RESOURCES *for the* FUTURE

Environmental, Distributional, and Fiscal Impacts of the Inflation Reduction Act and Further Policy in the Electricity Sector

Dallas Burtraw, Maya Domeshek, Karen Palmer, Nick Roy, Jhih-Shyang Shih

National Tax Association Spring Symposium: Energy Session

May 12, 2023

This research was supported by the Environmental Defense Fund and RFF's Comprehensive Climate Strategies and Electric Power Programs

Summary

- The Biden administration climate policy involves substantial **subsidies** (Bipartisan Infrastructure Law, Inflation Reduction Act) and EPA **regulations** (MATS, Good Neighbor Rule, Coal Combustion Residuals, and GHG Rule).

- How does this compare with **carbon pricing**? How well does it achieve the climate goals?

Main takeaways

1. The Inflation Reduction Act (IRA) has higher resources costs but is progressive in its cost shift from ratepayers to taxpayers

2. Net benefits swamp the difference in costs of alternative approaches

3. The IRA gets over half the way to achieving Biden's climate goal for the electricity sector in 2030

4. The IRA lowers the marginal cost (carbon price) necessary to achieve the remaining emissions reductions by 2030

Introduction: Subsidies versus Prices

- The IRA uses subsidies to motivate and unleash private capital
- Subsidies are not expected to be as cost effective as carbon pricing:
  - Subsidies suppress the change in product price
  - The IRA fails to operate on the coal versus gas margin
  - One-size-fits-all subsidies fail to distinguish “additional” investments in renewables versus ones that would have occurred “anyway”

Introduction: Three Policy Comparisons (2030)

Biden's climate goal for the electricity sector (to meet our Paris commitment) is 80% emissions reduction by 2030. (Termed: **80x30**)

We examine three policy comparisons to the IRA:

1. Incremental carbon pricing to achieve 80x30, given the IRA
2. Carbon pricing to achieve 80x30, without the IRA
3. Also, the carbon price that would have achieved IRA outcomes

Scenarios

- Baseline
- IRA
- Cap that mimics the IRA
- IRA + 80x30 Cap
- 80x30 Cap

Sensitivities

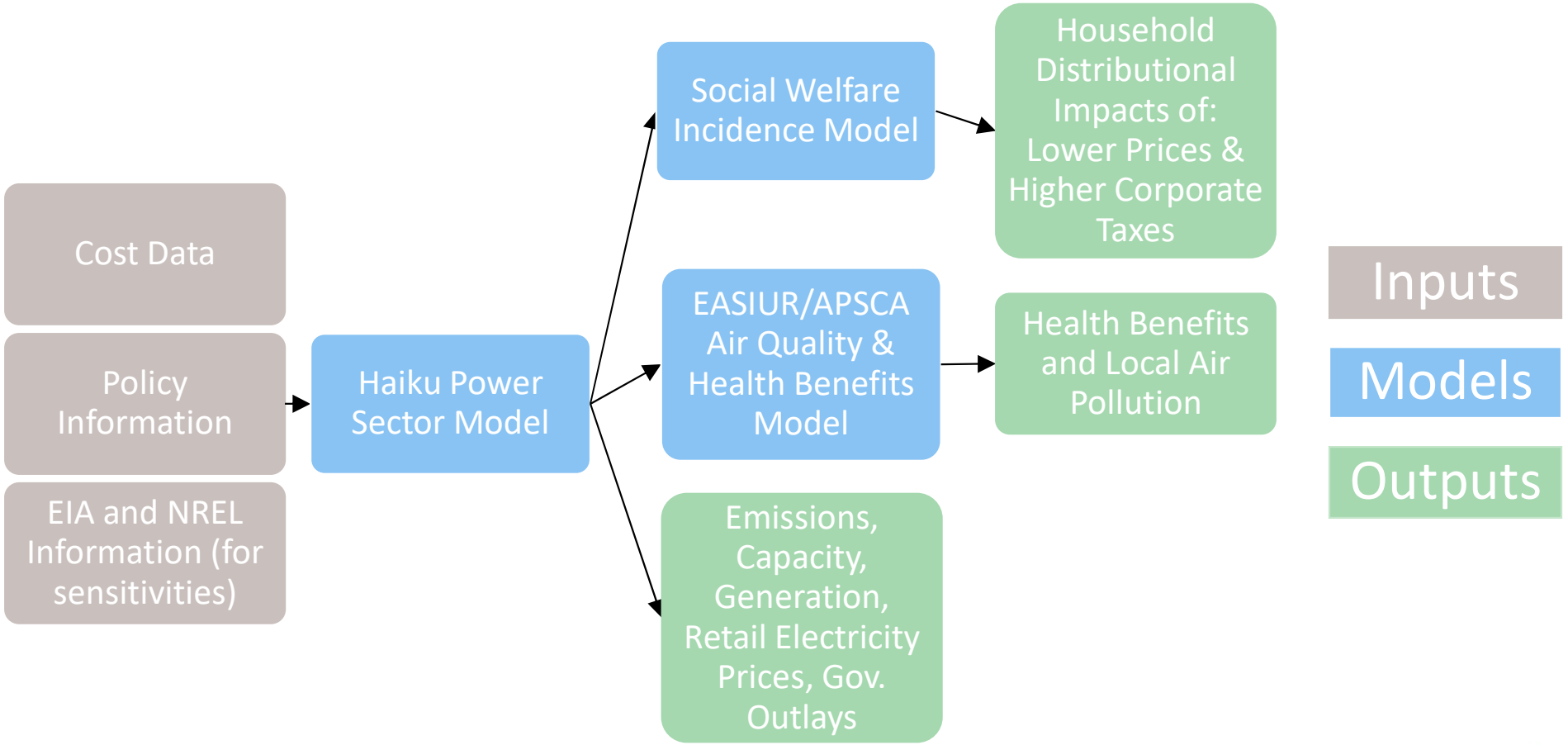
- Central Case
- Secular
  - High NG Prices
  - Low NG Prices
- Policy Driven
  - High Demand
  - Cofiring Regulation (proxy for 111d rules)

Climate-Related Features of the IRA

(We model ones in blue)

1. Clean energy production/investment tax credits
   - Technology neutral, through 2032 or until sector emission < 25% of 2022 levels
   - 2.5 cents/kWh (PTC) or 30% (ITC); inflation adj. after 2025; 10% bonus: domestic content, "energy communities"
2. Carbon capture tax credit (45Q) for >75% capture (elec) or >50% (industry)
   - $85/ton in electricity sector, mapping to $85/MWh for coal, $40/MWh for gas (We model new units only.)
3. Zero-emissions, nuclear support
4. Hydrogen production/investment tax credits
5. Electric vehicles / heavy vehicles tax credit
6. Advanced manufacturing tax credit
7. Clean fuels
8. Energy efficiency for nonbusiness buildings
9. Methane emissions fee
10. Permitting reform; leasing on federal lands; EJ investments $60 billion

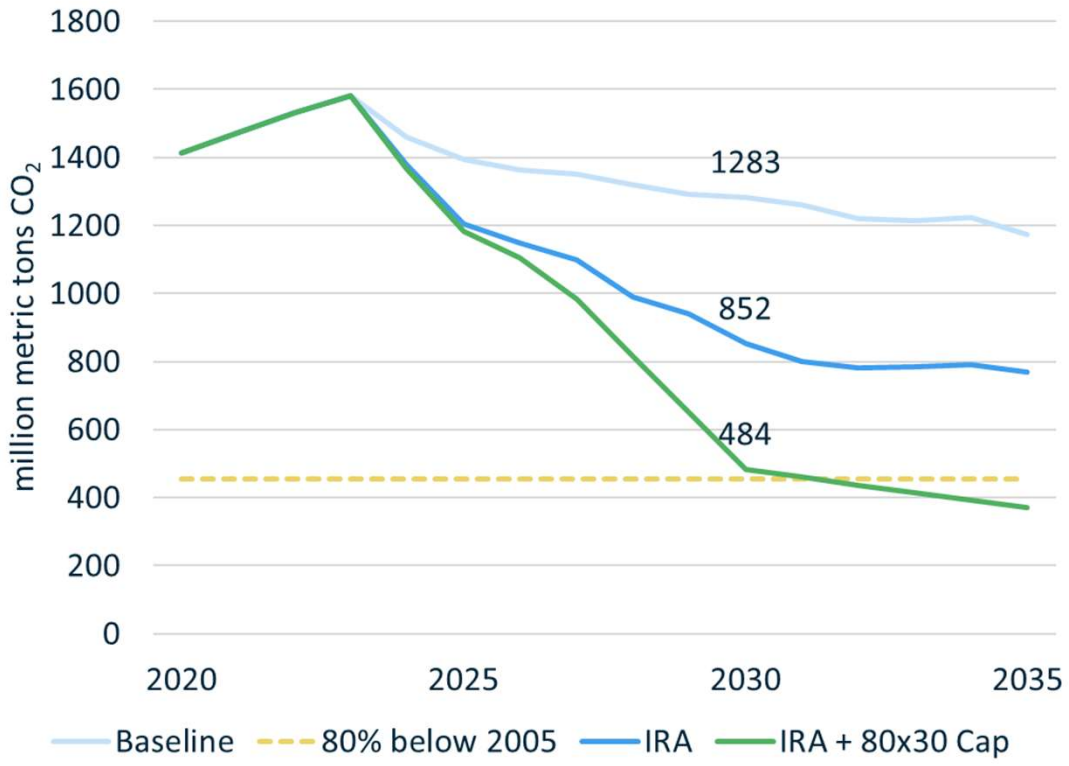
Multi-Model Analysis of Electricity Sector Provisions



RFF Analysis of Electricity Sector Provisions

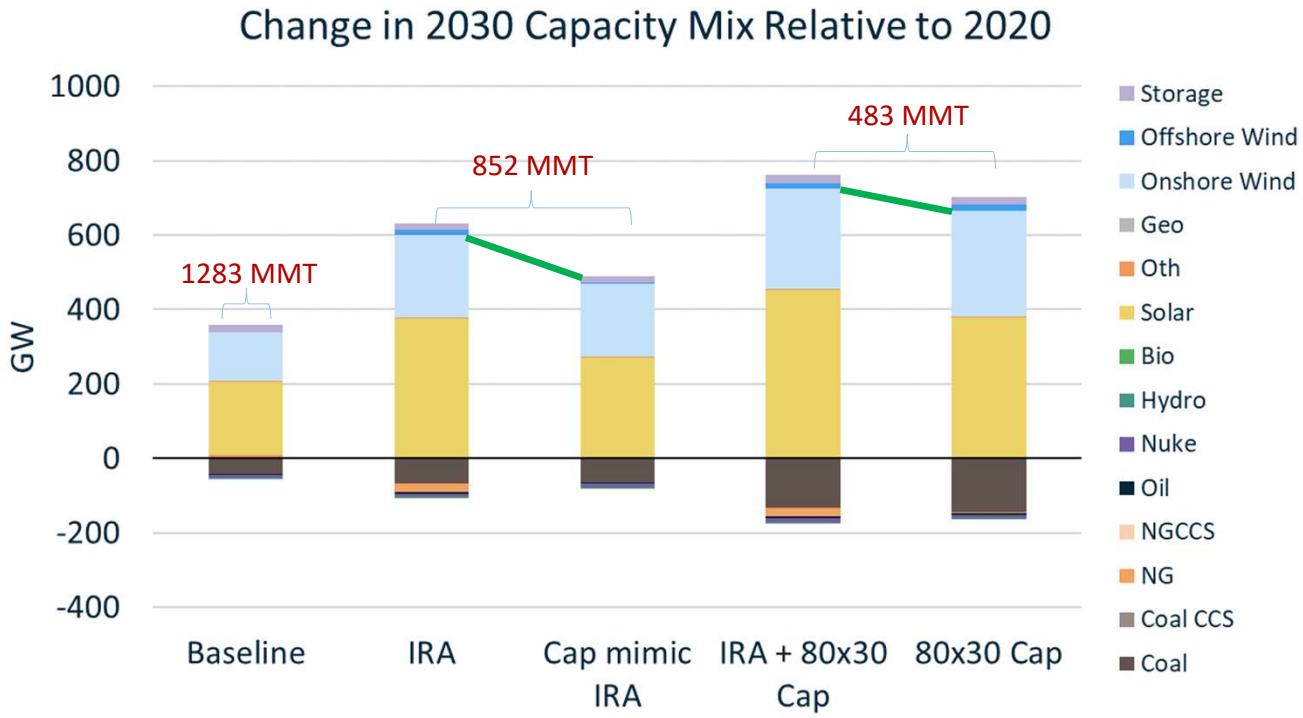
- Haiku electricity market model
  - Perfect foresight with 23-year horizon and 24 time-blocks per year
  - Solves at state level with inter-state transmission
  - "Optimistic" implementation meaning investments are driven by economic factors with substantial use of bonus credits and with modest siting constraints
- Carbon price scenarios modeled with a revenue-raising emissions cap, without banking. Revenue is recycled; government budgets are constant.
- All values in 2022$

The IRA gets the US electricity sector closer, but 369 million tons short, of its 2030 goal



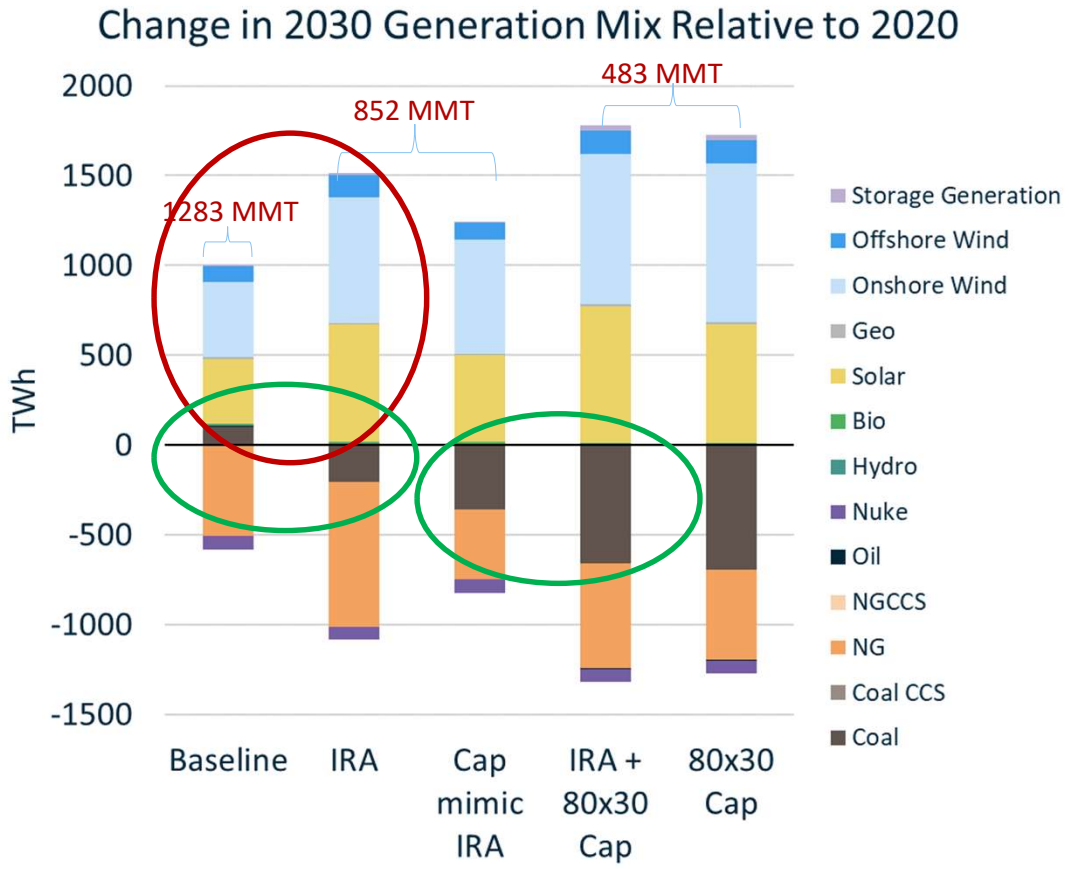
- Electricity sector emissions in 2005 for the contiguous US were 2280 million metric tons
- Electricity sector emissions are expected to continue to fall gradually even in the no-policy baseline
- …But the IRA accelerates emissions reductions

Capacity *Change* Relative to 2020



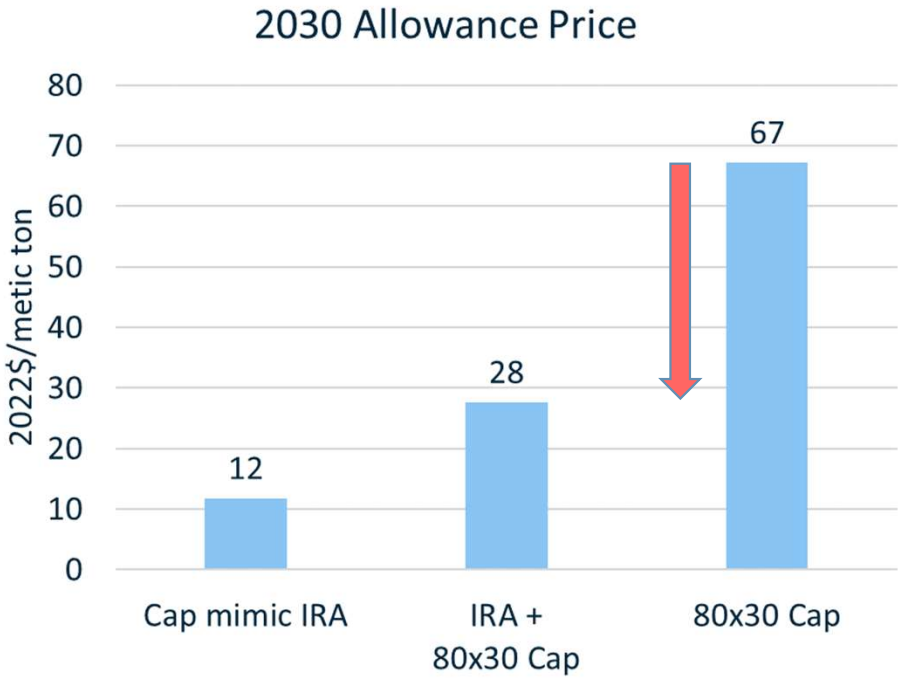
- For each emissions level, the IRA
  - leads to more renewable capacity
  - marginally more coal capacity and less gas capacity
- Only "planned" additions to natural gas capacity are built
- Compared to the IRA, meeting 80x30 means
  - net decrease in coal
  - more wind and solar
- Additional renewables infrastructure may put the US in a better position to meet longer term goals
  - 48% of the incremental renewable capacity built between 2023 and 2030 in the IRA scenario was also built in the Baseline
  - …but not until later!!

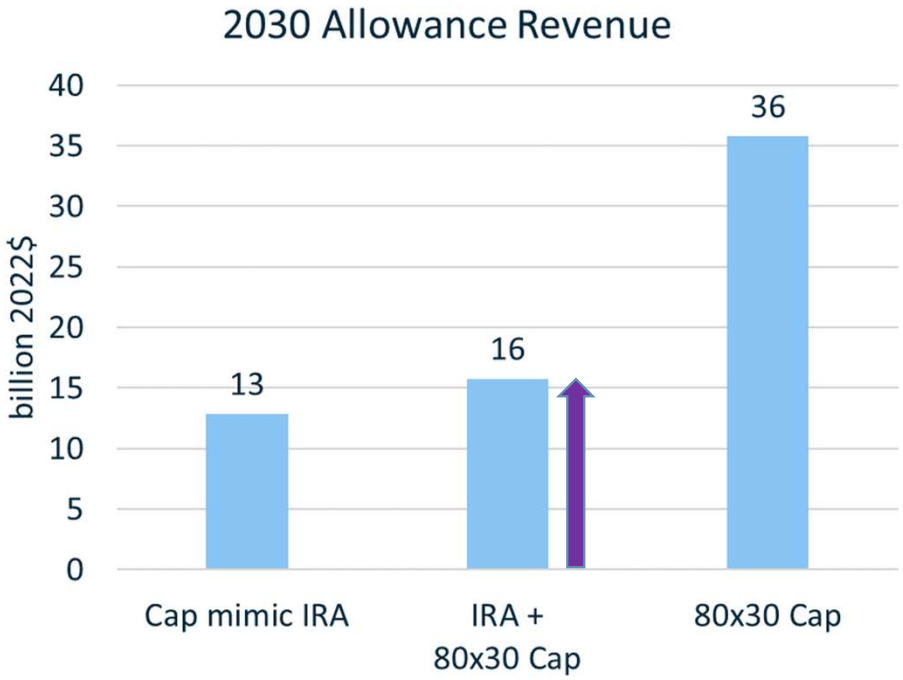
Generation *Change* Relative to 2020



- Substantial expansion in renewable generation is expected even in no-policy baseline compared to 2020
- … Hence, generous IRA subsidies likely yield inframarginal rents
  - ~$98 Billion “anyway” subsidies?
  - However, IRA scenarios have earlier emissions reductions and greater cumulative reductions due to early investments!
- Air quality benefits in IRA cases are reduced due to surviving coal

The US electricity sector can reach the 80x30 goal at lower marginal cost with the IRA than without the IRA





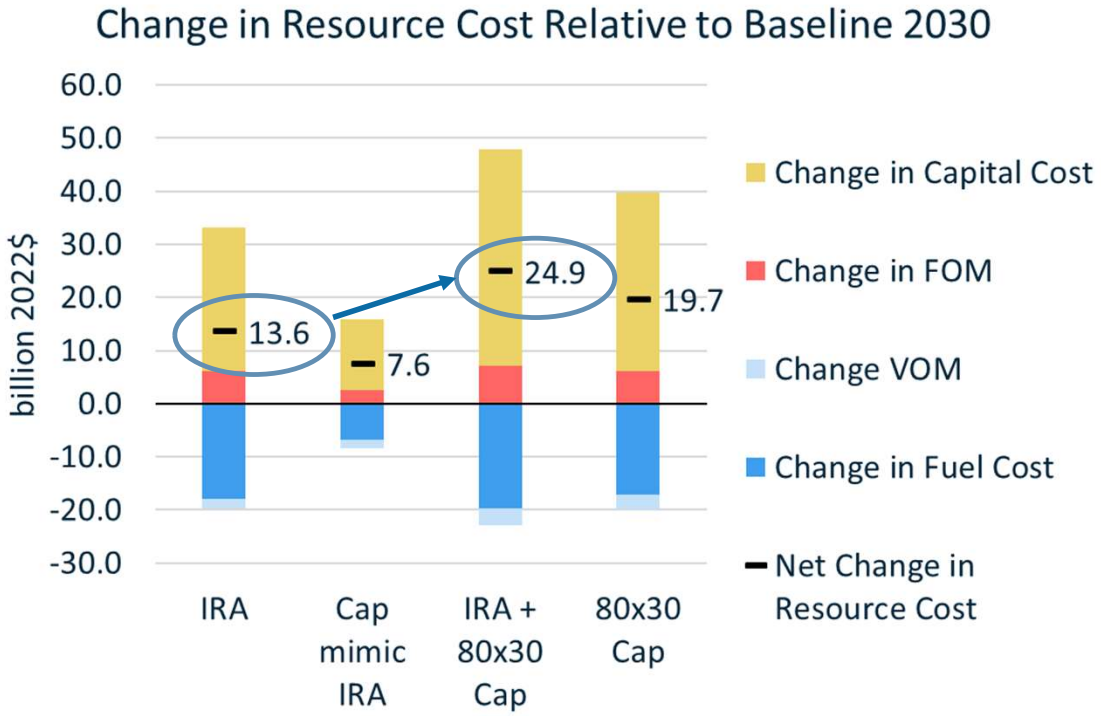
Bistline, Mehrotra, and Wolfram (2022) similarly find $12/ton *economywide* price in 2030 yields IRA emissions levels.

The 80x30 cap (carbon price) yields $16 billion in revenue.

Perspectives on Cost

- Resource Costs: Fuel Cost + Variable Operations and Maintenance + Fixed Operations and Maintenance + Capital Cost
- Fiscal Costs: PTC + ITC + 45Q – Carbon Revenue
- Rate Payer Costs: Retail Price * Consumption
- Social Costs (aggregate): Resource Cost + Health Benefits + Climate Benefits
- Social Cost (across income groups): Direct Household Rate Payer Costs + Indirect Electricity Expenditures + Generator Profits + Government Expenditures

The US electricity sector can meet the 80x30 target with modest additional resource costs relative to the IRA alone

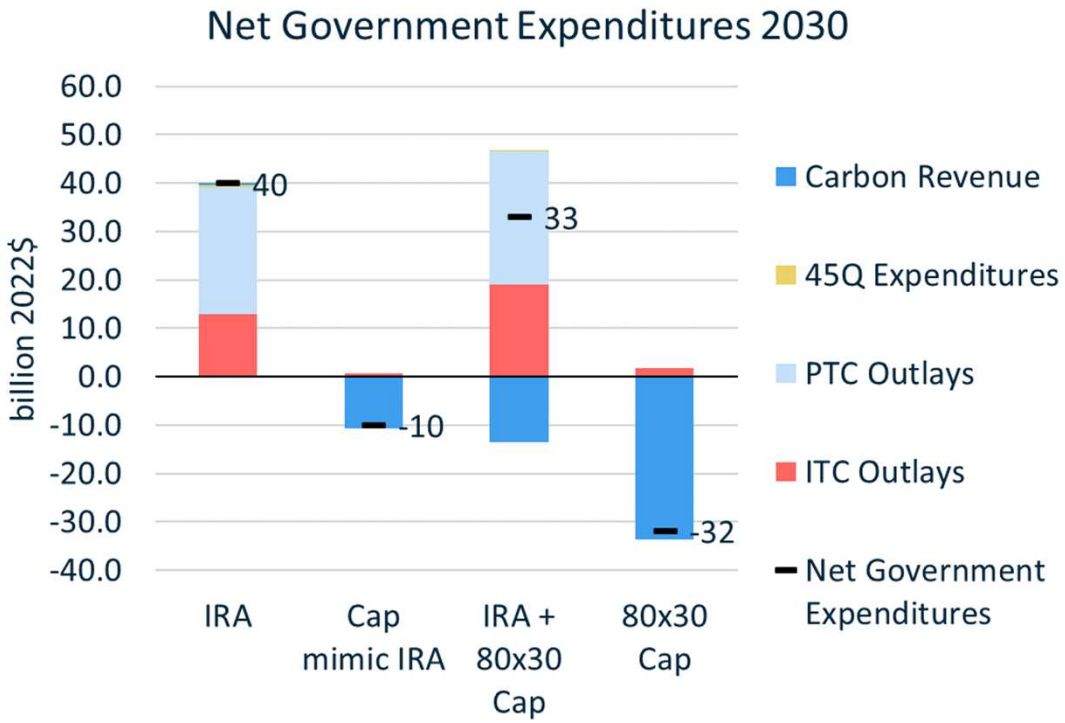


- Shifting towards renewables pushes resource costs to be more capital and less fuel intensive

National Average Retail Prices

- The no-policy baseline yields electricity prices about equal to 2020 levels
- The US can meet its 2030 goal (IRA + 80x30 Cap) without raising prices relative to baseline

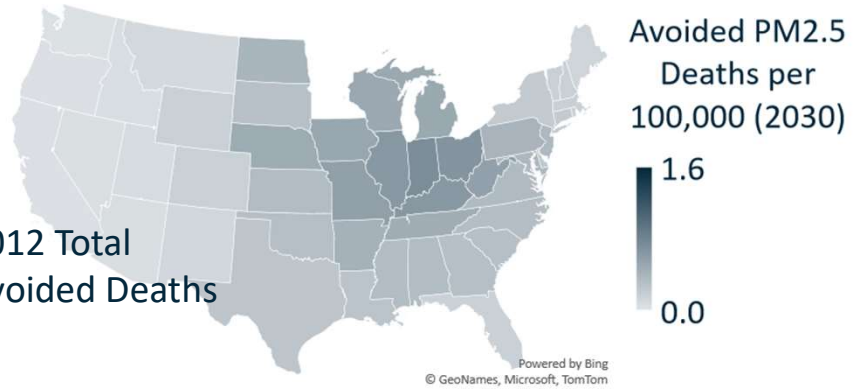
Fiscal Effects



- Cap mimics IRA raises $10.7B
- IRA + 80x30 cap:
  - Slightly more tax credit expenditures
  - A revenue raising cap more than offsets those *additional* costs
- Carbon pricing raises $33.6B
- Wide range of cumulative fiscal impacts of electricity incentives under the IRA:
  - CBO/JCT(2022): $174B in 2031
  - CBO/JCT(2023): $468B in 2031
  - Bistline (2023): $550B in 2035
  - Bistline (forthcoming): $235-$964B in 2031
  - RFF Haiku: $199B in 2030; $386B in 2035

- Greatest air quality health benefits accrue in the Midwest
- More coal survives under the IRA, lowering health benefits

IRA

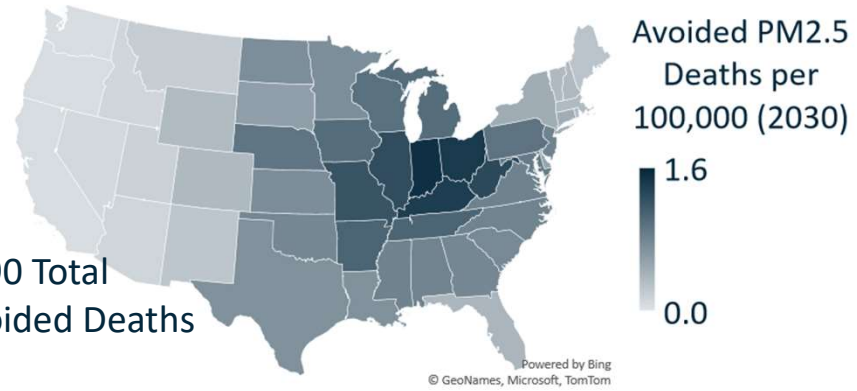


1012 Total Avoided Deaths

Cap mimic IRA

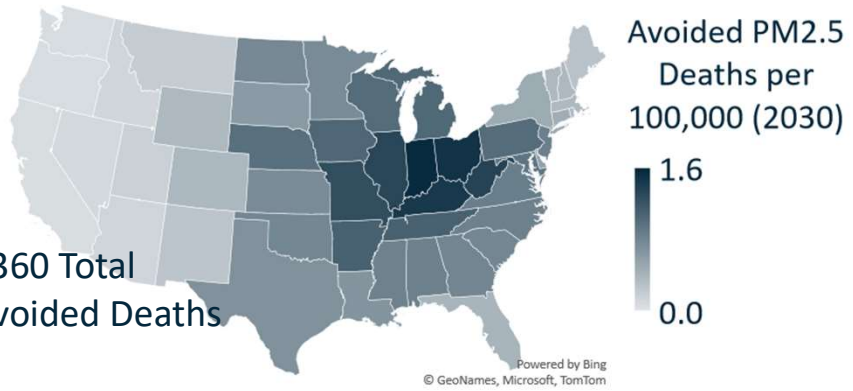
1355 Total Avoided Deaths

IRA + 80x30 Cap



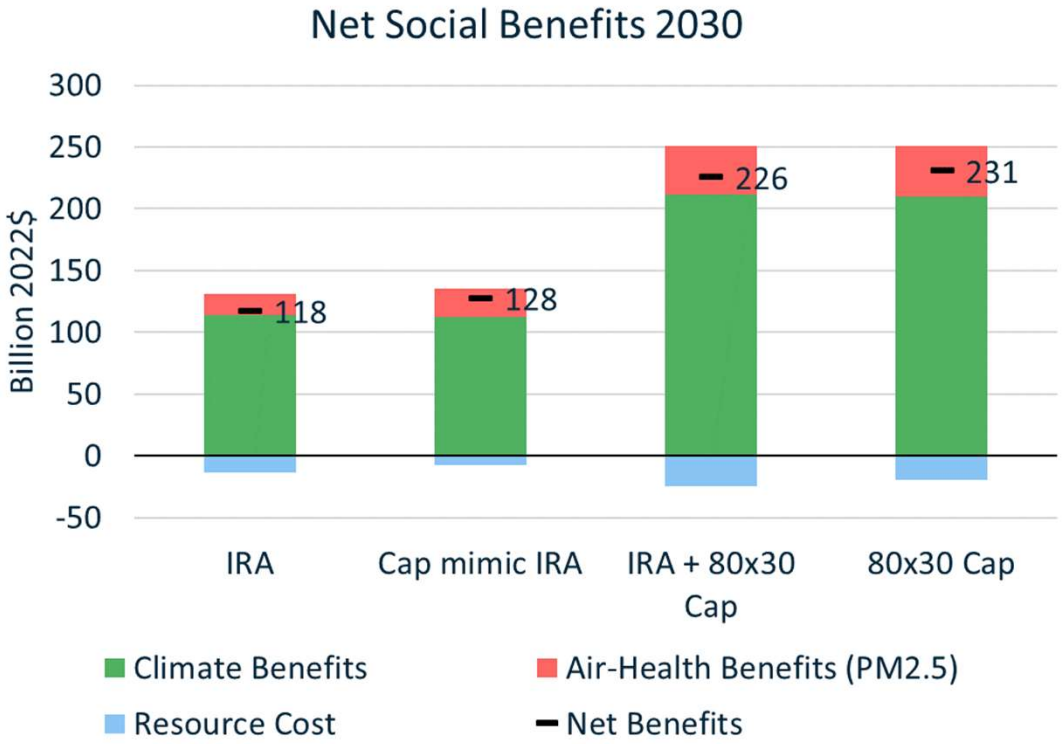
2290 Total Avoided Deaths

80x30 Cap



2360 Total Avoided Deaths

Reaching 80x30 nearly doubles net social benefits achieved by the IRA

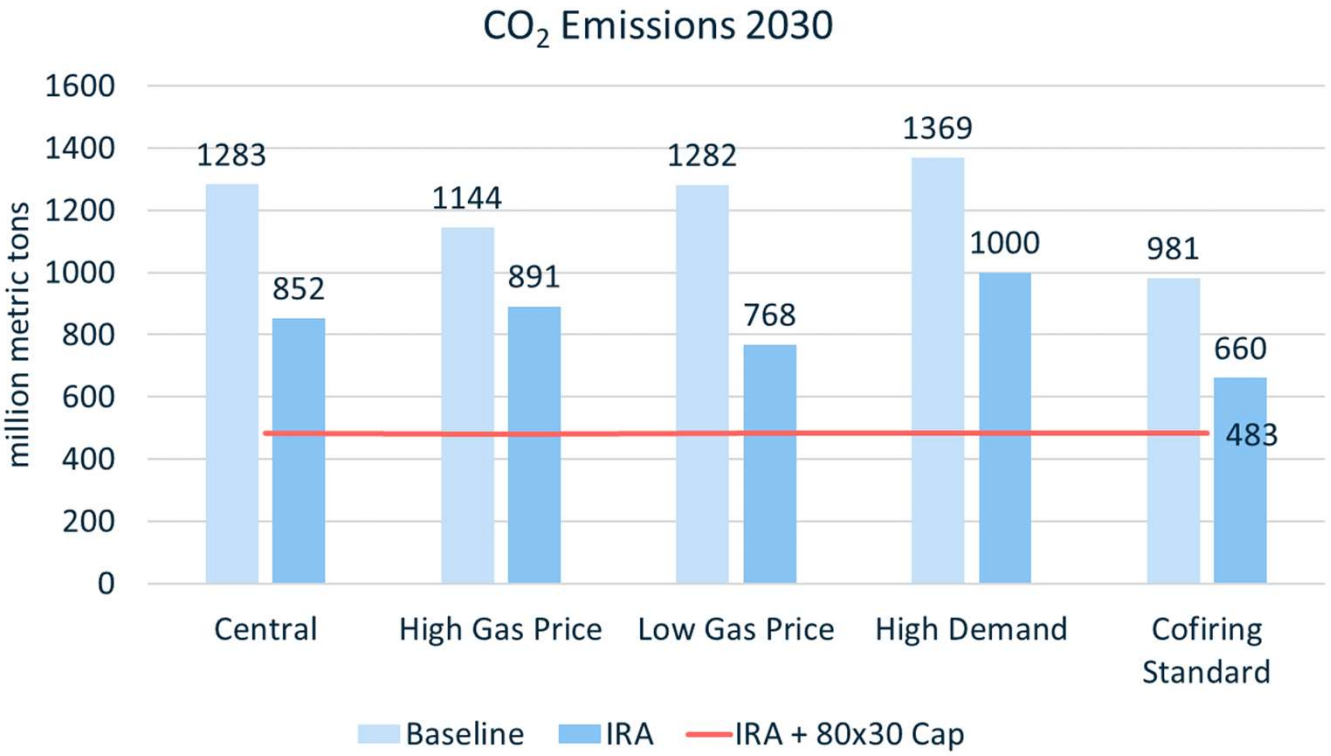


- Cap scenarios have slightly higher annual net benefits in 2030 due to greater reductions in SO_2 and NO_X from reduced coal generation
- The additional resource costs of reaching 80x30 are far smaller than the additional climate and health benefits
- Similar to Denholm et al. (NREL 2022) we find *health benefits alone* of 80x30 outweigh system costs independent of the IRA

Net Household Financial Impacts Compared to Baseline 2030

- Cost shift from ratepayers to taxpayers under the IRA is progressive in expenditure and revenue changes
- Progressivity is preserved in moving to 80x30
- Carbon price (cap alone) is regressive with budget neutral revenue recycling

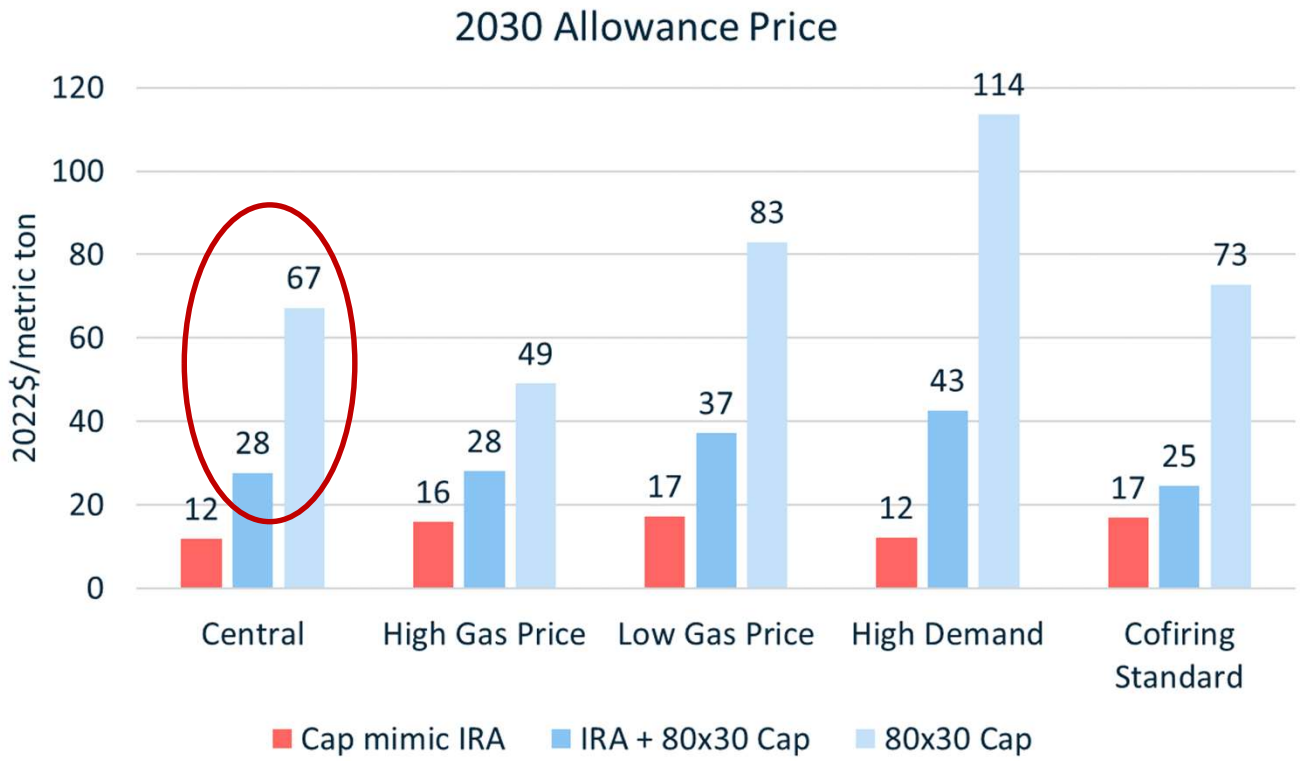
Across Sensitivities, the IRA gets the US electricity sector over halfway to the 80x30 goal but there is still some distance to go



Each sensitivity case is compared to its relevant no-policy baseline

- High demand incentivized under the IRA (i.e., EVs) may increase emissions
- A cofiring standard (proxy for EPA rules) closes the 80x30 gap by more than half
- High interest rates will reduce investments in renewables (Bistline Mehrotra and Wolfram 2023)

The US electricity sector can reach the 80x30 goal at lower marginal cost with the IRA than without the IRA



Summary

- The Biden administration climate policy involves substantial **subsidies** (Bipartisan Infrastructure Law, Inflation Reduction Act) and EPA **regulations** (MATS, Good Neighbor Rule, Coal Combustion Residuals, and GHG Rule).

- How does this compare with **carbon pricing**? How well does it achieve the climate goals?

Main takeaways

1. The Inflation Reduction Act (IRA) has higher resources costs but is progressive in its cost shift from ratepayers to taxpayers

2. Net benefits swamp the difference in costs of alternative approaches

3. The IRA gets over half the way to achieving Biden's climate goal for the electricity sector in 2030

4. The IRA lowers the marginal cost (carbon price) necessary to achieve the remaining emissions reductions by 2030

RESOURCES *for the* FUTURE

Thank you.

- Find out more about RFF online: www.rff.org
- Follow us on Twitter: @rff
- Subscribe to receive updates: rff.org/subscribe

Background and additional analysis

Useful References

- King, Ben, Hannah Kolus, Naveen Dasari, Michael Gaffney, Anna van Brummen and John Larsen. 2023. Pathways to Paris: Post-IRA Policy Action to Drive US Decarbonization, Rohdium Group Note, https://rhg.com/research/ira-us-climate-policy-2030/

- Denholm, Paul, Patrick Brown, Wesley Cole, et al. 2022. Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035. Golden, CO: National Renewable Energy Laboratory. NREL/TP6A40-81644. https://www.nrel.gov/docs/fy22osti/81644.pdf

- Bistline, John, Neil Mehrotra, Catherine Wolfram 2023. Economic Implications of the Climate Provisions of the Inflation Reduction Act, *Brookings Papers on Economic Activity.*

- Bistline, J. et al., "Emissions and energy impacts of the Inflation Reduction Act," *forthcoming*

- Bistline, J. et al. "Power Sector Impacts of the Inflation Reduction Act of 2022," *under review*

Climate-Related Features of the IRA (We model ones in blue)

1. Clean energy production/investment tax credits
   - Technology neutral, through 2032 or until sector emission < 25% of 2022 levels
   - 2.5 cents/kWh (PTC) or 30% (ITC), inflation adjusted after 2025
   - 10% bonus for domestic content; 10% bonus in "energy communities"
2. Carbon capture tax credit (45Q) for >75% capture (elec) or >50% (industry)
   - $85/ton in electricity sector, mapping to $85/MWh for coal, $40/MWh for gas (We model the credit for new units only.)
3. Zero-emissions, nuclear support
4. Hydrogen production/investment tax credits
   - "Clean" hydrogen <4 kg CO2e per kg
   - $3.60 per kg times cleanliness factor (20-100% range)
5. Electric vehicles / heavy vehicles tax credit
   - Up to $7,500 for low/moderate income with final assembly in No. America
   - 30% credit for new clean commercial EVs; $1 billion for heavy duty

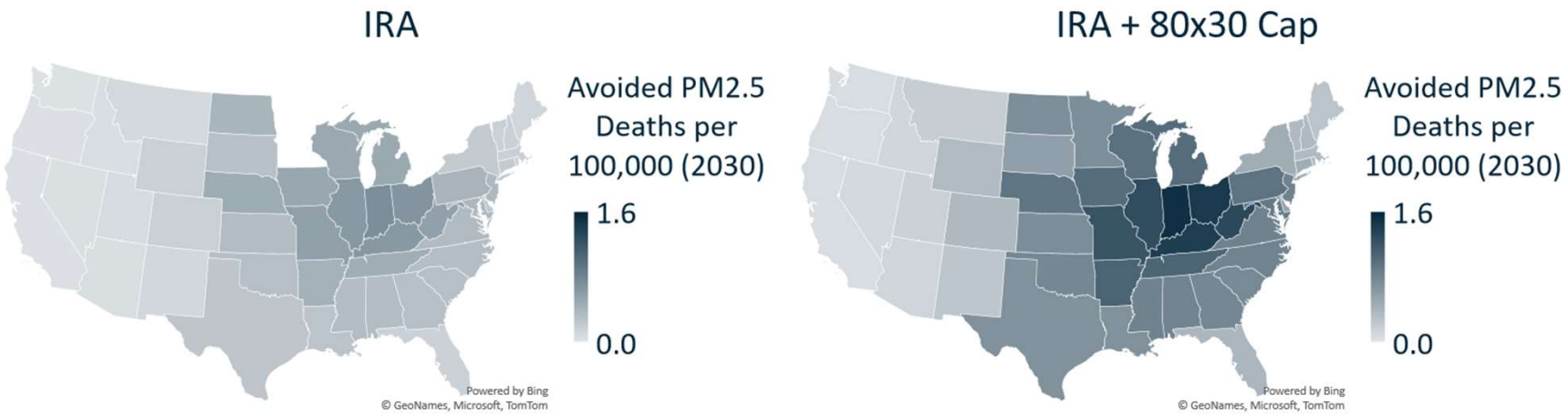
Features of the IRA (2)

5. Advanced manufacturing tax credit
   – Retool to reduce emissions >20%
6. Clean fuels
   – $1/gallon excise tax credit for biodiesel
   – $1.25/gallon for aviation fuels <50%; plus $0.01 gallon for each additional % point
8. Energy efficiency for nonbusiness buildings
9. Methane emissions fee
   – $1,500/ton for production leaks > 0.2% or 0.11/ton from transmission
10. Permitting reform; required offer of leasing on federal lands
    Environmental justice investments $60 billion

Introduction: Environmental and Economic Impacts

- Nonetheless, the IRA is the most important environmental law since 1970
- We investigate the IRA performance:
  - Emissions changes (CO_2 and conventional air pollutants SO_2 and NO_X)
  - (Average) cost per ton CO_2 reduced
  - Investments and generation mix
  - Price impact for consumers (under the *"Inflation Reduction Act"*)
  - Fiscal impacts
  - Distribution of benefits and costs across income groups
  - Air quality and public health outcomes

Reaching the 80x30 target reduces PM2.5 mortality above and beyond the reductions from the IRA



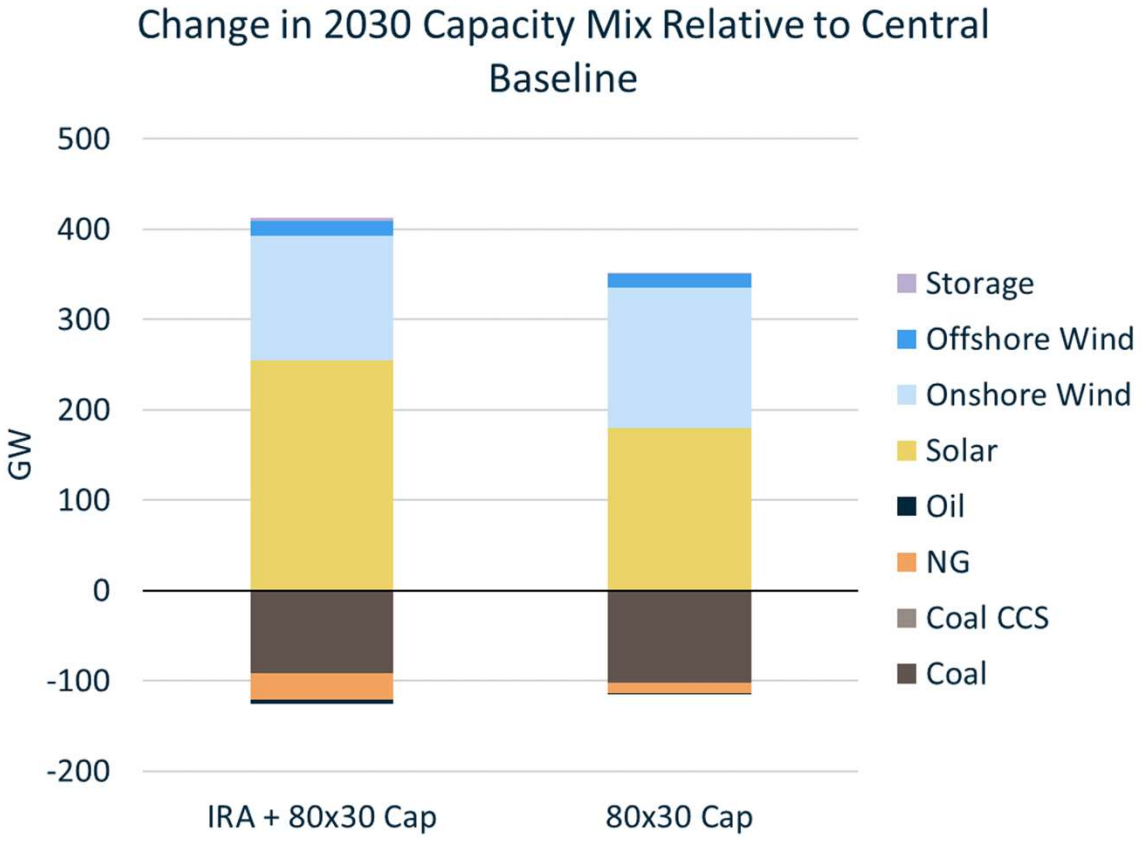
Introduction: Main Take-Aways

- The IRA gets the US power sector halfway to 80x30 relative to a no-policy baseline by 2030.
  - In order to get all the way to 80x30, the country must nearly eliminate coal generation, and increase renewable generation slightly above the levels obtained by the IRA subsidy
- The IRA's cost shift from ratepayers to taxpayers lowered consumer costs importantly. The IRA has progressive effects on household energy costs and tax burdens
- The IRA makes it possible to achieve 80x30 with an incremental $28 per metric ton carbon price in 2030, compared to $67 if the IRA were not in place. IRA + 80x30 Cap yields:
  - Additional uptake of tax credits and renewable investments
  - Retail prices remain below baseline levels
  - On net, reduces about one-fifth of the fiscal cost of the IRA (alone) in 2030.
- Annual and cumulative resource costs are lower in the 80x30 Cap than IRA+80x30 Cap.
- Meeting 80x30 goals with the IRA in place yields a generation mix with more renewables and less gas than with a carbon price alone. This may position the sector well for further emissions reductions.

Introduction: Sensitivities

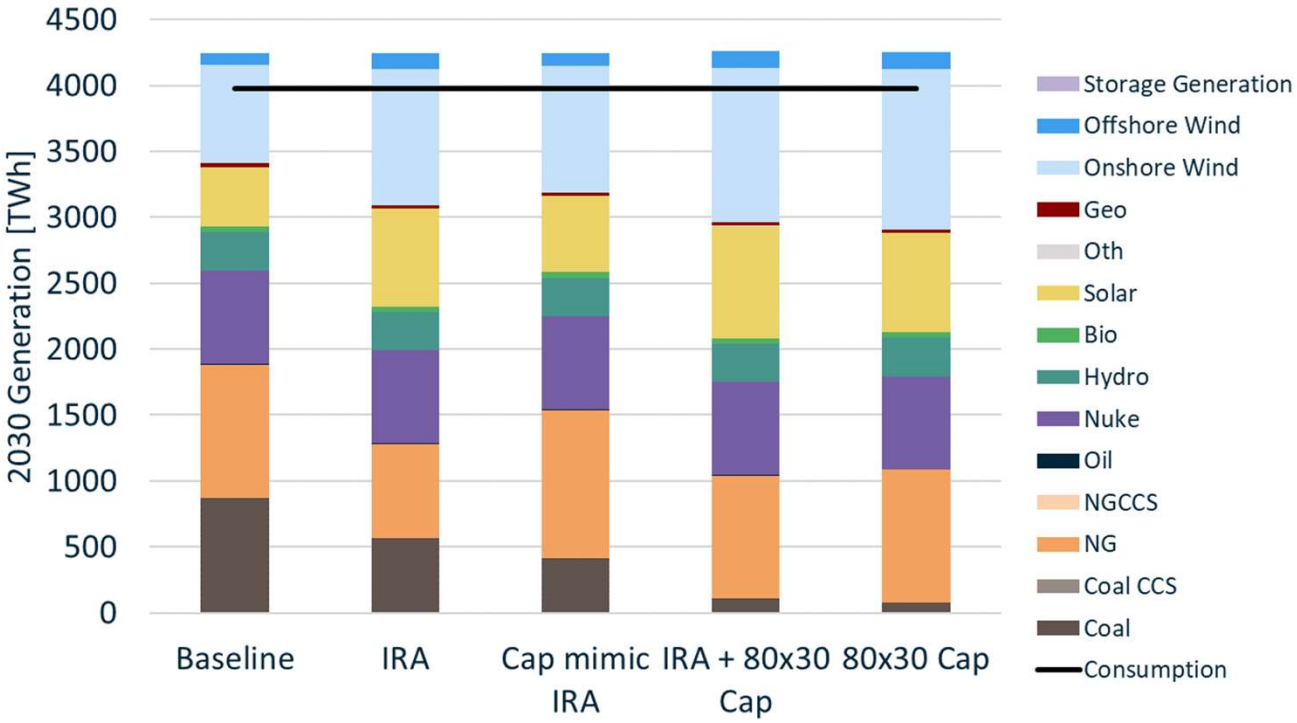
- Under the IRA alone, high gas prices yield high emissions (more coal generation) and low gas prices yield low emissions
- High natural gas prices create more room for coal and (with the IRA in place) require a higher carbon price $28/ton to achieve 80x30
- High electricity demand requires the greatest reduction in coal and the largest growth in renewables to reach 80x30
- Coincident implementation of a cofiring standard (as a proxy for possible EPA 111d rules) has the lowest allowance price in achieving 80x30
- Under various scenarios, the IRA reduces volatility in electricity prices in response to alternative natural gas price scenarios
- Across all sensitivities, the IRA holds consumers harmless from the retail price impacts of an 80x30 goal

Two Pathways to Meeting the 80x30 Target



- The IRA + Cap results in more renewable capacity, and lower reductions in coal
- Additional renewables infrastructure may put the US in a better position to meet longer term goals
- …But air quality benefits in 2030 are reduced due to surviving coal

Generation Mix Across Scenarios

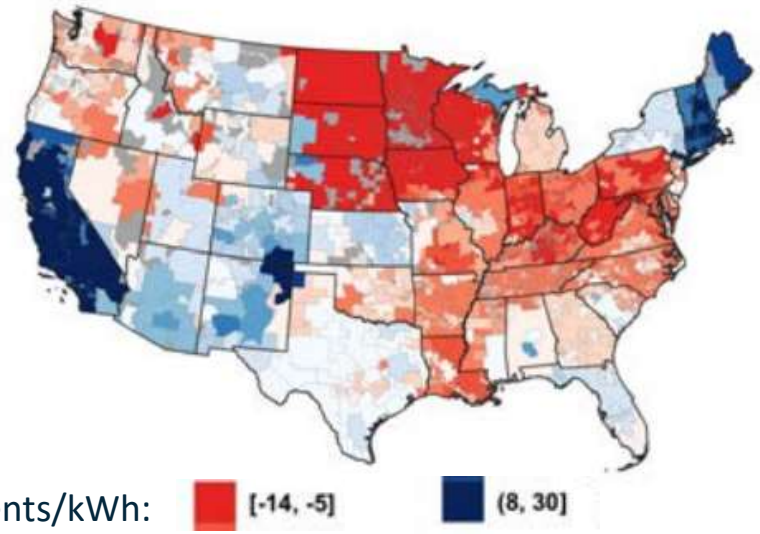


- The IRA has more wind and solar and it reduces gas more than coal than would a cap policy.
- The presence of the IRA yields more renewables and less gas than each comparable cap
- The IRA + Cap yields additional renewables and gas, and less coal than the IRA alone
- The Cap alone has less coal and renewables, and more gas, than IRA + Cap

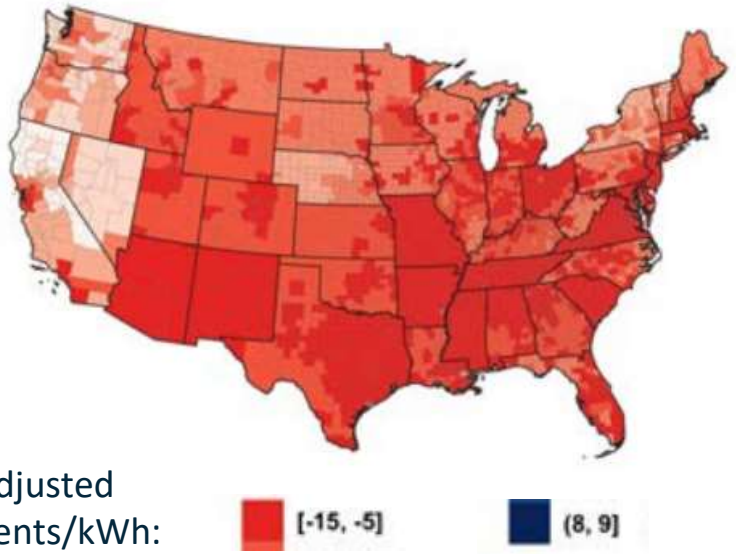
Pricing Paradox

The energy transformation is expected to increase electricity consumption by 70-150%

Electricity Price minus SMC



Gasoline Price minus SMC



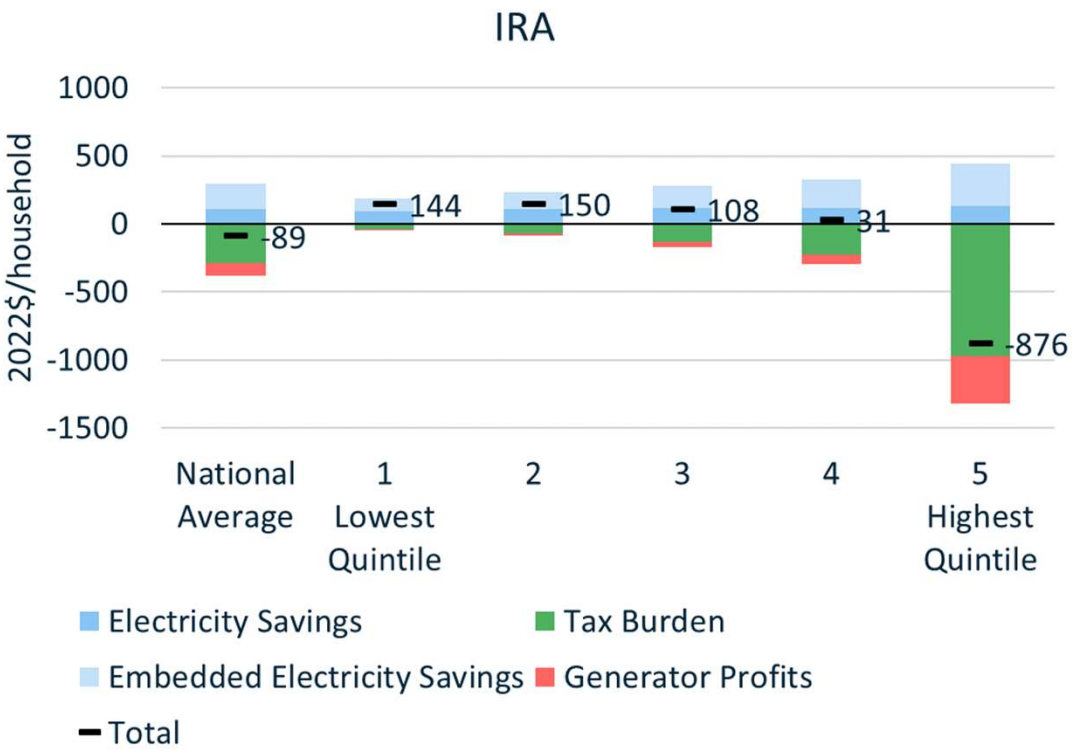
Prices of electricity and gasoline relative to their social marginal cost at \$100/ton CO_2

Borenstein and Bushnell *Headwinds and Tailwinds* 2021

Financial Impact on Households

- Electricity savings:
  - Proportional to electricity expenditure
- Savings on other goods and services (embedded electricity cost) :
  - Proportional to expenditures on other goods and services
- Generator profits:
  - Proportional to household capital income (10% of which is foreign held)
- Tax burden:
  - Proportional to corporate income tax burden: 75% on capital income (10% of which is foreign held) and 25% on labor income

Net household financial impacts are progressive



- Electricity costs are a greater share of low-income household budgets
- Indirect electricity price changes pass through changes in product prices
- Corporate income tax falls 75% on (higher income) owners of capital
- Excess burden of corporate income tax may be offset by efficiency gain from expanded electricity use
- 10% of equity is foreign held
- Changes in generator profits accrue to owners of capital

“Anyway” Subsidies?

	Baseline Incremental 2030-2023	Policy Incremental 2030-2023	Additional Incremental	Additional Share of Incremental
Wind and Solar Capacity [GW]	259	540	282	52%
Cumulative ITC/PTC [Billion 2022$]	28	216	(216-28)*0.52 = 98	

Cumulative Costs (2022$)

Cumulative [2024-2030]		IRA	Cap mimic IRA	IRA + 80x30 Cap	80x30 Cap
Resource Cost	billion $	60	37	84	58
	$/metric ton	32	20	29	22
Electricity Expenditure	billion $	-193	64	-149	103
	$/metric ton	-104	35	-52	40
Government Cost	billion $	191	-61	185	-66
	$/metric ton	104	-34	64	-25
CO2 Emissions Reduction	million metric tons	1847	1830	2872	2596

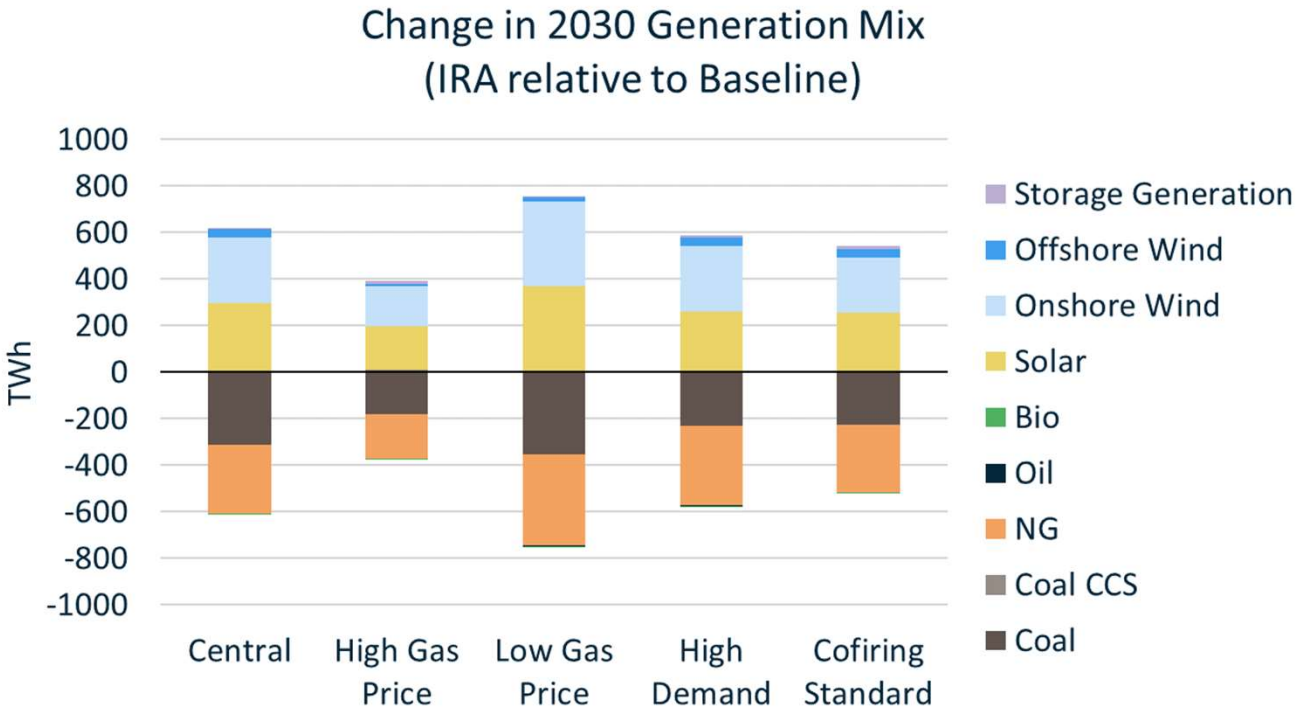
- For a given level of emissions, the IRA scenarios have higher resource costs, higher government costs, and lower electricity expenditures
- IRA scenarios have greater cumulative emissions reductions due to early investments

Annual Costs (2022$)

2030 Annual		IRA	Cap mimic IRA	IRA + 80x30 Cap	80x30 Cap
Resource Cost	billion $	14	8	25	20
	$/metric ton	32	18	31	25
Electricity Expenditure	billion $	-37	14	-14	55
	$/metric ton	-87	34	-18	69
Government Cost	billion $	40	-10	33	-32
	$/metric ton	93	-23	41	-40
CO2 Emissions Reduction	million metric tons	430	424	799	794

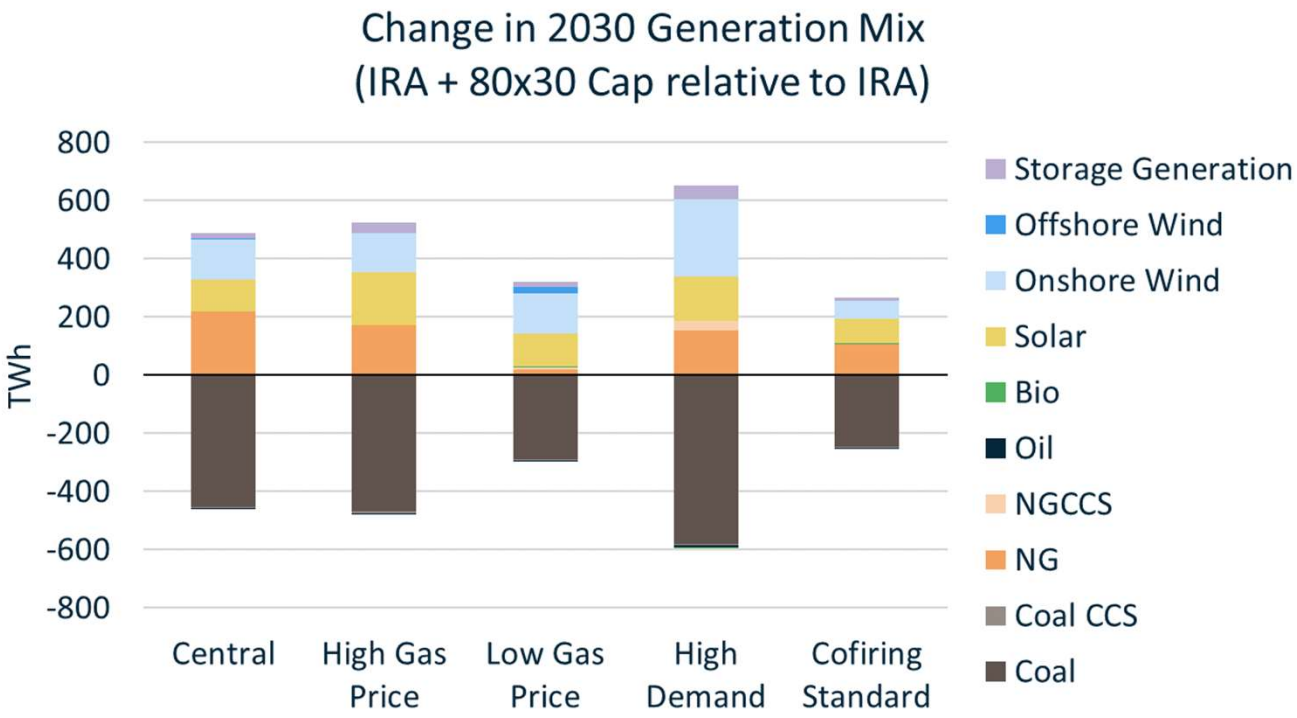
- Electricity expenditures are slightly higher in the IRA + Cap scenario than they were in the IRA scenario, but still lower than baseline
- Government is able to offset some of its expenditures on renewable subsidies with revenue from the carbon cap

Across Sensitivities, the IRA leads to more renewable generation and less coal and gas generation.



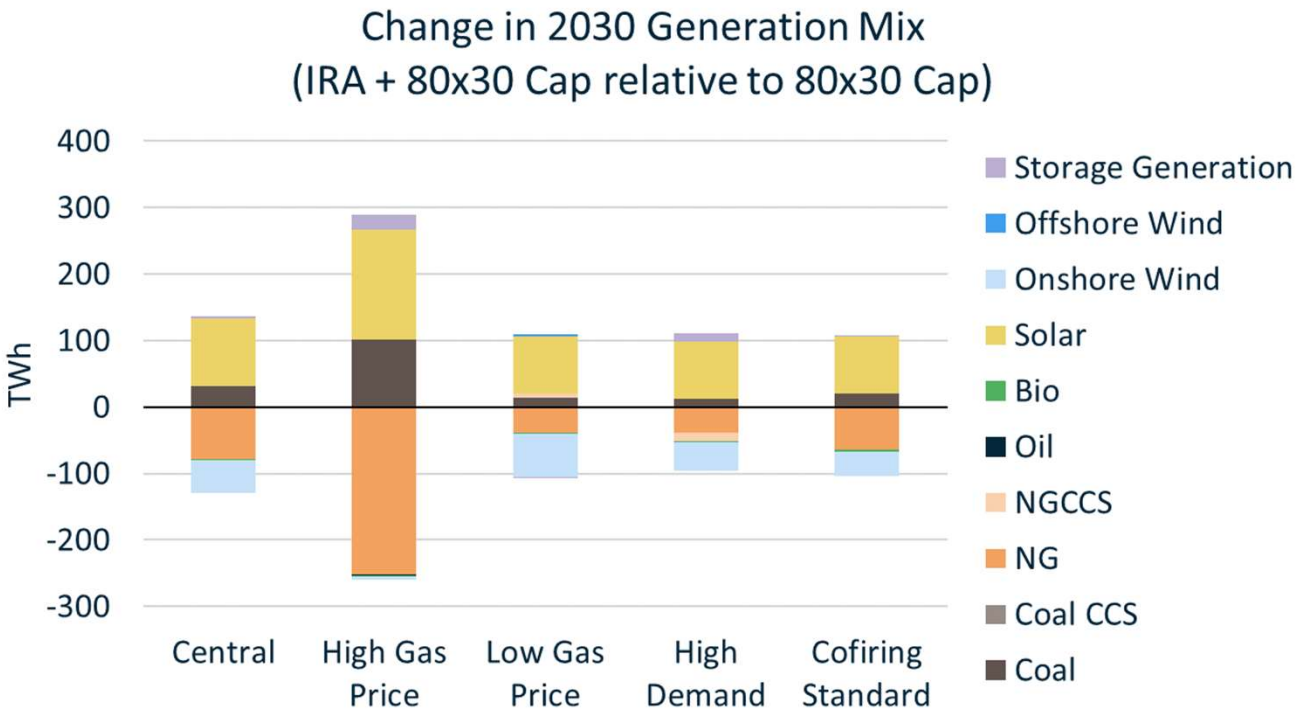
- Each sensitivity case is compared to its relevant no-policy baseline

With the IRA in place, to reach 80x30 the US needs to reduce coal generation and generate more with renewables and gas



- The High Demand case requires the largest reduction in coal generation and the largest growth in renewables to reach the target.
- In the Low Gas Price case, coal is already reduced
- The Cofiring Standard case (used as a proxy for EPA regulation) requires the least additional effort.

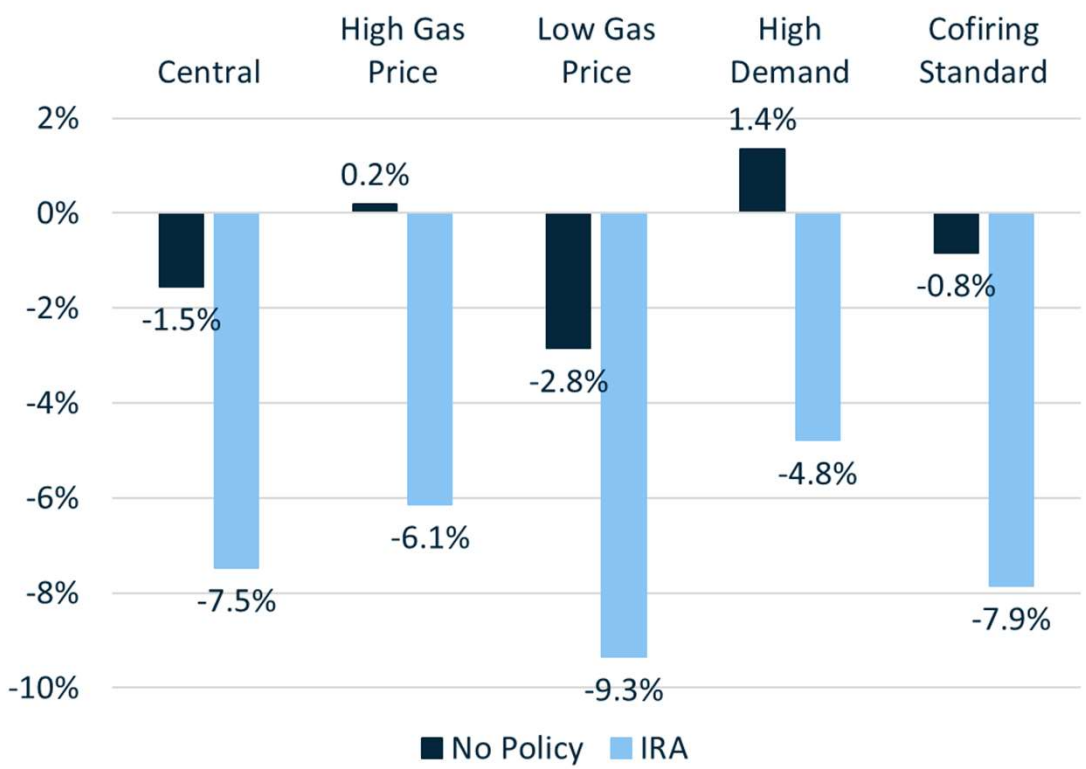
Achieving the 80x30 targets with the IRA + Cap rather than a cap alone results in more solar and coal generation, and less gas generation



The IRA + Cap consistently has more coal and less gas than the Cap alone

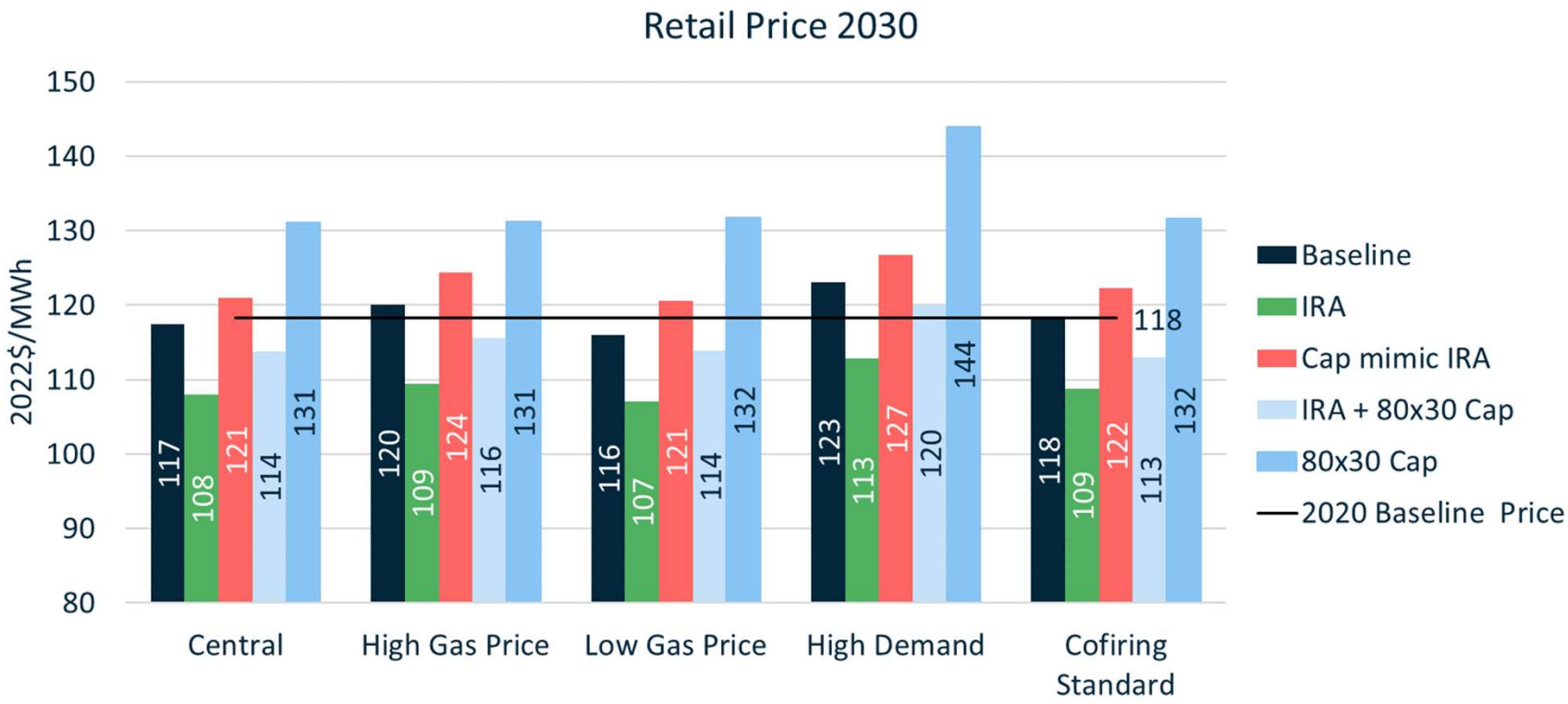
High gas prices create more room for coal generation under the cap

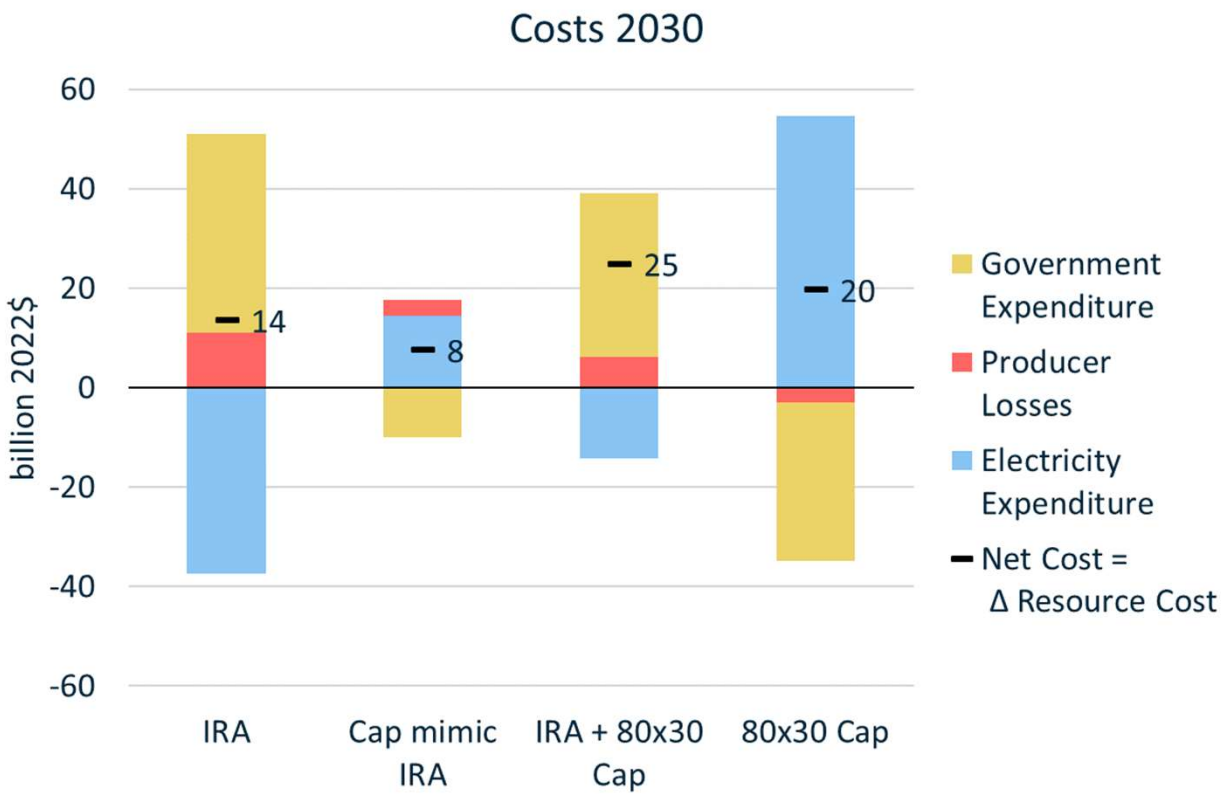
Percent Change Relative to 2022 Levels of Retail Electricity Price (average 2023-2032)



- Prices fall 4.8-9.3% over the next decade
- The cost shift from ratepayers to taxpayers is likely to be efficiency enhancing (Borenstein and Bushnell; Borenstein, Fowlie, Salee)
- Reducing electricity prices encourages additional electrification
- Volatility in electricity prices is reduced & decoupled from natural gas prices

Across all sensitivities, the IRA holds consumers harmless from the retail price impacts of a cap that pushes the electricity sector to the 80x30 goal





Policies shift revenue between government, producers, and consumers while also changing the makeup of the electricity sector.

If we ignore foreign ownership of capital, then each climate policy scenario changes net cost only due to the change in resource costs.

Across Sensitivities, Climate and Air Quality Benefits of the IRA far outweigh changes in resource costs