Opinion Dynamics

AMEREN ILLINOIS

2023 SOCIETAL HEALTH NON-ENERGY IMPACTS REPORT

FINAL

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I. EXECUTIVE SUMMARY

This report presents Opinion Dynamics' analysis of societal health non-energy impacts (NEIs) resulting from Ameren Illinois Company's (AIC) 2023 residential and nonresidential energy efficiency (EE) portfolio. This work is part of our ongoing evaluation of AIC's non-energy impacts. From 2008-2017, Illinois utilities excluded most NEIs from cost-effectiveness testing.[1] in 2016, the Illinois General Assembly passed the Future Energy Jobs Act (FEJA), which called for the addition of "other quantifiable societal benefits" (e.g. NEIs) to EE program cost-effectiveness testing.[2]

To help AIC meet these statewide policy goals, as well as the stated goals and objectives of the Illinois Stakeholder Advisory Group NEI Working Group (SAG NEI Working Group), Opinion Dynamics conducted an analysis of the reduction of air pollution emissions and resulting health benefits from AIC's 2018 EE portfolio,[3] which found substantial societal NEIs associated with the portfolio. These societal NEIs have been henceforth included in cost-effectiveness testing for the AIC portfolio, most notably in the filing and approval of AIC's 2022-2025 Energy Efficiency and Demand Response Plan.[4]

This report on the societal non-energy impacts associated with AIC's 2023 EE portfolio is an update to the 2018 analysis that leverages updated AIC portfolio data and updated modeling tools to support estimation of societal NEIs that can be used for cost-effectiveness testing on an annual basis as well as in the filing of AIC's forthcoming 2026-2029 Energy Efficiency and Demand Response Plan.

To provide context for the societal health non-energy impacts presented in this report, we provide an explanation of non-energy impacts and the three categories into which they are divided: participant, utility, and societal NEIs. Non-energy impacts include positive or negative effects attributable to EE programs apart from energy savings. Non-energy benefits (NEB) frequently refer to positive NEIs, while negative NEIs—non-energy costs—reflect ways that EE measures result in adverse effects. NEIs are further distinguished into participant and societal NEIs.

- Participant NEIs are monetary and non-monetary impacts (positive or negative) that directly affect a program partner, stakeholder, trade ally, participant, or the participant's household. Examples include lower operations and maintenance costs, or increased sales or revenue. Other examples of participant NEIs include changes to occupant comfort and reduced occupancy.
- Utility NEIs arise from energy programs that directly impact a utility / program administrator. Examples include reduced arrears, disconnection notifications, and shutoffs.
- Societal NEIs are the impacts that arise from energy efficiency and affect society at large. Examples include changes in greenhouse gas and pollution emissions, changes in the number of jobs, and differences in tax revenues.

This report focuses on societal health NEIs resulting from residential and nonresidential EE programs.[5] EE programs can lead to reductions of multiple greenhouse gases and criteria air pollutants, which can have positive impacts on air quality, public health, and climate change mitigation. However, many of these benefits are difficult to quantify and/or

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[1] Certain NEIs, most notably operations and maintenance (O&M) cost savings, were included during this time period.

[2] FEJA (Illinois Future Energy Jobs Act). Senate Bill (SB) 2814. www.ilga.gov/legislation/publicacts/99/PDF/099-0906.pdf. (passed December 7, 2016).

[3] Opinion Dynamics (2021). Ameren Illinois Company 2018 Societal Health Non-Energy Impacts Report. Accessed at: https://www.ilsag.info/wp-content/uploads/AIC-Societal-NEI-Results-REVISED-FINAL-2021-04-09.pdf

[4] Approval of the 2022-2025 EE and Demand Response Plan in ICC Docket 21-0158. Accessed at: https://www.icc.illinois.gov/docket/P2021-0158/documents

[5] Energy efficiency programs also result in additional participant and societal health NEIs (such as decreased thermal stress, improved workplace safety, improved environmental conditions, etc.). While these impacts are not included in this study, they may be included in future NEI research.

monetize.[6] Therefore, this report focuses on societal NEIs that are readily quantified and monetized. In particular, we estimate the health benefits associated with reduced exposure to fine particulate matter ($PM_{2.5}$) and ground-level ozone (O_3), which is associated with multiple health benefits, such as reduced premature fatality and lung disease. [7,8]

1.1 STUDY OBJECTIVES

The overall goal of this study was to provide monetized societal NEI estimates that reflect changes to human health resulting from program-induced reductions in generation and emissions that correspond to decreased energy consumption. To address this goal, Opinion Dynamics focused on the following research objectives:

- Estimate the change in electric generation and emissions of primary $PM_{2.5}$, sulfur dioxide (SO_2), and nitrogen oxides (NO_X) resulting from AIC's 2023 electric portfolio.
- Estimate the reductions in emissions of primary $PM_{2.5}$, SO_2, NO_X, ammonia (NH_3), and volatile organic compounds (VOCs)[9] associated with decreased natural gas combustion resulting from AIC's 2023 gas portfolio.
- Estimate the health benefits associated with decreased $PM_{2.5}$ and O_3 concentrations.
- Monetize the health benefits, which AIC can use for cost-effectiveness testing.

1.2 OVERVIEW OF METHODS

Opinion Dynamics estimated the reductions in emissions of $PM_{2.5}$, SO_2, NO_X, NH_3, and VOCs resulting from AIC's 2023 EE portfolio. Many of the installed EE measures have lifetimes of up to 25 years and will continue to provide emissions benefits through 2052. We, therefore, report both the first year (2023) and lifetime emissions reductions for the AIC energy efficiency portfolio.[10] We present the detailed methodology used to estimate emissions reductions in Section 3.2.

Figure 1 presents an overview of our societal NEI estimation approach. We modeled the total expected health benefits resulting from these emissions reductions and developed benefit-per-therm and benefit-per-kWh factors (referred to as benefit factors) to apply to each year of energy savings (see Section 3.3). For the gas and propane benefits factors, we assumed that the benefit factors would remain the same over the course of the lifetime. For the electric benefit factors, we developed three methods to model how the benefit factors will change over the lifetime based on how the grid changes. These benefit factors account for changes in ambient $PM_{2.5}$ and O_3 concentrations, their impact on human health, and the value of these avoided health costs. Using these benefit factors, we calculated the health benefits attributable to AIC's 2023 EE portfolio by multiplying the benefit factors by the energy savings each year and then adding the annual benefits over the lifetime of savings. We report high and low values for benefits, representing different assumptions about the impact of changes in ambient $PM_{2.5}$ and O_3 concentration on adult mortality and non-fatal heart attacks. Figure 1 summarizes each step in the analysis process.

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[6] For example, some benefits, such as improved visibility resulting from air quality improvements, can be difficult to monetize.

[7] U.S. EPA. 2024. Health and Environmental Effects of Particulate Matter. https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

[8] U.S. EPA. 2024. Health Effects of Ozone Pollution. https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

[9] Primary $PM_{2.5}$ refers to the direct emissions of $PM_{2.5}$ from fossil fuel combustion. Secondary $PM_{2.5}$ forms through a series of reactions between SO_2, NOx, NH_3, and VOCs in the atmosphere.

[10] Our analysis separates results by fuel saved. Gas and propane savings associated with the portfolio are further split into residential and nonresidential groupings.

Figure 1. Steps to Estimate and Monetize AIC 2023 Portfolio Societal Health NEIs from 2023–2052

Estimate Lifetime Energy Savings

2023 portfolio lifetime kWh and therms annual savings used in cost-effectiveness testing

Estimate Emissions Reductions

Electric	Gas
Use AVERT to estimate annual changes in electric generation and emissions of NOx, SO_2, and primary $PM_{2.5}$ from 2023–2027, and to forecast changes from 2028–2052	Multiply annual therm savings by emissions factors for NOx, SO_2, $PM_{2.5}$, NH_3, and VOCs

Estimate Changes in Air Quality and Monetize Health Impacts

Use COBRA to estimate air quality changes (i.e. county level $PM_{2.5}$ and O_3 concentrations) and to estimate and monetize public health benefits resulting from improved air quality

Create Benefit Factors

Divide dollar value of health benefits by annual energy savings

Apply Benefit Factors and Sum Lifetime Stream of Benefits

Multiply benefit factors by annual portfolio energy savings and sum lifetime stream of benefits

1.3 KEY FINDINGS

The 2023 AIC EE portfolio is projected to save 240 tons of primary $PM_{2.5}$, 2,618 tons of SO_2, and 2,322 tons of NO_x over the lifetime of the completed measures. Additionally, the gas portfolio is projected to save 18.7 tons and 11.2 tons of NH_3 and VOCs, respectively. Table 1 summarizes these benefits by sector and fuel type.

Table 1. AIC 2023 Energy Efficiency Portfolio Lifetime Emissions Reductions

Sector	$PM_{2.5}$ (tons)	SO_2 (tons)	NO_x (tons)	NH_3 (tons)	VOCs (tons)
Electric	*238.8*	*2,617.3*	*2,121.9*	*0*	*0*
Residential Gas	0.4	0.5	85.3	18.1	5.0
Nonresidential Gas	0.5	0.7	109.4	0.5	6.0
Gas Subtotal	*0.9*	*1.2*	*194.7*	*18.7*	*11.0*
Residential Propane	<0.1	<0.1	5.8	<0.1	0.2
Nonresidential Propane	0	0	0	0	0
Propane Subtotal	*<0.1*	*<0.1*	*5.8*	*<0.1*	*0.2*
Portfolio Total	**239.6**	**2,618.5**	**2,322.5**	**18.7**	**11.2**

Health benefits resulting from air quality improvements are not limited to one geographic region or state, and AIC's EE portfolio produces health benefits outside of Illinois. Therefore, we provide two estimates of health benefits produced by the AIC EE portfolio: an Illinois-specific estimate as well as a national estimate. Emissions reductions resulting from AIC's 2023 EE portfolio are expected to result in $332–551 million in national health benefits, as shown in Table 2. Illinois accounts for approximately 12% of the national benefits.

Table 2. AIC 2023 Energy Efficiency Portfolio Lifetime Societal Health Benefits

Sector	Verified Savings (GWh)	Verified Savings (Therms)	National Health Benefits (Million 2023 $)		Illinois Only Health Benefits (Million 2023 $)	
			Low	High	Low	High
Electric	*5,082*	*N/A*	*$311.27*	*$523.39*	*$32.27*	*$55.73*
Residential Gas	N/A	18,837,498	$8.84	$11.95	$3.00	$4.15
Nonresidential Gas	N/A	22,720,299	$11.01	$14.84	$3.63	$4.98
Gas Subtotal	*N/A*	*41,557,796*	*$19.86*	*$26.79*	*$6.63*	*$9.13*
Residential Propane	N/A	953,660	$0.57	$0.77	$0.19	$0.26
Nonresidential Propane	N/A	0	$0	$0	$0	$0
Propane Subtotal	*N/A*	*953,660*	*$0.57*	*$0.77*	*$0.19*	*$0.26*
Portfolio Total	**5,082**	**42,511,456**	**$331.70**	**$550.95**	**$39.09**	**$65.13**

The electric portfolio accounts for 95% of national benefits and 87% of Illinois benefits. This is because electric programs impact electric generation on a regional scale; the point at which reduced emissions occur is often not in the same region as where energy savings occur. In contrast, gas savings lead to direct emissions reductions in the same location as energy savings, and, therefore, a larger portion of the health benefits occur in Illinois.

The majority of health benefits come from avoided premature mortality, which makes up 94% of the low estimate and 96% of the high estimate for health benefits (both Illinois and nationally). The low and high estimates represent differences in the methods used to estimate some of the health impacts in COBRA.

1.4 CONCLUSIONS

EE programs can improve public health by reducing demand for fossil fuels and improving ambient air quality. We find that benefits are not limited to a single geographic area and are especially sensitive to measure lifetimes and the future fuel mix of the electric grid.

1.5 LIMITATIONS

There are inherent limitations to the analysis that come from various aspects, such as its focus and the projected fuel mix of the electric grid. Although improvements to air quality may result in additional societal benefits, such as improved visibility, recreational benefits, and avoided damages from decreased timber and agricultural yields, this analysis focused on monetizing the value of health benefits resulting from decreased exposure to ambient $PM_{2.5}$ and O_3. The health benefits largely depend on the accuracy of future projected electric grid fuel mixes; measure life and the emissions factors both play a key role in the accuracy of the projection. Increased measure savings over its life would produce higher than expected health benefits, and lower measure savings over its life would produce less than expected health benefits. A greener and cleaner grid will produce less than expected health benefits as fewer pollutants are being removed than if the grid still employed the same or more fossil fuel energy generating units.

Future electric emissions reductions are also uncertain. AVERT, used to determine the first five years, relies on historical generation and emissions data without considering factors such as fuel mix and/or changes in demand over the lifetime. Cambium data, used for the rest of the analysis lifetime, is not a perfect modeling dataset and has within it uncertainties that prevent it from perfectly matching the future. As such NREL encourages states that Cambium should be used in conjunction with other methods to better predict future scenarios.

1.6 RECOMMENDATIONS

Opinion Dynamics provides AIC with multiple estimates of societal health benefits from AIC's 2023 EE portfolio. To estimate these societal health benefits, we examined electric emissions reductions under three scenarios. The third scenario, which uses National Renewable Energy Laboratory (NREL)'s Cambium data to model the grid changes and emissions rates through 2052, projects a future period for the grid when health benefits from the electric program will reach an all-time low, due to a cleaner fuel mix for the electric grid. We recommend using this scenario to estimate emissions reductions moving forward.

We provide low and high estimates for the health benefits to demonstrate the full range of possible benefits accrued from AIC's EE portfolio. We recommend using the midpoint between high and low estimates for the cost-effectiveness testing and planning. These values are all provided in Appendix A.

2. INTRODUCTION

AIC administers dual-fuel EE programs across both the residential and nonresidential sectors that produce electric (kWh), gas (therms), and propane (therms) savings. By reducing consumption of natural gas, propane, and electricity, these programs result in reductions of emissions associated with fossil fuel combustion, including $PM_{2.5}$, ground-level O_3, NO_X, SO_2, NH_3, and VOCs. These pollutants can negatively impact the environment and human health. In particular, exposure to $PM_{2.5}$ and O_3 is associated with multiple health impacts, including premature fatality, non-fatal heart attacks, asthma aggravation, and other respiratory diseases.[11,12] By reducing emissions of primary $PM_{2.5}$, precursors to secondary $PM_{2.5}$ formation (NO_X, SO_2, NH_3, and VOCs),[13] and the buildup of ground level and O_3, EE programs represent a significant opportunity to improve regional air quality and increase health benefits.

Opinion Dynamics estimated the emissions reductions associated with measures implemented through AIC's 2023 EE portfolio of programs and quantified and monetized the public health benefits resulting from the subsequent reductions in ambient $PM_{2.5}$ and O_3 concentrations.[14]

This report includes the following sections:

- Section 3 details the methodology that we used throughout the analysis.
- Section 4 describes the results of our emissions reductions and health benefits analysis.
- Section 5 discusses final observations, model uncertainty, and considerations for future work.

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[11] U.S. EPA. 2024. Health and Environmental Effects of Particulate Matter. https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

[12] U.S. EPA. 2024. Health Effects of Ozone Pollution. https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

[13] Primary $PM_{2.5}$ refers to the direct emissions of $PM_{2.5}$ from fossil fuel combustion. Secondary $PM_{2.5}$ refers to $PM_{2.5}$ created through a series of reactions between SO_2, NO_X, NH_3, and VOCs in the atmosphere.

[14] Estimated health benefits reflect changes in regional emissions and air quality, and do not account for changes in indoor air quality.

3. DETAILED METHODOLOGY

This section describes our methodology for monetizing the societal health benefits associated with AIC's 2023 portfolio. First, we estimated the annual portfolio energy savings using inputs for cost-effectiveness testing and modeled their impact on emissions. Next, we modeled the impact of emissions reductions on ambient concentrations of $PM_{2.5}$ and O_3 and quantified the number and value of public health benefits resulting from changes in exposure to $PM_{2.5}$ and O_3. Because many of the measures implemented through AIC's 2023 EE portfolio continue to save energy beyond the first year, we modeled the emissions reductions and health benefits associated with the full measure lives of the measures installed through the 2023 EE portfolio. We calculate emissions reductions and public health benefits from electric, gas, and propane savings for years 2023–2052. In this report, propane savings are organized with gas savings due to similarities in units of measure, i.e., therms, analytical approach used to estimate emissions impacts and health benefits, and for practicality purposes as organizing propane with electric savings is confusing.[15]

3.1 ESTIMATE ENERGY SAVINGS

We based energy (kWh and therm) savings estimates on inputs used in cost-effectiveness testing.[16] To develop annual energy savings inputs, we aggregated the annual measure-level savings to the portfolio level and summed the savings from 2023–2052 to develop lifetime savings. First-year and lifetime portfolio savings are displayed in Table 3, and the annual savings estimates from 2023-2052 are displayed in Figure 2 and Figure 3.

Table 3. 2023 Portfolio Verified Savings[17]

Portfolio	First-Year (2023) Savings	Lifetime Savings
Electric Portfolio (GWh)	*413*	*5,082*
Residential Gas (therms)	772,285	18,837,498
Nonresidential Gas (therms)	1,346,649	22,720,299
Gas Subtotal (therms)	*2,118,934*	*41,557,796*
Residential Propane (therms)	86,696	954
Nonresidential Propane (therms)	0	0
Propane Subtotal (therms)	*86,696*	*953,660*
Gas Portfolio Total (therms)	*2,205,630*	*42,511,456*

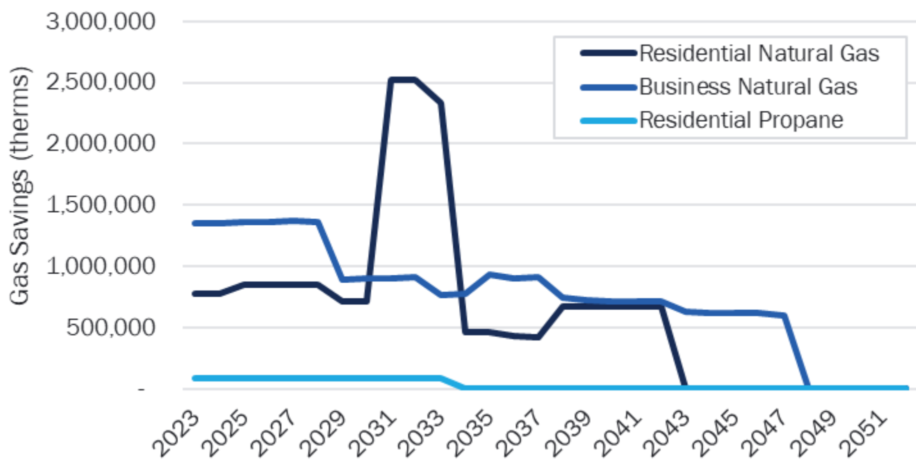
[15] Propane, non-AIC gas, and (b-25) fuel conversion gas savings are funded through 220 ILCS 5/8-103B (i.e., electric dollars) and are technically part of the 8-103B electric portfolio. Since AIC is a dual fuel utility, the cumulative benefits of the EE portfolio are prioritized in this report over proper accounting by funding mechanism.

[16] Opinion Dynamics 2023 program evaluations found at https://www.ilsag.info/evaluation-documents/final-evaluation-reports/#ameren.

[17] Ibid.

Figure 2. 2023 Verified Lifetime Electric Portfolio Savings[18]

Figure 3. 2023 Verified Lifetime Gas Portfolio Savings[19]



3.2 ESTIMATE EMISSIONS IMPACTS

3.2.1 ELECTRIC PORTFOLIO EMISSIONS IMPACTS

EE programs can reduce the emissions of criteria air pollutants and greenhouse gases by reducing consumption of electricity produced by the combustion of fossil fuels. However, the dynamic nature of the electric system creates uncertainty regarding the type and magnitude of emissions in future years. The location and magnitude of displaced emissions depends on the balance of electricity supply and demand, the generation fuel mix, the shape of the program's load impact profile, and a variety of other grid dynamics.

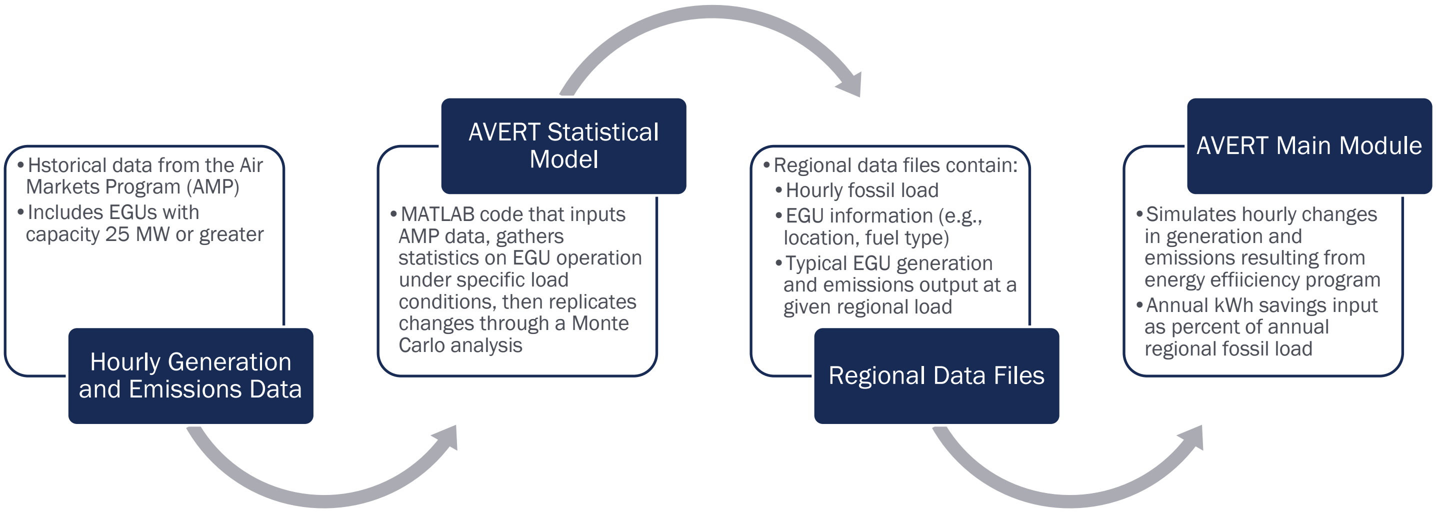
To estimate the emissions reductions from AIC's 2023 electric EE portfolio, we utilized the AVoided Emissions and GeneRation Tool (AVERT), a publicly available tool designed by the U.S. Environmental Protection Agency (EPA) to help

[18] Opinion Dynamics 2023 residential and business program evaluations found at https://www.ilsag.info/evaluation-documents/final-evaluation-reports/#ameren.

[19] Ibid.

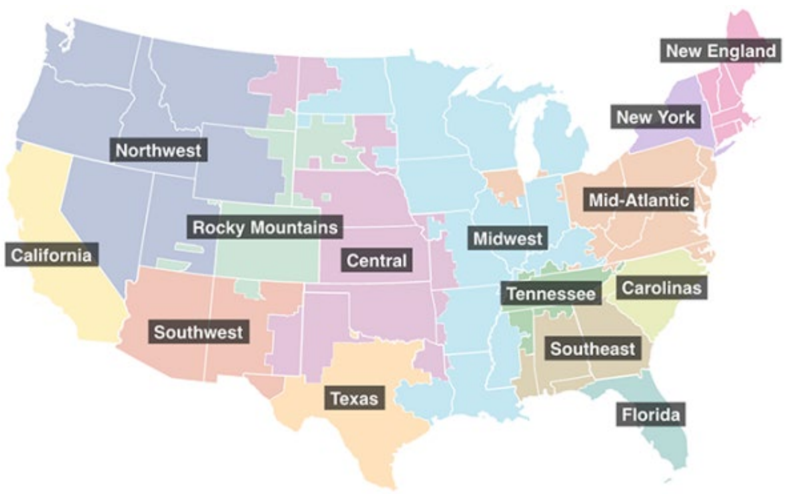
policy makers and analysts quantify the emissions impacts of EE and renewable energy programs.[20] AVERT performs statistical analysis on historical hourly emissions and generation data to estimate the impact of decreased demand for electricity on the generation of individual fossil fuel electric generation units (EGUs) and the subsequent emissions of SO_2, NO_X, and $PM_{2.5}$.[21] AVERT probabilistically estimates the output of individual EGUs and uses this statistical information to predict how they are likely to respond to load impacts. This process is demonstrated in Figure 4 below.

Figure 4. Process for Estimating Emissions Reductions from AIC's 2023 EE Portfolio



AVERT contains fourteen analysis regions, illustrated in Figure 5.[22] AIC operates within the Midcontinent Independent System Operator (MISO) service territory, which closely aligns with AVERT's Midwest region. We selected AVERT's Midwest region to model emission reductions.

Figure 5. AVERT Regions



[20] We conducted the analysis using AVERT v4.3, which was released on April 11, 2024.

[21] AVERT does not model reductions in NH_3 or VOCs, which are both precursors to $PM_{2.5}$ formation. However, according to the EPA, the electric generation sector accounts for less than one percent of NH_3 and VOC emissions.

[22] AVERT regions represent relatively autonomous electricity market trading and dispatch areas. While AVERT does account for the dependencies of generation units within a region, it does not account for electricity transfers between regions.

AVERT relies on historical data and does not account for potential future changes to the grid that may impact grid dynamics, such as increased renewable generation, coal plant retirement, changes in fuel prices, or technological advancements. AVERT's inability to accurately project changes in emissions five years beyond the most recent baseline year, currently 2023, is a limitation that the EPA acknowledges in their recommendation to not model emissions past 2027. Use of AVERT beyond 2027 could result in overestimation of emission reductions as the electric grid in the Midwest region is expected to see an increase in renewable resources. Therefore, we can reliably use AVERT to model changes occurring from 2023 through 2027. However, many of the measures included in AIC's electric portfolio have measure lives that continue through to 2052.

To estimate emissions reductions in the years 2028-2052, we developed three scenarios:

- Scenario A: Based on the EPA's historical trend of emissions factors from 2017 to 2023, we assume that avoided emissions per kWh will decrease at a consistent rate of 4% for NOx, 5% for SO2, and 2% for $PM_{2.5}$ through 2052. This represents a conservative estimate that is more likely to reflect future grid dynamics than Scenario B.
- Scenario B: We assume future avoided emissions per kWh will remain constant. Scenario B represents an aggressive estimate of emissions reductions from AIC's 2023 electric portfolio.
- Scenario C: We use the National Renewable Energy Laboratory's (NREL) Cambium data, which forecasts structural changes to the electric grid through 2050 based on fuel costs, technology costs, and policies, and provides annual emission rates which we used in our analysis.[23]

We discuss the methods used for modeling changes in emissions for 2023-2027 and 2028-2052 in the following sections.

Emissions Reductions for Analysis Years 2023–2027

We completed a separate AVERT run for each year to estimate the emissions reductions resulting from energy savings in 2023 through 2027. We used the projected savings from the verified cost-effectiveness analysis as the inputs for the annual generation reduction for these five years.

Emissions Reductions for Analysis Years 2028–2052

As previously discussed, we used three methods for modeling emissions reductions beyond 2027, the last year in which AVERT reliably produces results.

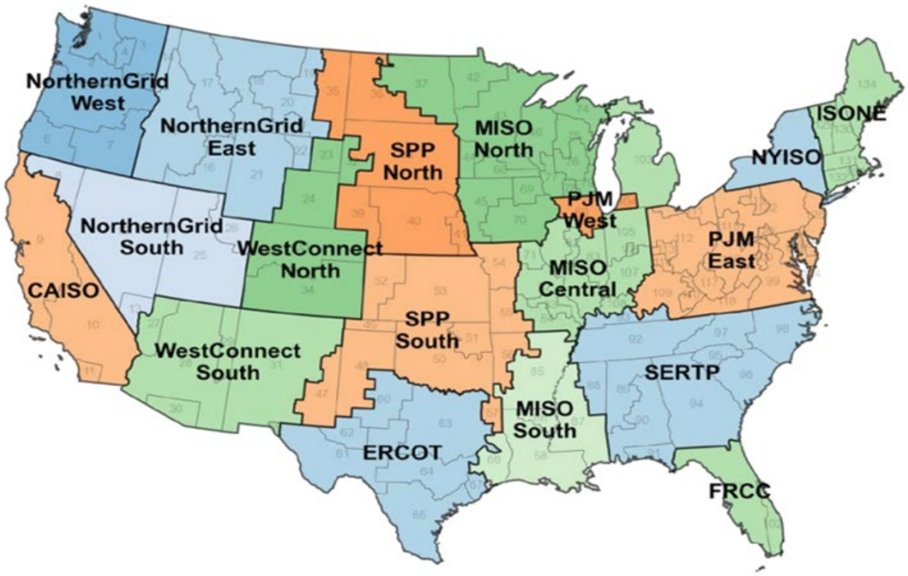
- For Scenario A, we first calculated the average annual percent reduction in AVERT-generated SO_2, NO_X, and $PM_{2.5}$ avoided emissions factors (e.g., tons of pollutant avoided per kWh of electricity saved) from 2017–2023.[24] We then forecasted future avoided emissions factors (2028–2052) by applying the percent change in each emission factor to the 2027 AIC 2023 electric portfolio emissions factors for each consecutive future year. Finally, we multiplied each year of kWh savings by the respective avoided emissions factors to find total emissions reductions for each year from 2028 to 2052.
- To estimate emissions reductions for Scenario B, we applied the modeled 2027 SO_2, NO_X, and $PM_{2.5}$ avoided emissions factors to the annual kWh savings each year from 2028 to 2052.
- To use the Cambium data in Scenario C, we combined the three MISO regions, shown in Figure 6, to align NREL's analysis regions to AVERT's analysis regions. We did this by weighing each region's total energy generation. Using the regional weights, we derived an average emissions factor for CO_2 equivalents (CO_2e) for the combined region

[23] Cambium 2023 Scenario Descriptions and Documentation. https://www.nrel.gov/docs/fy24osti/88507.pdf

[24] U.S. EPA. 2024. Avoided Emissions Factors Generated from AVERT v4.3. https://www.epa.gov/avert/avoided-emission-rates-generated-avert

for years 2028 through 2025. We then multiplied these average emissions factors by the kWh savings each year from 2028 to 2052.

Figure 6. Cambium Regions



3.2.2 GAS PORTFOLIO EMISSIONS IMPACTS

Opinion Dynamics used a separate approach to estimate emissions reductions resulting from program-induced natural gas and propane savings. We used the U.S. EPA's recommended natural gas and propane emissions factors to estimate the emissions reductions from gas and propane saved through AIC's 2023 portfolio.[25,26] We aggregated the annual portfolio savings and multiplied each year of savings by emissions factors for $PM_{2.5}$, NO_x, SO_2, NH_3, and VOCs. Table 4 displays the U.S. EPA recommended emissions factors, grouped by fuel, sector, and pollutant. Emissions factors are displayed as pounds per million cubic feet of natural gas. For propane, they are pounds per thousand barrels (lb/Mbbl) for residential use and pounds per thousand gallons (lb/MGal) for nonresidential use.

Table 4. Natural Gas and Propane Emissions Factors

Pollutant	Natural Gas		Propane	
	Residential (lb/MMCF)	Nonresidential (lb/MMCF)	Residential (lb/Mbbl)	Nonresidential (lb/MGal)
$PM_{2.5}$	0.43	0.43	1.71	0.04
NO_x	94	100	562.80	14.23
SO_2	0.60	0.60	2.39	0.06
NH_3	20	0.49	1.95	0.05
VOC	5.50	5.50	21.91	0.52

[25] Wagon Wheel Emissions Factors, March 2023. https://www.epa.gov/system/files/documents/2023-03/NEI_2020_Wagon_Wheel_EFs_24mar2023.xlsx

[26] Green House Gas Emissions Factor Hub, September 2023. https://www.epa.gov/climateleadership/ghg-emission-factors-hub

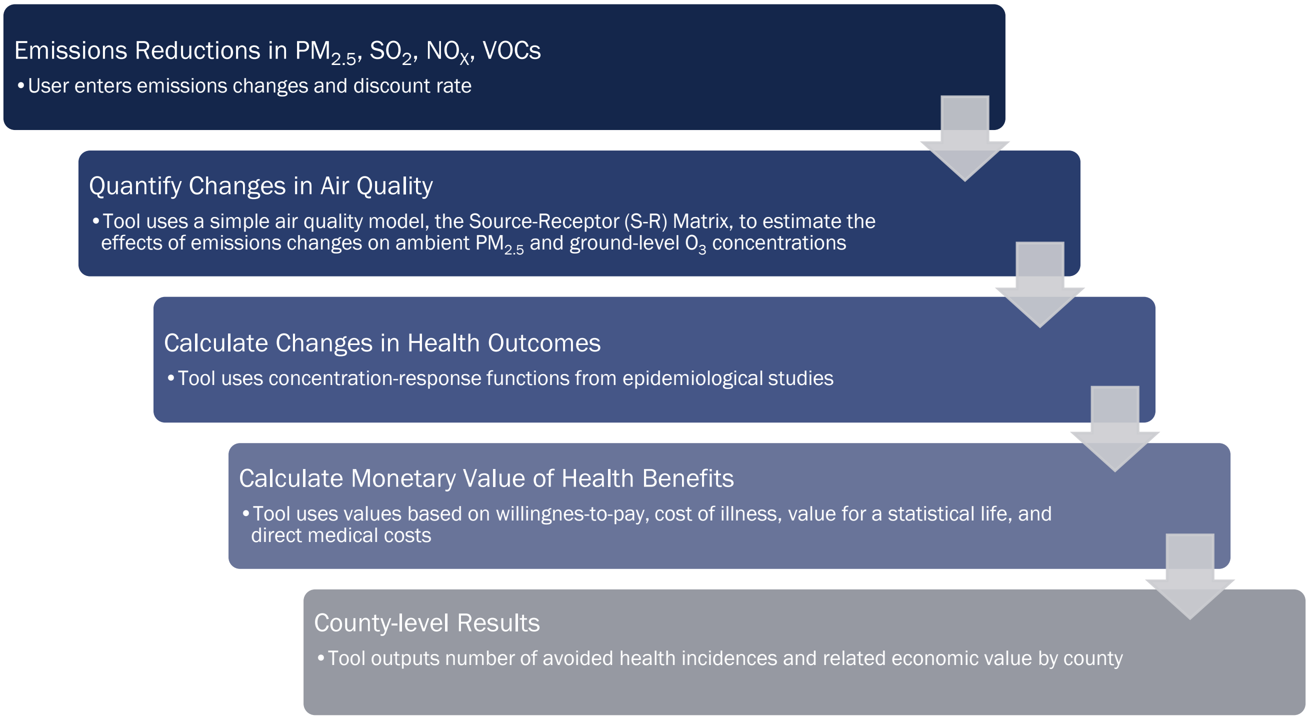
3.3 ESTIMATE CHANGES IN AIR QUALITY AND MONETIZE HEALTH IMPACTS

3.3.1 COBRA MODEL DESCRIPTION

Opinion Dynamics utilized the CO-Benefits Risk Assessment (COBRA) Health Impacts model to estimate changes in ambient air quality, public health impacts, and monetized health benefits resulting from emissions reductions of primary $PM_{2.5}$, SO_2, NO_X, and VOCs. COBRA is a peer-reviewed screening tool provided by the U.S. EPA.[27] The COBRA modeling process is summarized in Figure 7.

COBRA uses a reduced-form air quality model[28] to estimate how changes in emissions of $PM_{2.5}$ and its precursors will affect ambient $PM_{2.5}$ and O_3 concentrations in counties throughout the U.S. Next, COBRA uses a series of concentration-response functions to calculate how the change in $PM_{2.5}$ and O_3 affects health outcomes. Finally, COBRA calculates the value of the avoided health damages valuation functions from the economic literature.[29] We describe each of these steps below.

Figure 7. Steps to Estimate and Monetize Health Impacts using COBRA



QUANTIFY CHANGES IN AIR QUALITY

COBRA is based on runs from the EPA's Climatological Regional Dispersion Model (CRDM), a sophisticated air quality modeling tool. It is calibrated using actual EPA county-level monitoring data.

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[27] U.S. EPA. 2024. CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool. Version 5.1. https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool. Downloaded July 2024.

[28] COBRA relies on the Phase II Source Receptor (S-R) Matrix, a simplified version of the Climatological Regional Dispersion Model (CRDM), to conduct air quality modeling.

[29] COBRA allows users to input custom valuation functions. However, we used the default functions which are consistent with EPA regulatory analyses.

QUANTIFY CHANGES IN HEALTH OUTCOMES

COBRA uses health effect functions from epidemiological literature to determine the effect of changes in ambient $PM_{2.5}$ and O_3 concentrations on health impacts. These include the number of avoided premature deaths, heart attacks, hospital admissions for respiratory and cardiovascular-related illnesses, incidences of acute bronchitis, upper and lower respiratory symptoms, asthma exacerbations or emergency room visits, minor restricted activity days, and illness-related work loss days.

QUANTIFY THE MONETARY VALUE OF HEALTH BENEFITS

COBRA then estimates the monetary value of these health impacts using valuation functions from economic literature. While most health effects, like avoided emergency room visits for asthma, occur in the same year as the emissions reductions, avoided mortality and non-fatal heart attacks occur over multiple years. In other words, a decrease in $PM_{2.5}$ and O_3 exposure in 2023 is expected to result in a decrease in heart attack incidence over a period of 20 years. Therefore, we must discount these benefits to the year of emissions reductions. We use a 2.00% discount rate to align with an Illinois stakeholder agreement for the 2026-2029 EE plan filings.[30] Further detail on the health impact and economic valuation functions can be found in the COBRA user manual.[31]

3.3.2 COBRA MODEL RUNS DESCRIPTION

COBRA models the improvement in ambient air quality and health outcomes from emission reduction inputs for one of three baseline years: 2016, 2023, or 2028. Each baseline year contains detailed emissions, population, and health incidence estimates. We conducted COBRA runs at the portfolio level and separately ran COBRA for electric, residential and nonresidential gas, and residential and nonresidential propane savings produced by AIC's EE portfolio.[32]

COBRA allows users to specify emissions reductions at county, state, regional, or national levels for 14 emission source categories, including fuel combustion from electric utilities. We selected different geographies for gas and electric EE portfolios as a result of where emissions reductions occur and, in turn, where health benefits accrue.

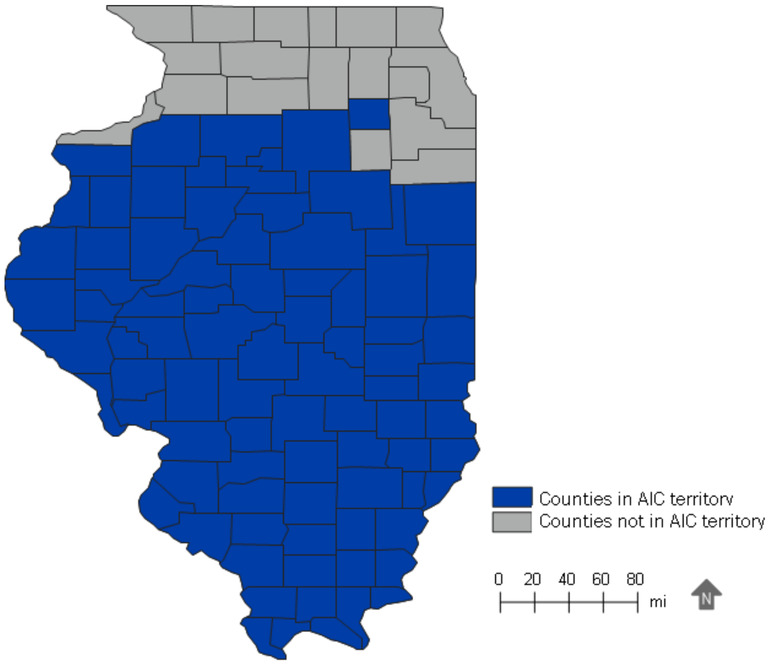
Emissions reductions from the gas EE programs occur in the same location where the programs take place. Therefore, we selected a subset of Illinois counties that are within AIC's service territory and contain more than ten customers served by a gas EE program in 2023. We exclude counties with ten or fewer AIC gas customers due to uncertainty around modeling small changes in energy use and correlation to health benefits. This is consistent with the 2018 study and recommendations by the U.S. EPA on application of AVERT and COBRA models. Figure 8 depicts the counties we included in the analysis.

[30] Personal communication from M. Armstrong, September 6, 2024.

[31] COBRA Version 5.1 User Manual. https://www.epa.gov/cobra/users-manual-co-benefits-risk-assessment-cobra-screening-model

[32] Because COBRA uses a simplified air quality model, the value of health benefits varies linearly with the magnitude of emissions impacts inputs. Therefore, AIC's electric, residential gas, nonresidential gas, residential propane and nonresidential propane portfolios can be modeled separately.

Figure 8. Selected Counties in Natural Gas and Propane COBRA Runs



For electric programs, emission reductions and health benefits are realized regionally and not isolated to where the EE intervention occurred. AVERT produces a COBRA formatted input file that contains a distribution of emissions reductions for each county in the Midwest region. For 2023 through 2027, we uploaded the AVERT output directly to COBRA. For analysis of years 2028 through 2052, which are modeled outside of AVERT, we distributed the total estimated emissions reductions across the Midwest region in the same proportion as the 2027 AVERT model output. This assumes no change in the distribution of emission reductions through 2052 but avoids evenly distributing the emission reductions, and health benefits, across the Midwest region, which is inconsistent with how emissions reductions are realized.

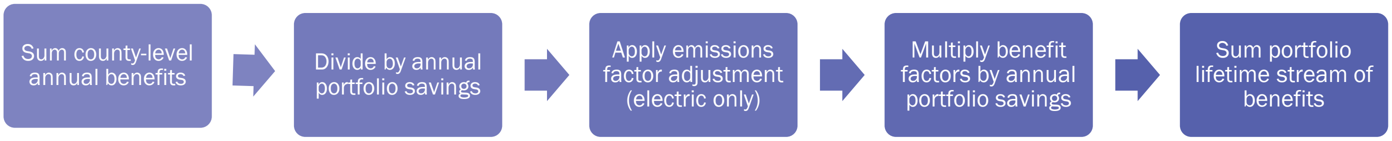
3.3.3 CREATE BENEFIT FACTORS

COBRA models air quality changes and health benefits at a county level. For each baseline year, we summed the total health benefits for every county in the U.S. and divided by the energy savings associated with those health benefits to develop portfolio-level benefit-per-kWh and benefit-per-therm factors. For Scenarios A and C, we needed to account for the effect of decreasing electric emissions intensities. For Scenario A, we applied an emissions factor adjustment that compared a 2028 COBRA run with a Scenario A adjusted 2029 run in COBRA to determine the yearly emissions adjustment factor. For Scenario C, we applied an emissions factor adjustment that compared the changes in emissions intensity for the different ranges of five-year intervals that the Cambium data provided. For each interval of years, we ran a COBRA analysis for two separate years to study the change within the interval and produce adjustment factors.[33] Finally, we applied the 2.00% AIC discount rate to discount the benefit factors back to 2023 benefits in COBRA. To estimate total portfolio benefits, we multiplied the annual savings for the portfolio by the appropriate benefit factor and then summed the annual stream of benefits. These steps are summarized in Figure 9 below.

Table 5. COBRA Baseline Year Used for Portfolio Years 2023 –2052

COBRA Baseline Year	Portfolio Years
2023	2023-2027
2028	2028-2052

Figure 9. Steps to Estimate Portfolio Annual Health Benefits



[33] Cambium data comes in five-year intervals starting from 2025 and ending in 2050. Each interval has a different trend for emissions factors, which was used to define the adjustment factors for each interval.

4. RESULTS

In the sections that follow, we present results of the emissions reduction analysis for AIC's 2023 EE portfolio of electric, gas, and propane energy savings, followed by the corresponding monetized health impacts.

4.1 EMISSIONS REDUCTIONS

4.1.1 ELECTRIC PORTFOLIO

The results of each AVERT run for the years 2023–2027 are displayed in Table 6 below. The emissions reductions reflect the fuel mix of the Midwest, which generally has higher avoided SO_2 and NO_X emissions rates compared to other regions.[34]

Table 6. AIC 2023 Electric Portfolio Avoided Emissions (2023–2027)

Year	Portfolio Verified Net GWh Savings	Avoided SO_2 (tons)	Avoided NO_X (tons)	Avoided $PM_{2.5}$ (tons)
2023	413.0	238.3	193.2	21.7
2024	413.0	238.3	193.2	21.7
2025	406.1	234.4	190.0	21.4
2026	402.8	232.5	188.5	21.2
2027	401.0	231.4	187.6	21.1

The measures installed as part of AIC's 2023 EE portfolio are expected to save 5,082 GWh over their lifetimes. Table 7 displays the expected emissions reductions resulting from these programs. Scenario C, which accounts for future changes to the grid using Cambium, results in 11% lower lifetime emissions reductions of $PM_{2.5}$, SO_2, and NO_X than in Scenario B, which does not account for these changes. Scenario C also has 1% higher lifetime emissions of SO_2 and NO_X and 16% lower emissions reductions of $PM_{2.5}$ than Scenario A, which also accounts for future changes to the grid using historical data.

Table 7. AIC 2023 Electric Portfolio Lifetime Emissions Reductions

Pollutant	Scenario A (tons)	Scenario B (tons)	Scenario C (tons)	Percent Difference between B and C	Percent Difference between A and C
$PM_{2.5}$	286	268	239	-11%	-16%
SO_2	2,579	2,936	2,617	-11%	1%
NO_X	2,091	2,381	2,122	-11%	1%

Figure 10 through Figure 12 display the predicted annual emissions reductions in $PM_{2.5}$, SO_2, and NO_X from 2023–2052. While we present all three scenarios for emissions reductions, we recommend using Scenario C to model future health benefits for context.

[34] U.S. EPA. 2024. Avoided Emissions Factors Generated from AVERT. April 2024. https://www.epa.gov/statelocalenergy/avoided-emission-factors-generated-avert-0

Figure 10. AIC 2023 Scenario A Electric Portfolio Annual Emissions Reductions

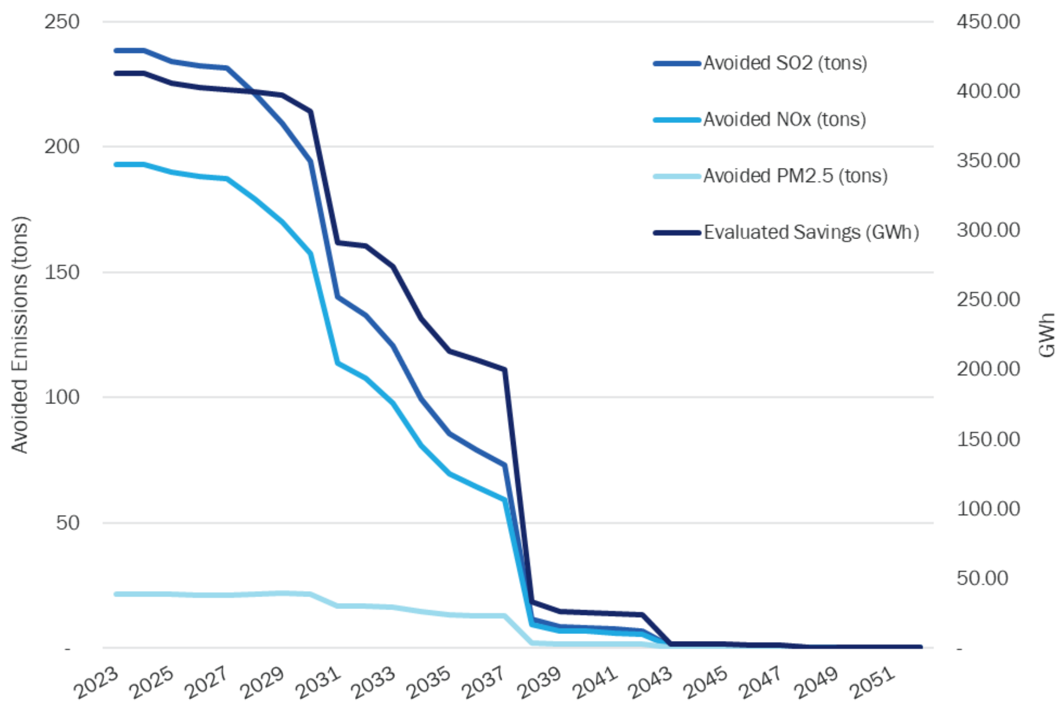


Figure 11. AIC 2023 Scenario B Electric Portfolio Annual Emissions Reductions

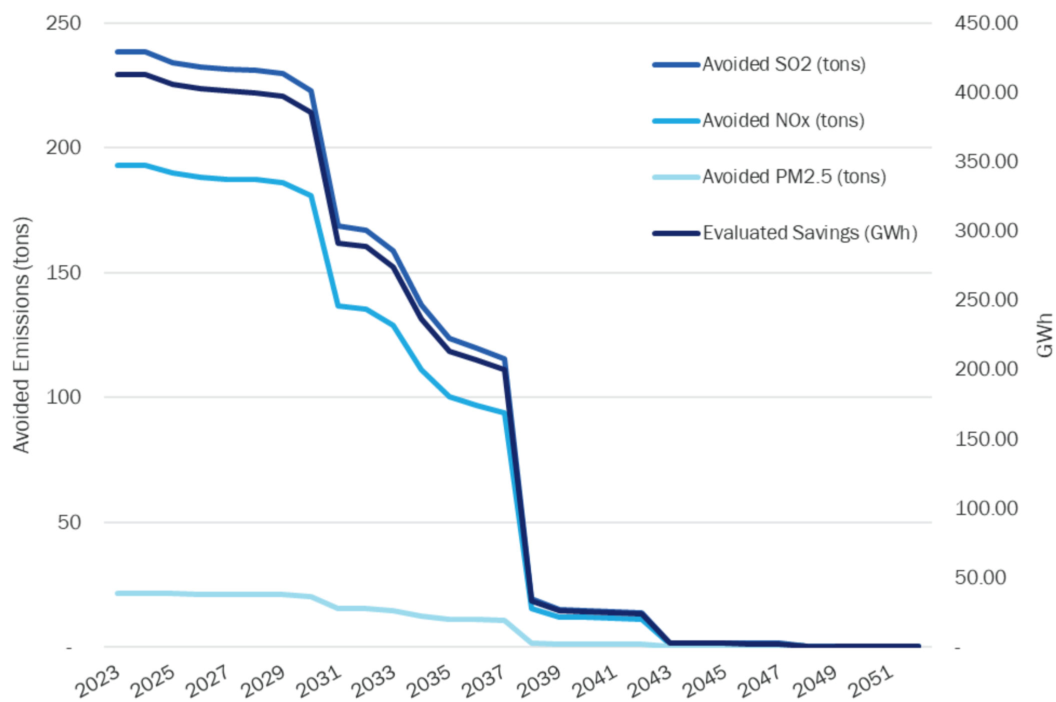
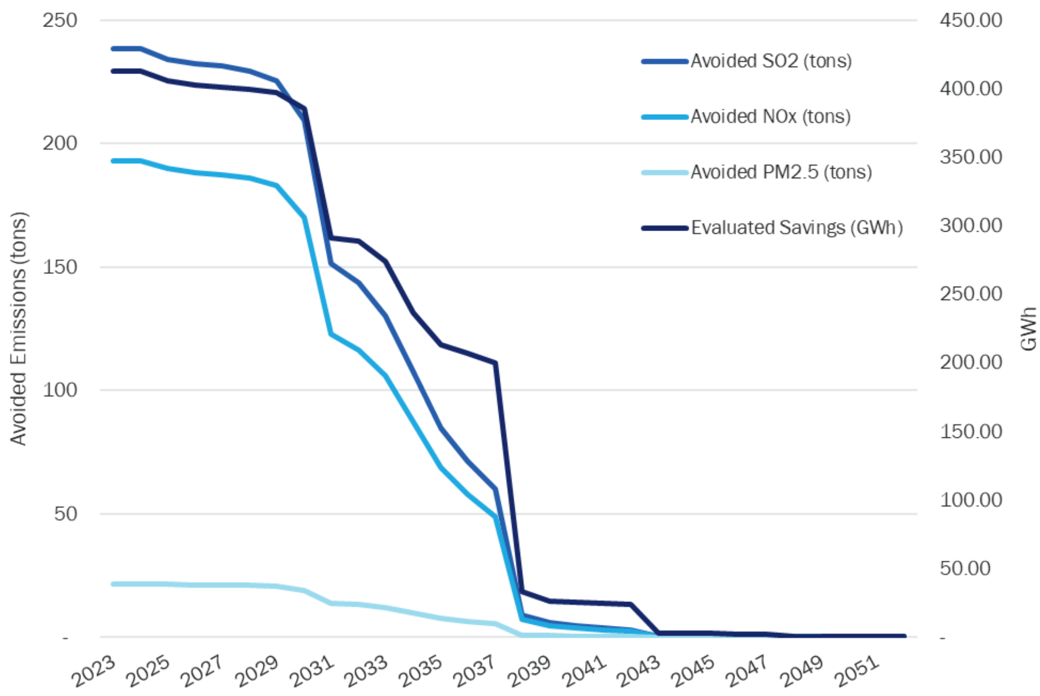


Figure 12. AIC 2023 Scenario C Electric Portfolio Annual Emissions Reductions



4.1.2 GAS PORTFOLIO

The lifetime savings for AIC's 2023 residential portfolio is 18,837,498 therms from natural gas and 953,660 therms from propane. The lifetime savings for its nonresidential portfolio is 22,720,299 therms from natural gas (see Table 3). Table 8 displays the emissions reductions resulting from these energy savings.

Table 8. AIC 2023 Gas Portfolio Lifetime Emissions Reductions

Pollutant	Natural Gas		Propane	
	Residential (tons)	Nonresidential (tons)	Residential (tons)	Nonresidential (tons)
$PM_{2.5}$	0.4	0.5	<0.1	0
SO_2	0.5	0.6	<0.1	0
NO_X	85.3	109.4	5.8	0
NH_3	18.1	0.5	<0.1	0
VOCs	5.0	6.0	0.2	0

4.2 HEALTH BENEFITS

Table 9 presents estimates for the national health benefits accruing from AIC's 2023 EE portfolio. Benefits are shown in high and low estimates. AIC's 2023 EE portfolio is expected to produce $332–551 million dollars in national health benefits from 2023–2052. The high and low estimates of health benefits primarily reflect uncertainty in the impact of changes in exposure to $PM_{2.5}$ and O_3 on pre-mature mortality and non-fatal heart attacks. On average, the electric portfolio accounts for approximately 94% of these national health benefits.

Table 9. COBRA Results - Portfolio National Health Benefits

Sector	First-Year Health Benefits (Million 2023 $)		Lifetime Health Benefits (Million 2023 $)	
	Low	High	Low	High
Electric	*$25.88*	*$44.14*	*$311.27*	*$523.39*
Residential Gas	$0.32	$0.44	$8.84	$11.95
Nonresidential Gas	$0.59	$0.80	$11.01	$14.84
Gas Subtotal	*$0.91*	*$1.24*	*$19.86*	*$26.79*
Residential Propane	$0.05	$0.06	$0.57	$0.77
Nonresidential Propane	$0	$0	$0	$0
Propane Subtotal	*$0.05*	*$0.06*	*$0.57*	*$0.77*
Portfolio Total	**$26.84**	**$45.45**	**$331.70**	**$550.95**

Table 10 presents estimates for the health benefits that are realized in Illinois from AIC's 2023 EE portfolio. AIC's 2023 EE portfolio is expected to produce $39–$65 million dollars in health benefits in Illinois from 2023–2052.

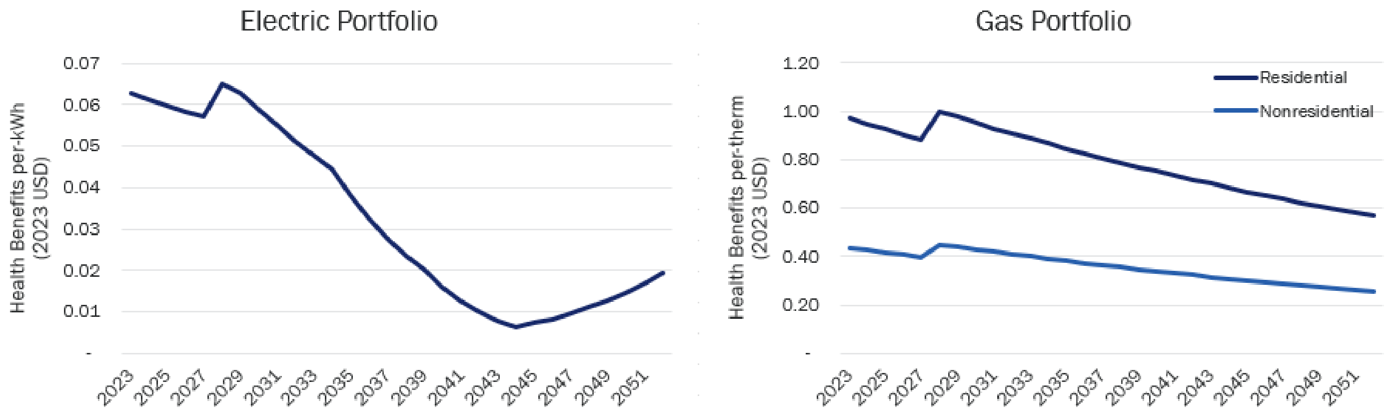
Table 10. COBRA Results - Portfolio Illinois Only Health Benefits

Sector	First-Year Health Benefits (Million 2023 $)		Lifetime Health Benefits (Million 2023 $)	
	Low	High	Low	High
Electric	*$2.71*	*$4.74*	*$32.27*	*$55.73*
Residential Gas	$0.11	$0.15	$3.00	$4.15
Nonresidential Gas	$0.19	$0.27	$3.63	$4.98
Gas Subtotal	*$0.30*	*$0.42*	*$6.63*	*$9.13*
Residential Propane	$0.02	$0.02	$0.19	$0.26
Nonresidential Propane	$0	$0	$0	$0
Propane Subtotal	*$0.02*	*$0.02*	*$0.19*	*$0.26*
Portfolio Total	**$3.03**	**$5.19**	**$39.09**	**$65.13**

Approximately 12% of the national benefits occur in Illinois. The health benefits of AIC's electric programs in Illinois, which impact electric generation and emissions on a regional scale, account for 11% of national electric benefits. The health benefits of AIC's gas and propane programs, which produce emissions reductions in the same location as energy savings (i.e. in Illinois), only account for 34% of the national health benefits for gas and propane. We expect the benefits from gas programs to be centralized in Illinois, due to where the fuel combustion occurs, but we find that they are dispersed more widely like those associated with the electric grid. This is due to a limitation in the COBRA model, in that it is an outdoor air dispersion model that is unable to model indoor air quality changes.

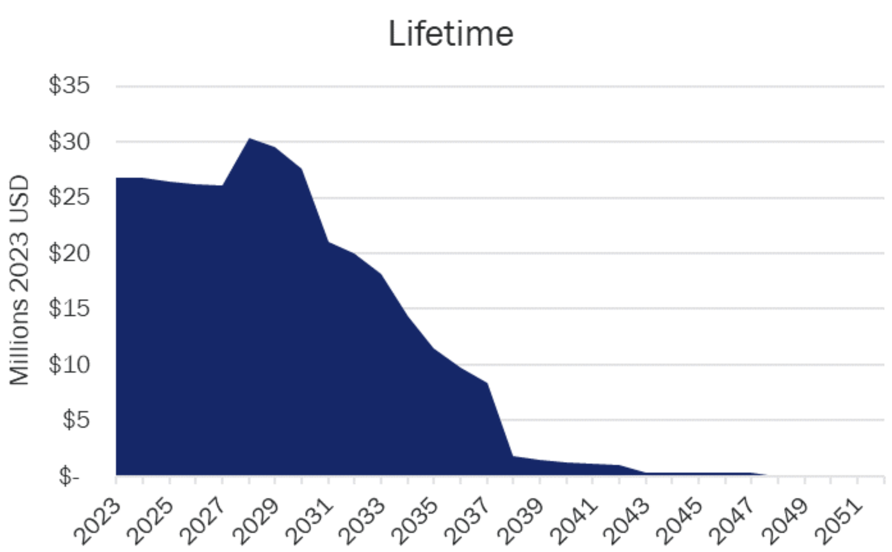
Figure 11 displays the discounted national benefit factors for the electric and gas portfolios. These factors represent the value of national health benefits per kWh or therm saved. Changes in the benefit factors over time are driven by multiple factors, including shifting COBRA baselines, the AIC discount rate, and, for electric factors, decreasing emissions intensity over time. The electric portfolio depicts the suggested Scenario C.

Figure 13. Electric and Gas Portfolio Benefit Factors (Low Estimate)



Nearly half (49%) of all national health benefits occur in the first six years of analysis (Figure 14). Benefits decline over time for various reasons and are driven by measure lifetimes, the value of avoided health impacts in the present versus the future (i.e., discount rate), and declining emissions intensities over time.

Figure 14. Lifetime National Societal Health Benefits (Low Estimate) 2023–2052



4.3 COMPARISON TO 2018

The total benefits from this year's analysis have increased significantly since the last time this analysis was completed in 2021 using the 2018 data. On average, between high and low estimates, the total benefits increase by 155% for Illinois-only and 196% for national benefits (see Table 11).

Table 11. Total Benefits Between 2018 and 2023 Compared

Program Analysis Year	Geography	Total Benefits (Low Estimate)	Total Benefits (High Estimate)	Total Benefits (Average)	% Change
2018	Illinois	$12,562,934	$28,303,185	$20,433,060	-
	National	$91,731,265	$206,821,702	$149,276,483	-
2023	Illinois	$39,088,201	$65,125,915	$52,107,058	155%
	National	$331,701,436	$550,950,683	$441,326,059	196%

This increase is due to multiple factors. The two most significant contributors to the increase between analysis years are the increase in portfolio savings and the introduction of ground-level O_3 concentration considerations with updated benefit calculations in the new version of COBRA. First, the increase in overall savings from the electric and gas portfolios due to reduced emissions lends itself to greater benefits. The electric portfolio saw a 42% increase in savings, while the gas portfolio saw a 14% decrease in savings, resulting in an increase in total benefits (see Table 12).

Table 12. Comparison of 2023 Electric and Gas Portfolios to 2018

Program Analysis Year	GWh Savings	Therm Savings
2018	3,570.59	49,235,852
2023	5,081.72	42,511,456
% Change	42%	-14%

Ground-level O_3 concentration reduction considerations are new to COBRA in version 5.1. From the analysis, we observed that O_3 accounted for roughly a third of the total benefits for the electric portfolio. From the gas portfolio, we observed that roughly 60% of the total benefits come from O_3; a major contributing factor to the large increase in benefits seen from the gas portfolio. The total benefits have increased with the addition of O_3, and new benefit factors based solely on $PM_{2.5}$ concentration reductions that were not seen in version 4.0.

5. CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

EE portfolios can improve air quality and public health by reducing demand for fossil fuels and improving ambient air quality. We find benefits are not limited to a single geographic area and are especially sensitive to the installed measure lifetimes and the future fuel mix. We see a significant increase in total health benefits due to two main factors: an overall increase in portfolio savings and adding ground-level O_3 concentration reductions to the COBRA model, producing new $PM_{2.5}$ and O_3 health-related benefits. The estimates provided in this report help AIC understand the extent of the societal health benefits stemming from their EE portfolio.

According to Cambium data trends, there will be a point between 2042 and 2047 when the health benefits received from the electric portfolio will hit a low point (see electric portfolio in Figure 13). This is likely because, as time progresses, the grid will adopt more green technologies for producing energy, making it cleaner. The cleaner the grid gets, the lower the health benefits that can be gained from electric programs, as emissions rates are lower. Although the future remains impossible to predict perfectly, this situation is not seen when using Scenario A and is important to consider for planning purposes for EE programs.

5.2 LIMITATIONS

5.2.1 EMISSIONS REDUCTIONS

AVERT does not account for factors such as fuel mix changes or electric demand changes. Therefore, AVERT cannot model changes in emission reductions in the past five years. In addition, AVERT assumes that the generation reductions resulting from EE programs only affect fossil fuel EGUs. If generation from other sources (nuclear, solar, etc.) is displaced by EE programs, AVERT will, in turn, overestimate emission reductions. To overcome this, we explored three scenarios that look at historical trends (Scenario A), assume a fixed rate (Scenario B), and use the Cambium data (Scenario C). Moreover, we feel that Scenario C is a better option to better predict the future of the grid.

AVERT conducts modeling for one of fourteen regions representing relatively autonomous electricity markets and dispatch systems. These systems are meant to account for regional differences in fuel mixes and emissions. However, while AVERT treats each region independently, the grid is interconnected, and electricity transfers occur across regions, which could result in either overestimating or underestimating emissions reductions.

NREL's Cambium database only provides emissions rates for carbon equivalents and not specifically SO_2, NO_X, and $PM_{2.5}$, which limits how well it compares to the emissions rates produced by AVERT. As seen in Figure 5 and Figure 6 the Midwest region is most nearly approximated by three separate MISO regions, which need to be averaged together to produce emissions rates for the approximated Midwest region. Although Cambium is not a perfect model, NREL states that it should also be used in conjunction with other methods to help better understand future scenarios, despite how comprehensively it strives to capture relevant phenomena.

5.2.2 AIR QUALITY AND HEALTH BENEFITS

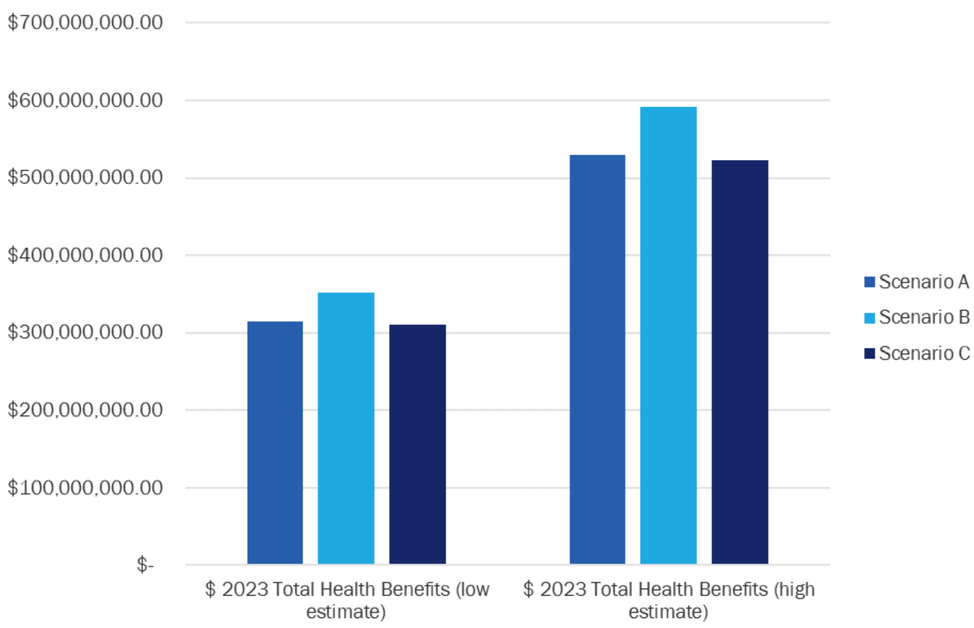
COBRA utilizes a reduced-form air quality model and thus does not account for much of the complexity of atmospheric $PM_{2.5}$ formation that more sophisticated air quality models do. Therefore, the EPA considers COBRA a screening-level tool. In addition, there is uncertainty surrounding the impact of changes in $PM_{2.5}$ and O_3 concentrations on human health, specifically, non-fatal heart attacks and adult mortality. COBRA reports low and high estimates for both impacts derived from different sets of assumptions from epidemiological literature.

There are additional societal benefits of emissions reductions that are outside the scope of this analysis. Reducing the ambient concentration of $PM_{2.5}$ and O_3 such as visibility improvements, recreational benefits, avoided damages from decreased timber and agricultural yields, among others. Finally, while it is possible to quantify the reductions in CO_2 resulting from AIC's EE portfolio, we exclude CO_2 from this analysis for several reasons. First, while CO_2 emissions and climate change are associated with public health impacts such as increased heat stress, these impacts are not quantified in COBRA. Furthermore, AIC already applies a carbon adder to their cost-effectiveness testing.[35,36]

5.3 RECOMMENDATIONS

Opinion Dynamics recommends using Scenario C to estimate emissions reductions for the years 2028 and beyond. Scenario A considers the fact that emissions will decrease over time per kWh. However, it only uses historical data to predict a trend that is only as accurate as the amount of historical data available. Using Cambium data, Scenario C can predict future grid changes using a more sophisticated model. Scenario A is the conservative option, holding to the previously known historical trend, Scenario B is the most liberal option, assuming that the grid will not change at all during the lifetime. As seen in Figure 15, Scenario C has 1% fewer total health benefits than Scenario A, which was set to be the conservative estimate between A and B.

Figure 15. Comparison of Total Health Benefits for Each Electric Scenario



[35] For the 2022-2025 Plan, see "Cost-Effectiveness Table – Oct. Update to Non-Measure Level Inputs" on the Illinois SAG website for further details: https://ilsag.s3.amazonaws.com/TRC_Inputs_Table_All-Utilities_Updated-Oct-2020.xlsx

[36] For the 2026-2029 Plan, personal communication from M. Armstrong, September 6, 2024.

This small overall difference between A and C is due to the distribution of electric energy savings and losses in the COBRA algorithms. The distribution of savings is as follows: The first 40% of the portfolio's savings occurs in the first five years (from 2023 to 2027), where there is no change in emissions health benefits between each scenario due to the use of AVERT. In the next ten years after AVERT (from 2028 to 2037), 57% of the portfolio's savings occurs. The final 3% of portfolio savings occurs in the final fifteen years. Over time, as the difference in emissions factors between Scenarios A and C increases, the amount of electric savings decreases. The lowest point in emissions taken from Cambium is from 2040-2047. The difference between Scenarios C and A is 84% at its lowest. This period only affects about 2% of the total portfolio savings, as shown below in Table 13, the full table is shown in Appendix B.

Table 13. Change in Portfolio Savings and Scenario A to C Over Time from 2040-2047

Savings Year	Portfolio Savings (MWh)	Distribution of Portfolio Savings	Sum of Savings Up to Year	% Change from A to C
2040	25,522	0.50%	98.71%	-64.44%
2041	24,494	0.48%	99.19%	-70.83%
2042	23,913	0.47%	99.66%	-76.08%
2043	2,880	0.06%	99.72%	-80.38%
2044	2,878	0.06%	99.78%	-83.91%
2045	2,549	0.05%	99.83%	-81.09%
2046	2,414	0.05%	99.88%	-77.77%
2047	2,401	0.05%	99.92%	-73.88%

This means that even though the decrease in emissions during this period is large, its effect on the overall scenario is small. From this we expected there to overall be about a 9% difference between Scenarios A and C, but due to losses in the calculation of health benefits in COBRA, this changed to the 1% shown in Figure 15. Despite the small overall difference between A and C, as time draws close to the projected low point and this analysis is repeated, the magnitude of the difference between the two scenarios will become more readily apparent. Scenario C captures the changes in the grid in greater detail.

We provide high and low estimates for health benefits to demonstrate the full range of possible benefits. We recommend using the midpoint between the high and low benefit estimates for cost-effectiveness testing. We also recommend that in developing plans for future programs, AIC should consider the low point resulting from using the Cambium data. During that period of eight years, the societal health benefits seen from electric programs will be comparatively lower. If possible, AIC should consider if there are other ways to make up for the difference during this period.

APPENDIX A. COST-EFFECTIVENESS INPUTS

Table 14 and Table 15 display the annual undiscounted health benefits per kWh or therm values associated with AIC's 2023 electric, residential gas and propane, and nonresidential gas and propane portfolios. Values represent the midpoint between the high and low health benefits estimates for national and Illinois-only factors.

Table 14. National Cost-Effectiveness Inputs

Savings Year	National				
	Electric	Residential Propane	Nonresidential Propane	Residential Gas	Nonresidential Gas
	$/kWh	$/therm	$/therm	$/therm	$/therm
2023	0.0848	0.6495	0	0.4944	0.5148
2024	0.0848	0.6495	0	0.4944	0.5148
2025	0.0848	0.6495	0	0.4944	0.5148
2026	0.0848	0.6495	0	0.4944	0.5148
2027	0.0848	0.6495	0	0.4944	0.5148
2028	0.0973	0.7479	0	0.5680	0.5919
2029	0.0964	0.7479	0	0.5680	0.5919
2030	0.0922	0.7479	0	0.5680	0.5919
2031	0.0882	0.7479	0	0.5680	0.5919
2032	0.0843	0.7479	0	0.5680	0.5919
2033	0.0806	0.7479	0	0.5680	0.5919
2034	0.0771	0.7479	0	0.5680	0.5919
2035	0.0672	0.7479	0	0.5680	0.5919
2036	0.0586	0.7479	0	0.5680	0.5919
2037	0.0511	0.7479	0	0.5680	0.5919
2038	0.0446	0.7479	0	0.5680	0.5919
2039	0.0389	0.7479	0	0.5680	0.5919
2040	0.0316	0.7479	0	0.5680	0.5919
2041	0.0257	0.7479	0	0.5680	0.5919
2042	0.0209	0.7479	0	0.5680	0.5919
2043	0.0169	0.7479	0	0.5680	0.5919
2044	0.0138	0.7479	0	0.5680	0.5919
2045	0.0162	0.7479	0	0.5680	0.5919
2046	0.0191	0.7479	0	0.5680	0.5919
2047	0.0225	0.7479	0	0.5680	0.5919
2048	0.0265	0.7479	0	0.5680	0.5919
2049	0.0312	0.7479	0	0.5680	0.5919
2050	0.0367	0.7479	0	0.5680	0.5919
2051	0.0433	0.7479	0	0.5680	0.5919
2052	0.0509	0.7479	0	0.5680	0.5919

Table 15. Illinois-Only Cost-Effectiveness Inputs

Savings Year	Illinois-Only				
	Electric	Residential Propane	Nonresidential Propane	Residential Gas	Nonresidential Gas
	$/kWh	$/therm	$/therm	$/therm	$/therm
2023	0.0090	0.2217	0	0.1708	0.1723
2024	0.0090	0.2217	0	0.1708	0.1723
2025	0.0090	0.2217	0	0.1708	0.1723
2026	0.0090	0.2217	0	0.1708	0.1723
2027	0.0090	0.2217	0	0.1708	0.1723
2028	0.0102	0.2540	0	0.1951	0.1967
2029	0.0101	0.2540	0	0.1951	0.1967
2030	0.0097	0.2540	0	0.1951	0.1967
2031	0.0092	0.2540	0	0.1951	0.1967
2032	0.0088	0.2540	0	0.1951	0.1967
2033	0.0084	0.2540	0	0.1951	0.1967
2034	0.0081	0.2540	0	0.1951	0.1967
2035	0.0070	0.2540	0	0.1951	0.1967
2036	0.0061	0.2540	0	0.1951	0.1967
2037	0.0054	0.2540	0	0.1951	0.1967
2038	0.0047	0.2540	0	0.1951	0.1967
2039	0.0041	0.2540	0	0.1951	0.1967
2040	0.0033	0.2540	0	0.1951	0.1967
2041	0.0027	0.2540	0	0.1951	0.1967
2042	0.0022	0.2540	0	0.1951	0.1967
2043	0.0018	0.2540	0	0.1951	0.1967
2044	0.0014	0.2540	0	0.1951	0.1967
2045	0.0017	0.2540	0	0.1951	0.1967
2046	0.0021	0.2540	0	0.1951	0.1967
2047	0.0025	0.2540	0	0.1951	0.1967
2048	0.0031	0.2540	0	0.1951	0.1967
2049	0.0037	0.2540	0	0.1951	0.1967
2050	0.0045	0.2540	0	0.1951	0.1967
2051	0.0054	0.2540	0	0.1951	0.1967
2052	0.0065	0.2540	0	0.1951	0.1967

APPENDIX B. CHANGE IN SCENARIO A AND C OVER TIME

Table 16 shows how the electric savings distribution changes over the entire portfolio lifetime and the change from electric Scenario A to C.

Table 16. Change in Portfolio Savings and Scenario A to C Over Time

Savings Year	Portfolio Savings (MWh)	Distribution of Portfolio Savings	Sum of Savings Up to Year	% Change from A to C
2023	412,977	8.13%	8.13%	0%
2024	412,977	8.13%	16.25%	0%
2025	406,122	7.99%	24.25%	0%
2026	402,820	7.93%	32.17%	0%
2027	401,035	7.89%	40.06%	0%
2028	400,055	7.87%	47.94%	-0.14%
2029	397,125	7.81%	55.75%	-0.28%
2030	385,704	7.59%	63.34%	-3.92%
2031	291,516	5.74%	69.08%	-7.42%
2032	288,877	5.68%	74.76%	-10.79%
2033	274,565	5.40%	80.17%	-14.05%
2034	237,077	4.67%	84.83%	-17.18%
2035	213,737	4.21%	89.04%	-27.23%
2036	207,009	4.07%	93.11%	-36.07%
2037	199,924	3.93%	97.04%	-43.83%
2038	33,358	0.66%	97.70%	-50.64%
2039	25,878	0.51%	98.21%	-56.64%
2040	25,522	0.50%	98.71%	-64.44%
2041	24,494	0.48%	99.19%	-70.83%
2042	23,913	0.47%	99.66%	-76.08%
2043	2,880	0.06%	99.72%	-80.38%
2044	2,878	0.06%	99.78%	-83.91%
2045	2,549	0.05%	99.83%	-81.09%
2046	2,414	0.05%	99.88%	-77.77%
2047	2,401	0.05%	99.92%	-73.88%
2048	782	0.02%	99.94%	-69.30%
2049	782	0.02%	99.95%	-63.91%
2050	782	0.02%	99.97%	-57.59%
2051	782	0.02%	99.98%	-50.15%
2052	782	0.02%	100.00%	-41.41%

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