



A new baseline for the power sector: Insights from the Haiku and E4ST models

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RFF Operates Two Detailed Power Sector Models: E4ST and Haiku

Both Haiku and the *Engineering, Economic and Environmental Electricity Simulation Tool* (E4ST):

- Are linear programs that represent the decisions of market participants and system operators in the context of existing state, regional, and national policies
- Project effects of new policies and generator and transmission investments on generator construction, retirement, and operation in future years
- Calculate emissions of multiple gases and use air pollution dispersion models to estimate mortality and other health effects
- Provide comprehensive benefit and cost calculations
- Have been used extensively to inform federal and subnational policies and in peer-reviewed academic publications



Key Differences Between E4ST and Haiku

E4ST

- Detailed transmission system model of US & Canada (7000 nodes) with linear approximation of physics-based flows
- Detailed generator data
- Site-specific, hourly wind and solar data

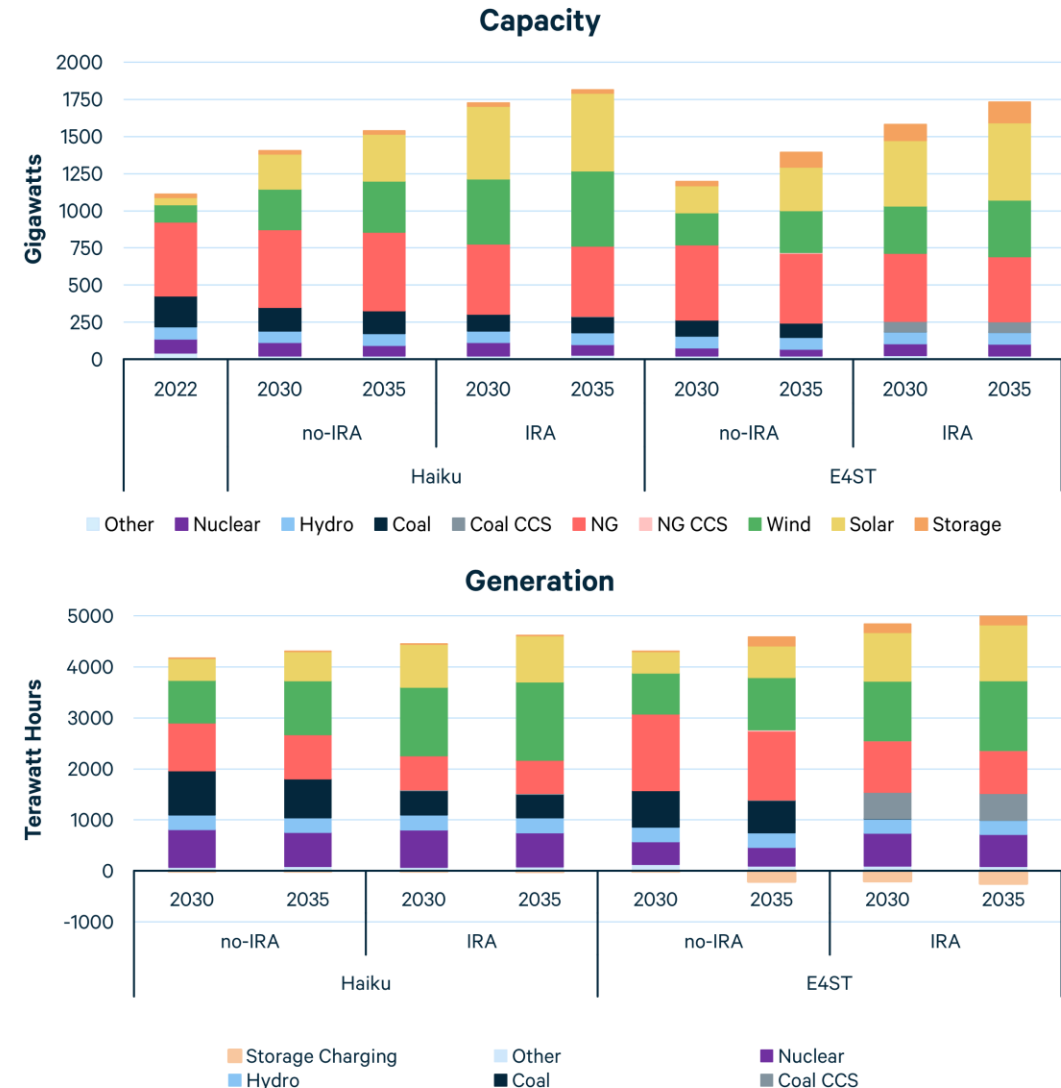
Haiku

- Capacity investment and retirement with 26-year perfect foresight
- Fast solving—5 to 15 minutes



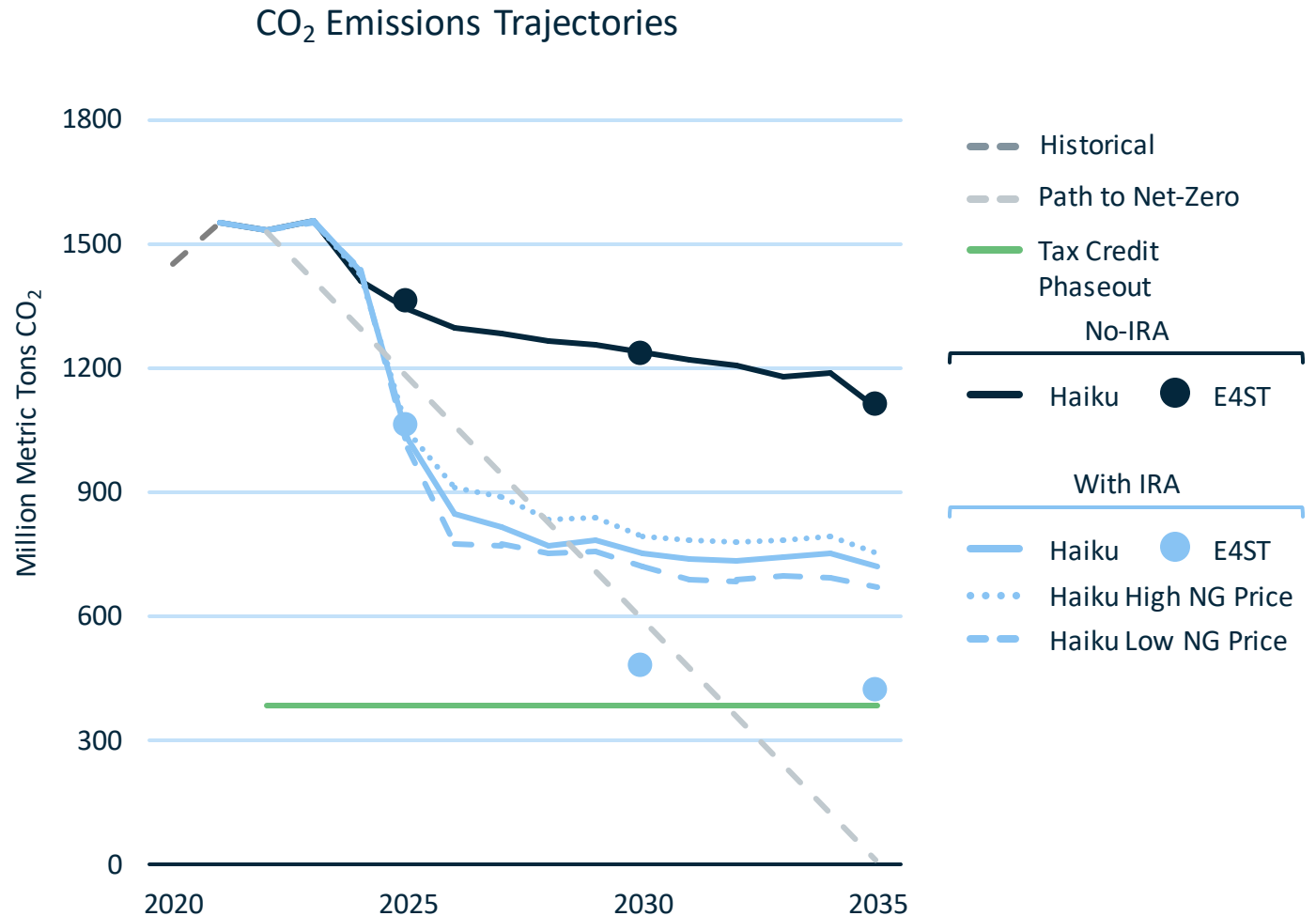
IRA Tax Incentives Favor New Builds and Use of Renewable and Low-Emitting Capacity

- Both models build solar and wind capacity at rates well above historical maxima
- CCS retrofits of coal are projected to be economically viable under 45Q incentives
- E4ST models a higher capacity factor for solar & wind than Haiku

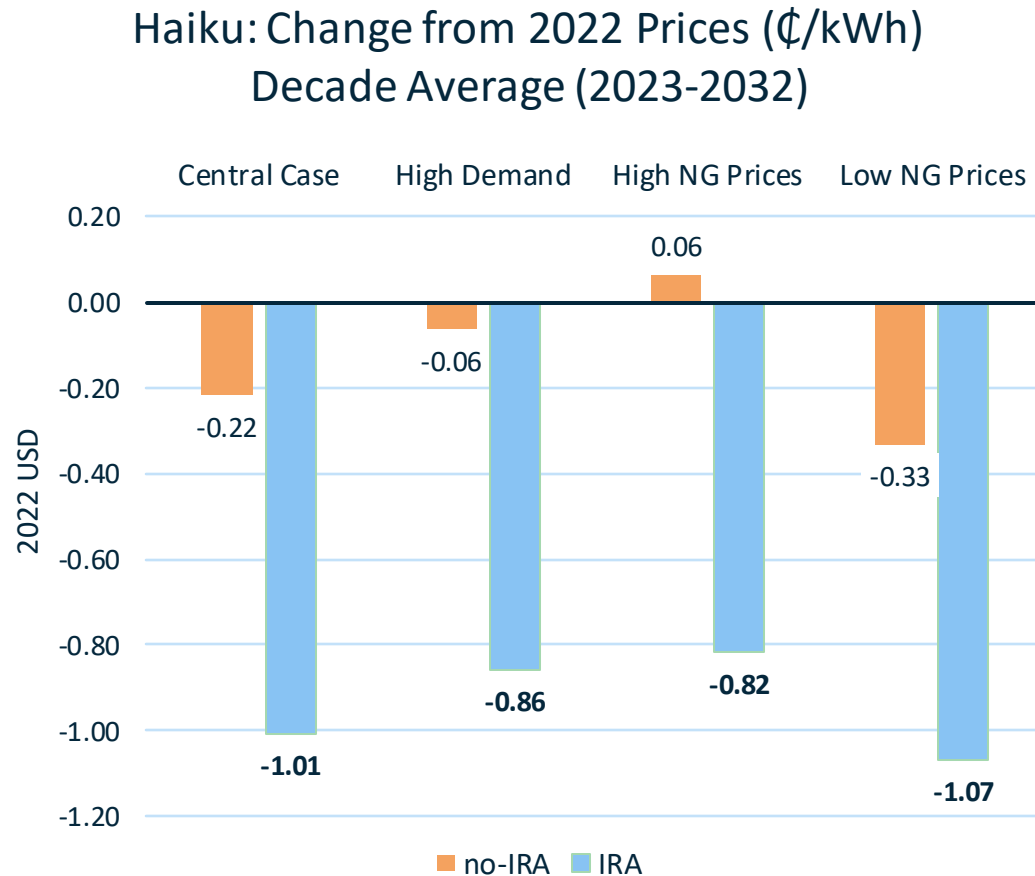


Projected Power Sector Emissions

- Both models indicate substantial CO₂ reductions compared to No-IRA baseline
- Emissions remain above the threshold for phaseout of the IRA tax credits through 2035, fall short of Biden net-zero goal
- E4ST sees greater emission reductions due to its CCS buildout



Retail Electricity Prices are Projected to Decline from 2022 Levels

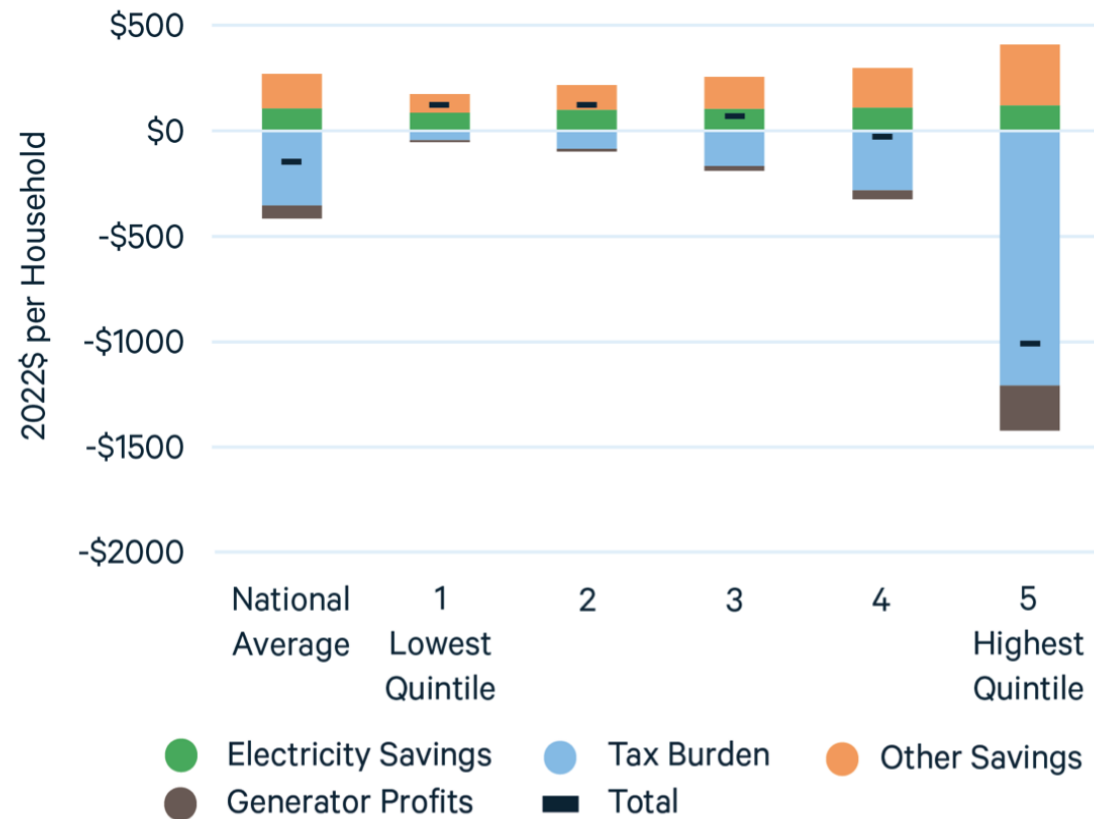


- Tax incentives for clean electricity are passed through to consumers in the form of lower retail rates
- Prices decline from approximately 12 ¢/KWh in 2022 (AEO)



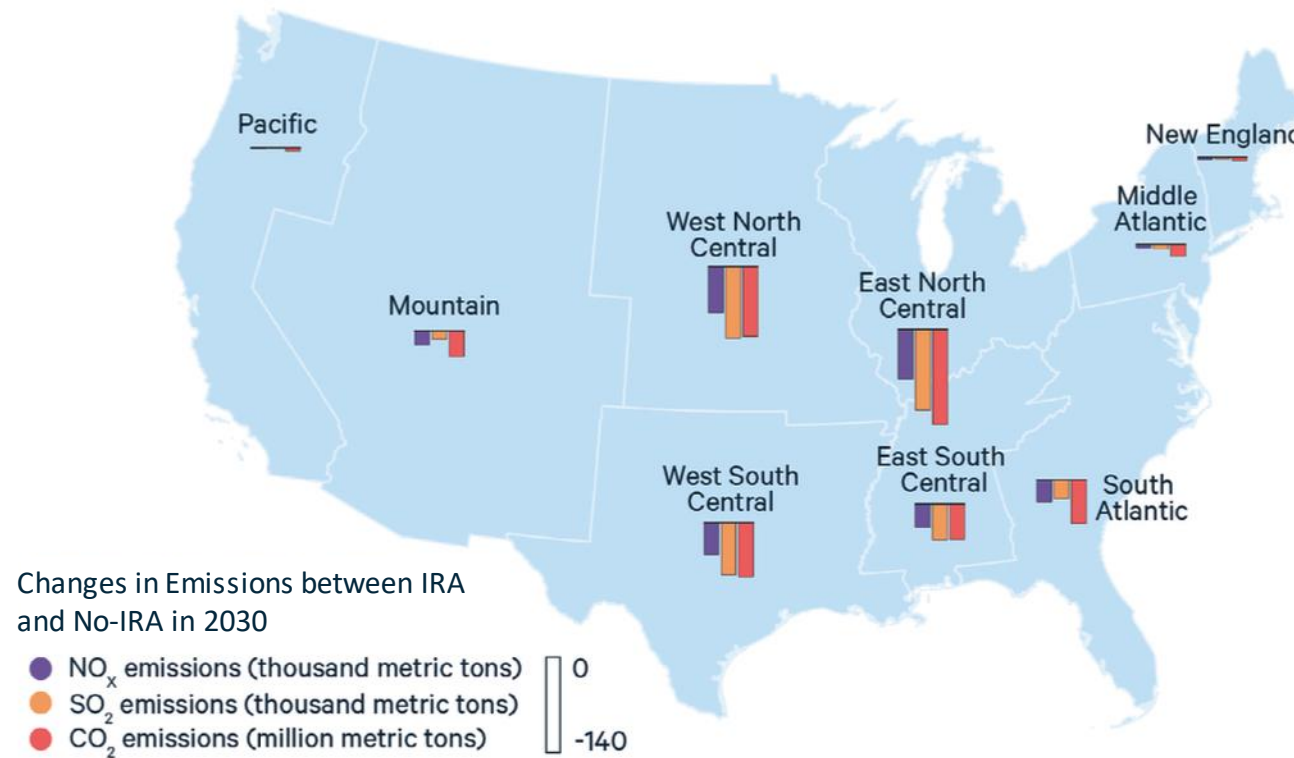
The IRA is Paid for Through a Progressive Tax Shift

The Distribution of Changes in Ratepayer and Taxpayer Costs in 2030



Baseline Air Quality is Improved under the IRA

Regional Emissions Changes in 2030



Conclusions

- The IRA provides a market environment that strongly favors the deployment of new clean electricity generation
- Updated baseline expectations suggest substantially greater clean electricity generation with associated reductions in emissions and widespread air quality improvements
- The tax incentives reduce retail electricity prices, encouraging electrification in other sectors, but by themselves are not projected to decarbonize the power sector by 2035
- Real world conditions not represented in the models are important sources of uncertainty that will require ongoing work to characterize



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Both Haiku and E4ST have been used extensively to inform federal and subnational policies

Haiku

- Federal Policy
 - Cofiring Standards
 - Carbon Taxes, Clean Energy Standards, and Tax Credits
 - CEPP
- Subnational Policy
 - State Policy Options to Price Carbon
 - RGGI
 - VA, CA, etc.
- Academic work
 - Linking Emissions Programs
 - Designing Carbon Markets
 - Production Incentives in Carbon Markets

E4ST

- RD&D funding
- State policies (e.g. 25 states and NY)
- Clean electricity standards
- Transmission expansion
- DOE proposals to prevent coal and/or nuclear retirements
- Vehicle electrification
- NG price, nuclear life, CO2 pricing, and electricity demand
- Biomass co-firing with coal
- Improved modeling methods

