Policy Pathways to an Advanced Energy Economy

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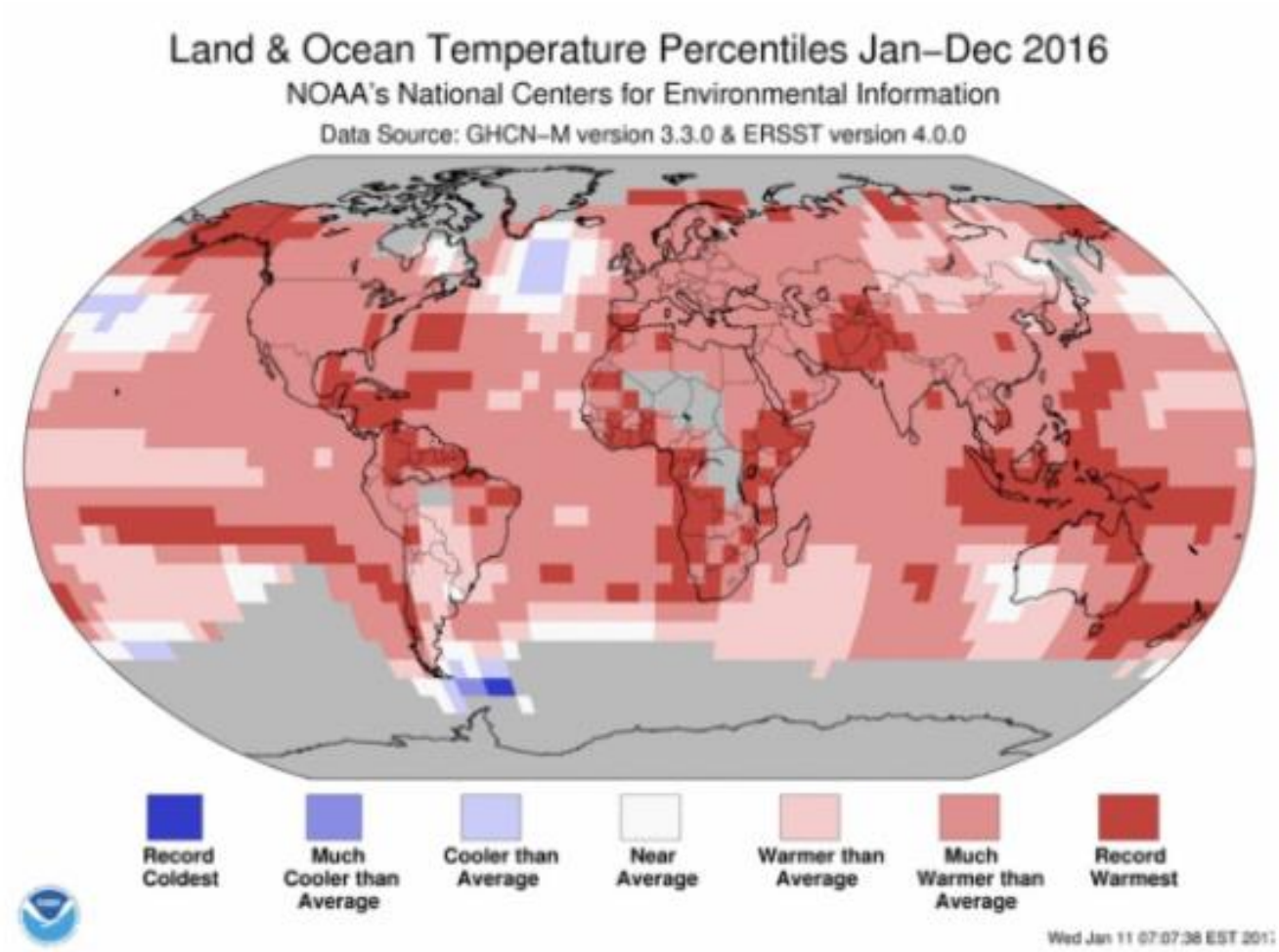
2016: Hottest Year on Record



2016 temperatures compared to normal around the globe. (NOAA)

The Southeastern U.S. is no longer an "anomaly".

Marilyn Brown
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$180 billion of new power plants to meet this load, or can we better manage our demand?

Peak Temperatures Will Push Electric Grid to the Brink in an Ever-Warming W…

Rising temperature could cost U.S. utilities as much as $180 billion this century due to greater electricity demand.

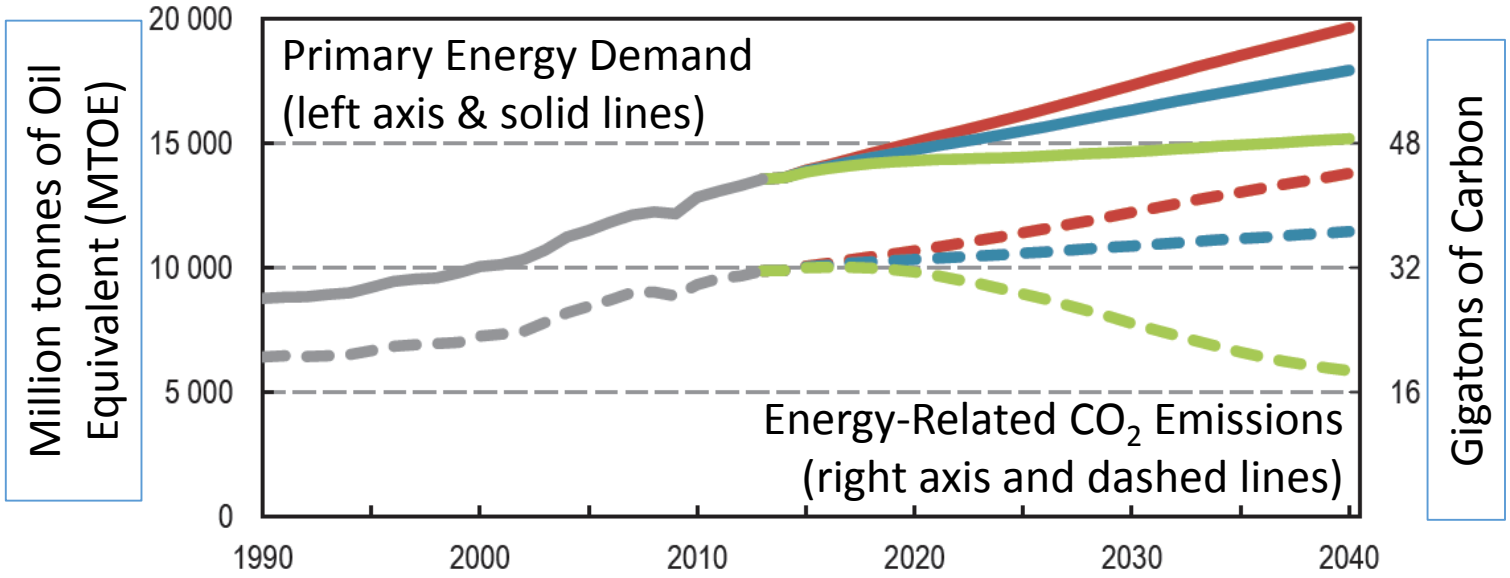
seeker.com

Meeting the 2°C Goal

Red ~ Current Policies

Blue ~ The Paris Accord – The "First Pivot"

Green ~ The 2ºC Goal – The "Second Pivot"

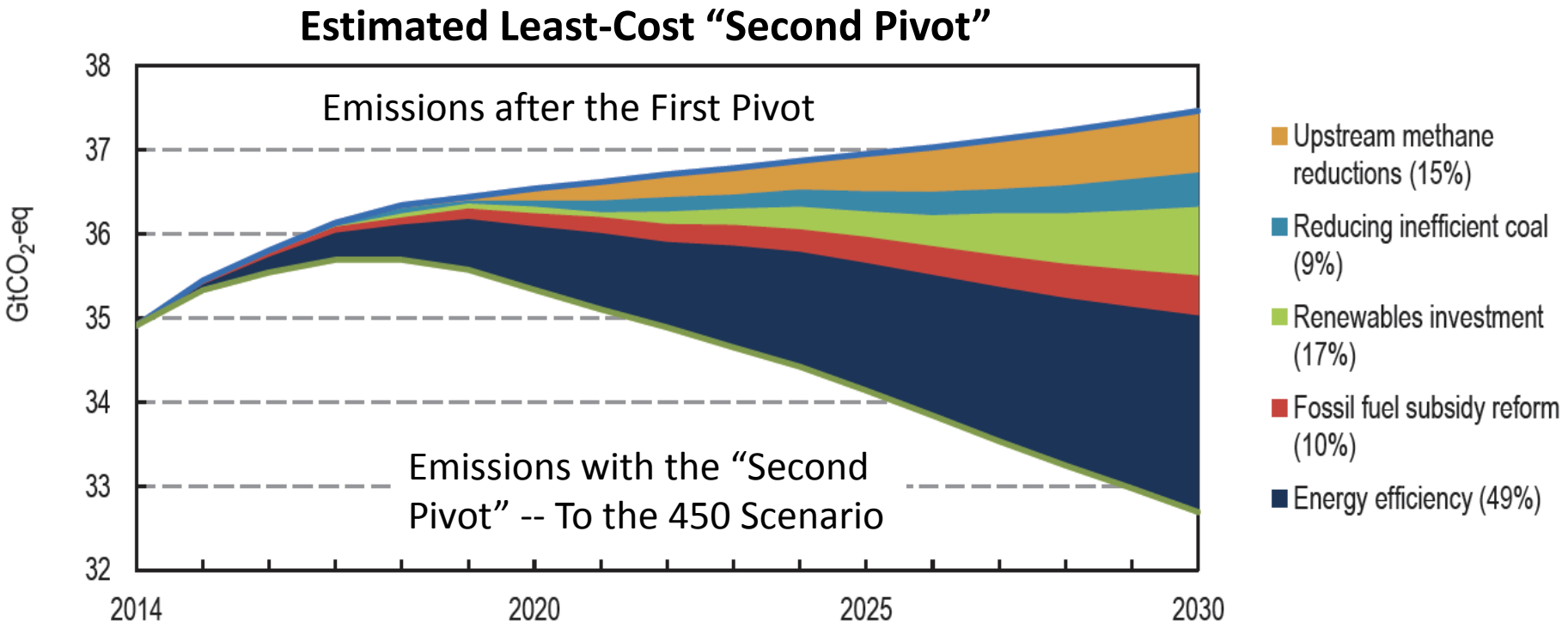


The Paris Accord is an important first step, but it is not strong enough to limit the global temperature increase to 2°C above the pre-industrial revolution.

Source: Adapted from the International Energy Agency's *World Energy Outlook*

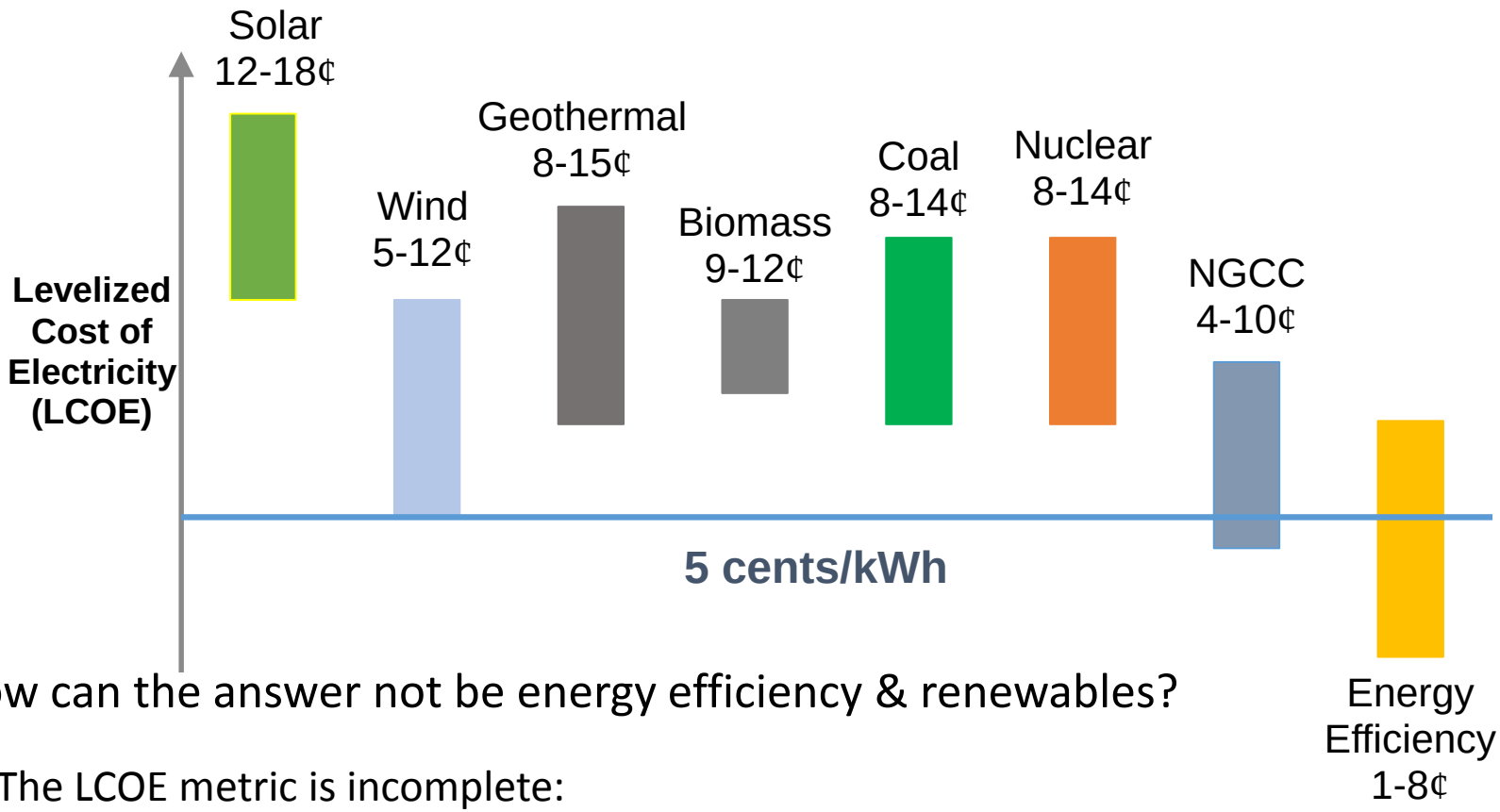
The Least-Cost Second Pivot

- IEA: Energy efficiency and renewables will likely dominate the "Second Pivot"



Adapted from: IEA (2015) *Energy and Climate Change: A Special Report*

The "LCOE" Metric

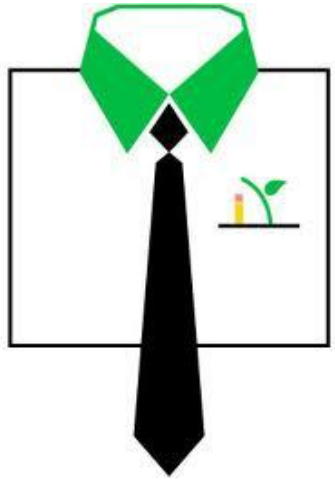


How can the answer not be energy efficiency & renewables?

The LCOE metric is incomplete:
--the hourly shape of supply and demand,
--the need for frequency and voltage control and support,
--reactive power planning and other locationally variable resource issues.

Source: *Green Savings*, Figure 2.10

Changing the Narrative



The U.S. has about 75,000 jobs in coal mining. Automation has had a major impact on this workforce: autonomous trucks work the Powder River Basin….

See: 30-minute CNN discussion: 175,000 live “hits”

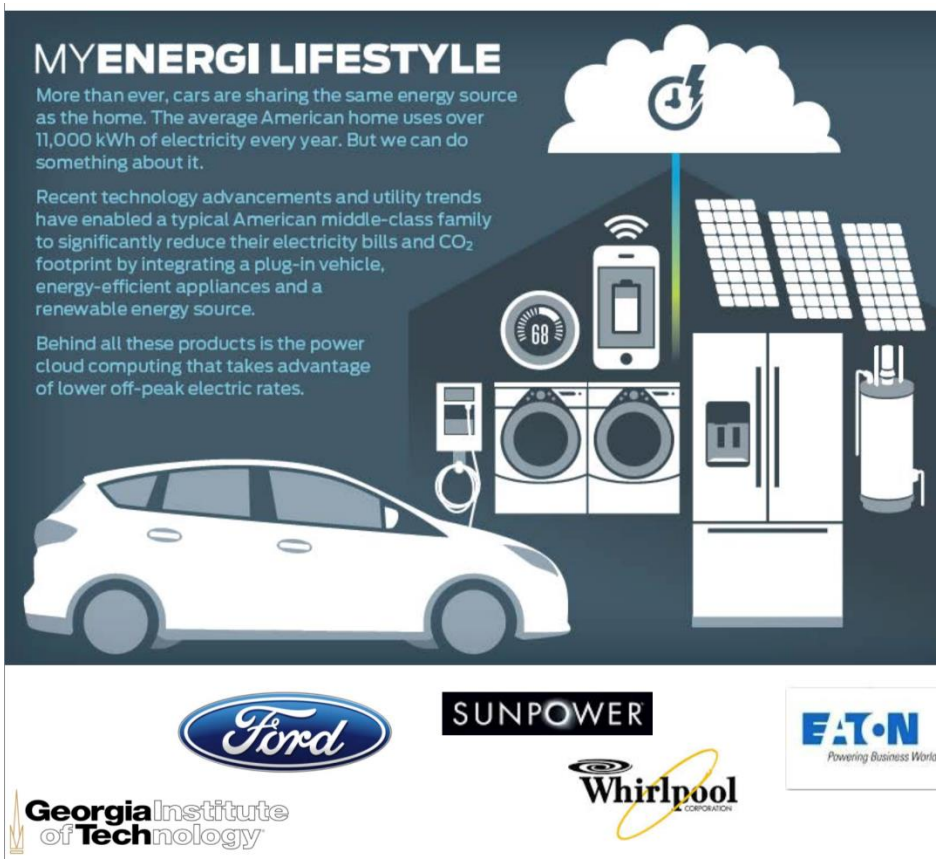
https://www.facebook.com/cnn/videos/10156318782866509/?hc_ref=NEWSFEED

Energy Efficiency Jobs

Nearly 1 million U.S. workers spend a majority of their time installing energy-efficient equipment and services.

Technologies include:

- Advanced windows & insulation
- High efficiency HVAC
- Smart thermostats
- Efficient lighting and controls
- Energy Star appliances, etc.



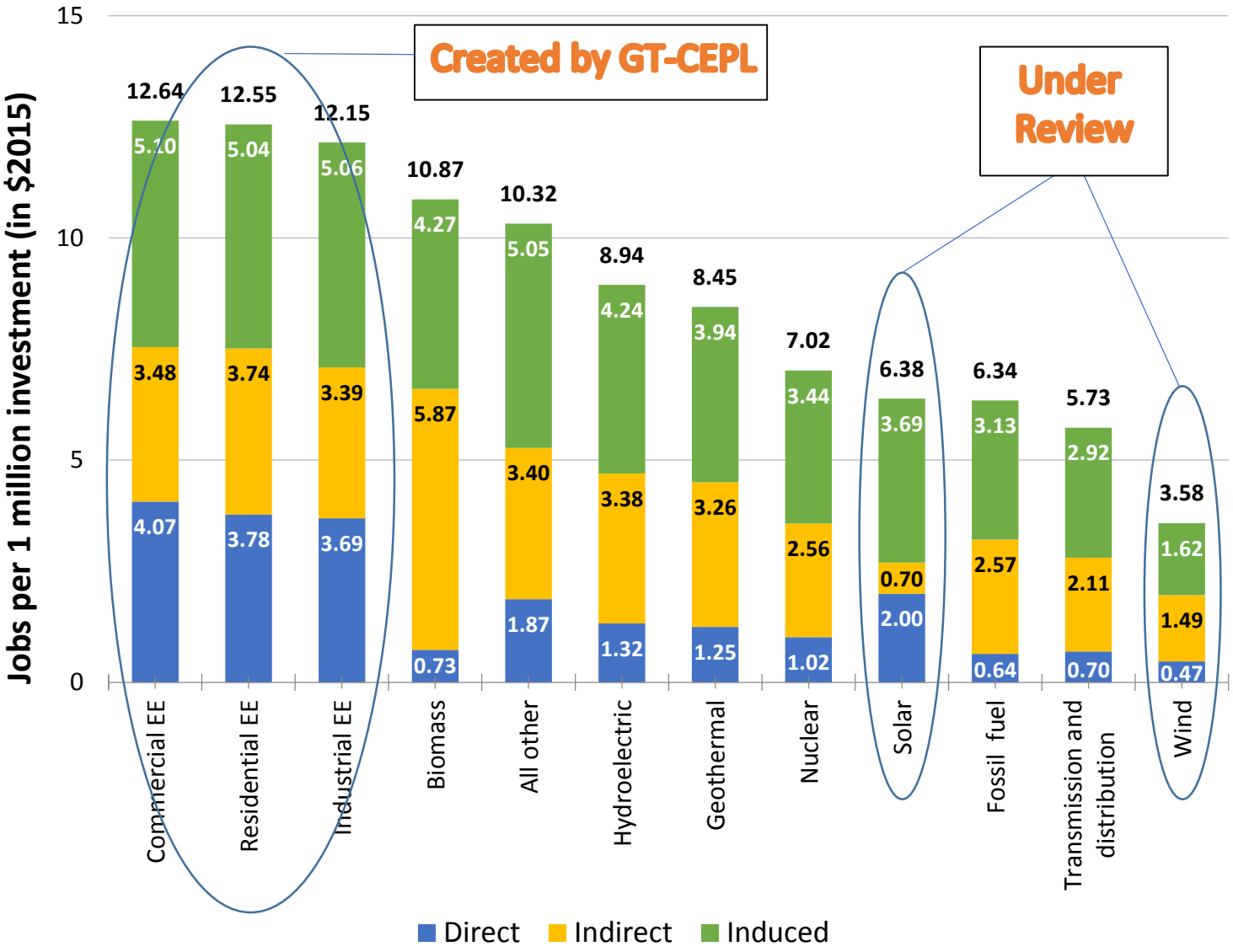
Source: Environmental Entrepreneurs (E2) and E4 The Future. 2016. *Energy Efficiency Jobs in America*.

Solar Jobs

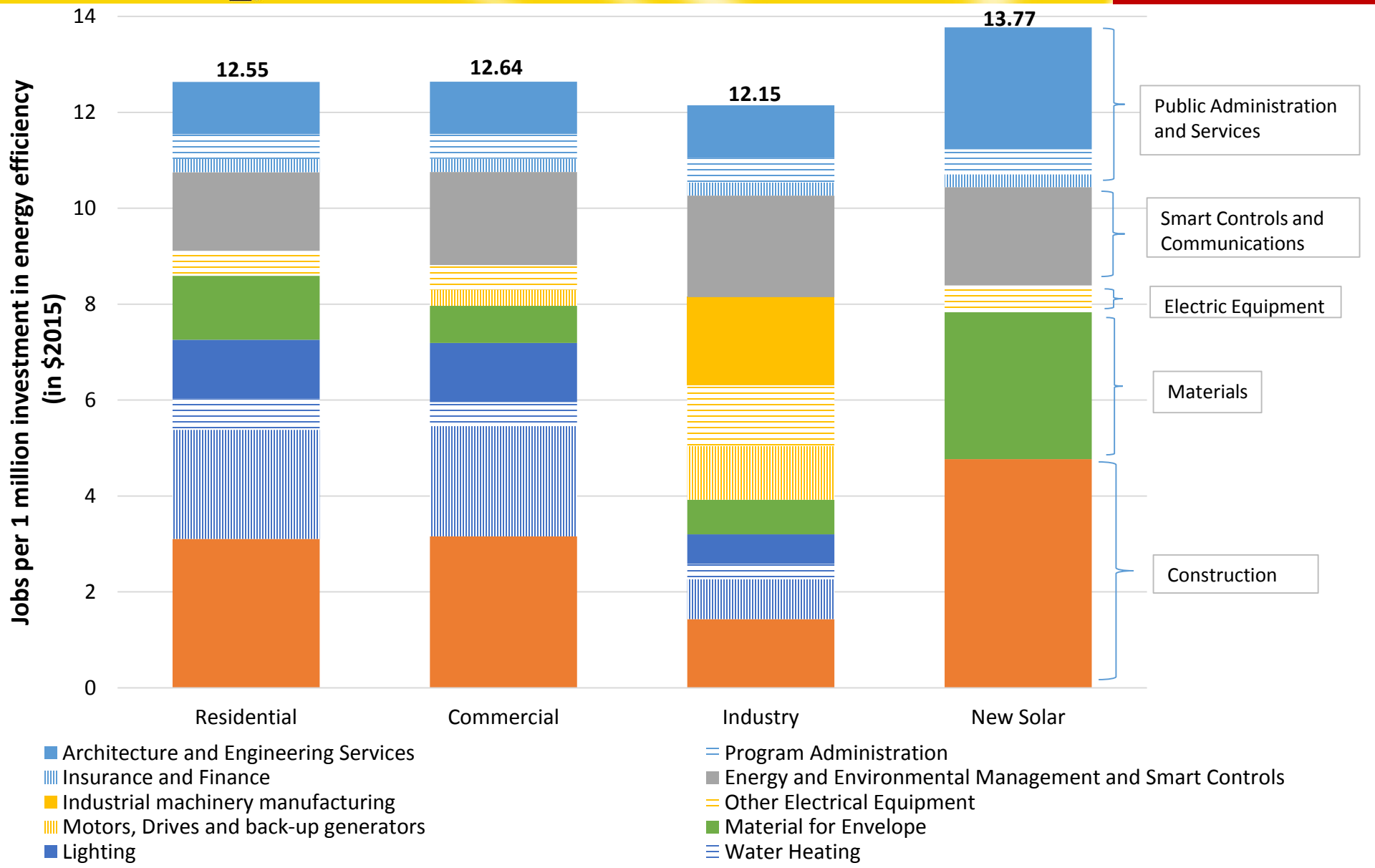
- The U.S. has about 250,000 workers in the solar industry.
- One out of every 50 new jobs added in the U.S. in 2016 was created by the solar industry.

Source: The Solar Foundation. 2017. *National Solar Jobs Census 2016*, available at: SolarJobsCensus.org.

Job Coefficients for Different Types of Energy Investments

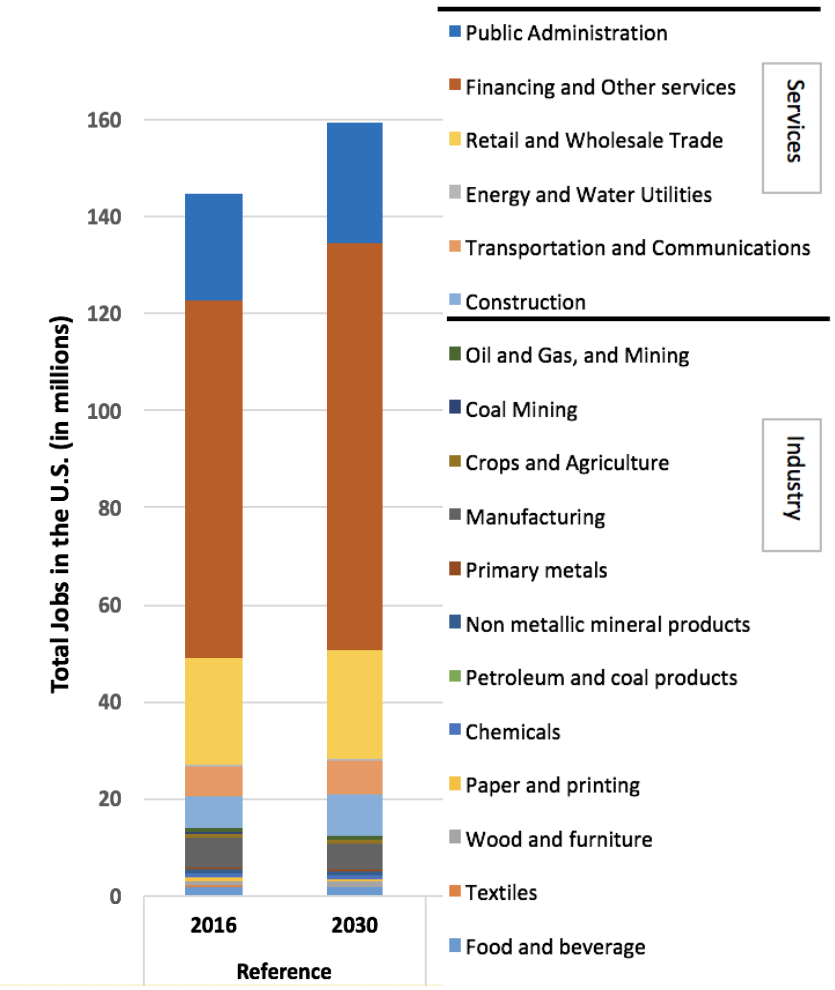


Types of Jobs Generated by Investments in Energy Efficiency and New Solar

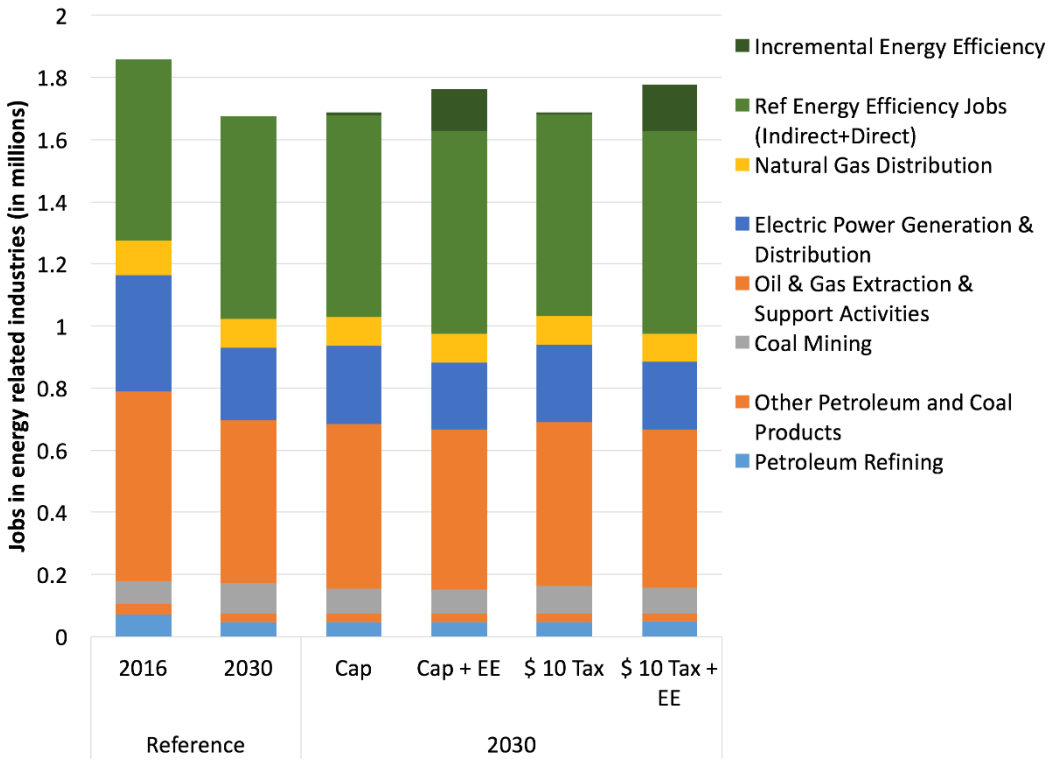


Conventional Energy Jobs are Shrinking

Jobs in the U.S. are forecast to continue to grow, especially service sectors:



Conventional energy jobs are forecast to shrink, but jobs In the new energy economy will grow:

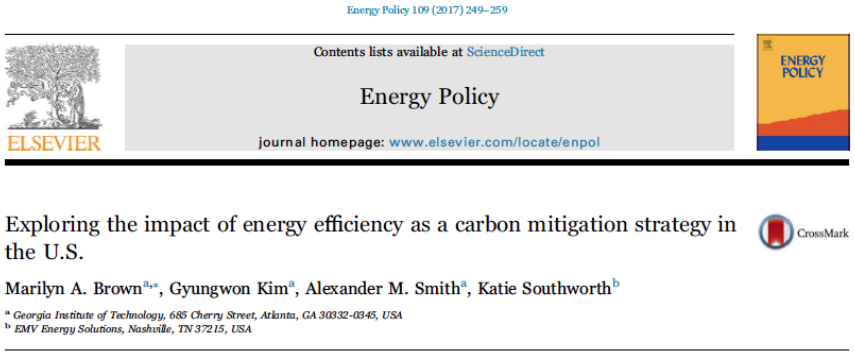


Source: GT-NEMS modeling results

Co-optimizing demand- and supply-side resources can cut carbon and save money

Smart climate policies are needed:

- Carbon caps: "Clean Power Plan"
- Carbon taxes: "Carbon Dividends Plan"
  - redistribute taxes on a per capita basis vs
  - redistribute per source of CO_2.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Exploring the impact of energy efficiency as a carbon mitigation strategy in the U.S.

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Cumulative policy costs in 2015-2030 per cumulative tons of CO_2 avoided

Climate Policy:	Cost per ton of CO_2 Reduction
Carbon Cap	$39.13
Carbon Cap + EE	-$26.30
$10 Carbon Tax	$8.11
$10 Carbon Tax + EE	-$28.63

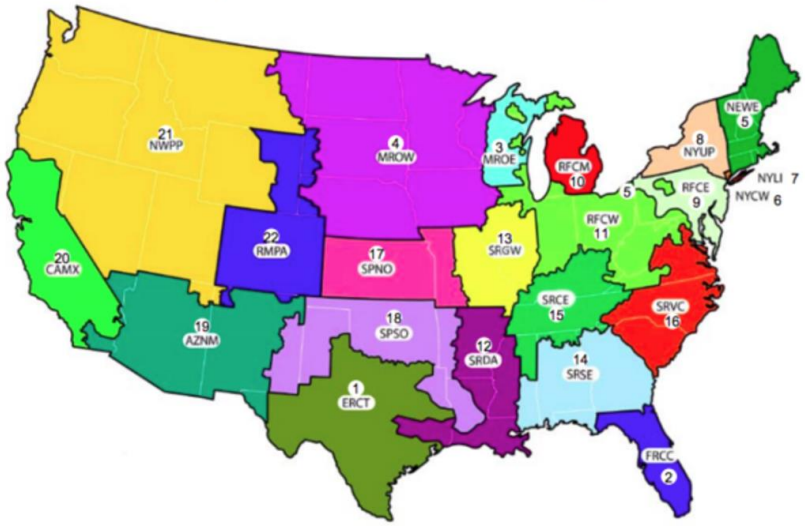
Cost of climate policy = utility resource costs + EE costs + administrative costs – carbon tax recycling (in $2013)

Winners and Losers

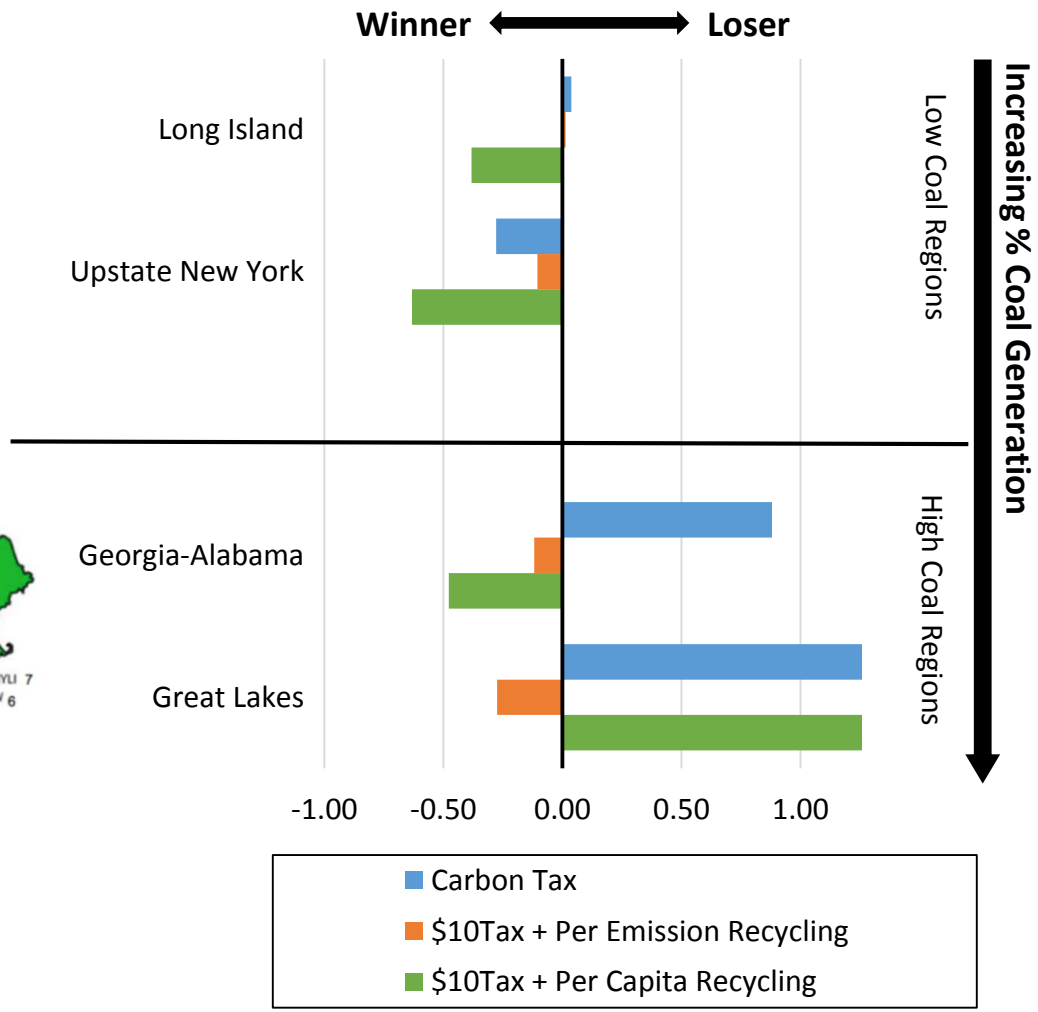
Policy design matters!

- How carbon tax revenues are recycled creates different regional winners and losers.

Electricity Market Module Regions



Cost of Climate Policy in 2030*



*Net present value (in $2013) using a 7% discounte rate

Conclusions

The clean power transformation can grow the economy, create jobs with livable wages, improve human health, and protect the environment.

A great deal is at stake, and policy design matters.

Winners and losers are inevitable at all geographic scales.

Blending the engineering and natural sciences with economics, social sciences, and policy analysis can reveal new possibilities and avoid undesirable futures.

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