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IL SAG NON-ENERGY IMPACTS WORKING GROUP

Quantifying and Monetizing NEIs for AIC: Research Update

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Meeting Agenda

- Summary of Opinion Dynamics' NEI work
  - Ongoing and work-to-date for Ameren Illinois
- Overview of initial findings from participant NEI cognitive pre-tests
- Overview of societal NEI analysis and results
  - Ameren Illinois 2018 Societal Health Non-Energy Impacts Report
- Plans and timing for NEI research in 2021

Ameren Illinois NEIs Research Update

Research Activity	Status	Next Steps
Societal Health NEIs	▪ Draft report completed ▪ Ameren Illinois 2018 Societal Health Non-Energy Impacts Report	▪ Respond to comments and finalize report
Income Qualified Participant NEIs	▪ Completed cognitive pre-tests ▪ Draft memo completed	▪ Respond to comments and finalize memo ▪ Revise survey based on cognitive pre-test results ▪ Revisit timelines and sampling for Q1
Commercial Participant NEIs	▪ Data collection for NEI screening assessment is ongoing	▪ Complete data collection ▪ Begin survey data analysis
Utility NEIs	▪ Submitted data request supporting arrearage and other analyses to AIC	▪ Review data once received and begin analysis

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INCOME QUALIFIED PARTICIPANT NEIS

Results from Cognitive Pre-tests

Participant NEI Research

- When we initially shared the draft Income Qualified Participant NEI survey instrument, respondents shared concern about potentially sensitive or hard to answer questions about participants' health and economic well being
- *Cognitive Pre-Testing: evidence-based qualitative method designed to investigate reliability and validity of survey questions, with a focus on question clarity, wording, reference periods and precision*
- We completed 10 cognitive pre-test interviews with 2019 IQ participants who either participated in the single-family program or received SAVE kits

Participant NEI Research: Cognitive Pretest Results

- Respondents generally comfortable sharing answers to questions about their health, household, and finances with Ameren Illinois
  - However, several respondents interested in why AIC was asking these types of questions
- Respondents generally confident reporting on their spouse's or child's missed days of school or work
- Two sections necessitate multiple revisions or additions:
  - Employment related questions
  - Thermal stress questions

Participant NEI Research: Next Steps

- Sent Cognitive Pre-test Results Memo to AIC for review 12/4
- Respond to comments and finalize memo
- Revise participant survey based on cognitive pre-test results
- Revisit timelines and sampling in Q1 2021

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SOCIETAL HEALTH NEIS

2018 Portfolio Analysis

Societal Health NEI Research: Key Goals

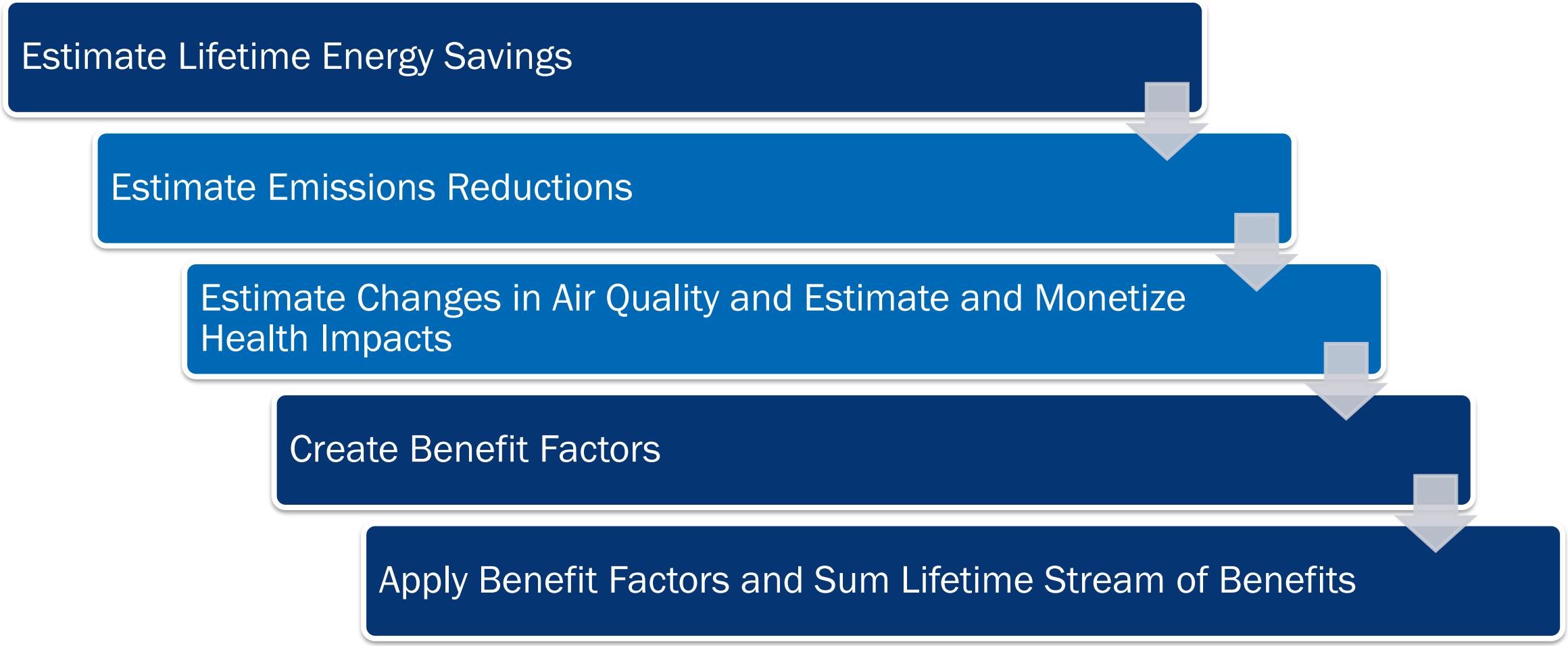
- Opinion Dynamics developed monetized societal health NEI estimates resulting from AIC's 2018 electric and gas energy efficiency portfolio
  - *Societal NEIs: the impacts that arise from energy efficiency and affect society at large*
- Key Goals:
  - Estimate reductions in electric generation, natural gas consumption, and emissions ($PM_{2.5}$, SO_2, NO_X, CO_2, NH_3*, VOCs*)
  - Estimate health effects resulting from fine particulate matter ($PM_{2.5}$) reductions (e.g., reduced asthma exacerbations, non-fatal heart attacks, etc.)
  - Monetize the health benefits

*Estimated for gas portfolio only

Societal NEI Research: Recap of Models

- Opinion Dynamics leveraged two publicly available EPA tools to estimate societal NEIs:
  - Avoided GeneRation and Emissions Tool v2.3 (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 $PM_{2.5}$
  - Co-Benefits Risk Assessment Tool 4.0 (COBRA)
    - Models county-level changes in concentrations of $PM_{2.5}$ resulting from emissions reduction inputs, then models the subsequent impacts on public health and calculates the value of the avoided health damages.
    - Conducts modeling for one of three baseline years: 2016, 2013, or 2028. Each baseline year contains detailed emissions, population, and health incidence estimates.

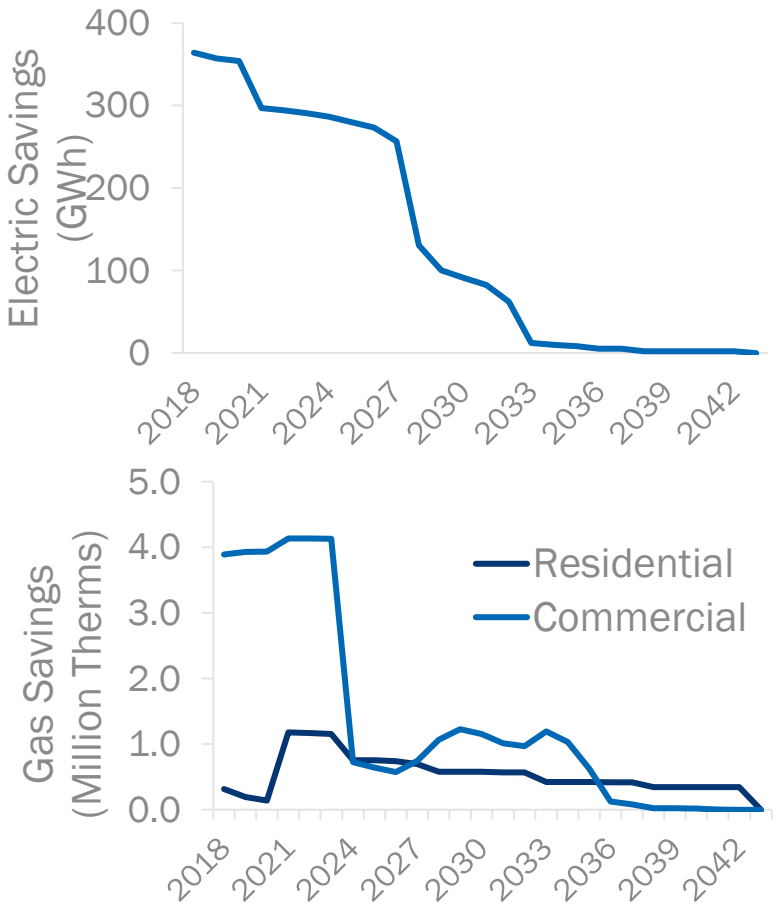
Societal NEI Research: Analysis Steps



Estimate Lifetime Energy Savings

- We estimated the lifetime energy savings resulting from AIC's 2018 EE portfolio
  - Many measures have lifetimes of up to 25 years, and will continue to produce energy savings through 2042
- Savings reflect interactive effects (e.g., heating penalties) and are consistent with inputs to cost-effectiveness testing

AIC 2018 EE Portfolio Lifetime Energy Savings



Estimate Emissions Reductions (Electric)

- AVERT relies on historical data to model generation and emissions impacts resulting from energy efficiency programs in one of 10 regions in the US
- EPA suggests using AVERT to model generation reduction only five years in the future
  - At the time of analysis, the most recent baseline year was 2018, so we used AVERT to model emissions reductions from 2018-2022
- For future years (2023-2042) we leveraged EPA avoided emissions factors (i.e., lbs. pollutant per MWh of avoided generation) to forecast future emissions reductions

Estimate Emissions Reductions (Gas)

- AVERT cannot be used to estimate natural gas emissions reductions
- We aggregated the annual natural gas portfolio savings by sector and multiplied by EPA recommended emissions factors for each year of savings

Emissions Factors - pounds per million cubic feet of natural gas

Pollutant	Nonresidential (lb/MMCF)	Residential (lb/MMCF)
$PM_{2.5}$	0.43	0.43
SO_2	0.6	0.6
NO_X	100	94
NH_3	0.49	20

Estimate Changes in Air Quality and Monetize Impacts

Steps to estimate and monetize health impacts using COBRA

Emissions Reductions in $PM_{2.5}$, SO_2, NO_X, NH_3, VOCs

- COBRA user enters emissions changes and discount rate

Quantify Changes in Air Quality

- COBRA uses a simple air quality model produced by the EPA, the Source-Receptor (S-R) Matrix, to estimate the effect of emissions changes on ambient PM concentrations

Calculate Changes in Health Outcomes

- Tool uses concentration-response functions from epidemiological studies

Calculate Monetary Value of Health Benefits

- Tool uses values based on willingness-to-pay, cost of illness, value for a statistical life, and direct medical costs

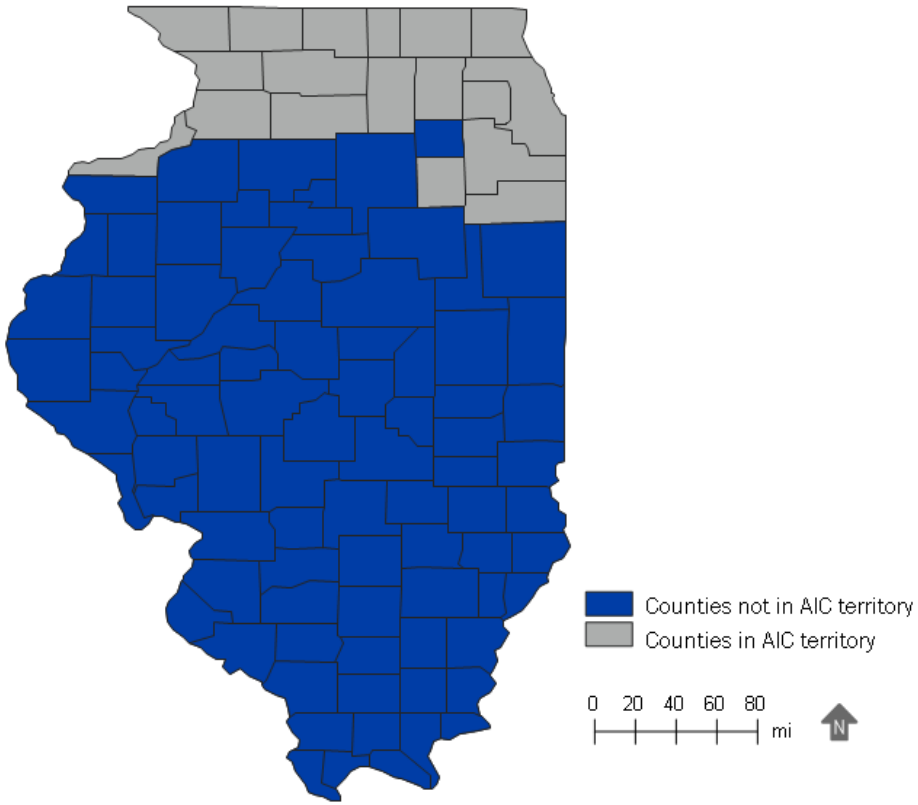
County-level Results

- Tool outputs number of avoided health incidences and related economic value by county

COBRA Model Runs Specifications

- Completed separate runs for the electric, nonresidential gas and residential gas portfolio
- Completed separate runs for each baseline year (2016, 2023, 2028)
- Method of emissions reductions input differed by portfolio
  - Residential and nonresidential gas: Selected IL counties in AIC territory
  - Electric portfolio (2016 baseline year): Input county-level estimates by uploading AVERT 2018 output file
  - Electric portfolio (2023/2028 baseline years): selected counties in the Upper Midwest region predicted to have non-zero emissions reductions in the 2018-2022 results

Selected Counties in Gas COBRA Runs



Create Benefit Factors

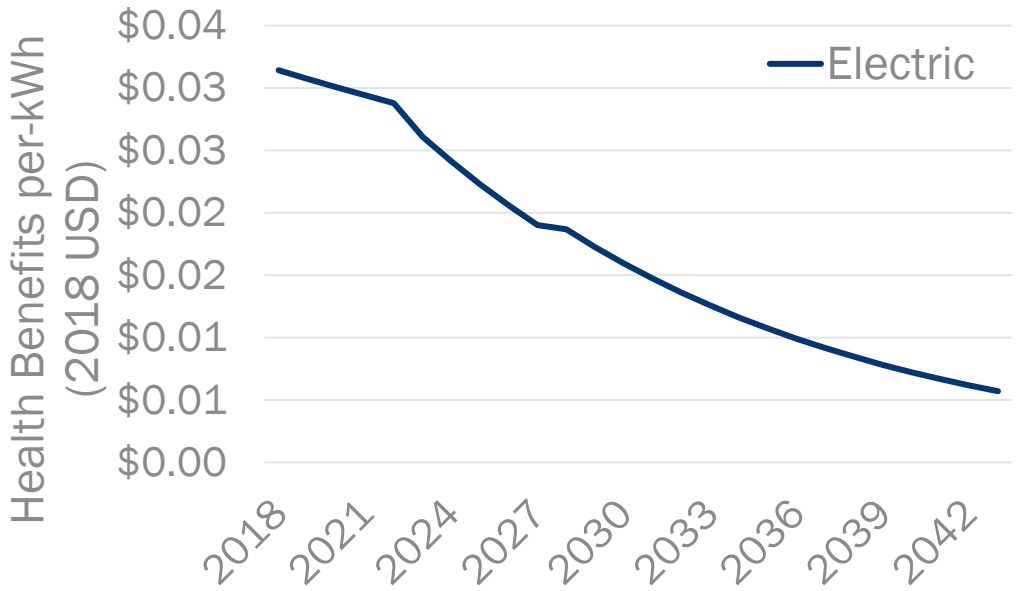
- Benefit Factors: Benefit ($) per kwh or them saved
  - Produced national and IL only benefit factors
- Electric factors: applied emissions factor adjustment to account for forecasted decreasing emissions intensities
- Discounted annual factors to present value and adjusted to $2018 dollars

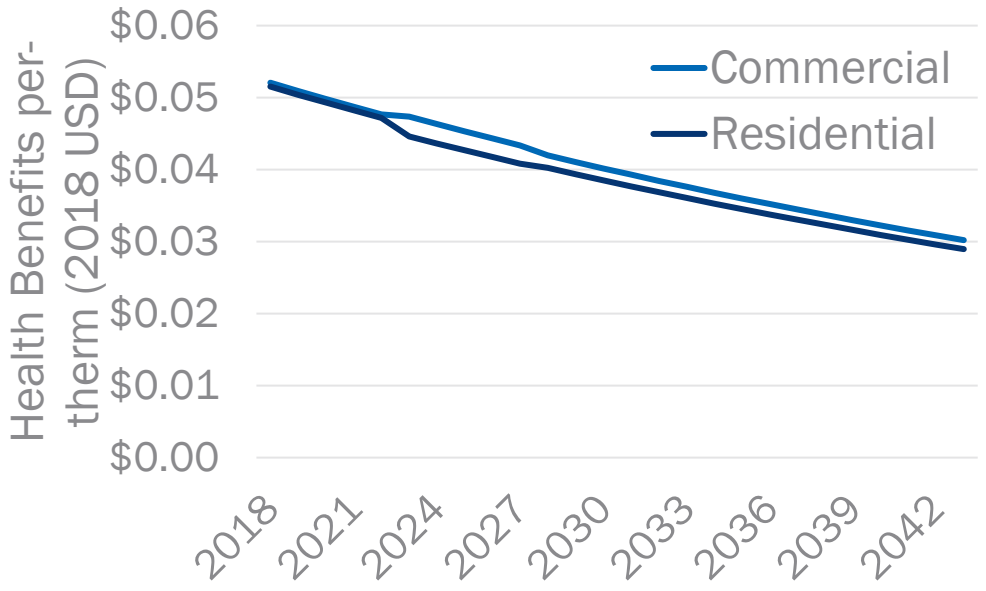
COBRA Baseline Year Used for Portfolio Years 2018-2042

COBRA Baseline Year	Portfolio Years
2016	2018–2022
2023	2023–2027
2028	2028–2042

Apply Benefit Factors

National Benefit Factors (Low Estimate)





- Multiply annual portfolio savings by benefit factors
- Sum lifetime stream of benefits

Societal Health NEI Research: Emission Reductions

- AIC's 2018 EE portfolio is expected to save:
  - 152 tons of primary $PM_{2.5}$
  - 2,939 tons of SO2
  - 2,317 tons of NO_x
  - 14 tons of NH_3
  - 13 tons of VOCs
- These emissions reductions are expected to result in $92-207 million in national health benefits
  - Approximately 15% of these benefits occur in Illinois

Sector	$PM_{2.5}$ (tons)	SO_2 (tons)	NO_X (tons)	NH_3 (tons)	VOC (tons)
Electric	151.0	2,937.5	2,083.4	NA	NA
Residential Gas	0.3	0.4	62.6	13.3	3.7
Nonresidential Gas	0.7	1.0	170.8	0.8	9.4
Gas Subtotal	*1.0*	*1.4*	*233.4*	*14.2*	*13.1*
Portfolio Total	**152.0**	**2,939.0**	**2,316.8**	**14.2**	**13.1**

Societal Health NEI Research: Results

Sector	Verified Savings (GWh)	Verified Savings (Thousand Therms)	National Health Benefits (Million 2018 $)		Illinois Only Health Benefits (Million 2018 $)	
			Low	High	Low	High
Electric	3,571	NA	$89.67	$202.18	$11.85	$26.69
Residential Gas	NA	13,819	$0.56	$1.26	$0.19	$0.42
Nonresidential Gas	NA	35,417	$1.65	$3.71	$0.55	$1.23
Gas Subtotal	*NA*	*49,236*	*$2.21*	*$4.97*	*$0.73*	*$1.65*
Portfolio Total	**3,571**	**49,236**	**$91.88**	**$207.15**	**$12.58**	**$28.35**

- High and low benefits reflect uncertainty in the impact of changes in exposure to $PM_{2.5}$ on premature mortality and non-fatal heart attacks
  - Avoided pre-mature mortality responsible for >98% of health benefits
- Electric portfolio accounts for 98% of national benefits and 94% of Illinois benefits

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AIC NEI RESEARCH ACTIVITIES PLANNED FOR 2021

AIC NEI Research Activities Planned for 2021

Note that we are still finalizing the draft 2021 evaluation plan in concert with AIC

- Participant NEIs
  - Update participant survey instrument based on cognitive pre-test results and field surveys
- Utility NEIs
  - Plan to examine pre- and post-initiative arrearages, service terminations, and reconnections for an AIC Income Qualified Initiative treatment group and a comparison group
  - We plan to use a difference-in-difference analysis to detect whether arrearages and service terminations decline due to initiative participation
- C&I NEI Screening Assessment
  - Developed and incorporated non-energy impact screening questions in participant surveys planned to evaluate the AIC's 2020 Business Program