



Clean Energy Market Trends: Status and Trends in the Voluntary Market & IRA Impacts

Jenny Sumner

Advancing Towards 100% Clean Energy: A
State-Federal Summit

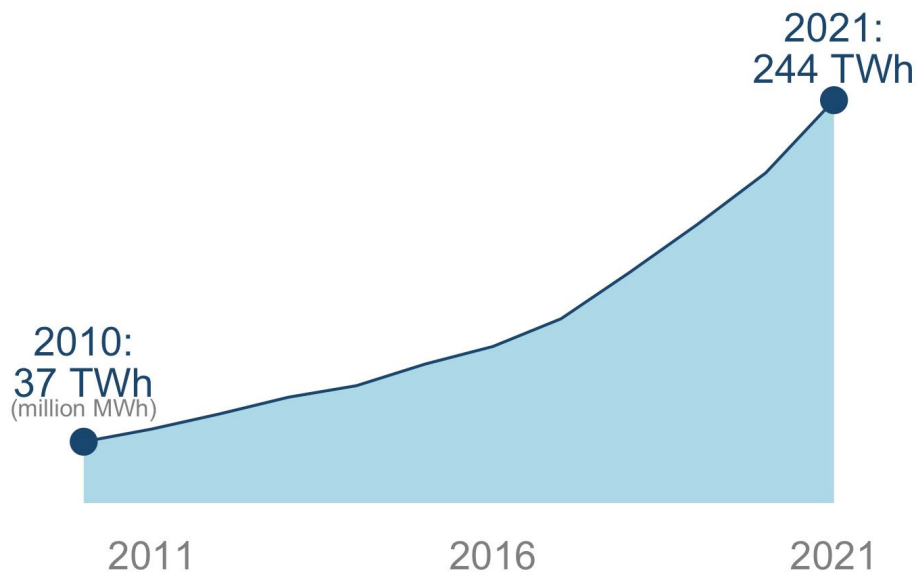
May 17, 2023

Topics

- 1 Status and Trends in the Voluntary Market
- 2 Evaluating Impacts of the IRA and BIL on the U.S. Power Sector

Voluntary Market Context

In 2021, about **8 million customers** (8% increase y/y) procured about **244 million MWh** (22% increase y/y) of voluntary green power.



That represents about:

1 in 20

U.S. retail electricity customers

6%

of U.S. retail electricity sales

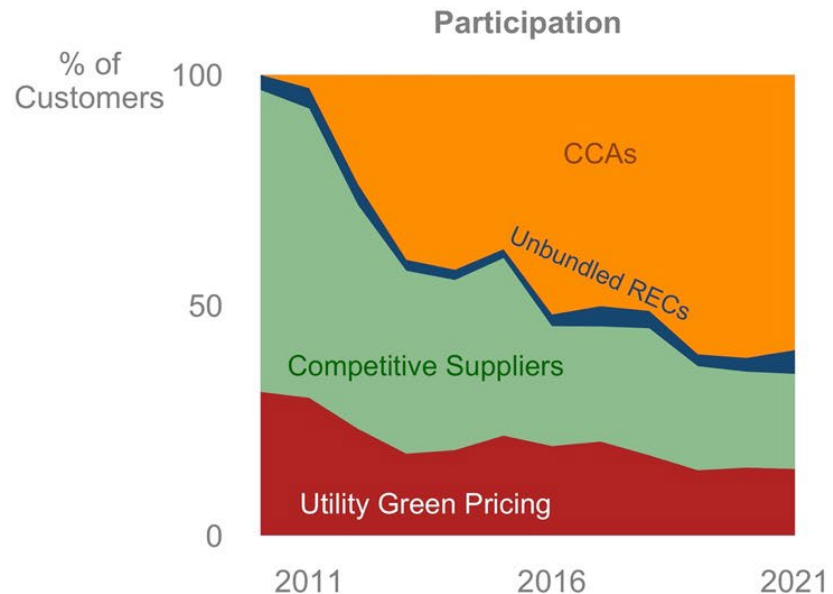
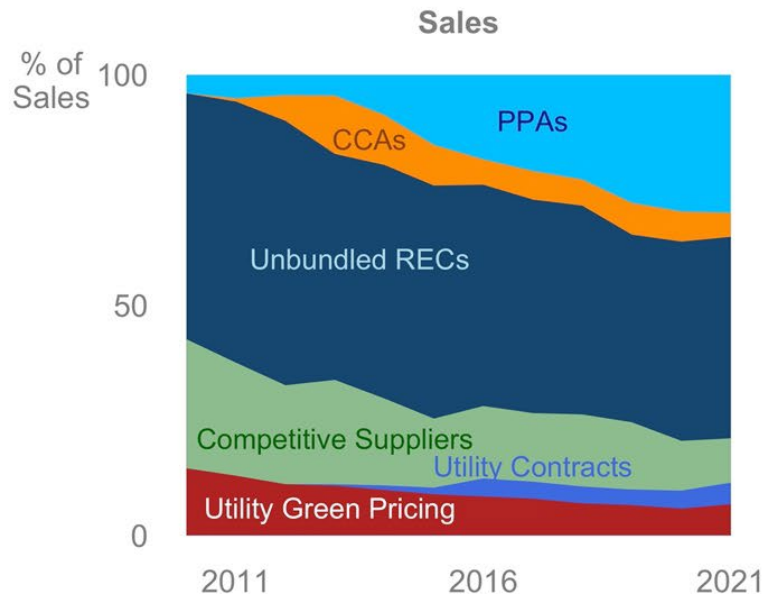
38%

of U.S. non-hydro renewable energy generation

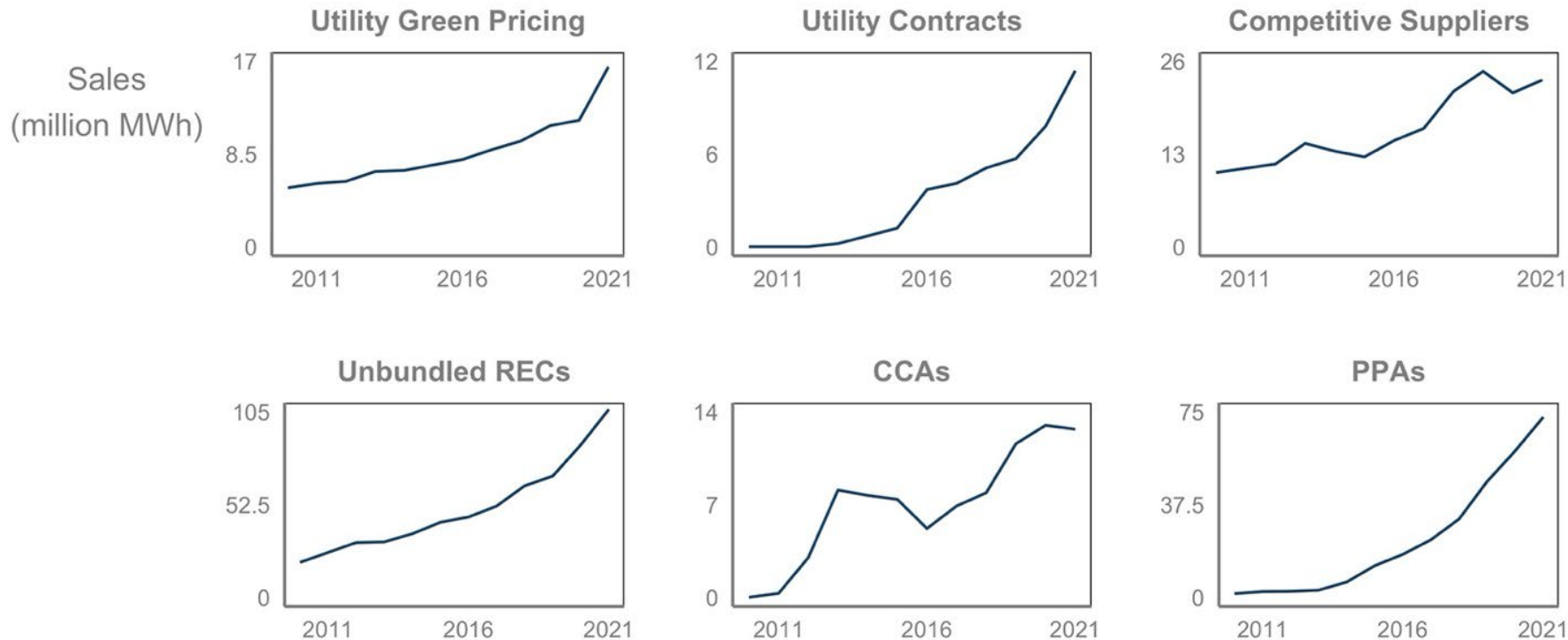
Total green power sales 2010-2021 (million MWh)

Green Power Sales and Customers by Mechanism

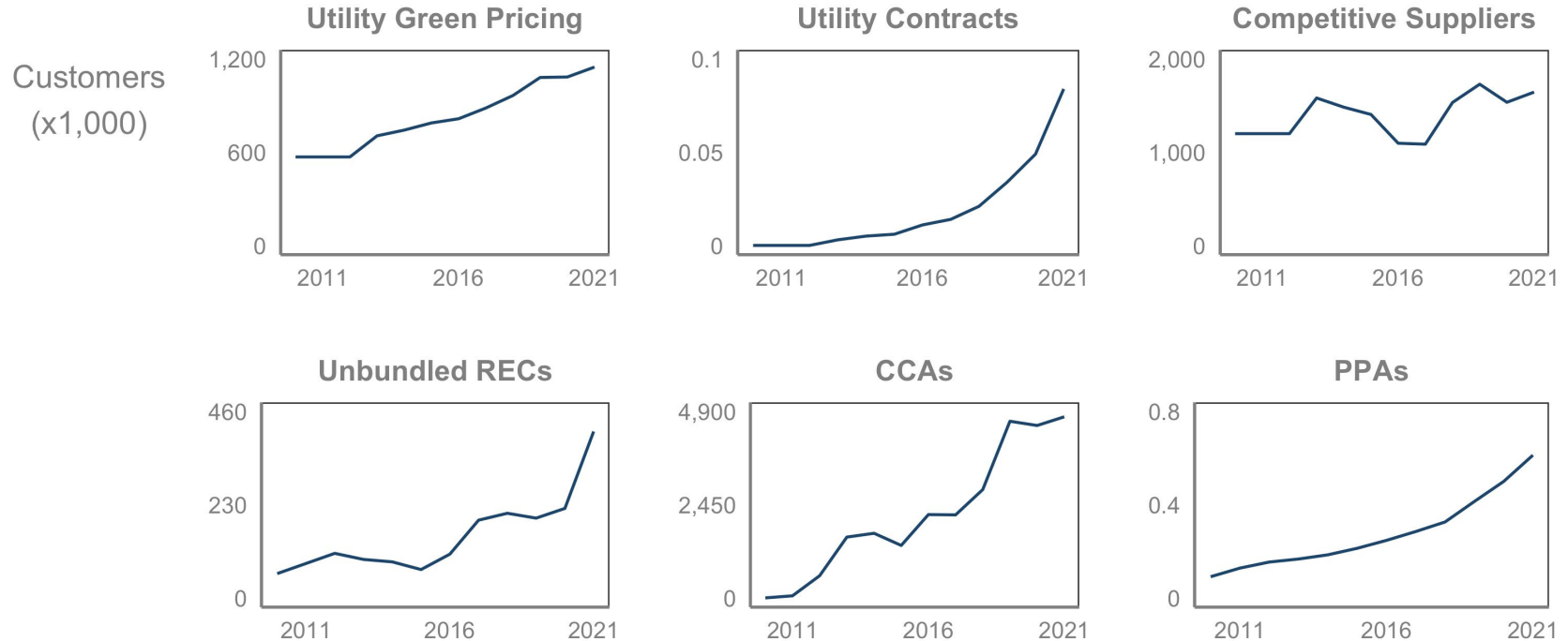
In 2021, the most voluntary sales were via unbundled RECs, while the most customers were via community choice aggregation (CCA) programs. Unbundled RECs purchases are dominated by C&I customers who purchase large volumes, while CCA customers are typically residential customers purchasing low volumes.



Voluntary Sales Continue to Increase



Voluntary Customers Grew in Most Market Segments



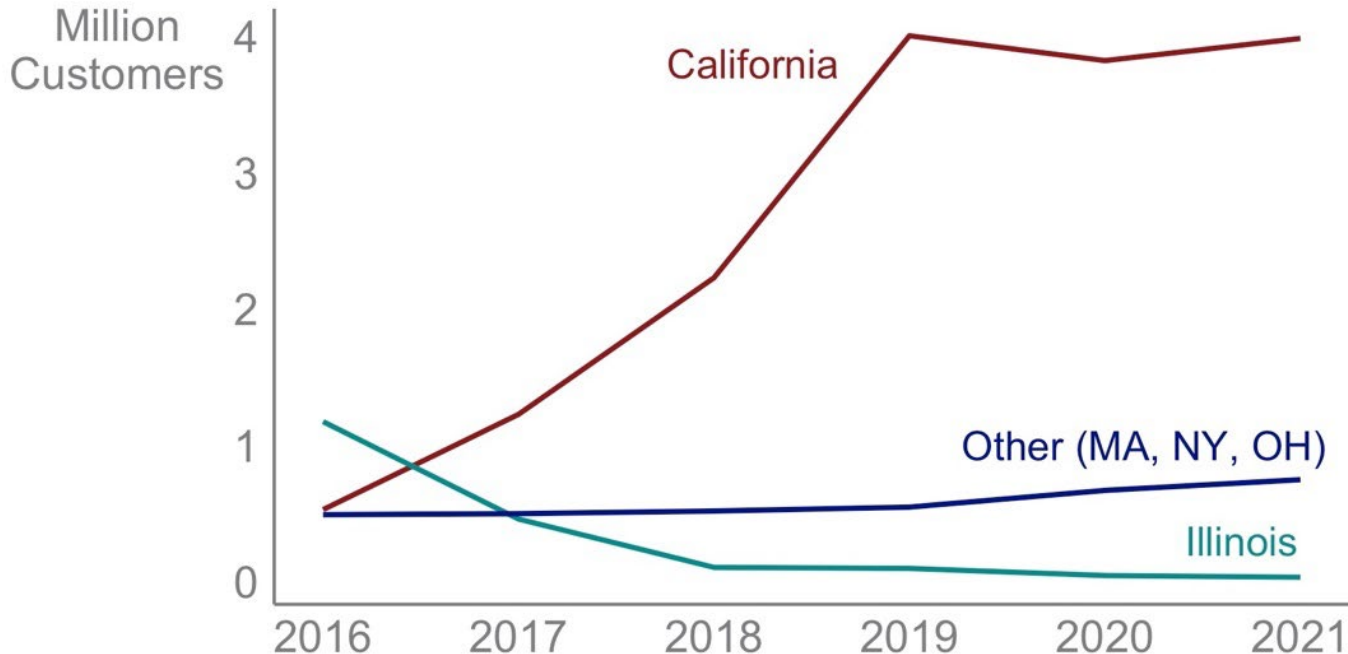
Large Pipelines of Utility Contracts Exist Across the Country

In 2021, utility contracts served 11.4 million MWh; nearly the size of the utility green pricing market. Sales increased 46% from 2020 and a substantial share of projects are in the pipeline.



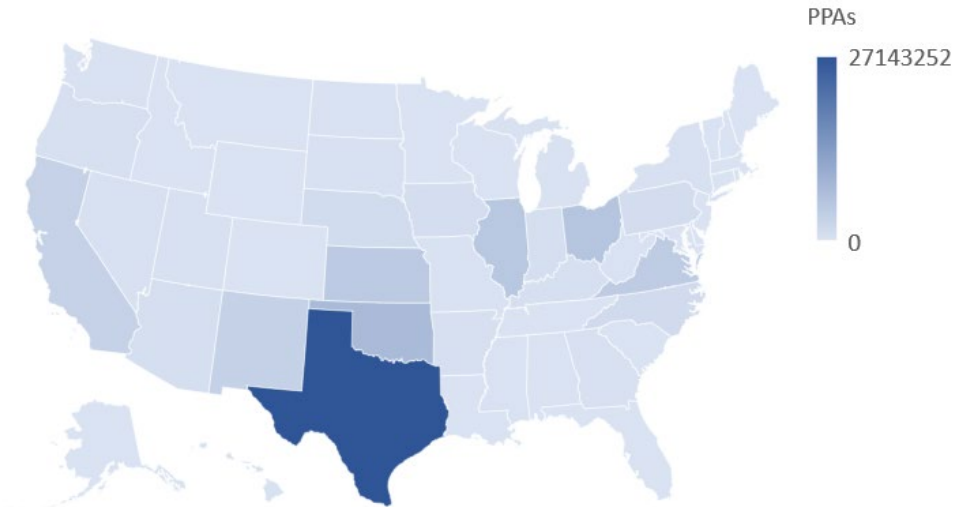
CCA Trends

About **4.8 million customers** procured about **12.8 million MWh** of voluntary green power through CCAs in 2021; largely the same as in 2020.



PPA Trends

- More than **600 offtakers** procured about **73.0 million MWh** of voluntary green power through PPAs in 2021.
- These figures include only PPA sales where we estimate that the purchaser has retained the RECs.
- Sales grew by around 23% from 2020 to 2021.
- Texas continues to dominate PPA supply.



Summary Trends

- Market sales grew 22% and customers grew by 8% in 2021
- Unbundled REC purchasing represents 44% of market sales and continues to grow, despite higher prices than in previous years
- Community choice aggregation (CCA), which greatly expanded residential customer access, has flatlined in California, the leading CCA market
- Utility renewable contract (“green tariffs”) supply is similar in scale to green pricing, but far behind the power purchase agreement supply.

Evaluating Impacts of the Inflation Reduction Act & Bipartisan Infrastructure Law on the U.S. Power Sector

Daniel C. Steinberg, Maxwell Brown,
Ryan Wiser, Paul Donohoo-Vallett, Pieter
Gagnon, Anne Hamilton, Matthew
Mowers, Caitlin Murphy, and Ashreeta
Prasanna

Disclaimer and Acknowledgements

This work was authored in part by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy (DOE) Office of Policy. The views expressed herein do not necessarily represent the views of the DOE or the U.S. Government.

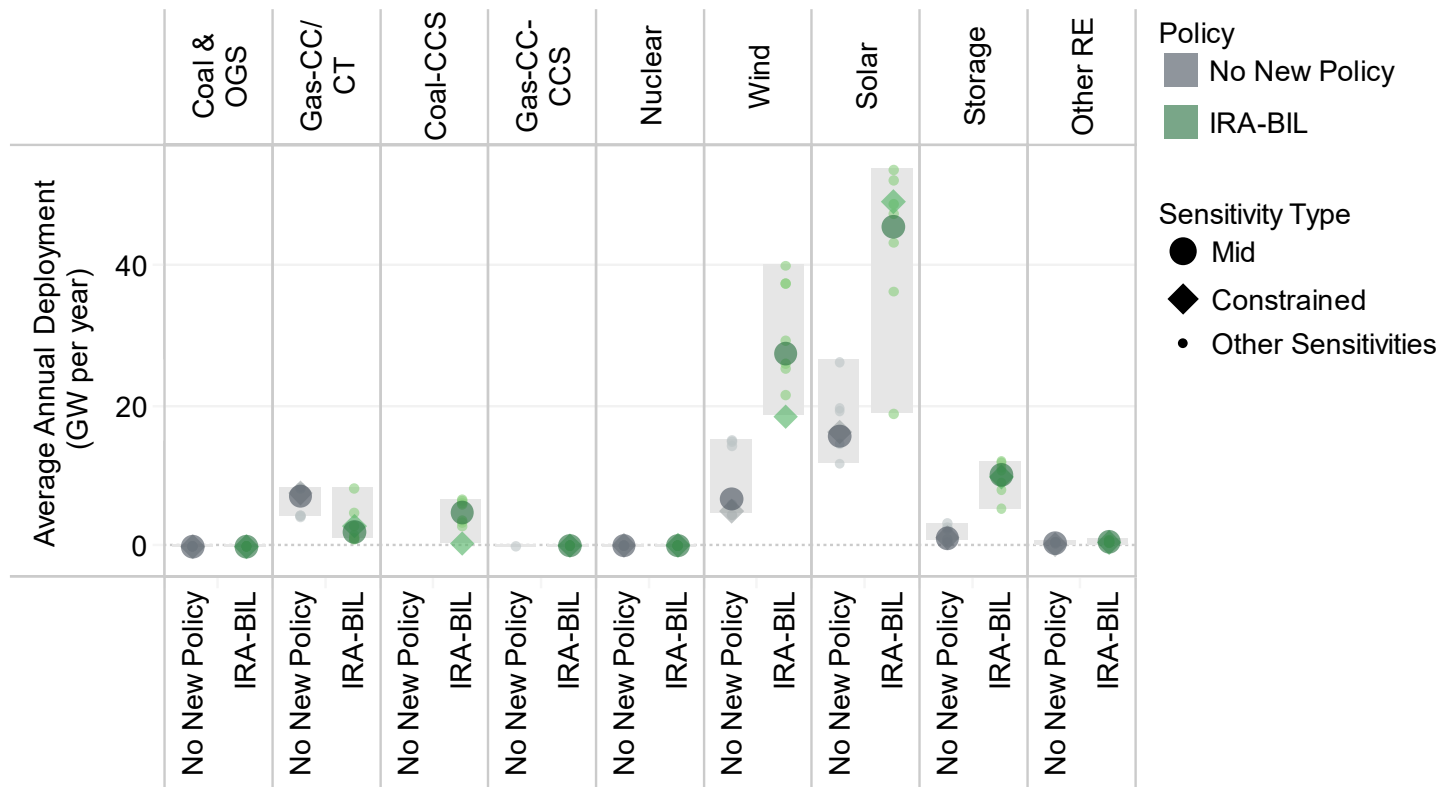
Scenario Framework

Scenario	Description
No New Policy	<ul style="list-style-type: none">• Federal and state policies frozen as of September 2022; excludes IRA and BIL• Electricity demand growth from EIA's AEO 2022: 0.7%/year average
IRA-BIL	<ul style="list-style-type: none">• Includes major IRA and BIL power sector policies and programs• Increased demand modified from Electrification Futures Study: 1.1%/year average
IRA-BIL Constrained	<ul style="list-style-type: none">• Captures possible impacts of non-economic institutional barriers• Restricted renewable resource available for deployment: wind, solar, geo, biomass• Annual transmission expansion capped at recent historical average (1.4 TW-mi/yr)• Does not allow new inter-regional (across 11 regions) transmission expansion• Doubled CO₂ transport, injection, and storage costs

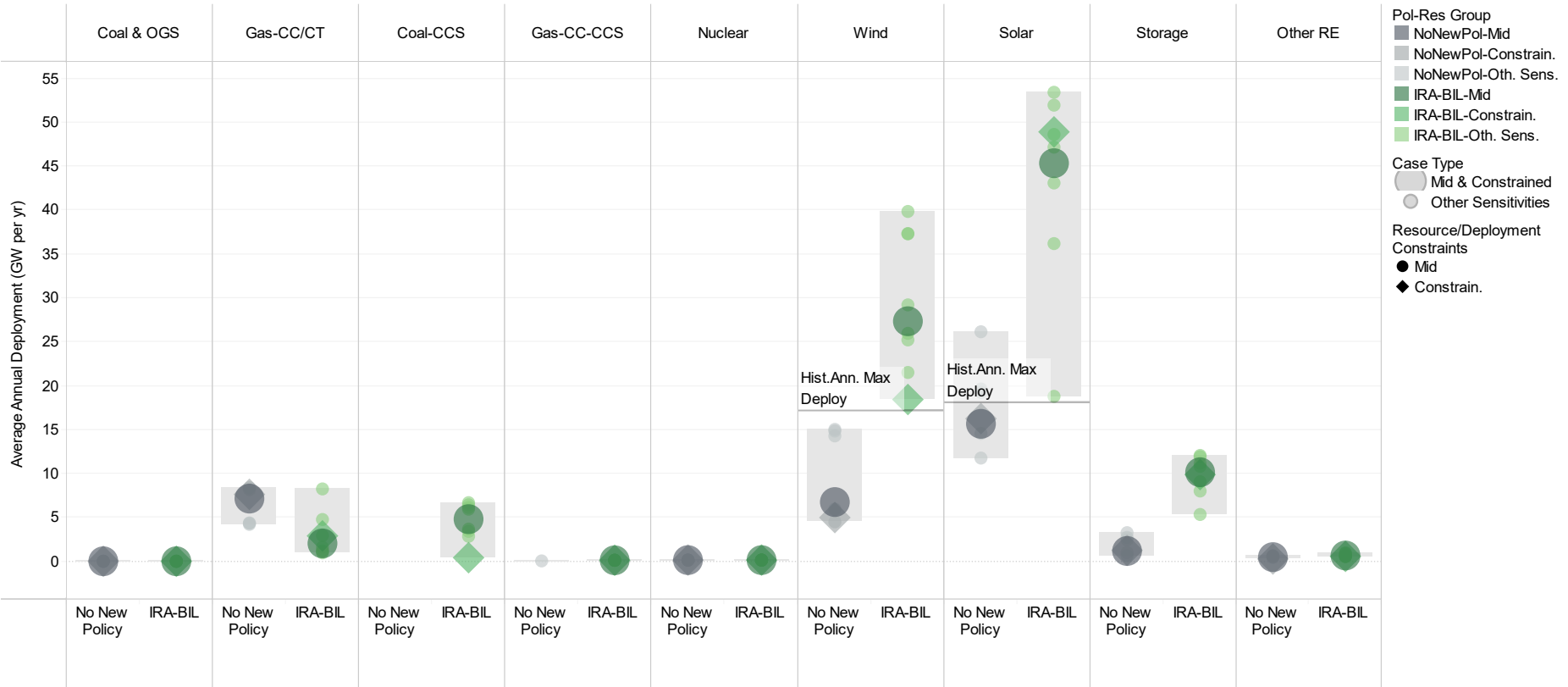
Sensitivities

- *Natural gas prices*: High and low from AEO 2022 High- and Low- Oil and Gas Resource cases
- *Technology cost and performance*: NREL ATB Advanced and Conservative trajectories
- *IRA impact*: Vary bonus and credit monetization assumptions

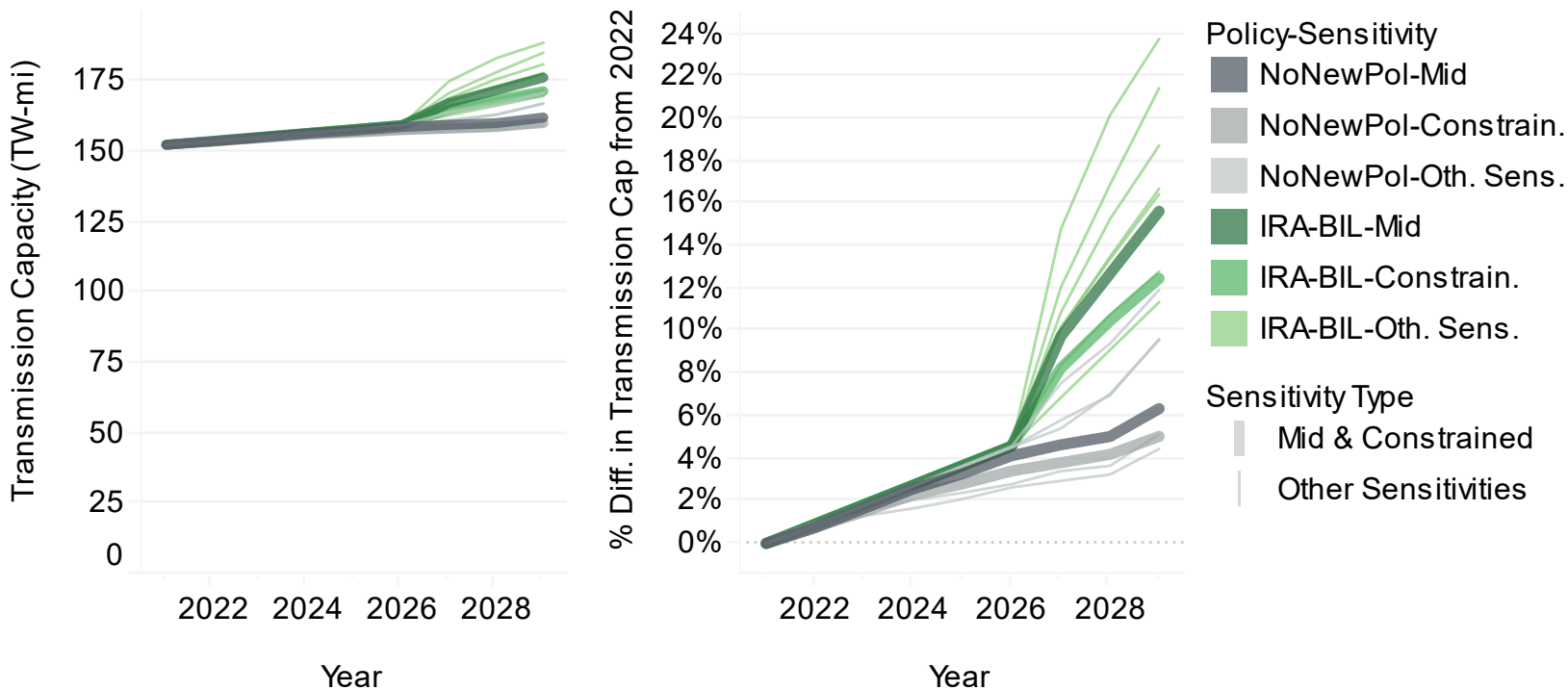
Clean electricity share of total generation increases to 71%-90% across sensitivities by 2030



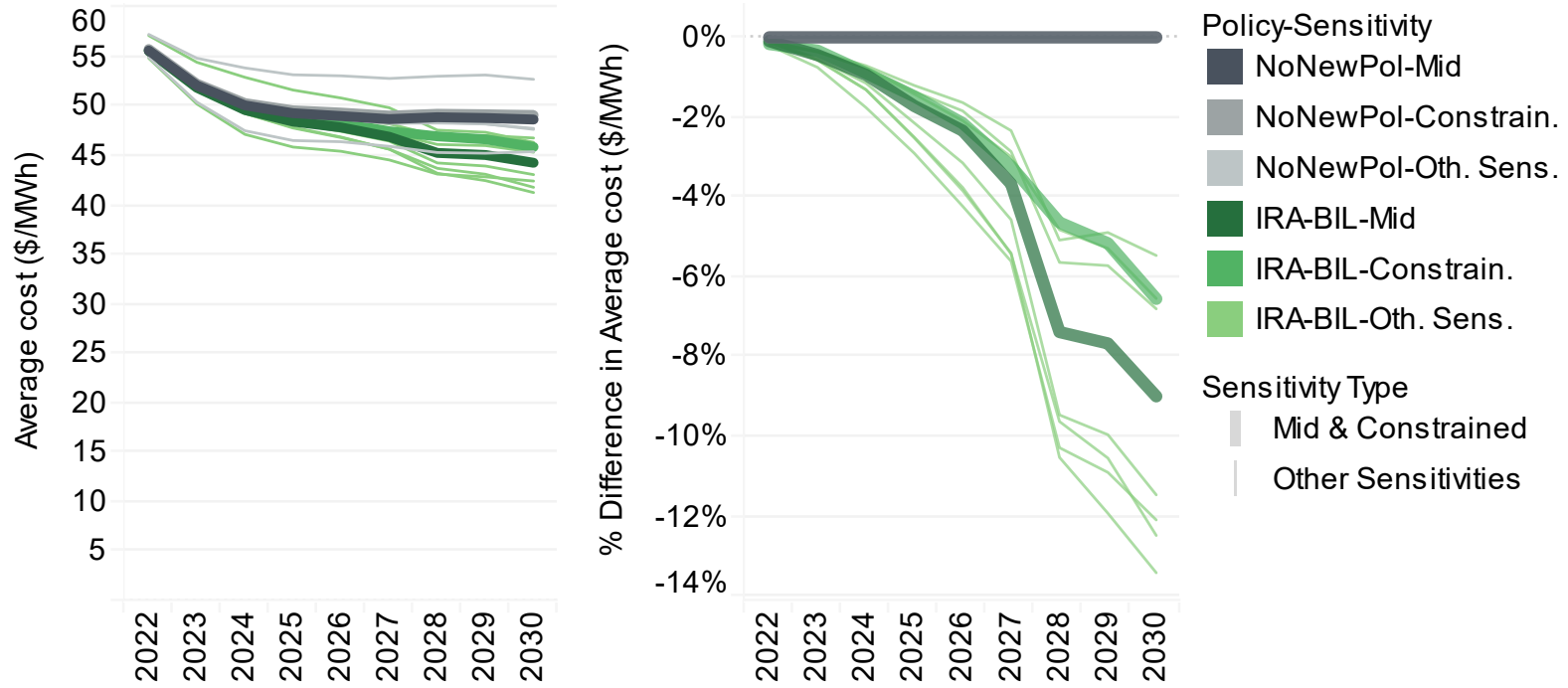
Wind, solar, and storage deployment rates could more than double relative to historical annual maximum levels



Long-distance transmission grows 11-24% by 2030 relative to 2022 across all IRA-BIL cases; 16% increase in mid case



Bulk-system costs decline (net of tax credits) by \$3 per MWh to \$6 per MWh (5%-13%)



Key Results

- **Clean generation:** Clean electricity shares could increase substantially with IRA, ranging from 71% to 90% of total generation by 2030 (up from 50%-63% under no new policy), depending on market conditions, deployment barriers, and other drivers
- **Renewable and storage deployment:** the year-over-year deployment rate for wind, solar, and storage deployment rates could substantially exceed their historical annual maximum levels
- **Fossil-CCS:** IRA could drive 10s of GWs of retrofits of fossil generation capacity with carbon capture reaching 1%-8% of generation
- **Emissions:** decrease to 72% to 91% below 2005 emissions levels resulting in \$670 billion-\$700 billion in cumulative avoided climate damages (2023-2030), assuming Rennert et al. (2022) preferred mean SC-CO₂ value; reductions in NO_x and SO₂ emissions could result in up to \$120 billion-\$190 billion cumulative avoided health damages (2023-2030).
- **Costs:** bulk-system costs decline (net of tax credits) by \$3 per MWh to \$6 per MWh (5%-13%)

Concluding thoughts

- IRA will likely drive substantial increases in the total share of clean generation and support continued reductions in power sector carbon dioxide emissions
- However, IRA also creates the potential for transformational change in the US power sector that could be realized if:
 1. RD&D continues to improve the cost and performance of clean electricity technologies—both those with established markets as well as developing technologies,
 2. barriers to technology deployment (e.g., supply chain constraints, permitting queues and other regulatory hurdles, social opposition) are mitigated, and
 3. coordination in investment and operation is increased across utilities and market operators.
- IRA has the potential to drive the development of new markets associated with clean technologies that have had little commercialized deployment to date, such as generation with CCS, H₂, and DAC, further impacting the generation portfolio

Thank you

Jenny Sumner

Jenny.Sumner@nrel.gov

Modeling & Analysis Group Manager

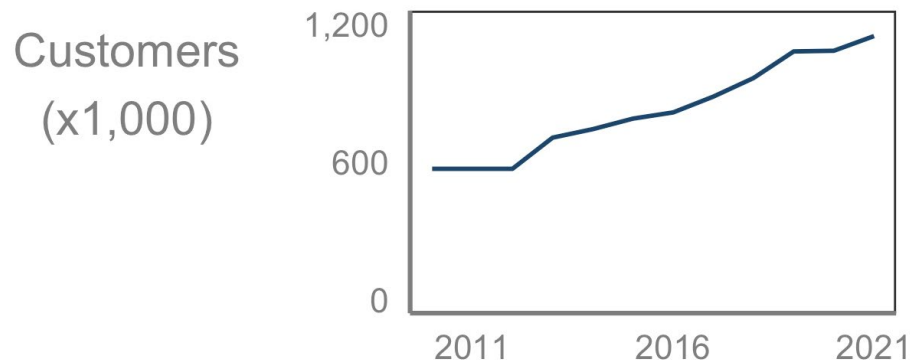
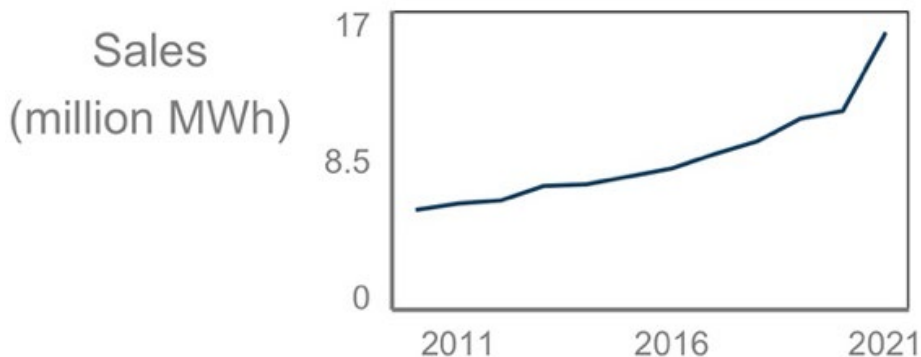
National Renewable Energy Laboratory

Supplemental Slides

Utility Green Pricing Trends

About **1.2 million customers** procured about **16.5 million MWh** of voluntary green power through utility green pricing programs in 2021.

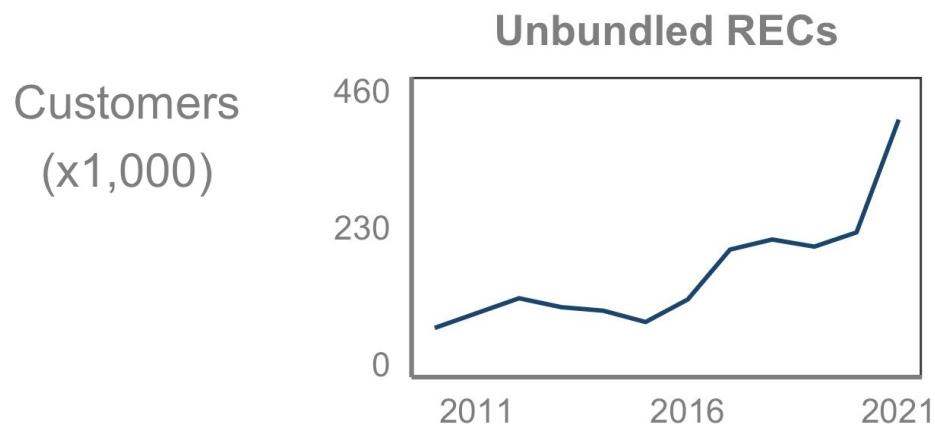
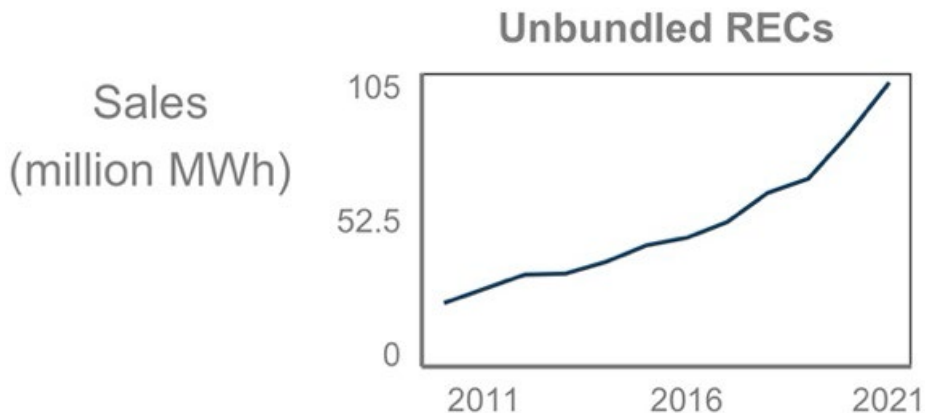
The market recovered after a relatively flat year in 2020, increasing sales by 42% ('20-'21) compared to only 5% ('19-'20). While sales increased 42% ('20-'21), customers only increased by 6%, indicating that larger per-customer volumes are driving sales growth.



Unbundled RECs

Unbundled RECs represented **44% of total market sales** in 2021. Higher REC prices in 2021 did not translate into slower growth; the market grew 23% from 2020-2021, similar to growth trends in previous years.

Unbundled REC customers increased sharply in 2021, to more than 400k.



Other 2021 Trends

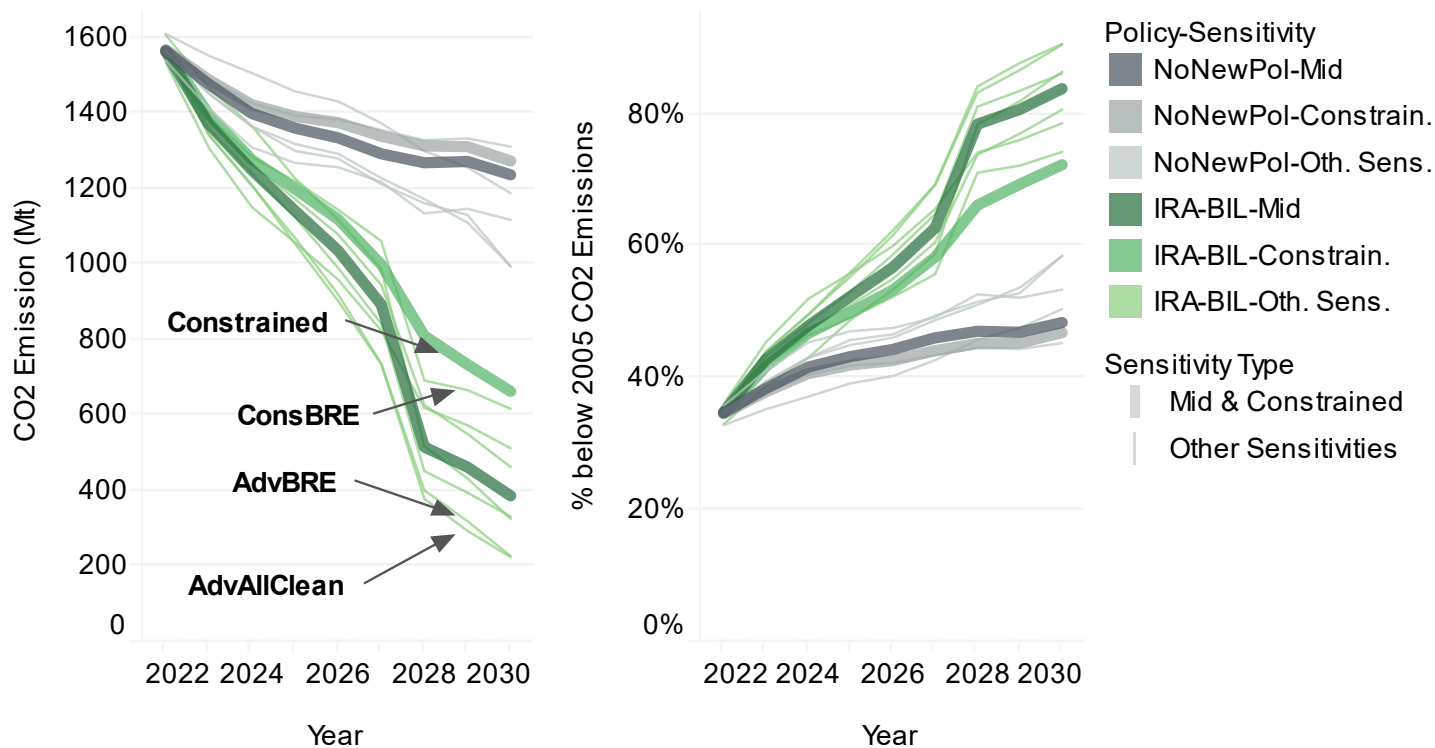
- **Purchasing:** Executive Order for federal purchasing: 100% carbon pollution-free electricity by 2030; 50% of that on a 24/7 basis
- **Disclosure:** SEC proposed climate-related disclosure requirements for public companies
- **Impact:** Increasing interest in purchasing with *social* impacts
- **New Focus Areas:** Renewable fuels (renewable natural gas, green hydrogen), international procurement, supply chain products

Summary of IRA and BIL Policy Implementation

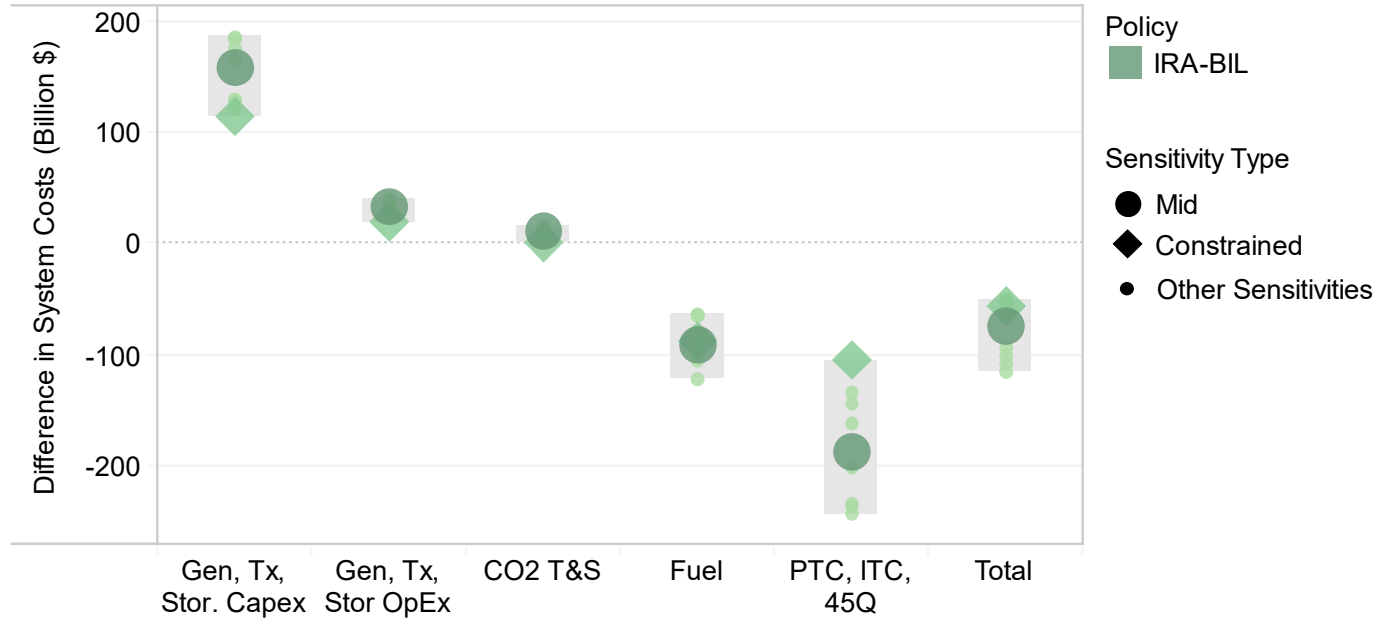
IRA-BIL Policy	Implementation Assumptions
ITC and PTC (48, 48E, 45, 45Y)	<ul style="list-style-type: none"> All projects meet prevailing wage and apprenticeship requirements, so receive full ITC/PTC ITC or PTC selection based on exogenous analysis, does not vary with time or geography Endogenous phase out (with safe harbor) when emissions reach 25% of 2022 levels
ITC and PTC Bonuses	<ul style="list-style-type: none"> All qualifying projects receive ½ bonus (5%) ramping to one bonus (10%) by 2028 Additional 0.9 GW-dc/year of distributed solar exogenously added to dGen results due to 48(e) environmental justice bonus credit (and other non-tax IRA programs, including EPA GHG Fund)
Nuclear PTC (45U)	<ul style="list-style-type: none"> No endogenous retirements allowed through 2032 due to PTC and Civil Nuclear Credit Tax credit value and expenditures not endogenously tracked
Carbon Capture (45Q)	<ul style="list-style-type: none"> Geologic storage assumed New build and retrofits allowed
Credit Monetization	<ul style="list-style-type: none"> Transferability + partial direct pay assumed to reduce tax credit value by 10% Additional direct pay allowance for CCS assumed to reduce value by only 7.5%
Accel. Depreciation	<ul style="list-style-type: none"> Technologies that qualify for technology-neutral PTC or ITC also qualify for 5-year depreciation
Other Provisions	<ul style="list-style-type: none"> Most grant, loan, demo programs assumed to support and/or direct modeled outcome Some additionality assumed for subset of programs, evaluated outside ReEDS and dGen

Additional caveats: H_2 45V PTC and DAC 45Q not represented; simple load growth assumptions

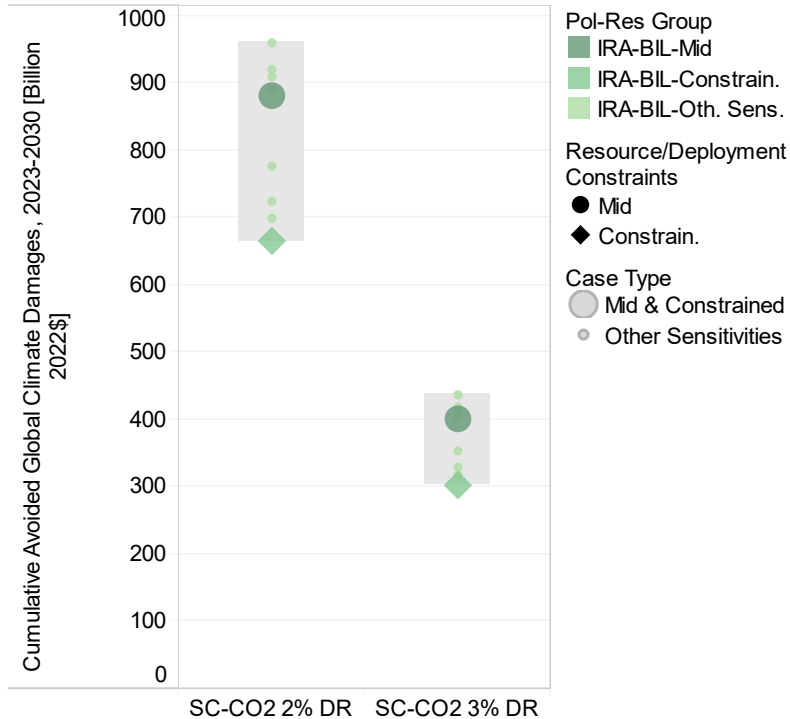
Emissions decline to 72% to 91% below 2005 emissions levels



IRA and BIL drive gross increases in investment, but net change in costs is negative driven by value of fuel savings and tax credits



Emissions reductions are associated with substantial avoided climate and health damages



- Avoided climate damages are estimated using SC-CO₂ values from Rennert et al. (2022):
 - “Preferred mean,” 2% near-term discount rate: \$185 per t CO₂
 - 3% near-term discount rate: \$80 per t CO₂
- Avoided health damages associated with reduced mortality:
 - ACS study: \$45 billion-\$76 billion, cumulatively 2023-2030
 - H6C study: \$120 billion-\$190 billion, cumulatively 2023-2030

Jenny Sumner
Modeling & Analysis Group Manager
jenny.sumner@nrel.gov
303-275-4366

www.nrel.gov

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

