Electricity Demand in a Warming World

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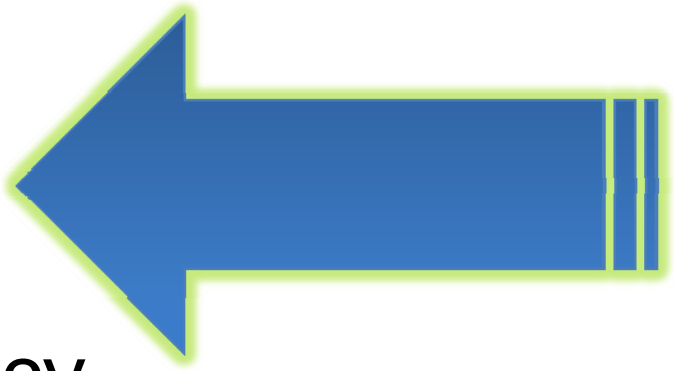
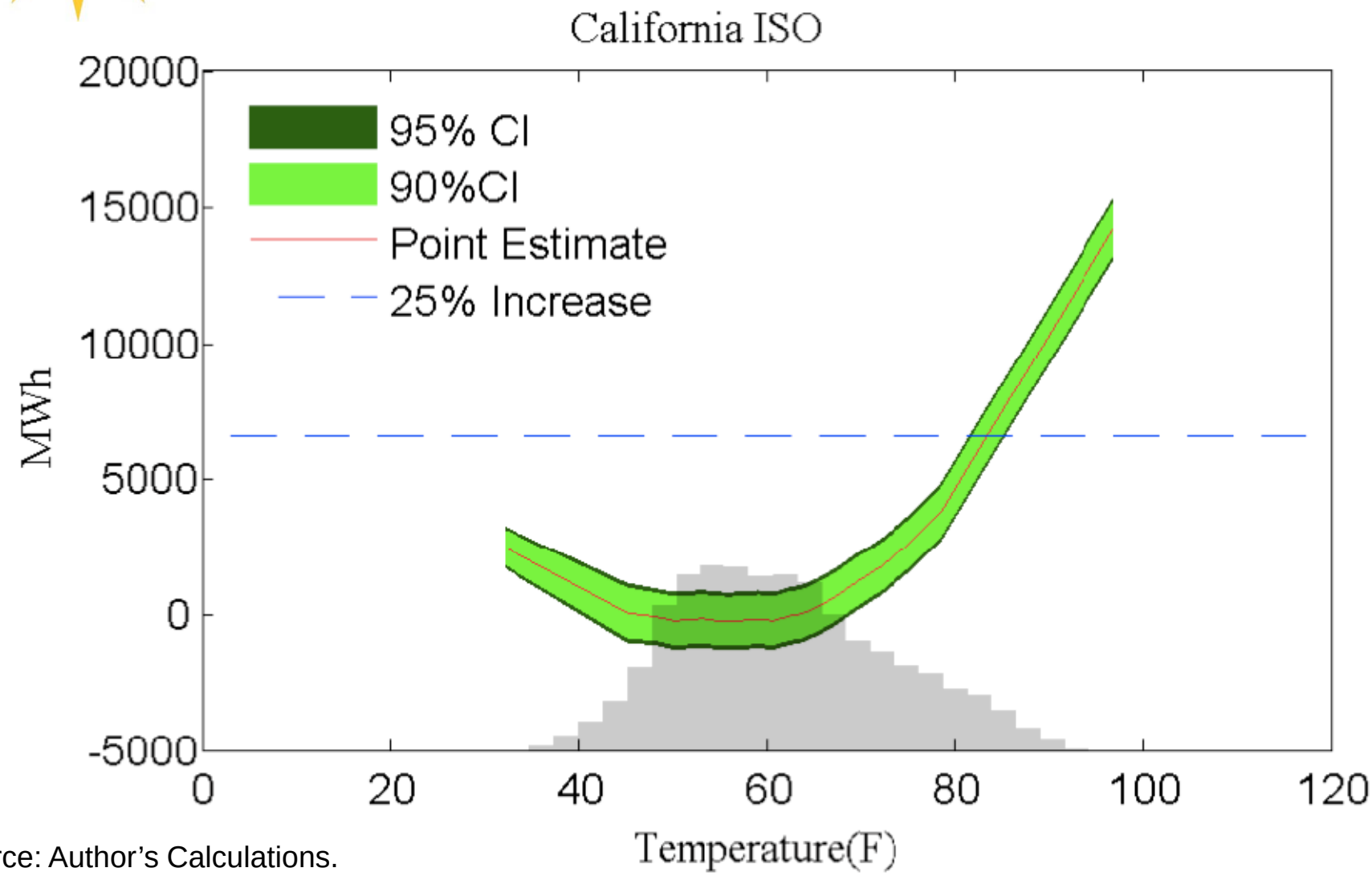
Climate Change Will Impact California's Electricity System

- Cooling Demand
- Heating Demand
- Transmission Efficiency
- Power Plant Efficiency
- Wildfire Risk
- Sea-Level Rise impacts coastal power plants



Electricity Load Increases on Hot Days



Source: Author's Calculations.

Recent literature projects significant climate driven increases in electricity/energy demand by EOC

- Franco and Sanstad (2008)
  - Electricity Consumption increase by 4.8-17.8%
  - Peak Load 5.7 – 19.8
- Greenstone and Deschenes (2011)
  - Annual Energy Consumption 11% (8.9% Pacific)
- Auffhammer & Aroonruegsawat (2012)
  - Residential Electricity Consumption 4.25-11.32%
- CEC 2011 IEPR contains detailed projections of climate change impacts for the first time.

Climate Change Impacts in CEC's 2011 IEPR Electricity Demand Forecast

- Scripps Institute provided 8 temperature scenarios for California
- Staff chose a "mid" and a "high" temperature increase for mid and high electricity demand forecast scenarios
- Low electricity demand forecast scenario included no climate change adjustment

Climate Change Impacts in Energy Commission's 2011 IEPR Electricity Demand Forecast

- Staff used long-term trend (1990-2020) from scenarios to calculate annual maximum *average631*
  - *average631*: 60 percent of current day's average temperature, 30 percent of previous day's, and 10 percent two days previous
- Econometric peak model used to estimate peak demand impacts

Climate Change Impacts on Peak Demand, 2011 IEPR Demand Forecast

		Annual Maximum *Average631* (°F), Mid Demand Scenario	Annual Maximum *Average631* (°F), High Demand Scenario	Peak Impact, Mid Scenario (MW)	Peak Impact, High Scenario (MW)
LADWP	2015	84.0	84.2	35	54
	2020	84.5	85.0	83	131
	2022	84.7	85.2	105	165
PGE	2015	86.0	86.1	114	143
	2020	86.4	86.6	277	349
	2022	86.6	86.8	348	440
SCE	2015	86.2	86.3	121	171
	2020	86.6	87.0	293	421
	2022	86.8	87.2	368	533
SDGE	2015	78.6	78.6	27	28
	2020	79.0	79.1	66	70
	2022	79.2	79.3	84	88
SMUD	2015	85.4	85.6	13	23
	2020	85.7	86.2	31	57
	2022	85.9	86.5	39	72
State	2015	--	--	316	430
	2020	--	--	768	1,056
	2022	--	--	965	1,334

Impacts of projected population growth are much bigger than those of climate change

Climate Change Only

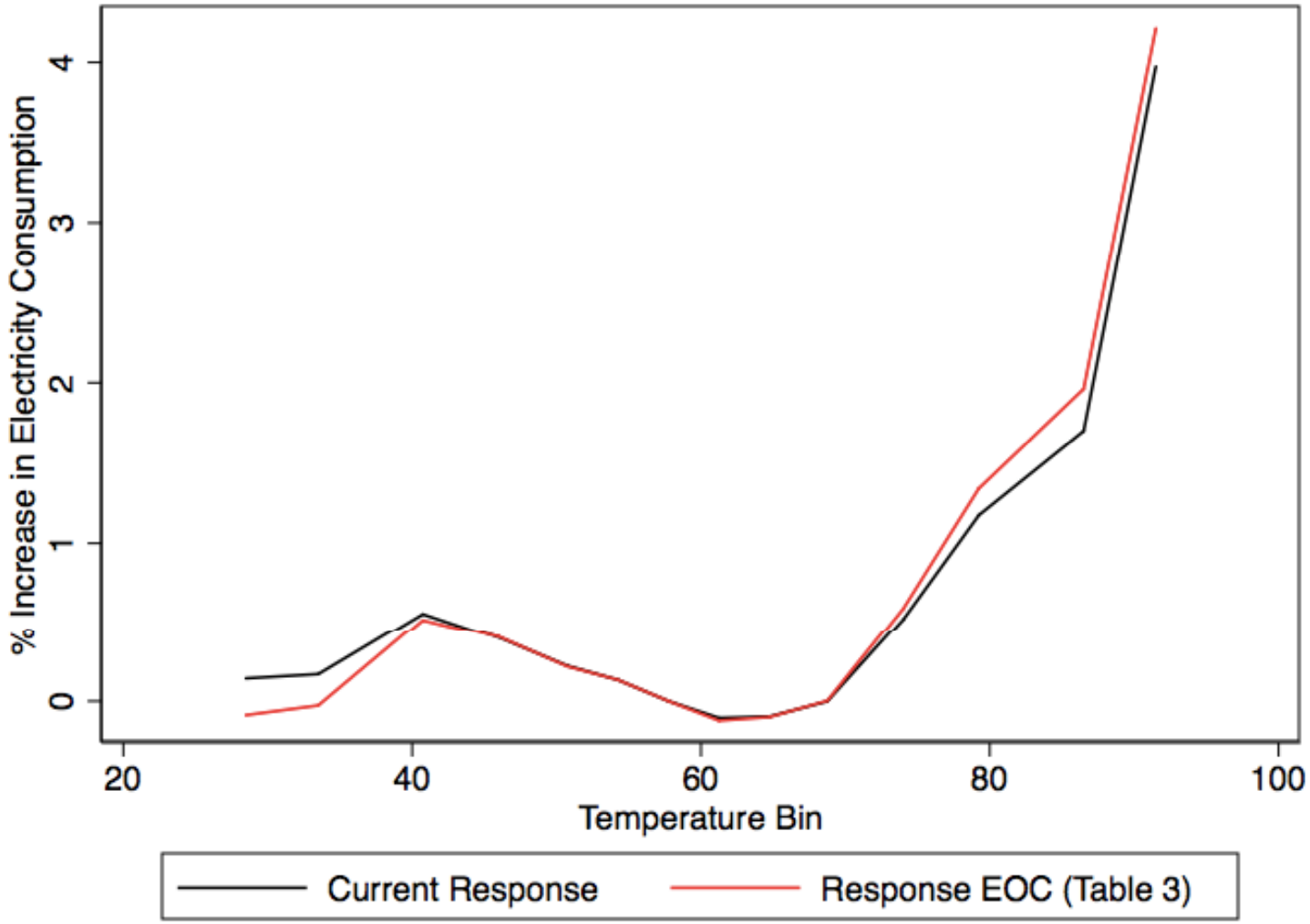
Climate Model	CNRM	CNRM	GFDL	GFDL	NCAR	NCAR
SRES Scenario	A2	A2	A2	A2	A2	A2
Extensive Margin	No	Yes	No	Yes	No	Yes
2000–19	0.69%	1.12%	0.81%	1.43%	0.69%	0.81%
2020–39	1.01%	1.67%	2.05%	3.05%	0.56%	0.72%
2040–59	2.14%	3.20%	3.04%	4.60%	1.37%	1.69%
2060–79	4.08%	6.13%	4.70%	7.03%	2.02%	2.50%
2080–99	6.52%	9.67%	7.74%	11.32%	3.50%	4.25%

Climate Change & Population Growth

Climate Model	CNRM	GFDL	NCAR	CNRM	GFDL	NCAR
SRES Scenario	A2	A2	A2	B1	B1	B1
Extensive Margin	Yes	Yes	Yes	Yes	Yes	Yes
2000–19	14%	14%	13%	13%	14%	13%
2020–39	43%	45%	42%	43%	44%	42%
2040–59	76%	79%	73%	73%	75%	72%
2060–79	112%	115%	104%	105%	106%	102%
2080–99	154%	160%	141%	138%	141%	134%

Source: Auffhammer & Aroonruengsawat (2012)

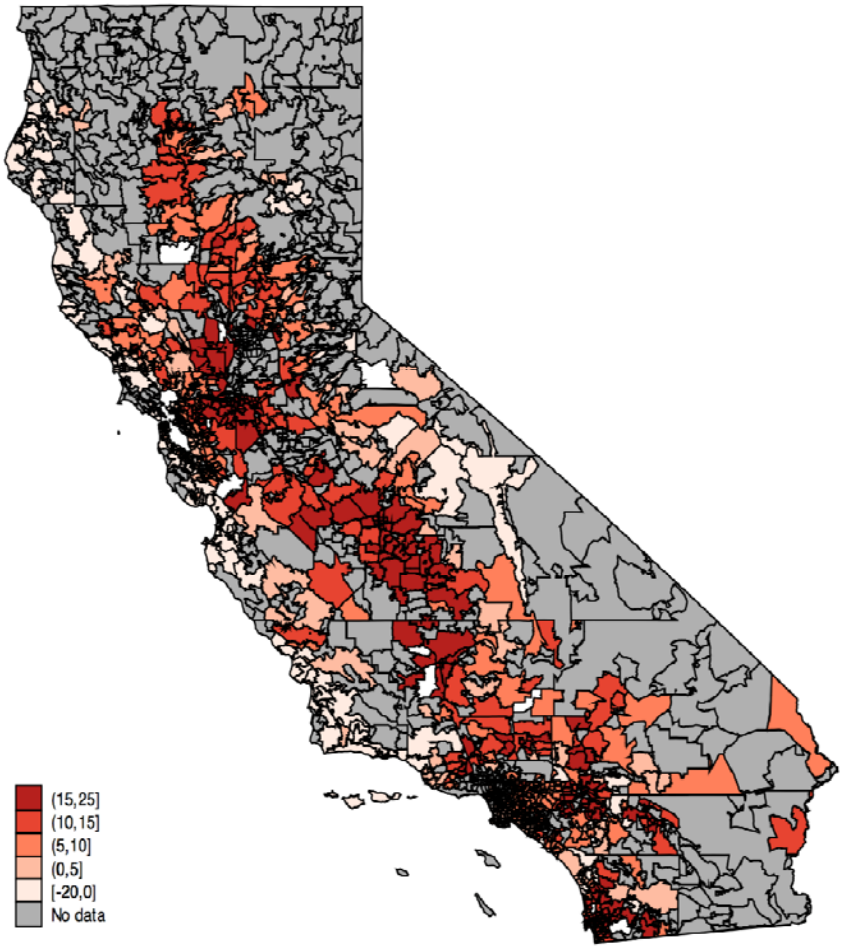
Electricity demand is expected to become more temperature sensitive due to adaptation



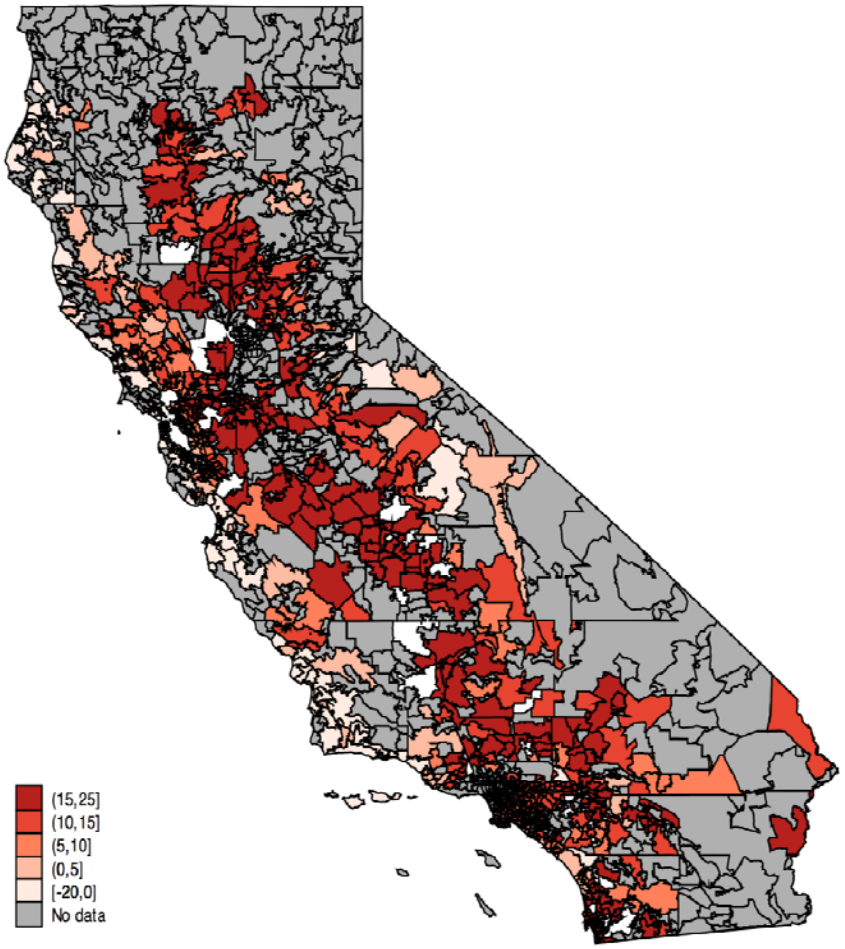
Source: Auffhammer & Aroonruengsawat (2012)

Distribution of Climate Change Driven Increases in Residential Consumption

Intensive Margin Adaptation Only

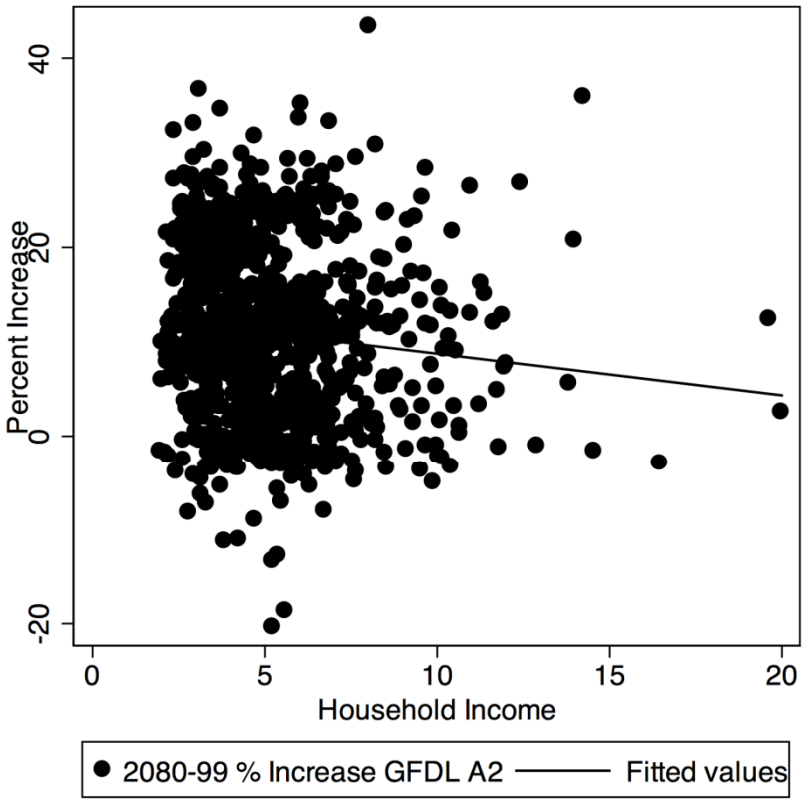


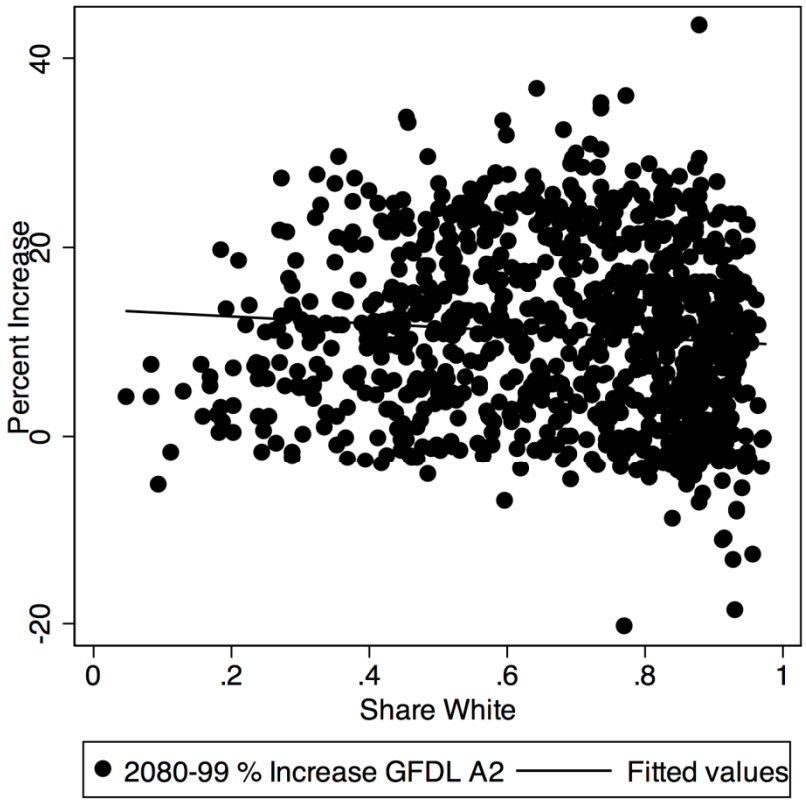
Intensive & Extensive Margin Adaptation



Source: Auffhammer & Aroonruengsawat (2012)

Impacts are heterogeneous across population groups.





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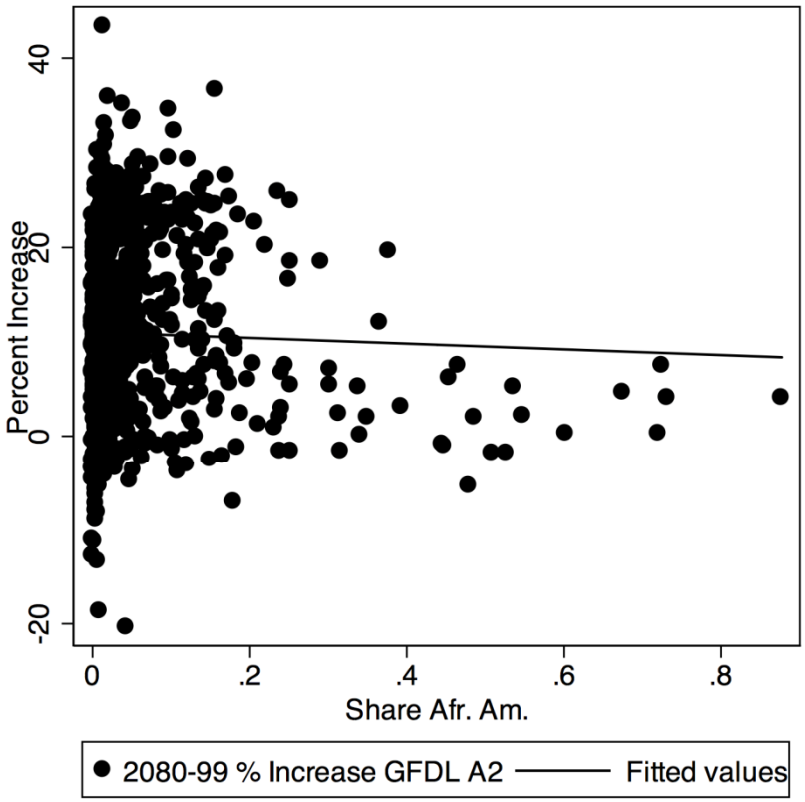

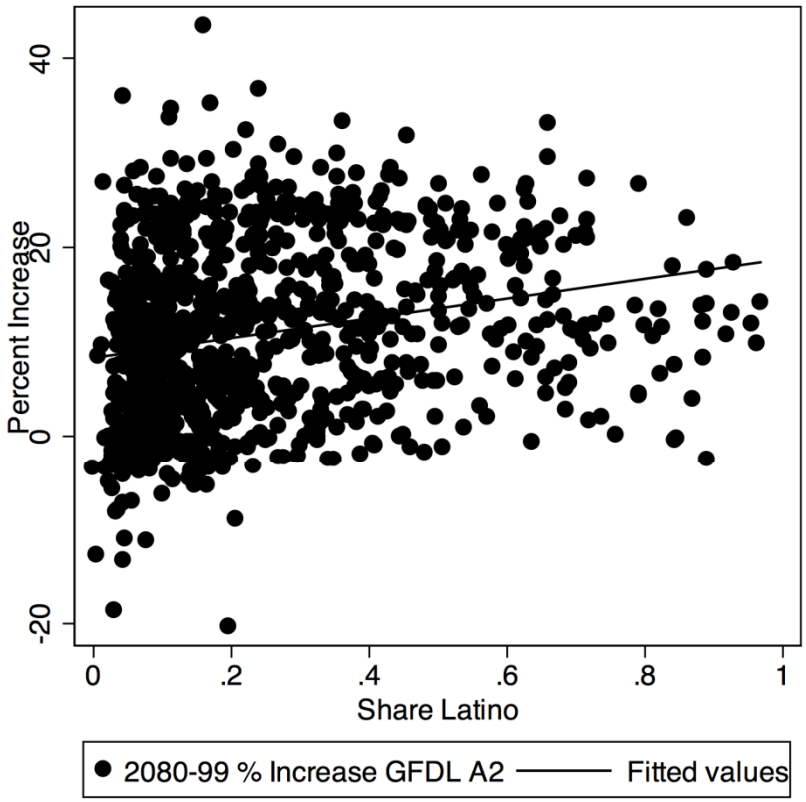

Source: Auffhammer & Aroonruengsawat (2012)

Conclusions

- Climate Change is expected to have a significant impact effect on electricity consumption by end of century
- Short to medium term impacts on peak load may be sizable.
- Impacts on consumption are heterogeneous.
- There is always an "energy penalty.”
- % Increases in the summer are expected to be much larger than the annual numbers

Thank you.

Questions?

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