

IMPLEMENTATION GRANT APPLICATION TECHNICAL APPENDIX

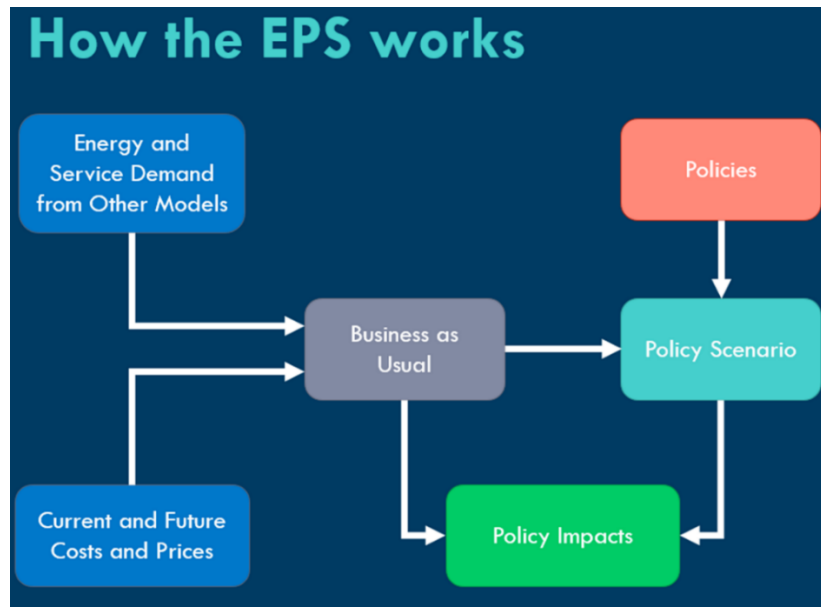
This technical appendix explains the methodology and assumptions used for developing the estimated greenhouse gas (GHG) emissions reduced for the RISE PA program. The “GHG Emission Reduction Calculation Spreadsheet” included with this application provides the specific GHG emissions reduction calculations.

GHG Reduction Estimate Method and Tools Utilized

To model emission reduction from RISE PA industrial process and industrial fugitive emissions reductions were estimated using the [Energy Policy Simulator \(EPS\) for Pennsylvania](#), a model maintained by Energy Innovation and RMI. The EPS is a free-to-use, publicly available, open-source model for estimating the environmental, economic, and human health impacts of climate and energy policies. RMI and Energy Innovation have developed state-level EPS models for all lower 48 states. The models use official data from the EPA, DOE, NREL, and other federal and state sources. The state versions of the EPS, such as the Pennsylvania EPS, are downscaled versions of the national EPS model with state-specific modifications based upon state law where applicable.

Sector	Subsectors	Source
Electricity	In-state capacity and generation; out-of-state imports	Energy Information Administration (EIA) State Electricity Data
Building Energy Use	All energy use, all building components, residential and commercial buildings	EIA’s State Energy Data Systems from 2020 NREL 2017 Electrification Futures Study - Reference Scenario
Industrial Energy Use	All fuel use for industrial sector	EIA’s Annual Energy Outlook tables on Industrial Energy Use EIA’s State Energy Data Systems
Industrial Process Emissions	Agriculture and industrial process emissions	EPA’s US State-level Non-CO2 GHG Mitigation Report

The EPS allows the user to control a large variety of policies that affect energy use and emissions in every major sector of the economy including transportation, electricity, buildings, industry, agriculture, and land use. It also includes various smaller components, such as hydrogen supply, district heat, waste management, and geoengineering. The model reports outputs at annual intervals and provides outputs such as GHG emissions, energy usage, cash flow, and others.



Reference Case Scenario

The reference case scenario, or Business-As-Usual (BAU), for Pennsylvania industrial emissions comes from Pennsylvania version of the EPS. The EPS model works by drawing upon outputs from energy and service models, plus current and future costs and prices, to form a BAU scenario. The most significant external basis for data and calibration of the BAU scenario is EIA’s Annual Energy Outlook. The BAU takes into account federal legislation and projections prior to 2022, including the Infrastructure Investment and Jobs Act. The BAU does not include projections of the Inflation Reduction Act and CHIPS act due to uncertainty about implementation and still-ongoing rulemaking. This scenario was not post-processed to be in alignment with estimates from the PCAP as only the deltas between the reference case scenario and each RISE PA category would need to be accounted for.

Table 1. Reference BAU developed through EPS

	2025	2030	2036	2040	2045	2050
Reference BAU	81.65	80.30	79.06	80.10	81.77	84.57

Measure Implementation and GHG Reduction Assumptions

Each RISE PA category was modeled directly in the EPS as an individual scenario. This resulted in annual emissions outputs for each scenario, which were then subtracted from the EPS reference case scenario to find the marginal emissions impact in each year for each RISE PA category. Emissions rates associated with each industrial subsector are embedded in the EPS model. The EPS uses AR5 emission factors. Details on implementation in the EPS model of each measure are included in the table in section “Measure-Specific Assumptions and Activity Data” below.

Funding amounts for each RISE PA category were determined by PA DEP. The funding amounts only apply to PA DEP's share of grants during the 5-year grant period and is only used for capital expenditures; scenarios were calibrated accordingly.

The implementation timeline is based upon typical lead times for energy project completion, with significant differences in implementation timeframe based upon technological readiness and complexity. For example, carbon capture and storage technology on a cement plant would take much longer to plan and implement than a commercial scale solar facility. Table 2 **Error! Reference source not found.** shows the total amount invested per RISE PA category, and **Error! Reference source not found.** (next page) shows the measure specific assumptions and activity data.

Table 2. Planned Operational Investment per Year

RISE PA Category	Amount to Invest (\$ million)	Planned Operational Investment per Year (\$ millions)			
		2025	2026	2027	2028
Renewable Energy and Energy Efficiency	\$60	\$9.00	\$15.00	\$18.00	\$18.00
Industrial Electrification	\$180	-	\$18.00	\$63.00	\$99.00
Fuel Switching	\$95	-	\$4.75	\$33.25	\$57.00
Carbon Capture and Storage	\$45	-	-	-	\$45.00
Fugitive Emissions	\$60	\$9.00	\$15.00	\$18.00	\$18.00

Project lifetime and attribution for the emissions reduction due to the RISE PA investment is incorporated as part of the EPS structure and the scenario design. Certain technologies require varying levels of continual funding to keep operating effectively while others do not. Over time, RISE PA has a lower and lower directly attributable impact because fuel, operation, maintenance, capital re-investment, and other costs take over that have to be paid by other sources. Grants will be made to projects in 2025 with implementation and construction expected in the initial program years. While some portion of savings will occur, to provide a conservative approach, no emissions reductions were assumed in the modeling in 2025.

EPS's methodology of converting dollars invested into reductions in emissions shows significant reductions in emissions based on capital expenditures and thus, emission reductions for the implementation phase of the projects (2025-2029), often demonstrate reductions that are locked in for their useful life in the real world. The EPS model estimates post-grant period (2030-2050) industrial emissions in a very conservative fashion due to a presumed lack of new capital infusions, with a model tendency to revert close to business-as-usual level emissions for technology categories. We would expect 2030-2050 industrial emissions to actually be lower (thus providing more reductions from investments) than can be reflected in the model due to RISE PA investments.

Table 3 Measure-Specific Assumptions and Activity Data

RISE PA Category	Modeled as	EPS Levers Utilized	EPS Industrial Subsectors Included
Renewable Energy and Energy Efficiency	Implementation of industry energy efficiency standards resulting in a reduction of fuel use at cumulative \$60m expenditure level.	Industry Energy Efficiency Standards in electricity use, natural gas use, petroleum use, coal use, other fuel use	Other Mining and Quarrying, Food Beverage and Tobacco, Textiles Apparel and Leather, Wood Products, Pulp Paper and Printing, Refined Petroleum and Coke, Chemicals, Rubber and Plastic Products, Glass and Glass Products, Cement and Other Nonmetallic Minerals, Iron and Steel, Other Metals, Metal Products Except Machinery and Vehicles, Computers and Electronics, Appliances and Electrical Equipment, Other Machinery, Road Vehicles, Nonroad Vehicles, Other Manufacturing
Industrial Electrification	Conversion of low-temperature heat processes to electricity at cumulative \$180m capital expenditure level.	Electrification (Low Temp)	Other Mining and Quarrying, Food Beverage and Tobacco, Textiles Apparel and Leather, Wood Products, Pulp Paper and Printing, Refined Petroleum and Coke, Chemicals, Rubber and Plastic Products, Glass and Glass Products, Cement and Other Nonmetallic Minerals, Iron and Steel, Other Metals, Metal Products Except Machinery and Vehicles, Computers and Electronics, Appliances and Electrical Equipment, Other Machinery, Road Vehicles, Nonroad Vehicles, Other Manufacturing
Fuel Switching	Fuel switching to hydrogen for medium and high temperature processes at cumulative \$95m capital expenditure level. Hydrogen produced through electrolysis.	Electrification + Hydrogen (Med & High Temp), Shift to Hydrogen	Other Mining and Quarrying, Food Beverage and Tobacco, Textiles Apparel and Leather, Wood Products Shift, Pulp Paper and Printing, Refined Petroleum and Coke, Chemicals, Rubber and Plastic Products, Glass and Glass Products, Cement and Other Nonmetallic Minerals, Iron and Steel, Other Metals, Metal Products Except Machinery and Vehicles, Computers and Electronics, Appliances and Electrical Equipment, Other Machinery, Road Vehicles, Nonroad Vehicles, Other Manufacturing
Carbon Capture and Storage	Carbon capture of process emissions as a % of CO2 captured at cumulative \$45m capital expenditure level.	Carbon Capture and Sequestration of process emissions	Refined Petroleum and Coke Process, Chemicals Process, Cement and Other Nonmetallic Minerals Process, Iron and Steel Process
Fugitive Emissions	Methane abatement at level of potential commensurate with a cumulative expenditure of \$60m capital.	Methane Destruction	Oil and Gas Extraction, Energy Pipelines and Gas Processing, Coal Mining

GHG Emissions Reduced

Table 3. Measure-Specific Estimated Annual GHG Emission Reductions

RISE PA Category	Annual GHG Emission Reductions (MTCO ₂ e)					
	2025	2030	2035	2040	2045	2050
Industrial Electrification	-	89,700	22,800	18,000	18,000	18,150
Fuel Switching	-	1,200	8,850	2,100	1,200	1,350
Carbon Capture and Storage	-	40,950	7,050	1,800	1,050	1,050
Fugitive Methane Abatement	-	450	6,000	6,300	6,300	6,600
Renewable Energy and Energy Efficiency	-	207,334	156,787	142,345	144,420	145,167
Total	-	339,634	201,487	170,545	170,970	172,317

Table 4. Measure-Specific Estimate Cumulative GHG Emission Reductions

RISE PA Category	Cumulative GHG Reductions (MTCO ₂ e)	
	2025-2030	2025-2050
Industrial Electrification	2,900,400	3,349,500
Fuel Switching	33,450	145,950
Carbon Capture and Storage	154,950	312,900
Fugitive Methane Abatement	1,605,900	1,727,250
Renewable Energy and Energy Efficiency	587,225	3,641,210
Total	5,281,925	9,176,810