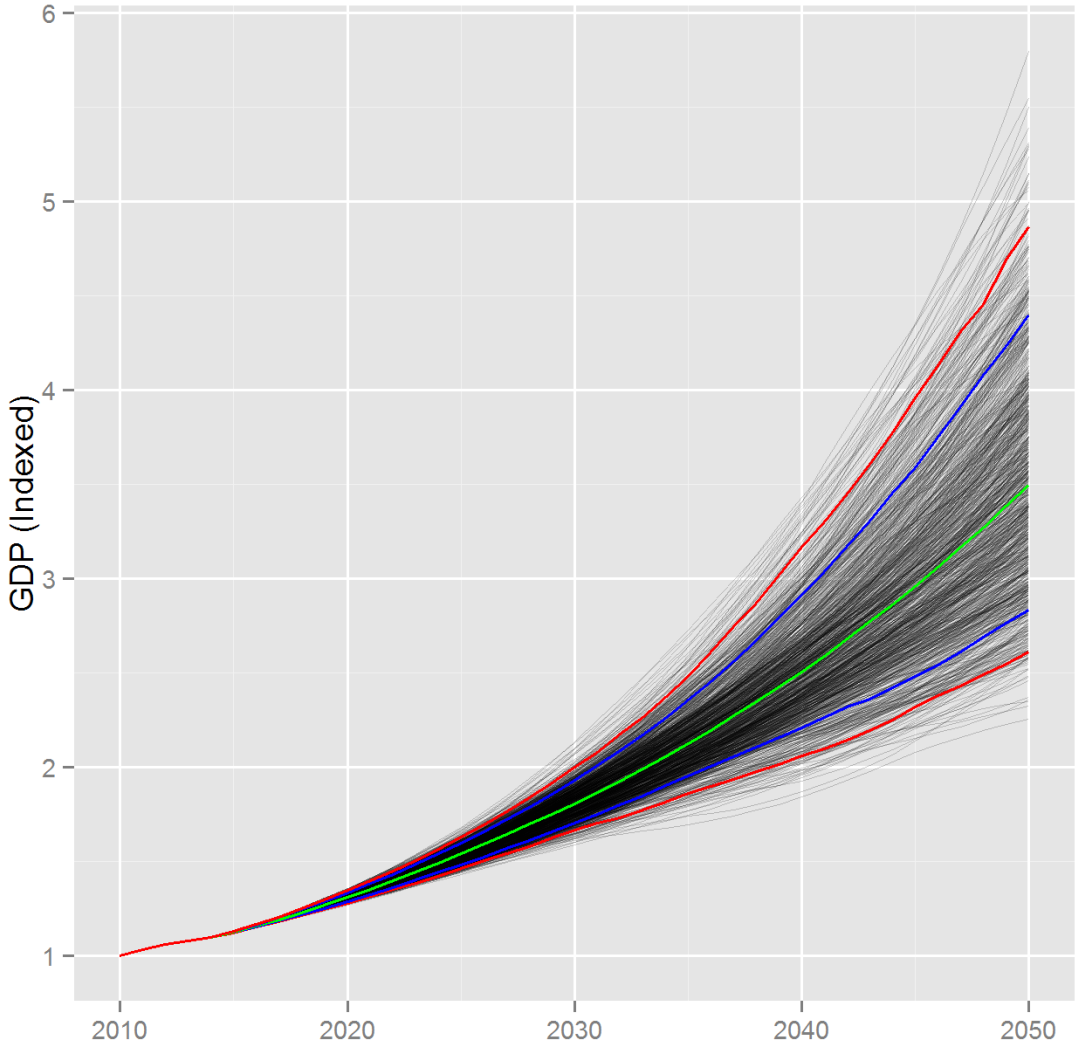
Source: United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects. 2012 Version. http://esa.un.org/unpd/ppp/Figures-Output/Population/PPP_Total-Population.htm

GDP Growth [Elicited]

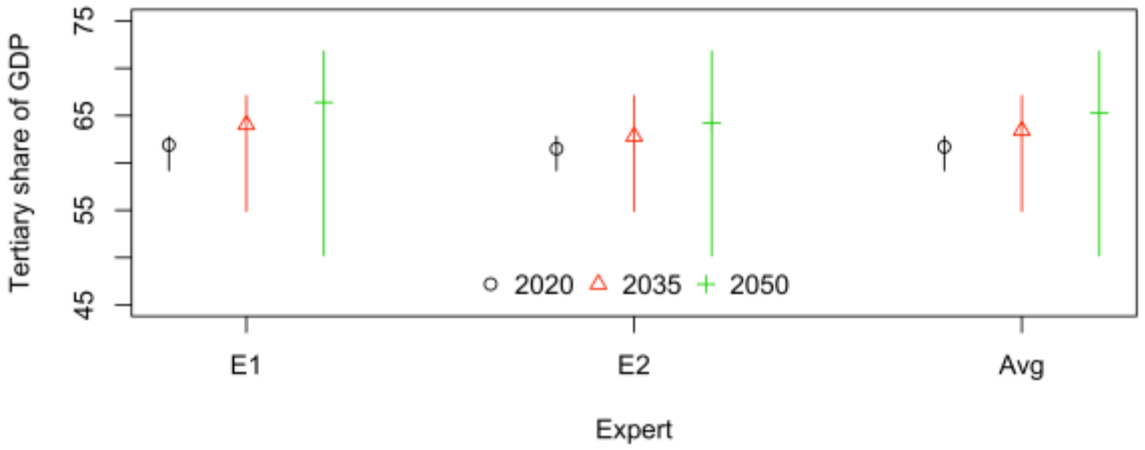


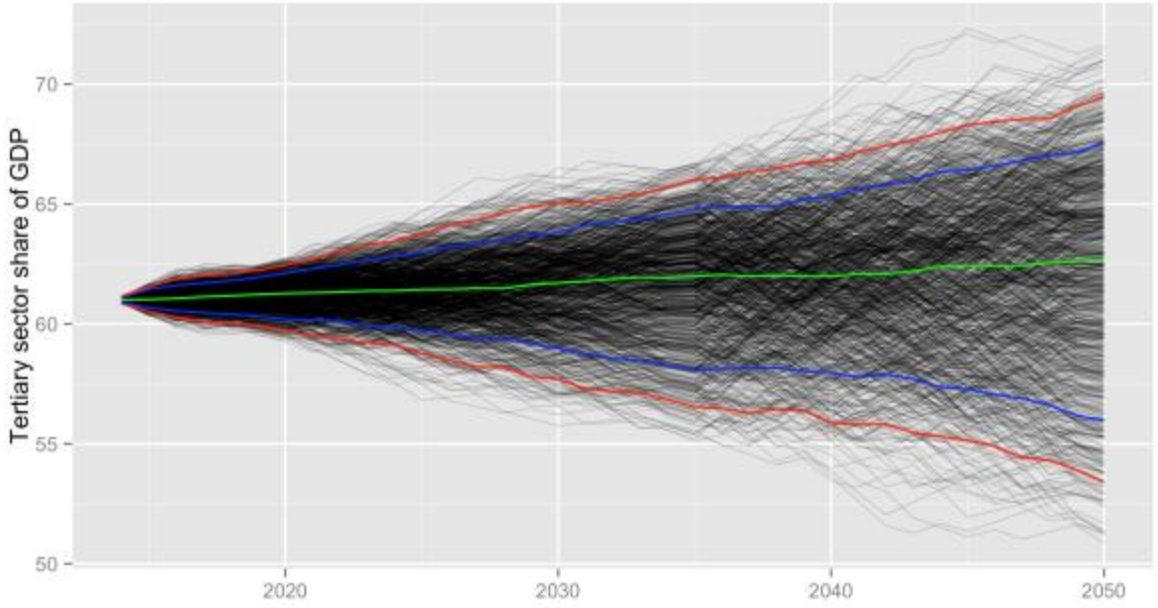


GDP [Result – Indexed]

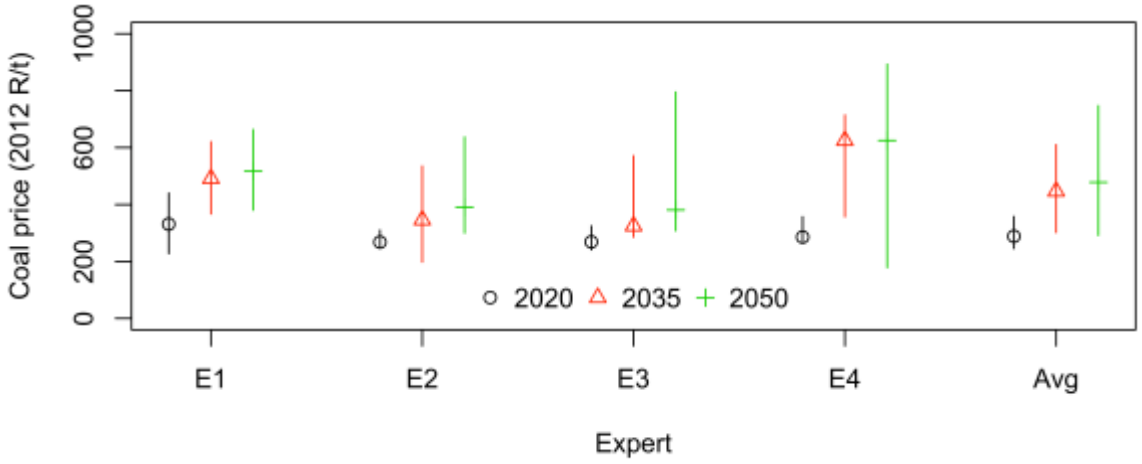


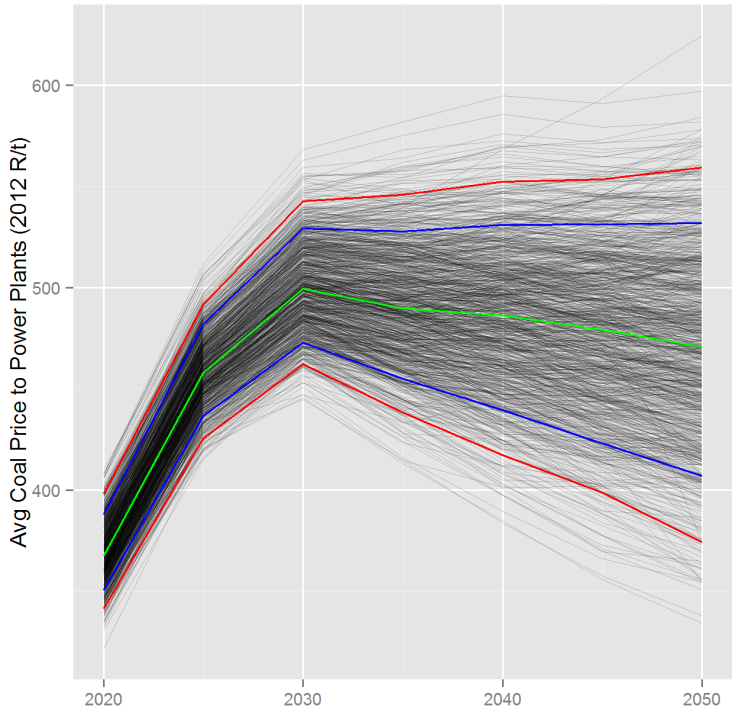
Share of Tertiary Sector excl. Transport (Elicited)



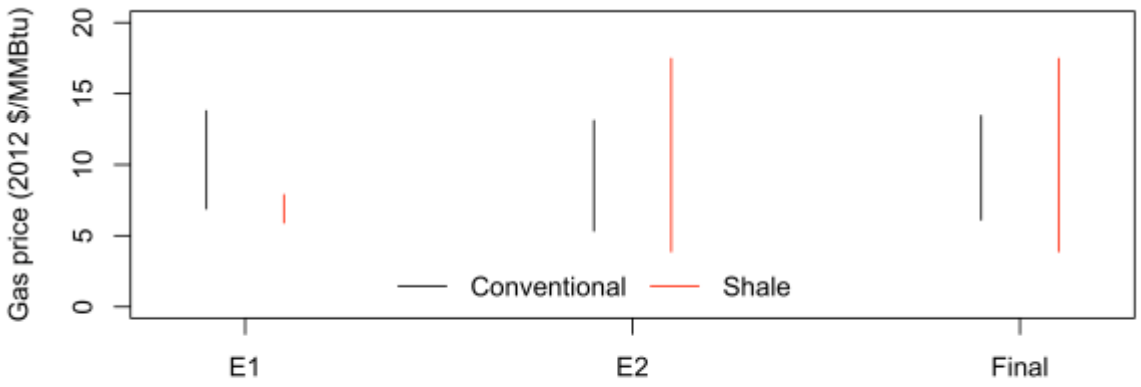


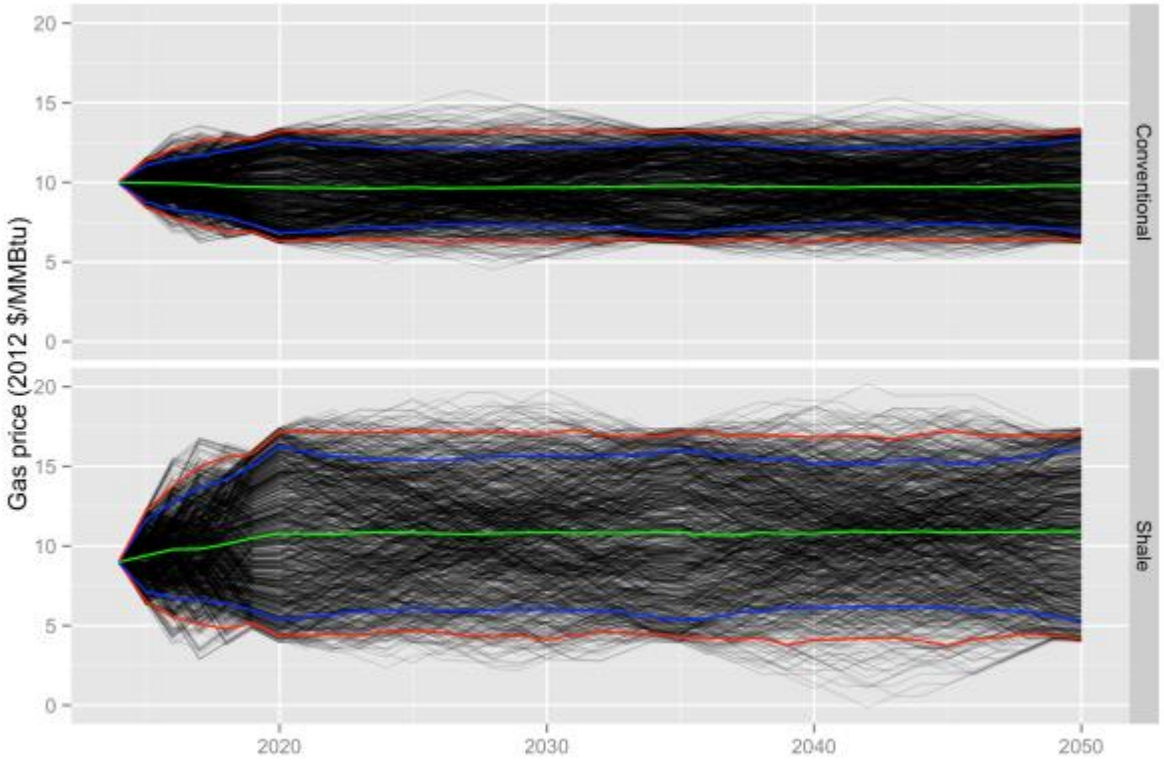
Domestic Coal Price (Elicited + further processing)





Domestic Gas Price (Elicited)



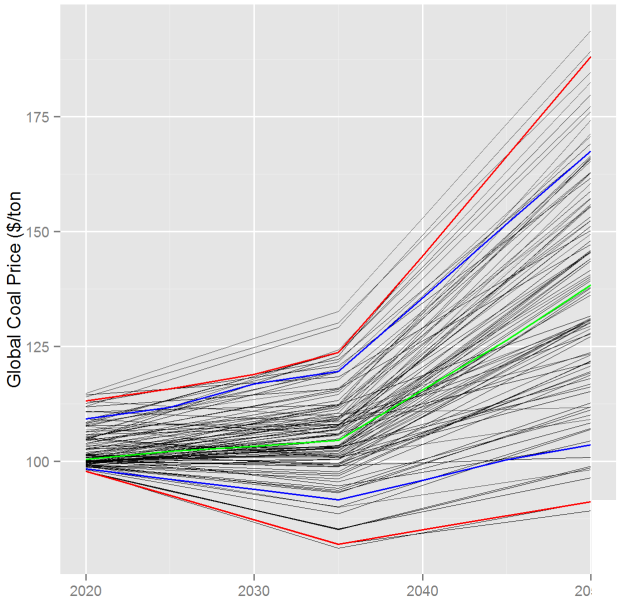


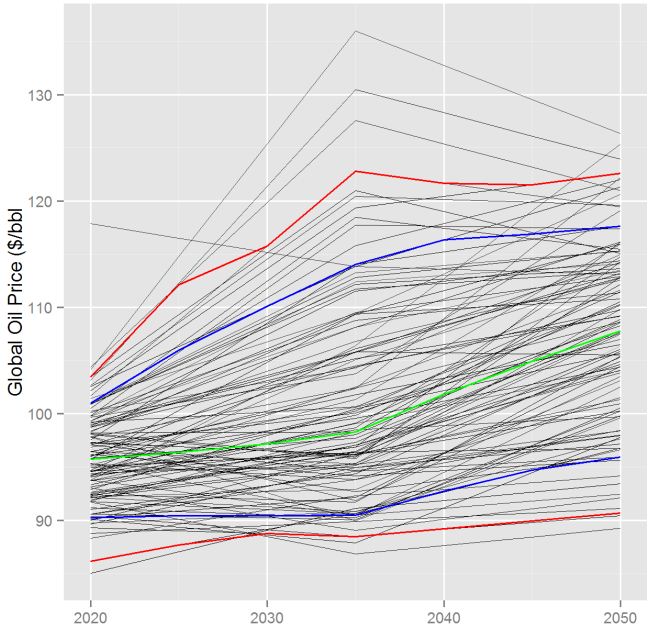
International Oil, Coal and Gas Prices (from existing global model with adjustment)

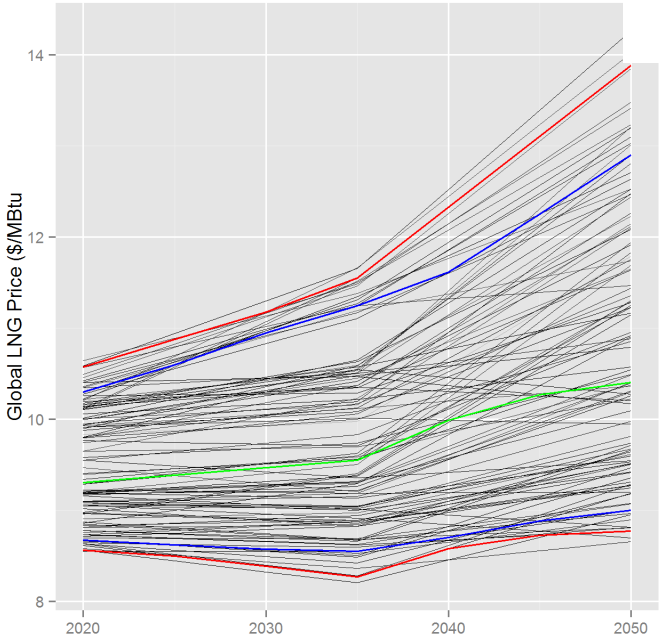
		Business as usual		
		2020	**2035**	**2050**
Coal	IMACLIM-R (avg)	0.99/1.16	1.37/2.23	1.8/3.91
	IEA WEO 2013 (NP)	1.04	1.08	
	WoodMac	0.92	1.22	
	Adj.Fact.	1	0.6	0.5
Gas	IMACLIM-R (avg)	0.99/1.23	1.09/1.55	1.59/1.2.49
	IEA WEO 2013 (NP)	1.53	1.65	
	Adj.Fact.	1.15	1	0.9
Oil	IMACLIM-R (avg)	1.21/1.68	1.59/2.49	1.63/2.31
	IEA WEO 2013 (NP)	1.41	1.60	
	ADj.Fact.	0.9	0.7	0.7

Imaclim-R (avg): Rozenberg, Julie, Céline Guivarch, Robert Lempert, et Stéphane Hallegatte. 2014. « Building SSPs for Climate Policy Analysis: A Scenario Elicitation Methodology to Map the Space of Possible Future Challenges to Mitigation and Adaptation ». *Climatic Change* 122 (3): 509-22. doi:10.1007/s10584-013-0904-3.

International Oil, Coal and Gas Prices (108 runs)



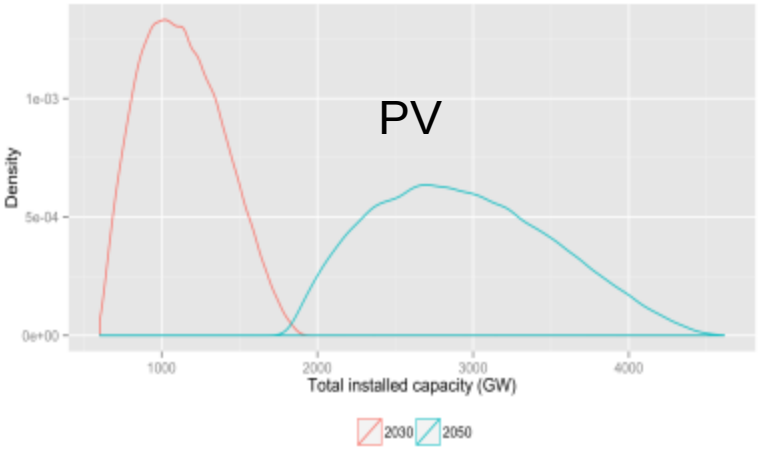


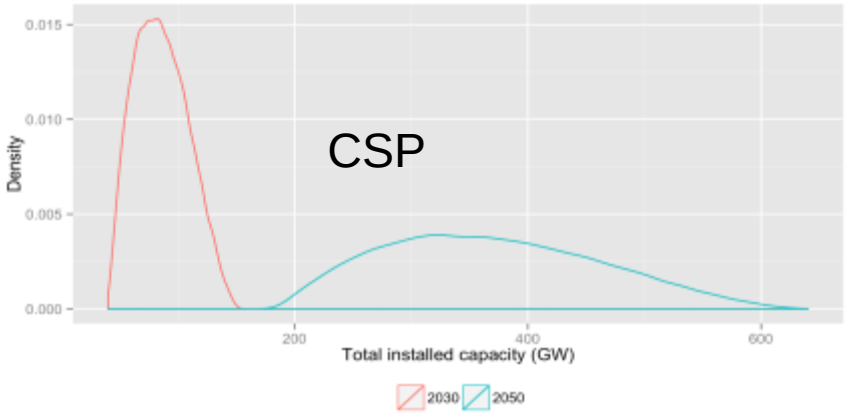


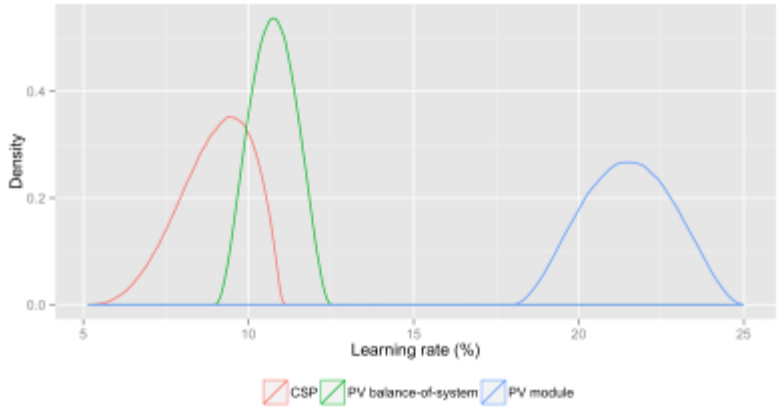
Solar Costs (from Literature)

From ETP 2014: Installed Capacity (GW)

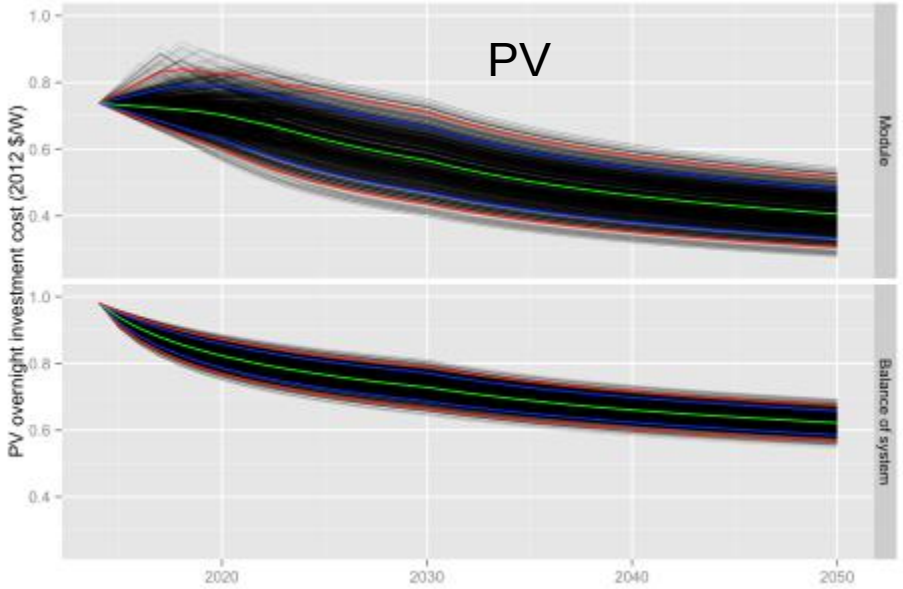
	PV			CSP		
	2014	**2030**	**2050**	**2013**	**2030**	**2050**
4DS	176	602	1813	3.4	40	185
2DS	176	1927	4626	3.4	155	646

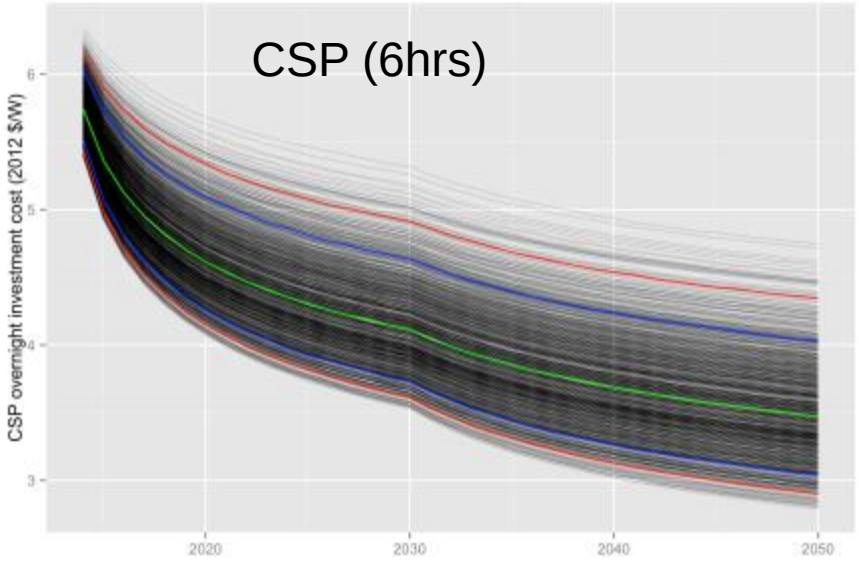






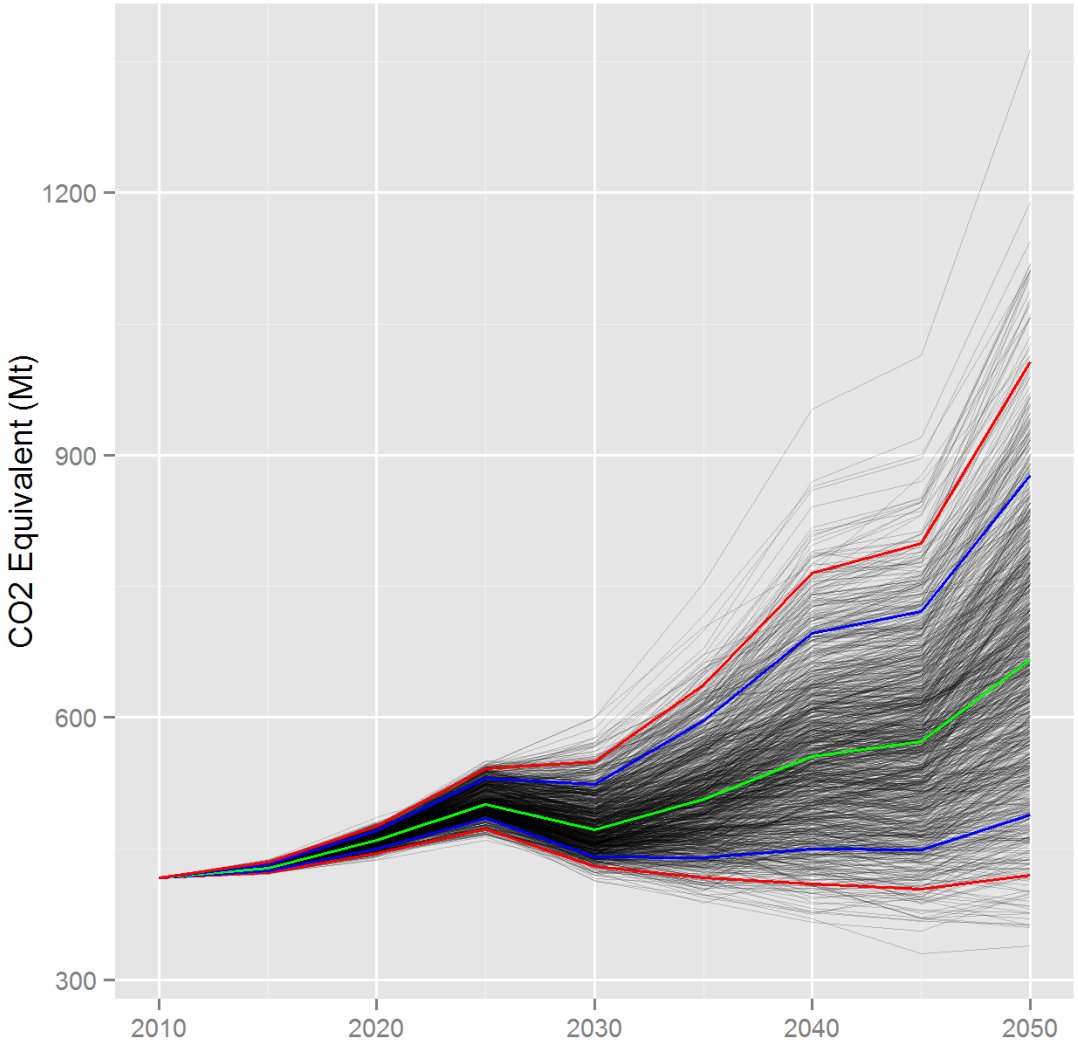
Solar Costs


PV
PV overnight investment cost (2012 $/W)
1.0
0.8
0.6
0.4
Module
Balance of system
2020
2030
2040
2050

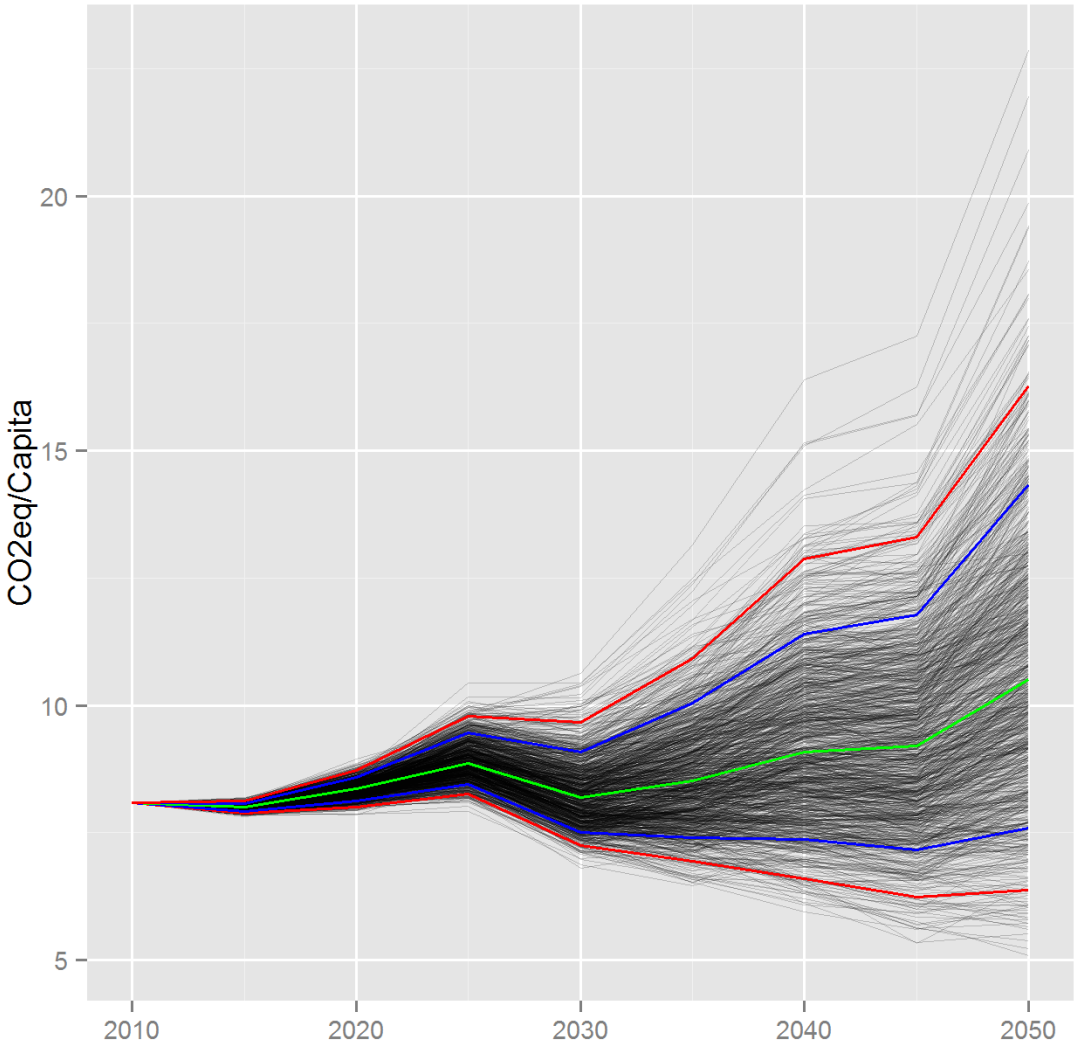

CSP (6hrs)
CSP overnight investment cost (2012 $/W)
6
5
4
3
2020
2030
2040
2050

4. RESULTS SO FAR

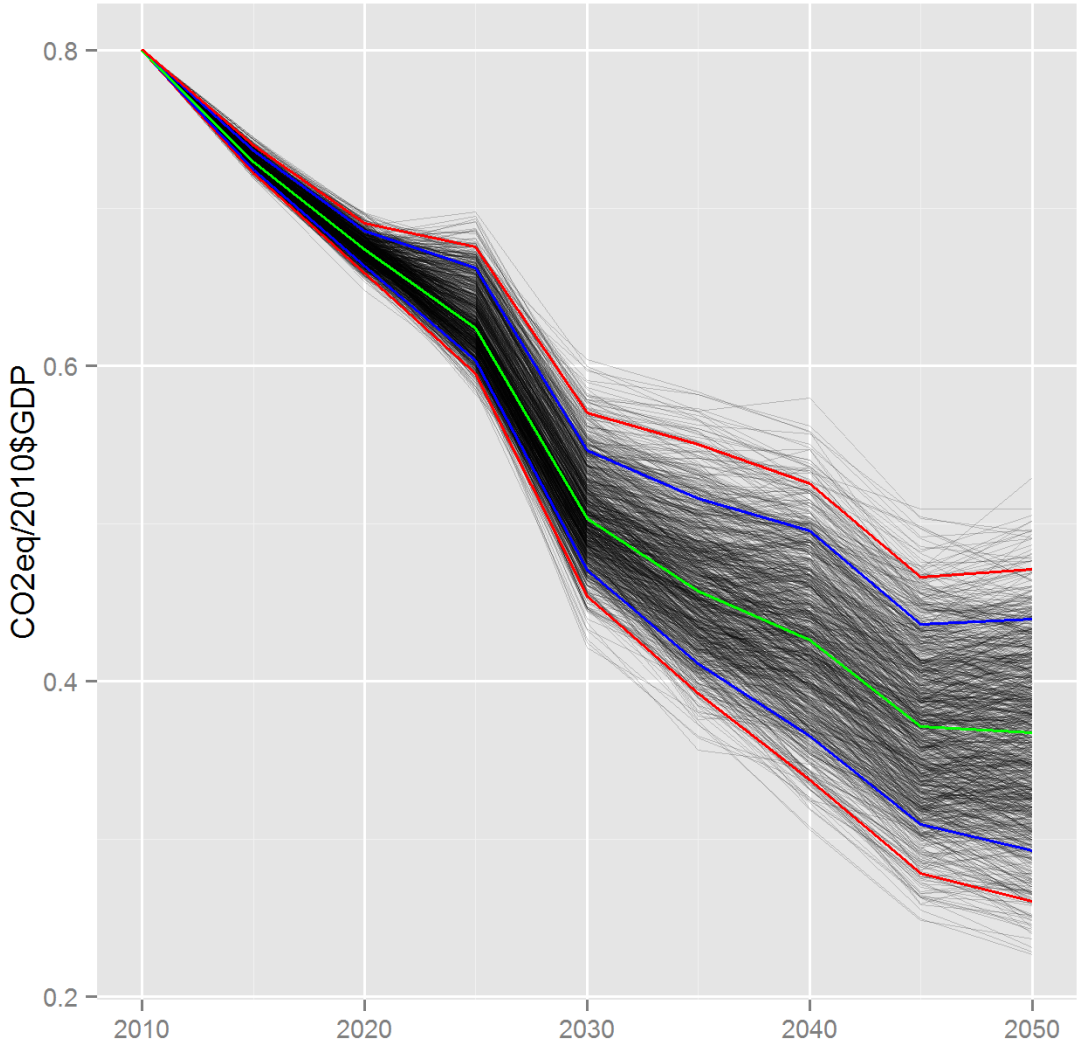
CO2-eq Emissions



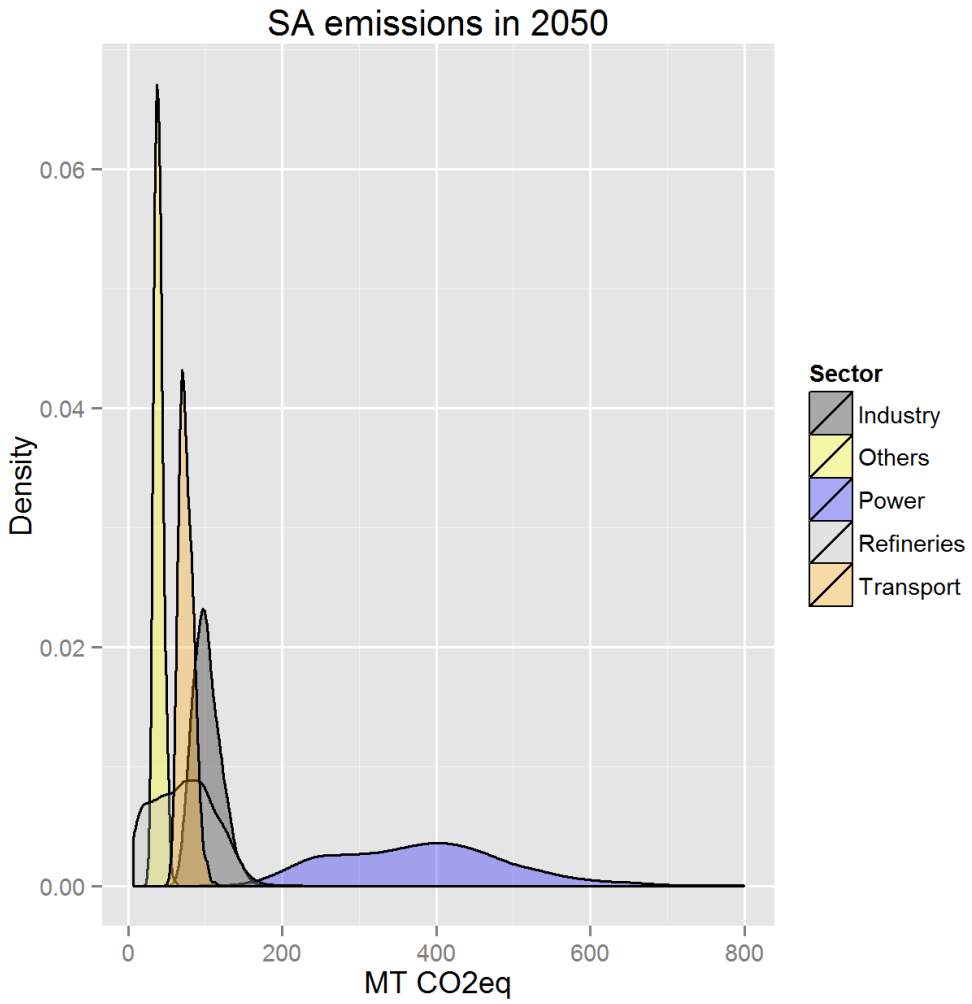
CO2 per Capita



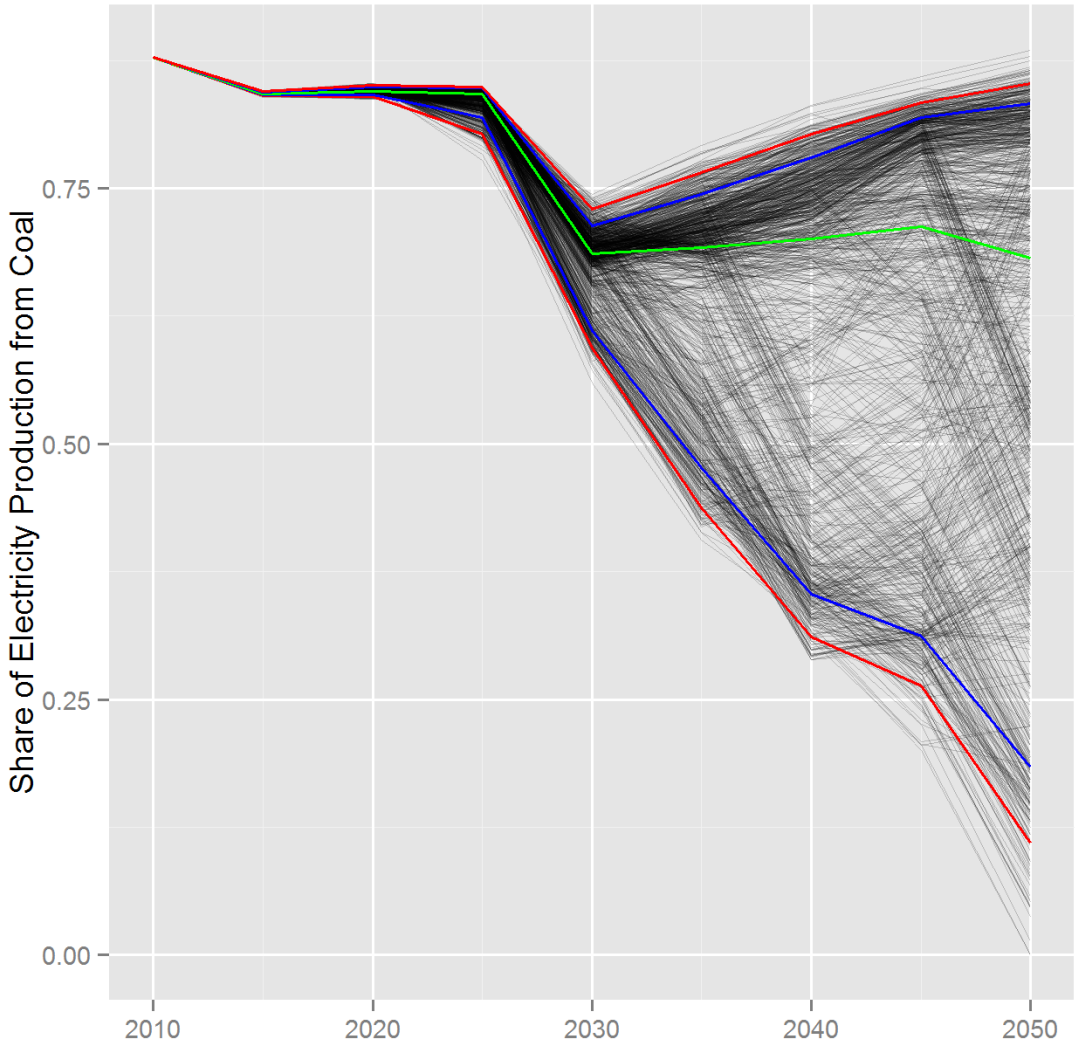
CO2 per $ GDP



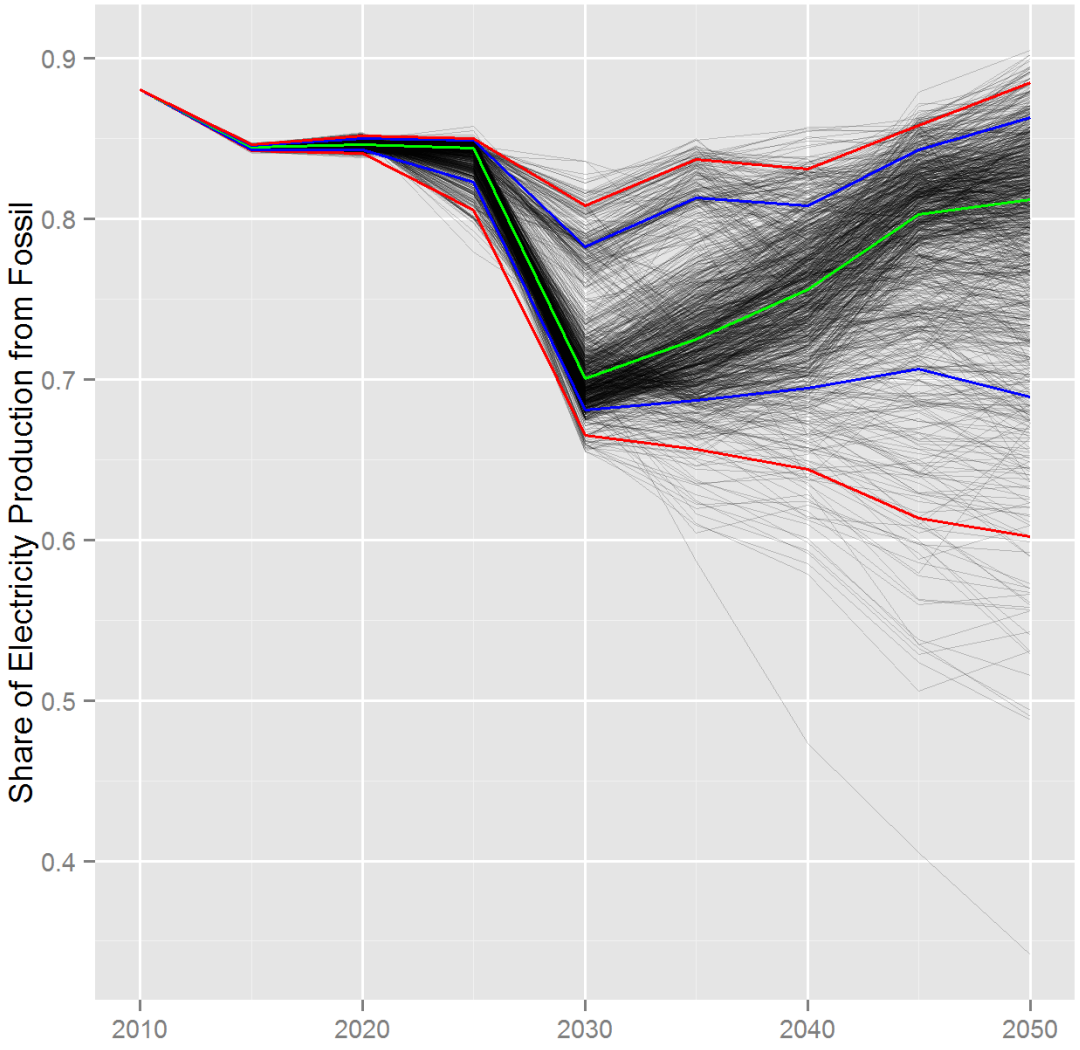
CO2 by Sector in 2050



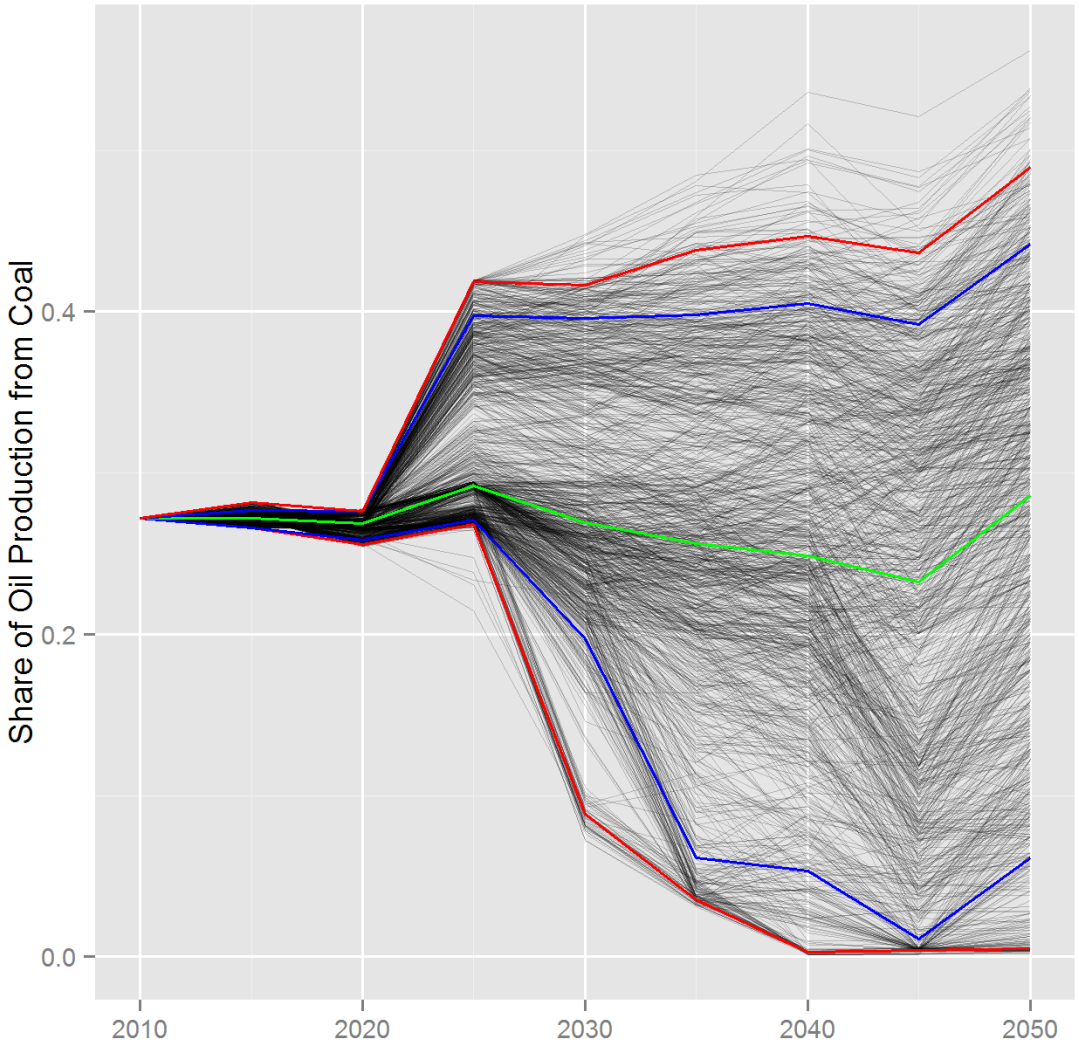
Share of Coal in Electricity Generation



Share of Fossil in Electricity Generation



Share of Coal in Oil Production



5. POLICY IMPLICATIONS AND FUTURE WORK

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
- CO2 per GDP reduction targets would have lower uncertainty

Future Work

- Explore results further:
  - Sensitivity analysis (One-at-a-time, Morris)
- Refine what we have and add more uncertain parameters:
  - Household behaviour (intangible costs)
  - Distribution infrastructure costs
  - Other new technologies (cost and performance) on the demand side
  - Fugitive emissions on Shale
- Review sampling methods (Latin hypercube?)
- Start looking at some policy scenarios

UNEP

FIRM Facilitating Implementation and Readiness for Mitigation

THANK YOU

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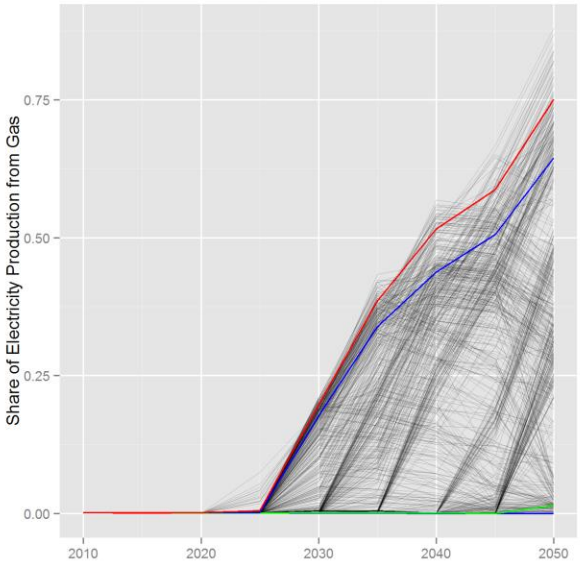
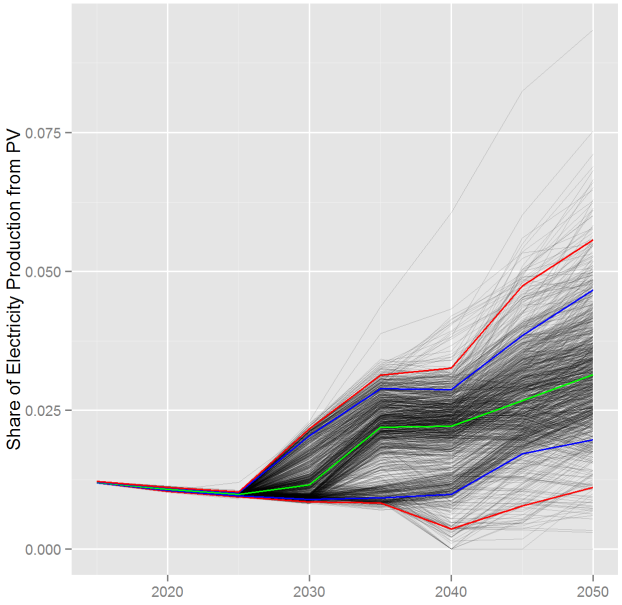
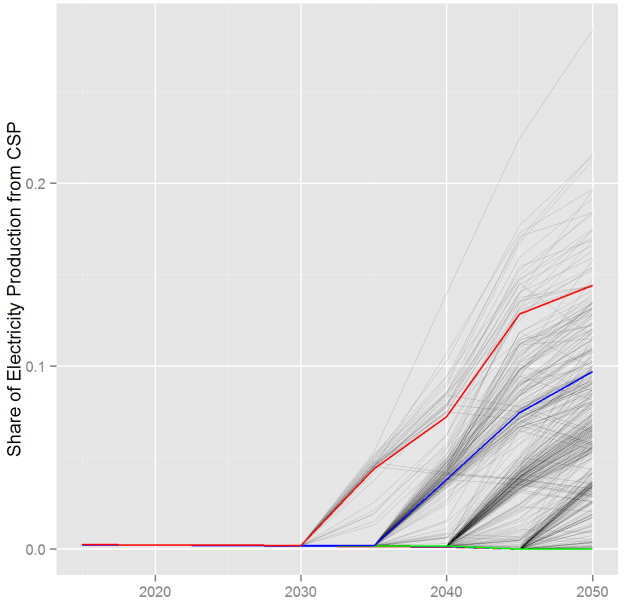
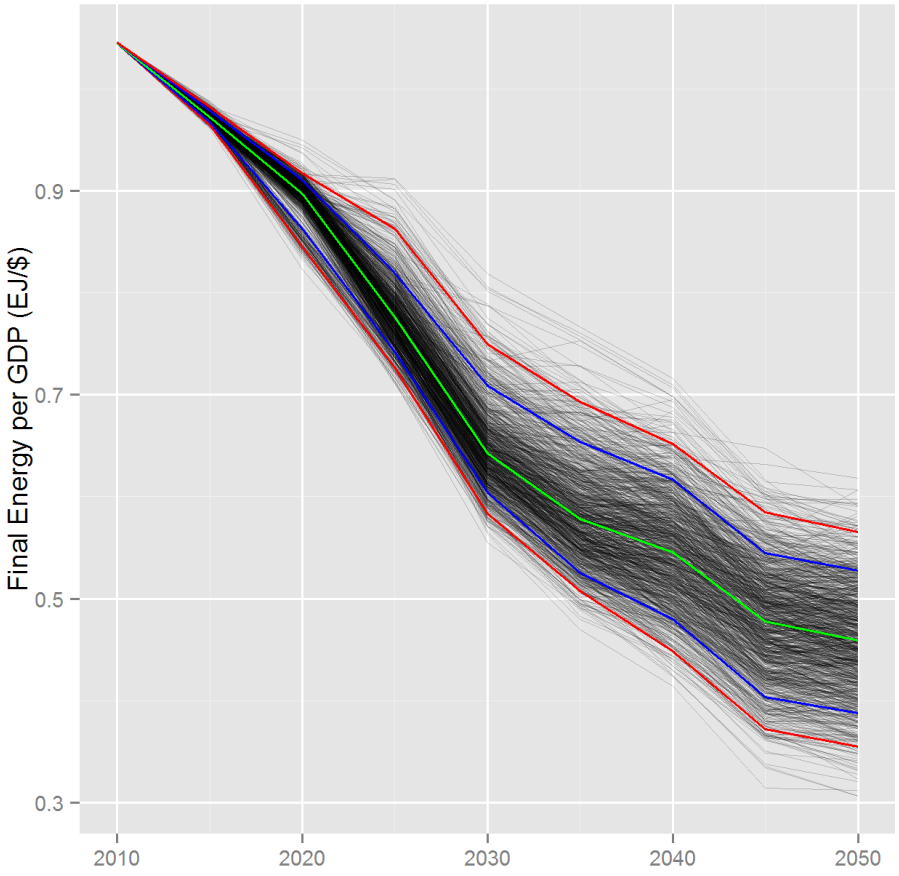
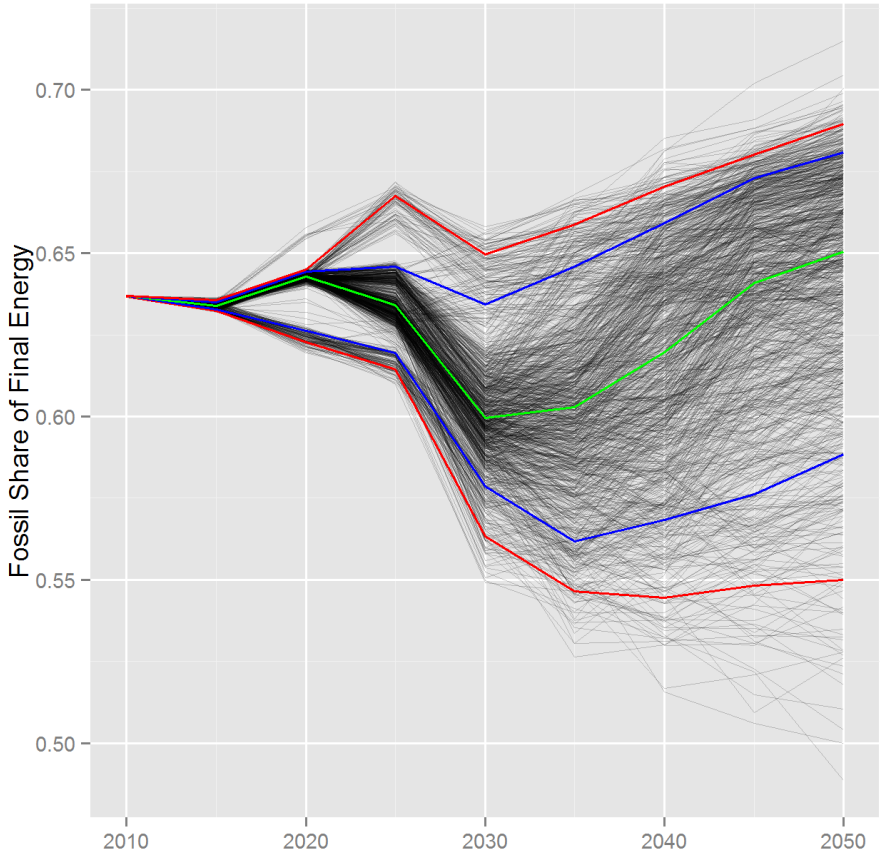

Share of Electricity Production from Gas
0.75
0.50
0.25
0.00
2010
2020
2030
2040
2050


Share of Electricity Production from PV
0.075
0.050
0.025
0.000
2020
2030
2040
2050


Share of Electricity Production from CSP
0.2
0.1
0.0
2020
2030
2040
2050


Final Energy per GDP (EJ/$)
0.9
0.7
0.5
0.3
2010
2020
2030
2040
2050


Fossil Share of Final Energy
0.70
0.65
0.60
0.55
0.50
2010
2020
2030
2040
2050