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TECHNICAL APPENDIX

CLEAN ELECTRICITY TAX CREDITS IN THE INFLATION REDUCTION ACT WILL REDUCE EMISSIONS, GROW JOBS, AND LOWER BILLS

ASSESSMENT OF ENERGY, EMISSIONS, AND RETAIL RATE IMPACTS OF THE CLEAN ENERGY TAX CREDITS

Background on the Integrated Planning Model

NRDC used ICF's Integrated Planning Model (IPM®) to model the impacts of the clean energy tax incentives in the Inflation Reduction Act on the electricity sector. IPM is a detailed model of the electric power system that is used routinely by the electricity industry and regulators, including the U.S. Environmental Protection Agency (EPA), to assess the effects of environmental regulations and policies.[1]

IPM determines the most cost-effective pathway available for the construction, retirement, and use of power plants, subject to resource adequacy requirements and environmental constraints. The outputs of IPM modeling include emissions of carbon and other pollutants, wholesale electricity prices, natural gas prices, electricity generation by fuel type, capacity retirements and additions, and average residential retail bills.[2] All modeling projections in the fact sheet are drawn from NRDC analysis performed by ICF, with all assumptions and policy scenarios developed by NRDC.[3]

The modeling is based on NRDC's 2022 business-as-usual (2022 BAU) case. Table 1 offers a comprehensive list of data sources and assumptions for technology cost and performance, demand, operating parameters, policies, and existing and under-construction generation used in the 2022 BAU.

TABLE I: ASSUMPTIONS IN NRDC'S 2022 BAU CASE

REFERENCE CASE (2022 BAU) SOURCES	
Assumption	**NRDC 2022 Base Case**
RUN YEARS	
Run Years	2023, 2025, 2028, 2030, 2035, 2040, 2045, 2050
MODEL REGIONS	
Model Regions	NRDC
Electric Demand	AEO 2022[4]
Peak Demand	AEO 2022
Planning Reserve Margin	EPA v6 Summer 2021[5]
Inter-Region Transmission	EPA v6 Summer 2021
Transmission Builds (Endogenous)	EPA v6 Summer 2021
EXISTING GENERATORS	
Unit-Level Heat Rates	EPA NEEDS v6 (Summer 2021)
FOM and VOM	EPA v6 Summer 2021
Availability	EPA v6 Summer 2021

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TABLE I: ASSUMPTIONS IN NRDC'S 2022 BAU CASE	
REFERENCE CASE (2022 BAU) SOURCES	
Assumption	**NRDC 2022 Base Case**
NOx Rates and SO_2 Permit Rates	EPA v6 Summer 2021
Life Extension Cost	EPA v6 Summer 2021, NRDC Approach for Coal (Methodology Available on Request)
Nuclear Life Extension Cost	NRDC Approach (Methodology Available on Request)
Renewable Generation Profiles (Existing Units)	NRDC Approach (Methodology Available on Request)
NEW GENERATORS	
Capacity Build Costs—Conventional	AEO 2022
Emission Rates	EPA v6 Summer 2021
Capacity Build Costs—Renewable	NREL 2021 ATB (Mid) for Solar and Onshore Wind NREL 2021 ATB (Low) for Offshore Wind[6]
Capacity Build Costs—Storage	4/8/10 Modeled, NREL 2021 Mid Assumptions
Capacity Build Costs—Solar & Storage	NREL 2021 ATB (Mid)
Capital Cost Step Adders	NRDC Approach (Methodology Available on Request)
Renewable Reserve Margin Contribution	NRDC Approach (Methodology Available on Request)
Storage Reserve Margin Contribution	NRDC Approach (Methodology Available on Request)
Renewable Generation Profiles (New Units)	EPA v6 Summer 2021
POLLUTION CONTROLS	
Pollution Controls for Existing Units (SO_2, NOx, HCl, Hg)	EPA v6 Summer 2021
CCS Retrofit Cost and Performance—Coal	EPA v6 Summer 2021
CCS Retrofit Cost and Performance—New Gas (90% CCS)	AEO 2022
CCS Retrofit Cost and Performance—Existing Gas (90% CCS)	EPA v6 Summer 2021
CCS Retrofit Cost and Performance—99% Post-Combustion Capture With Capture & Solvent Technology	NRDC Assumption
CCS Transportation and Storage Curves	EPA v6 Summer 2021
CCS Incentives	Includes 45Q Representation
OTHER EXISTING UNIT MODIFICATIONS	
Coal to Gas Conversions	EPA v6 Summer 2021
Heat Rate Improvements	EPA v6 Summer 2021
FINANCING	
New Combined Cycle Capital Charge Rate (CCR)	CCR to Represent Additional Risks Associated with a Potential Cost on Future CO_2 Emissions (EPA v6)
Financing	NRDC
FIRM DECISIONS	
Firm Capacity Additions	NRDC Database as of Q2 2022
Firm Retirements	NRDC Database as of Q2 2022
Firm Pollution Controls and Coal to Gas Conversions	NRDC Database as of Q2 2022
NUCLEAR	
Nuclear Retirements	Two License Renewals for a Total of 80 Years
Nuclear Retirement Limits	EPA v6 Summer 2021
Nuclear FOM Adjustment	EPA v6 Summer 2021

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REFERENCE CASE (2022 BAU) SOURCES	
Assumption	**NRDC 2022 Base Case**
FUEL	
Coal Supply/Prices	EPA v6 Summer 2021
Gas Supply/Prices	Developed using ICF's Gas Market Model
Gas Basis and Seasonality	Developed using ICF's Gas Market Model
Biomass Supply Prices	EPA v6 Summer 2021
Nuclear Prices	AEO2022
Fuel Oil Prices	AEO2022
Biomass Co-firing at Coal Facilities	EPA v6 Summer 2021
Gas Co-firing at Coal Facilities	EPA v6 Summer 2021
ENVIRONMENTAL REGULATIONS	
SO_2/NOx	CAIR and CSAPR
MATS	As Finalized; Allow HCl Compliance Via Low-Chlorine PRB Coals
Coal Combustion Residuals	EPA v6 Summer 2021
Water Intake Structures	EPA v6 Summer 2021
ELG	EPA v6 Summer 2021
NSPS for Combustion Turbines	NRDC Assumption
LRPS/CES—Requirements Modeled	NRDC Database as of Q2 2022

Modeling of the Clean Electricity Tax Credits

The clean electricity tax credits were modeled in IPM with the same underlying cost, performance, and system assumptions of the 2022 reference case. The clean electricity tax package was modeled as:

- Production Tax Credit (PTC) for wind at 2.5¢/kWh (2022$) (or 1.5¢/kWh (2002$) through 2024, tied to inflation.
- Investment Tax Credit (ITC) at 30% for solar through 2024.
- PTC for new zero-emission technologies (wind, solar, small hydro, and new nuclear) at 1.5¢/kWh (1992$) from 2025, tied to inflation, until the later of 2032 or until power sector emissions are 75% below 2005 levels.[7]
- ITC at 30% for energy storage, with same phase-down schedule as the zero-emission technologies PTC.
- 45Q at $85/ton through 2032, tied to inflation.
- 45U for nuclear at 1.5¢/kWh (2022$) through 2032, tied to inflation, unless wholesale revenue is greater than 2.5¢/kWh, at which point the credit is reduced by 80%.[8]

This modeled package differs from the tax package in the Inflation Reduction Act of 2022 in that it does not include:

- Additional "bonus" credits for projects located in low-income or "energy" communities.
- Programs for clean energy funding beyond the tax credit format.

ASSESSING POTENTIAL CLEAN ENERGY JOBS IMPACTS FROM CLEAN ELECTRICITY TAX CREDITS

To estimate the clean energy job impacts from the clean electricity tax credit package, NRDC used the Economic Impacts of Decarbonizing America (Eco-IDeA) model, developed by Synapse for NRDC in the fall of 2020. Eco-IdeA is a multisectoral model, provided in three separate files, that enables users to estimate the macroeconomic impacts of changes in spending across the electric, transportation, and buildings sectors. Users may evaluate impacts for historical or projected changes in spending occurring in one or more years during the period 2020–2050. Modeling resolution is provided at the state and national levels. For this analysis, only the electric sector file was used to estimate changes in power-related clean energy jobs.

Jobs impacts are classified on the basis of two criteria in Eco-IdeA:

- First, Eco-IDeA classifies impacts as associated with either project labor or materials.
- Impacts are then classified as direct, indirect, or induced.

While Eco-IDeA can tabulate direct, indirect, and induced jobs, NRDC's analysis included only labor direct, materials direct, and materials indirect jobs related to incremental clean energy investment in the electricity sector. NRDC's analysis looked at gross job impacts from low-carbon and clean energy spending and did not consider or net out changes in employment in other, non-clean-energy-related fields (e.g., construction and operation of gas-fired power plants). The jobs figures in the report represent gross employment changes in these three categories of employment for the clean electricity sector:

- **Labor direct effects,** including, for example, the jobs, income, and GDP impacts of constructing generation units and/or transmission and distribution facilities, as well as the operation and maintenance of generation units. They include jobs like solar installer and wind turbine technician.
- **Materials direct effects,** including, for example, the jobs, income, and GDP associated with manufacturing offshore wind turbines.
- **Materials indirect effects,** including the jobs, income, and GDP impacts of manufacturing the components used in equipment for the construction, operation, and maintenance of energy infrastructure.

ASSESSING PUBLIC HEALTH BENEFITS FOR THE CLEAN ELECTRICITY TAX CREDITS

To assess the potential public health benefits from the clean electricity tax credits, we used the EPA benefit-per-ton (BPT) and incident-per-ton (IPT) estimates for modeled reductions in nitrogen oxides (NOx) and sulfur dioxide (SO_2) from the IPM data outputs.[9]

NOx and SO_2 emission changes between the reference and policy cases were drawn from the IPM modeling for each state. NRDC then used the state-level electric generating units BPT and IPT values from the EPA to estimate the public health outcomes and benefits from these incremental reductions in NOx and SO_2 emissions. While these benefits were tabulated at the state level, they were aggregated to the national level for our report.

Other public health benefits from the reduction of other co-pollutants, such as $PM_{2.5}$ and mercury, were not included in NRDC's estimates. Therefore the reported public health impacts and benefits should be thought of as a conservative estimate, given that they measure and estimate only some of the benefits from reductions in these co-pollutants.

ENDNOTES

1 Full documentation of the IPM model can be found at U.S. Environmental Protection Agency (hereinafter EPA), "EPA's Power Sector Modeling Platform v6 Using IPM Summer 2021 Reference Case," September 20, 2021, https://www.epa.gov/power-sector-modeling/epas-power-sector-modeling-platform-v6-using-ipm-summer-2021-reference-case.

2 Retail prices are calculated based on the IPM outputs similar to the approach used by EPA.

3 NRDC's report represents the assumptions of NRDC based on consultation with industry participants and private sector energy and power investors.

4 U.S. Energy Information Administration, *Annual Energy Outlook 2022*, March 3, 2022, https://www.eia.gov/outlooks/aeo/.

5 For details about the EPA v6 Summer 2021 assumptions, see EPA, "EPA's Power Sector Modeling Platform v6."

6 National Renewable Energy Laboratory, *Annual Technology Baseline 2021*, July 12, 2021, https://atb.nrel.gov/electricity/2021/data.

7 With phase-down over three years after applicable year is reached (100%, 75%, 50%).

8 This is a simplified approach. As modeled, reactors receive one of two credit levels: the full (1.5¢) or reduced (0.3¢) value based on projected wholesale revenue. The actual section of the Inflation Reduction Act would reduce the value of the credit by subtracting 80% of the individual plant's excess revenue (gross receipts, inclusive of any revenue from local, state, and/or federal zero-emission credit programs) above 2.5¢ per kWh.

9 EPA, "Estimating the Benefit per Ton of Reducing Directly Emitted PM2.5, PM2.5 Precursors and Ozone Precursors From 21 Sectors," January 2022, https://www.epa.gov/benmap/estimating-benefit-ton-reducing-directly-emitted-pm25-pm25-precursors-and-ozone-precursors.