The Heritage Foundation

The Smoke and Mirrors Behind Integrated Assessment Modeling

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Important questions to ask

- How does the government come up with its energy/climate policies?
- Are the tools for doing so even reliable for such purposes?

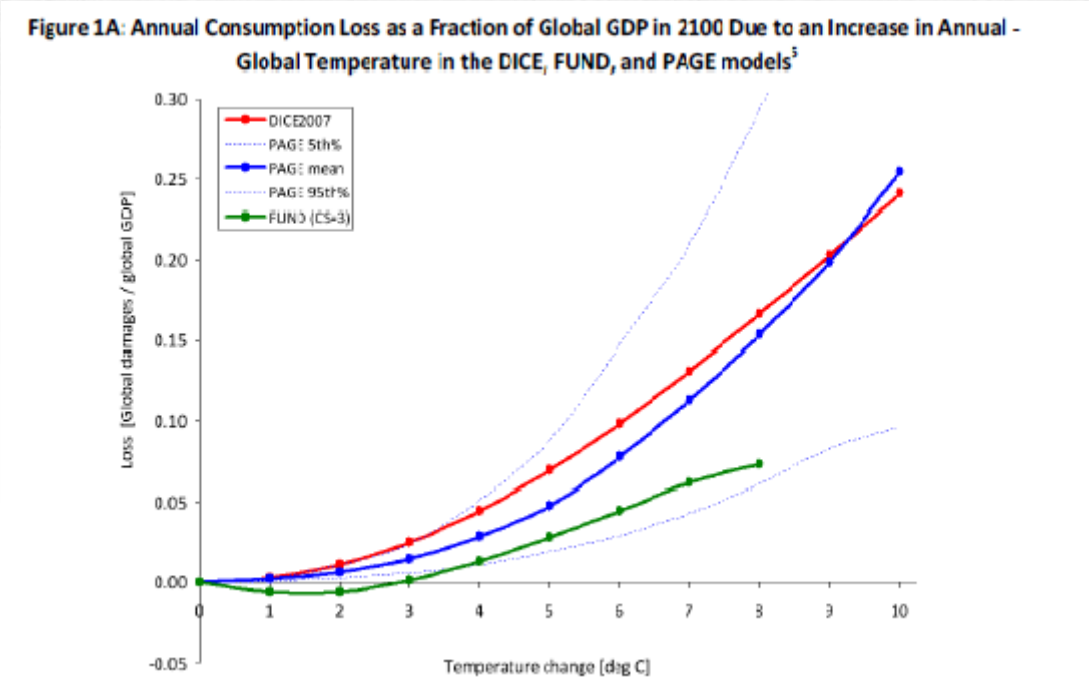
What is the Social Cost of Carbon?

- Defined by the EPA as “the economic damages per metric ton of carbon dioxide emissions”

So how does one actually estimate the SCC?

- General question – What is the long term economic impact of carbon dioxide emissions summed over a particular time horizon?
- Three statistical models (IAMs)
  - DICE model
  - FUND model
  - PAGE model
- Series of equations modeling economic growth and climate response computed using Monte Carlo analysis

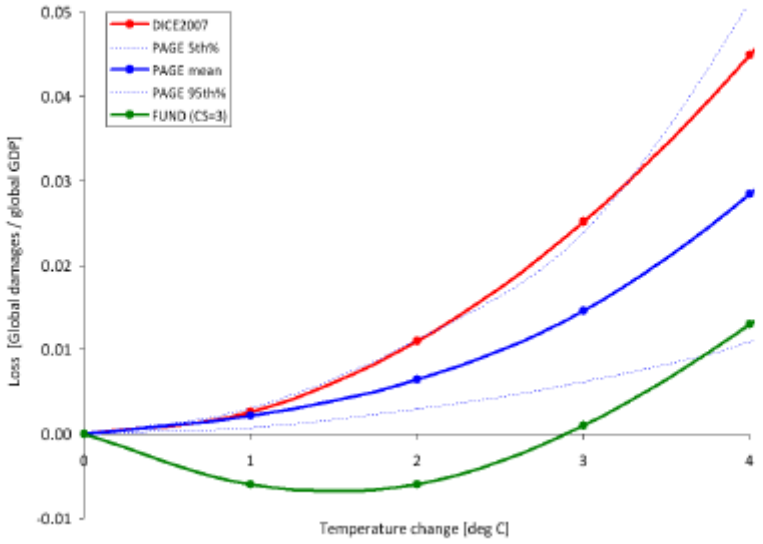
Damage functions



Source: IWG 2010 TSD

Damage functions – lower temperature changes

Figure 1B: Annual Consumption Loss for Lower Temperature Changes in DICE, FUND, and PAGE -



Source: IWG 2010 TSD

As with any statistical model …

- These models are grounded by assumptions
  - Discount rate
  - Time horizon
  - Equilibrium climate sensitivity
- We ran two of the three models, rigorously examining the following assumptions …

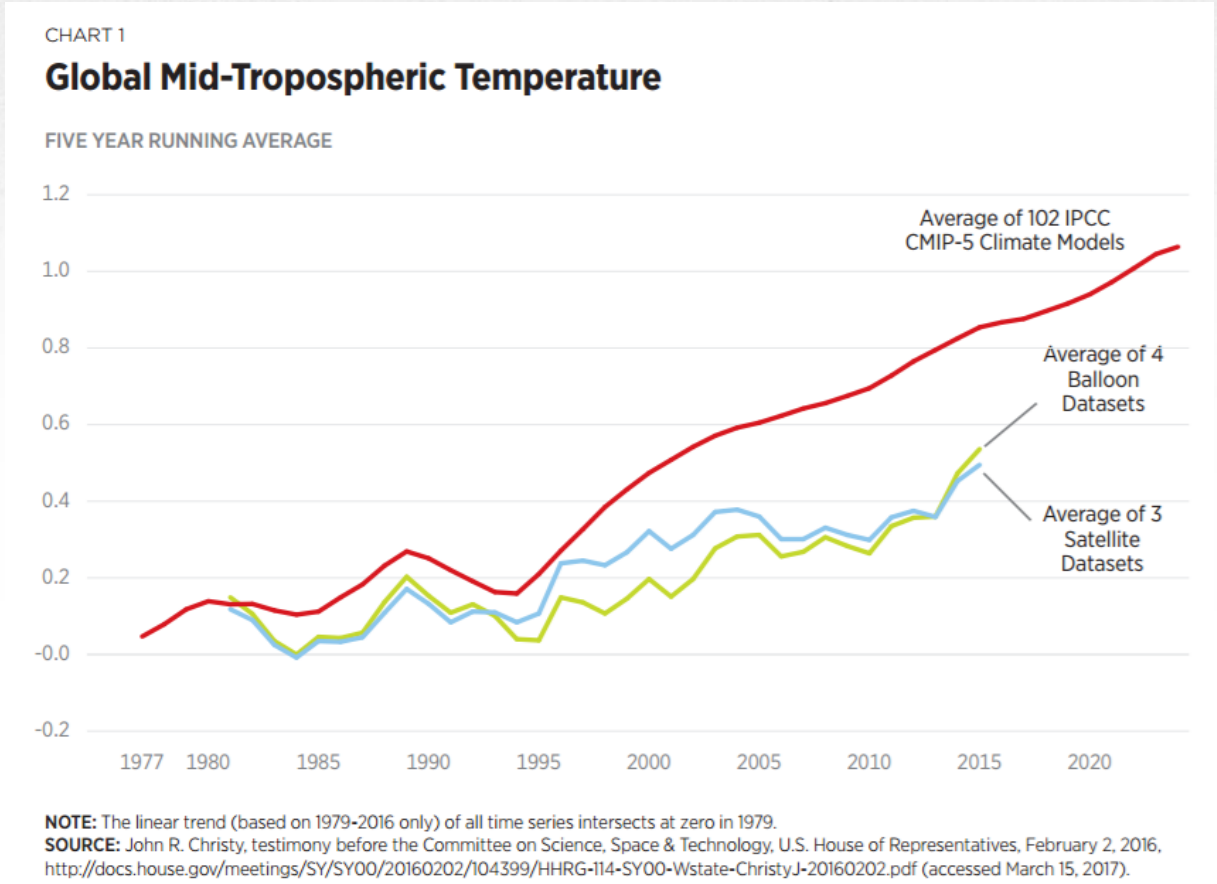
Discount rate

- We talked about economic damages
- How much should be invested to prevent the associated damages?
  - EPA used 2.5%, 3%, and 5% discount rates
  - Office of Management and Budget (OMB) suggested a 7% discount rate be used

Time horizon

- Projected economic damages are summed
- Question – For how long?

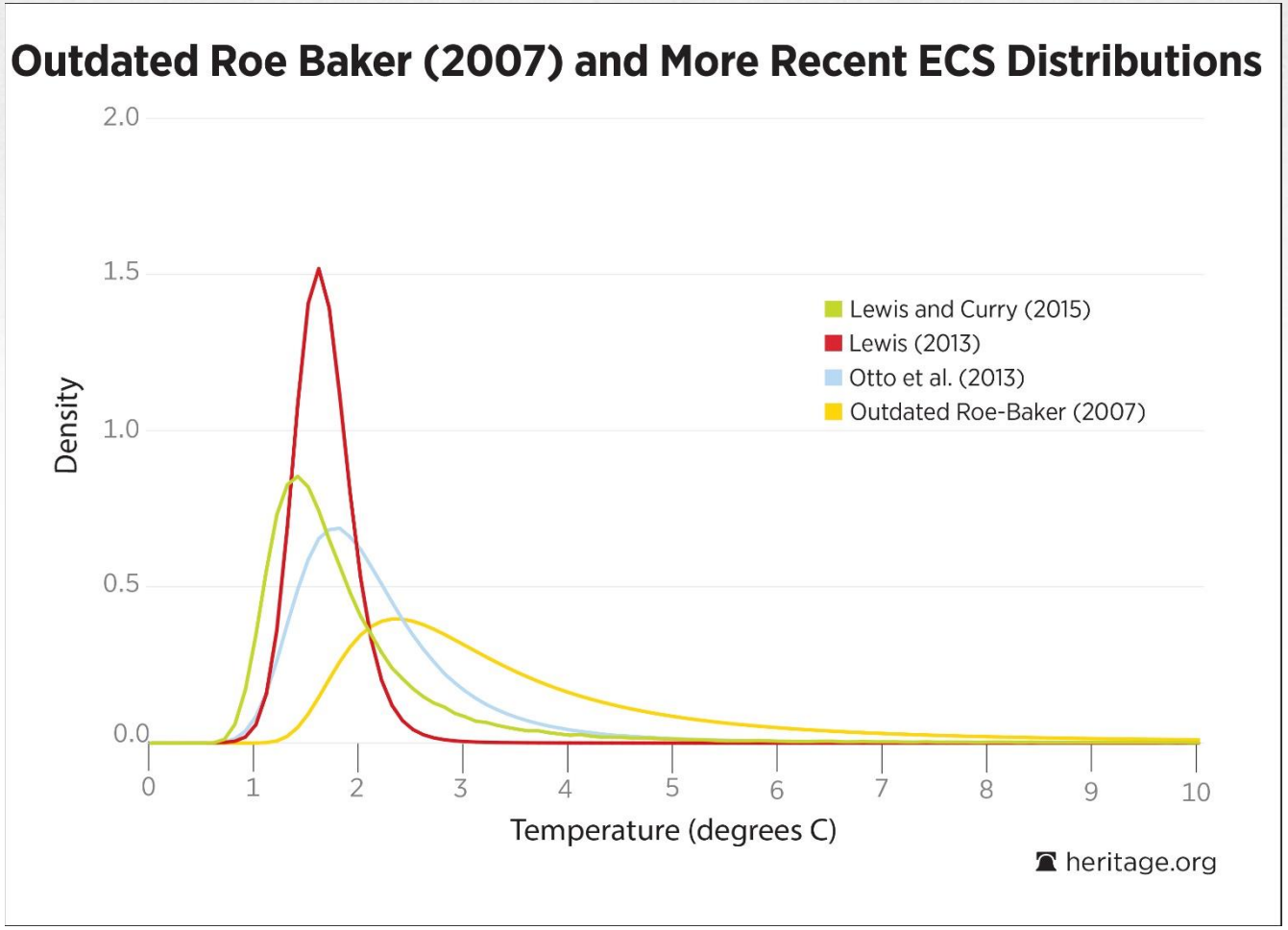
How accurate are forecasts?



Equilibrium Climate Sensitivity

- Is the science truly settled on global warming?
- ECS Distributions
  - Roe Baker (2007)
  - Otto et al (2013)
  - Lewis (2013)
  - Lewis and Curry (2015)

Comparison of ECS distributions



ECS Probabilities

Prob of Temp increasing by more than …	Roe Baker (2007)	Lewis and Curry (2015)
2	0.86	0.28
3.5	0.36	0.07
4	0.27	0.05
4.5	0.20	0.04

Now what happens if we alter these assumptions?

In particular, tweaking the discount rate and ECS distributions

(Joint work with Ross McKitrick and David Kreutzer)

DICE model – Using Outdated Roe-Baker distribution

Discount rates	**3.00%**	**7.00%**
2010	$30.04	$4.02
2020	$37.79	$5.87
2030	$45.15	$7.70
2040	$53.26	$9.85
2050	$61.72	$12.25

DICE model – Using empirical Lewis and Curry (2015) distribution

Discount rates	**3.00%**	**7.00%**
2010	$15.62	$2.48
2020	$19.66	$3.57
2030	$23.56	$4.65
2040	$27.88	$5.91
2050	$32.51	$7.32

DICE model – % change between 3% and 7% discount rate

Year	Outdated RB (2007)	LC (2015)
2010	-86.62%	-84.12%
2020	-84.47%	-81.84%
2030	-82.95%	-80.26%
2040	-81.51%	-78.80%
2050	-80.15%	-77.48%

DICE model – % change between Outdated Roe Baker (2007) and Lewis and Curry (2015) ECS Distributions

Discount Rate	**2020**	**2050**
3%	-48.00%	-47.33%
7%	-39.20%	-40.24%

FUND model – Using Outdated Roe-Baker distribution

Discount rates	**3.00%**	**7.00%**
2010	$16.98	-$0.53
2020	$19.33	-$0.37
2030	$21.78	-$0.13
2040	$24.36	$0.19
2050	$27.06	$0.63

FUND model – Using empirical Lewis and Curry (2015) distribution

Discount rates	**3.00%**	**7.00%**
2010	$2.78	-$1.12
2020	$3.33	-$1.10
2030	$3.90	-$1.01
2040	$4.49	-$0.82
2050	$5.09	-$0.53

FUND model – % change between 3% and 7% discount rate

Year	**Outdated RB (2007)**	**LC (2015)**
2010	-103.12%	-140.29%
2020	-101.91%	-133.03%
2030	-100.60%	-125.90%
2040	-99.22%	-118.26%
2050	-97.67%	-110.41%

FUND model – % change between Outdated Roe Baker (2007) and Lewis and Curry (2015) ECS Distributions

Discount Rate	**2020**	**2050**
3%	-82.80%	-81.19%
7%	-197.3%	-184.13%

Is global warming necessarily a bad thing?

Are there economic damages associated with carbon dioxide emissions?

FUND model – Using Outdated Roe-Baker distribution

Discount rates	**3.00%**	**7.00%**
2010	0.121	0.642
2020	0.115	0.601
2030	0.108	0.555
2040	0.101	0.507
2050	0.093	0.455

FUND model – Using empirical Lewis and Curry (2015) distribution

Discount rates	**3.00%**	**7.00%**
2010	0.45	0.73
2020	0.432	0.69
2030	0.414	0.646
2040	0.394	0.597
2050	0.372	0.542

Does the madness stop with the SCC?

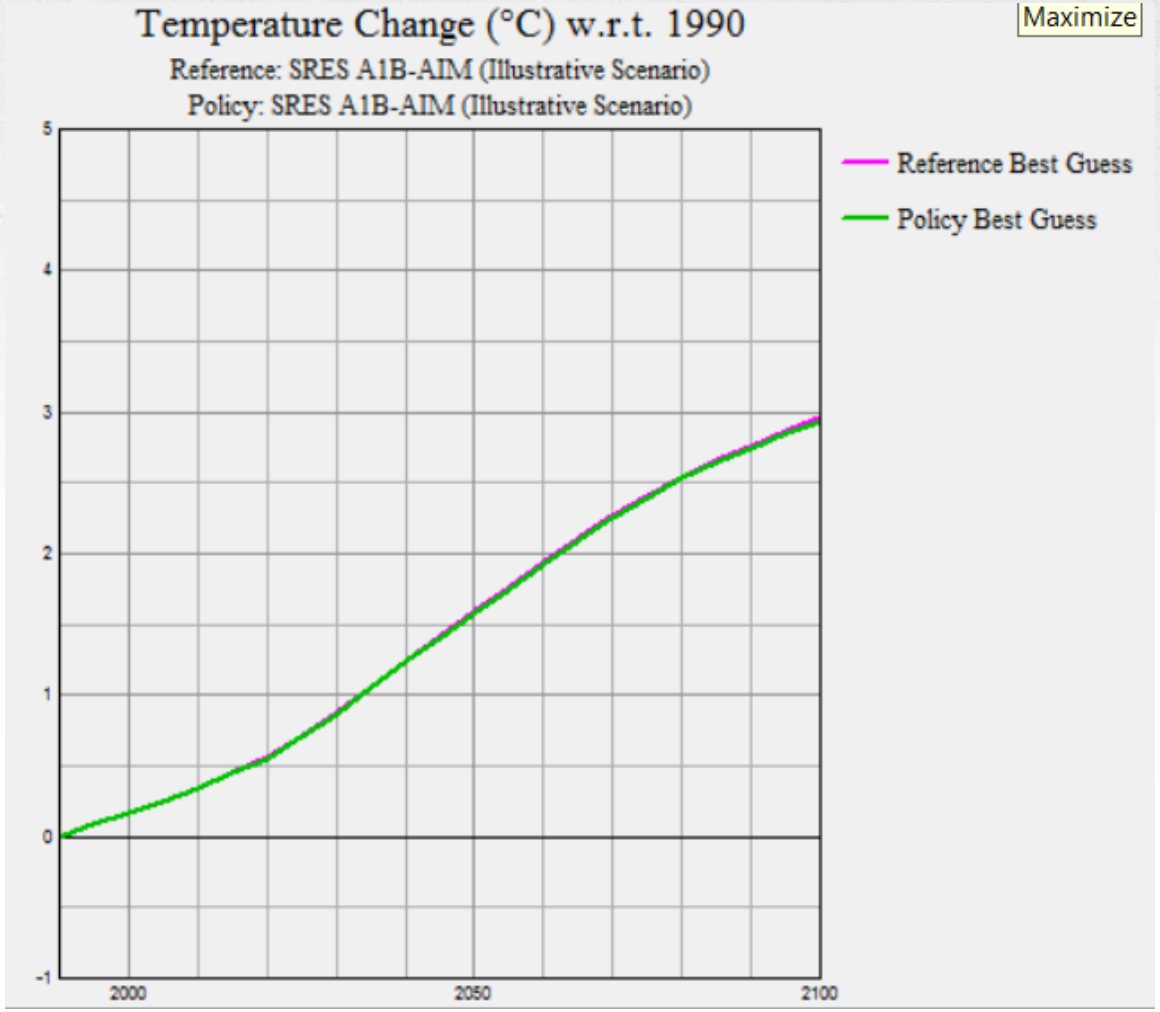
Federal government using analogous models regarding methane and nitrous oxide emissions

So what if we actually wanted to take these models seriously?

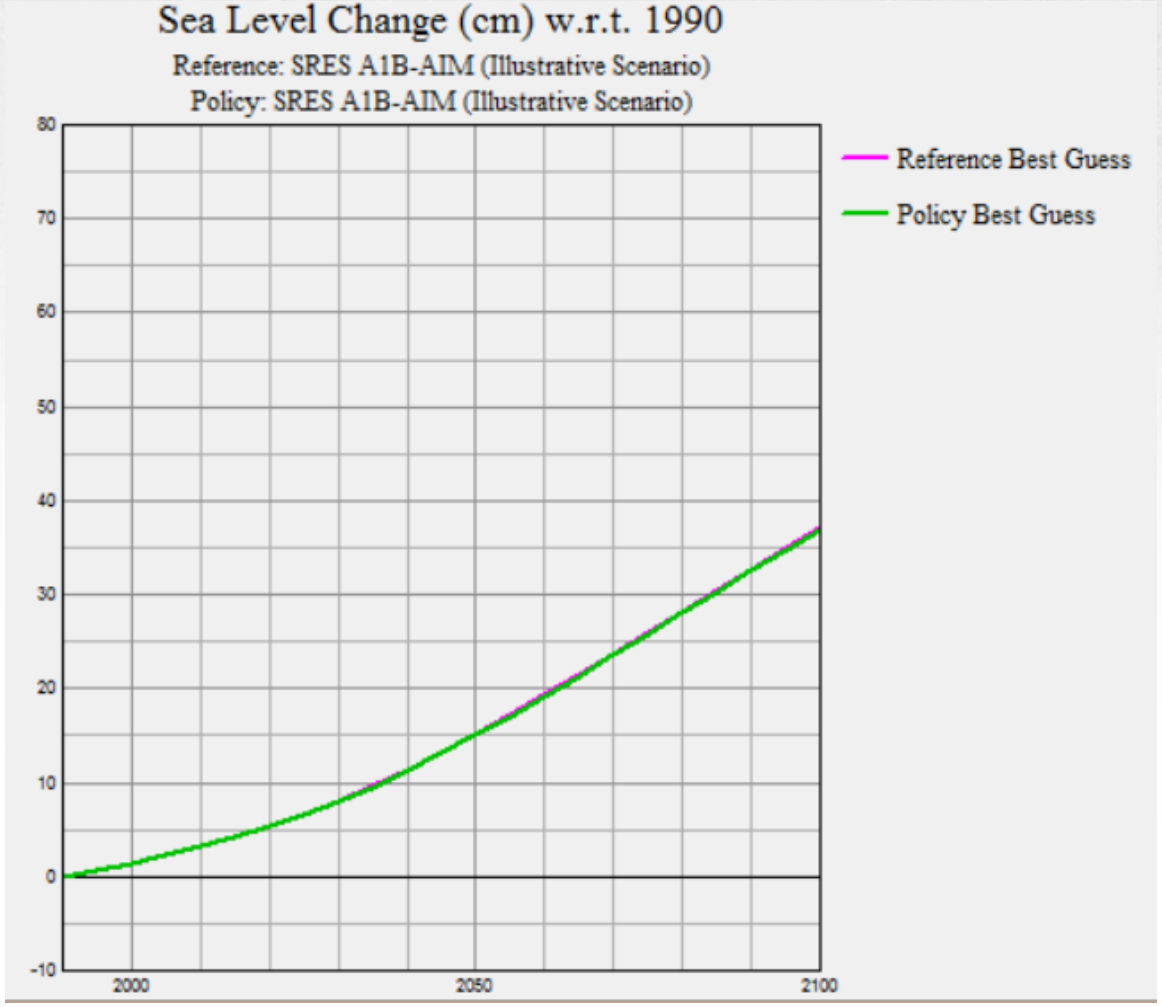
Supposing they have legitimacy (which they don't) …

What impact would these policies have in actually changing the climate?

What impact would these GHG reducing policies actually have in reducing global temperatures?

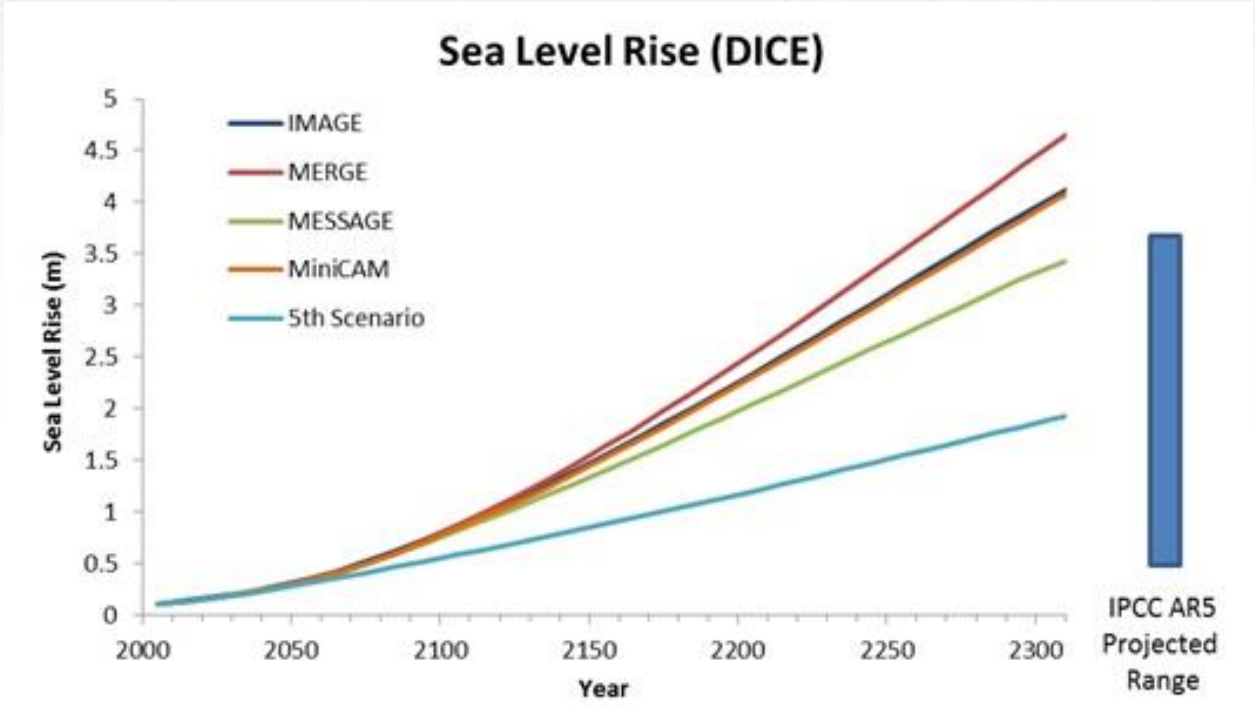


What impact would these GHG reducing policies actually have in reducing sea level rise?



Speaking of sea level rise, what assumptions are being made about it these IAMs?

Sea Level Rise Computations in DICE



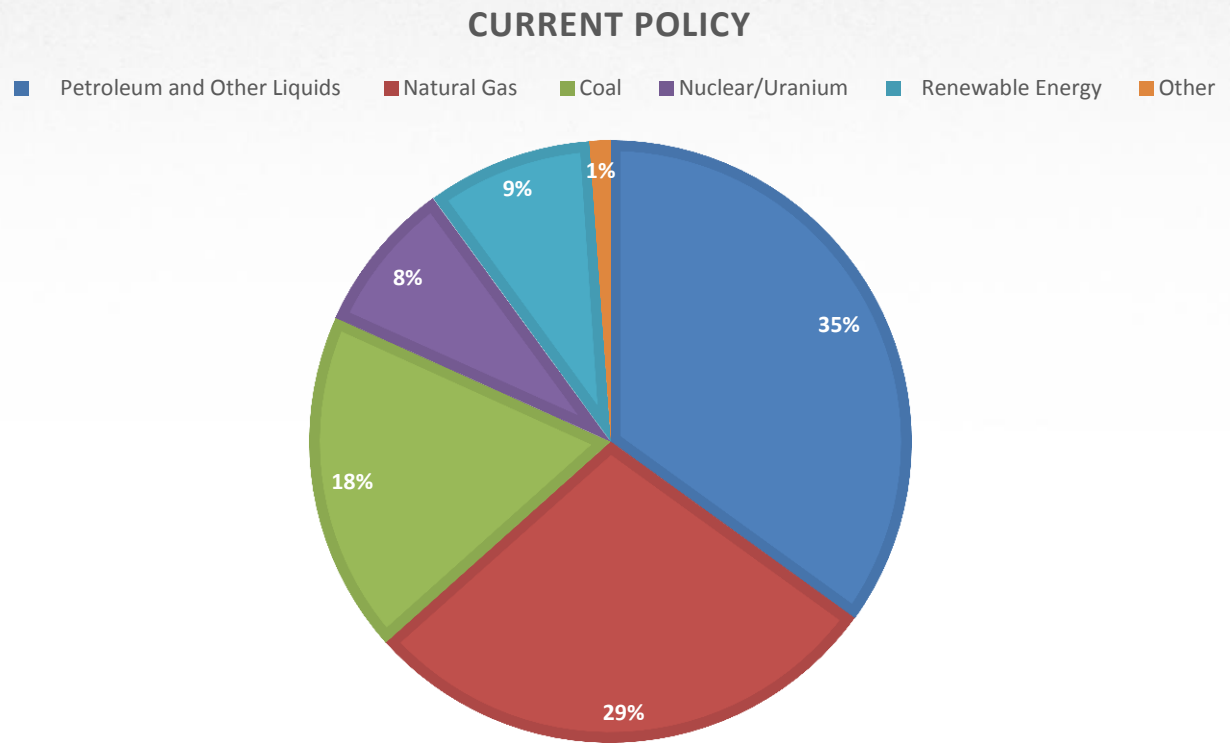
What would be the economic impact of taking these models seriously?

What would be the economic impact of taking these models seriously?

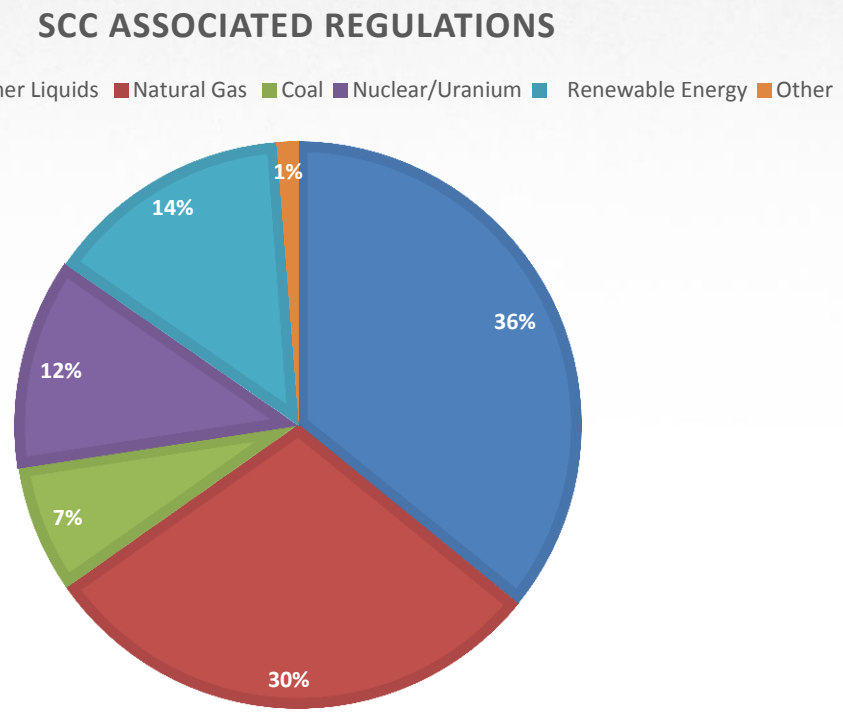
- Instituting carbon capture regulations, we found that using the Heritage Energy Model that by 2035:
  - Average employment shortfall of almost 400,000 lost jobs
  - A total loss of income of more than $20,000 for a family of four
  - 13-20% increase in household electricity prices
  - Aggregate $2.5 trillion loss in GDP

Would these policies induce a notable shift toward renewables?

Energy consumption breakdown – Current Policy



Energy consumption breakdown – Regulations associated with SCC



So what if we actually wanted to take these models seriously?

- These integrated assessment models are extremely sensitive to reasonable tweaks to assumptions
- Damage functions are arbitrary
- Even negative at times
- Can be easily manipulated by policymakers
- Taking them seriously would literally result in economic disaster with no environmental benefit.

Thank you!