Missed Opportunities

The Impacts of Recent Policies on Energy Efficiency Programs in Midwestern States

Prepared for Midwest Energy Efficiency Alliance

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ERRATA

Synapse issued this revised report to correct a few errors in the modeling results.

The original report had incorrect numbers for the health cost impacts for Indiana and Missouri. This revised report corrects those numbers in the Executive Summary (page iv, v, and ix, ES Figure 2, and ES Figure 5), Section 3.2 (page 21 and Table 17), Section 3.5 (page 43 to 44 and Table 46), and Appendix B.3 (page B-23, Table 86 and 87). While the corrected health cost impacts for those two states are substantially lower than the original, these changes are relatively small and do not change the overall findings or conclusions of the report.

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EXECUTIVE SUMMARY

In recent years, several midwestern states have adopted or proposed policies with substantial impacts on the effectiveness of ratepayer-funded energy efficiency programs. Through regulatory orders and legislative actions, some of these states are restricting the programs by limiting funding, repealing efficiency standards or targets, exempting large business customers, or failing to adopt progressive proposals on energy efficiency policies.

The adoption of these regressive policies (or the failure to adopt progressive policies) results in large, missed opportunities to provide multiple benefits. These benefits include reduced energy use, energy bill savings, reduced emissions from greenhouse gases and other pollutants, reduced health care costs, and new jobs. These policies mean that customers are already experiencing reduced benefits and will continue to experience reduced benefits for many years to come.

On behalf of the Midwest Energy Efficiency Alliance (MEEA), Synapse Energy Economics (Synapse) assessed the impacts of recently adopted or proposed energy efficiency policies for six selected Midwestern states, namely Illinois, Indiana, Iowa, Missouri, Ohio, and Wisconsin. For Iowa, our analysis focused on both electricity and natural gas energy efficiency. For the rest of the states, our analysis focused on electric energy efficiency programs only.

The types of assessments in this study include the following:

- **Cost-effectiveness**: We assessed the cost-effectiveness of policy impacts from different perspectives, including utility system, total resource cost, societal, and non-participant perspectives. We developed estimates of utility system avoided costs, non-energy impacts, and social costs of carbon for this assessment.
- **Emissions and health impacts**: We estimated and projected emissions impacts from the policies and estimated health impacts in terms of dollar amounts from the expected changes in emissions from power plants.
- **Macroeconomic impacts**: We used the IMPLAN model to assess potential changes in the number of jobs, incomes, and gross domestic product (GDP) due to the recent energy efficiency policies.
- **Affordability implications**: We assessed affordability implications of the policies by assessing the potential changes in rate, bill, and program participation impacts.

The recent policies analyzed in our study are four actual and two hypothetical policy shifts across the six states. We used the best data available to develop a Reference Case and a Policy Case to assess the impact of the recent policies that are represented under the Policy Case in this study. These scenarios assume energy efficiency programs implemented in 2021 only and our analysis estimates the potential impacts of energy efficiency measures implemented in 2021 over the lifetime of the measures under the two scenarios for each state.

We provide a summary of the policies analyzed in this study along with the major assumptions for our scenarios in the table below. The Reference year (RY) refers to the most recent historical or current year that had/has no impacts of the policies analyzed. For example, for Illinois, the key historical year that had no policy impact was in 2016. The Policy year (PY) refers to the most recent year or the current year that had/has the impacts of the policies analyzed. We developed program costs and savings estimates for the Policy Case and the Reference Case based on the historical or projected performance for these reference and policy years.

ES Table 1. Summary of energy efficiency program scenarios

State	Policy	Reference year (RY)	Policy year (PY)	Major scenario assumptions
Electric EE				
Illinois	Large C&I exemption	2016	2019	RY: 2019 savings + 2016 PY inc. savings for large C&I; PY: 2019 savings
Indiana	Repeal of the Energy Efficiency Resource Standards (EERS) and large C&I opt-out	2013	2019	RY: 2013 savings for all sectors with current performance on peak savings (kW/MWh), measure life and costs of saved energy; PY: 2019 savings
Iowa	2% budget cap	2018	2019	RY: 2018 data; PY: 2019 data
Missouri	Staff's energy efficiency program proposal (not adopted)	2021	2021	RY: 2021 approved program; PY: staff proposal
Ohio	Repeal of EERS and large C&I opt-out	2014	2021	RY: 2019 savings for RES and COM and 2014 savings for IND sector; PY: no energy efficiency impact
Wisconsin	Proposed 2021 budget (not adopted)	2019	2021	RY: 2019 data; PY: doubling budget and savings
Gas EE				
Iowa	1.5% budget cap	2018	2019	RY: 2018 data; PY: 2019 data

Note: RES, COM, IND stand for residential, commercial, and industrial sectors, respectively.

In the following sections, we present high level results for net lost benefits of the Policy Case relative to the Reference Case. We also present net macroeconomic impacts of the Policy Case.

For our analysis of rate and bill impacts, we found that the expected net rate and bill impacts of an expanded program case (either under the Reference Case or the Policy Case) are very small across all states, roughly ranging from 0.1 percent to 1 percent per year. This implies that the expanded program case is affordable for each state. Finally, our participation analysis found that the net participation impacts are substantial. In all states except Wisconsin, we found the participation rates would be reduced by 40 to 100 percent under the Policy Case relative to the Reference Case. For Wisconsin, which assumes a progressive policy under the Policy Case, we estimated that the participation rate would be increased by roughly 100 percent.

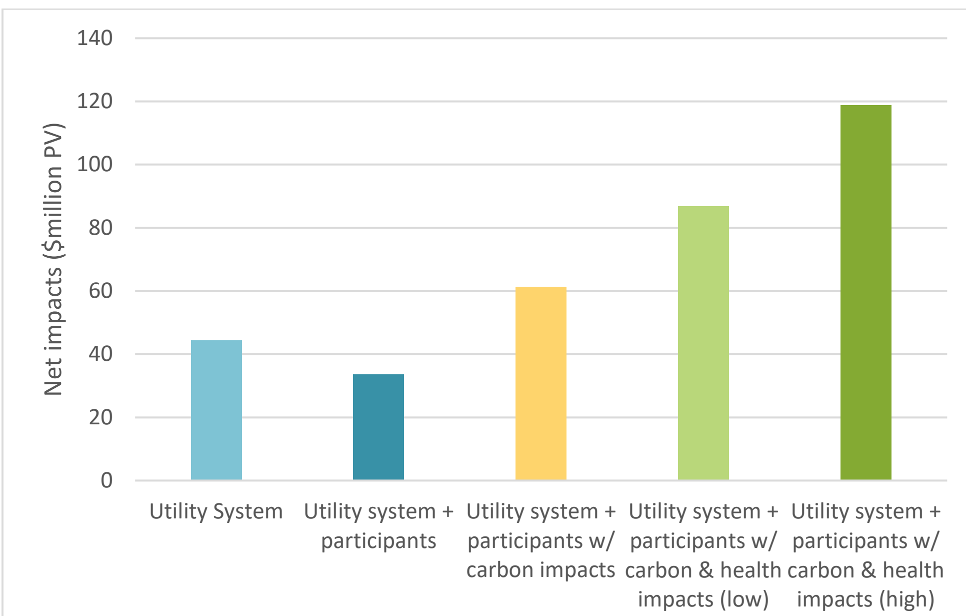
Illinois – electric energy efficiency

The Policy Case for Illinois represents the status quo that has the impacts of the *Future Energy Jobs* bill, which exempted large commercial and industrial (C&I) customers from the state's energy efficiency programs. The Reference Case represents a scenario where this regressive policy does not exist today.

ES Figure 1 below summarizes the potential lost net benefits of the Policy Case relative to the Reference Case in Illinois. From the utility system cost perspective, we estimate that the Policy Case results in approximately $45 million net lost benefits relative to the Reference Case. This represents an approximate impact of the large customer exemption policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers can enjoy from a single program year if the regressive policy did not exist today.

From the total resource cost perspective that includes both utility system and participants perspectives, the Policy Case results in $34 million less in net total benefits (in present value or PV) relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—would lose from a single program under the Policy Case. When the social cost of carbon is considered, the total lost net benefit increases to approximately $60 million (PV) for the state. Further, when the cost of potential health impacts is considered, the total lost net benefit due to the regressive policy increases to approximately $90 million to $120 million (PV) just from a single program year. Over multiple years, the effect of this regressive policy will be much greater.

ES Figure 1. Lost net benefits of the Policy Case relative to the Reference Case – Illinois



We also estimated non-participant net benefits that exclude benefits only accruing to participants, in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $14 million less in net benefits (PV) to non-program participants.

Further, we estimated that the Policy Case results in 235 fewer job-years, $15 million less income, and $1 million more GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 2. Lifetime macroeconomic results – policy impacts for Illinois

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	(235)	(15)	1

Note: GDP and income estimates are not discounted.

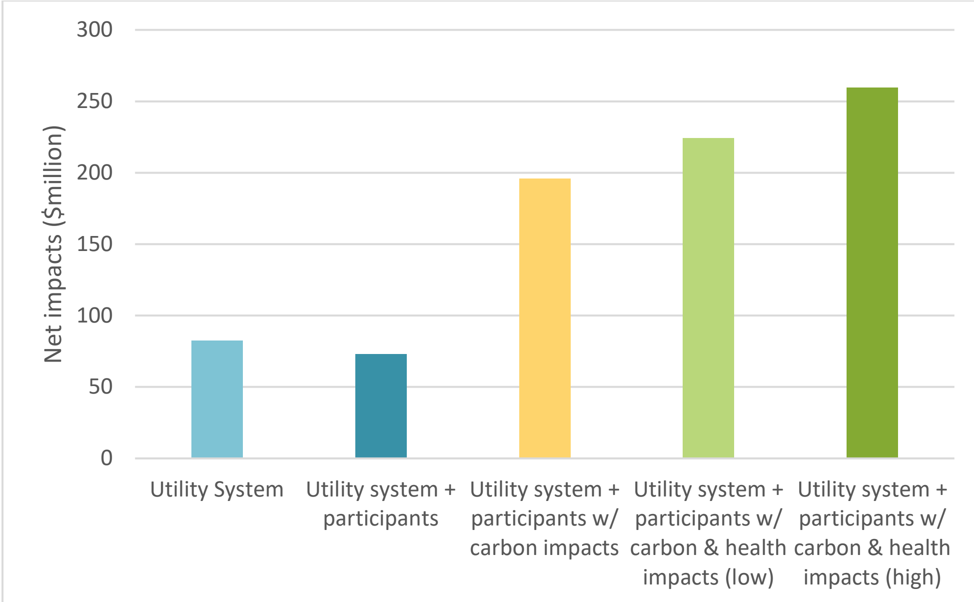
Indiana - electric energy efficiency

The Policy Case for Indiana represents the status quo that has the impacts of the existing large customer opt-out policy and the repeal of the state's energy efficiency resource standard (EERS). The Reference Case represents a scenario where these regressive policies do not exist today.

ES Figure 2 below summarizes the potential lost net benefits of the Policy Case relative to the Reference Case in Indiana. From the utility system cost perspective, we estimate that the Policy Case results in approximately $80 million net lost benefits (PV) relative to the Reference Case. This represents an approximate impact of the regressive policies in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers can enjoy from a single program year if the regressive policy did not exist today.

From the total resource cost perspective, which includes both utility system and participants perspectives, the Policy Case results in $73 million less in net total benefits (PV) relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—would lose from a single program under the Policy Case. When the social cost of carbon is considered, the total lost net benefit increases to approximately $195 million (PV) for the state. Further, when the cost of potential health impacts is considered, the total lost net benefit due to the regressive policy increases to approximately $225 million to $260 million (PV) just from a single program year. Over multiple years, the effect of this regressive policy will be much greater.

ES Figure 2. Lost net benefits of the Policy Case relative to the Reference Case – Indiana



We also estimated non-participant net benefits that exclude benefits only accruing to participants in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $21 million less in net benefits (PV) to non-program participants.

Further, we estimated that the Policy Case results in 260 fewer job-years, $14 million less income, and $4 million less GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 3. Lifetime macroeconomic results – policy impacts for Indiana

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	(260)	(14)	(4)

Note: GDP and income estimates are not discounted.

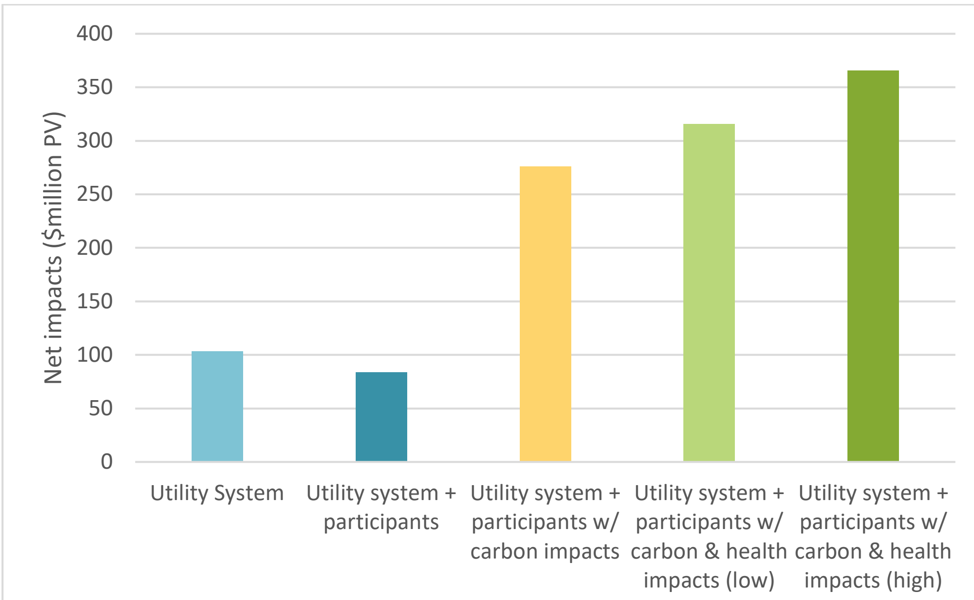
Iowa - electric energy efficiency

The Policy Case for Iowa on electric energy efficiency programs represents the status quo that has the impacts of the existing budget cap equal to 2 percent of the utilities' revenues. The Reference Case represents a scenario where this regressive policy does not exist today.

ES Figure 3 below summarizes the potential lost net benefits of the Policy Case relative to the Reference Case in Iowa. From the utility system cost perspective, we estimate that the Policy Case results in approximately $100 million net lost benefits (PV) relative to the Reference Case. This represents an approximate impact of the program budget cap in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers can enjoy from a single program year if the regressive policy did not exist today.

From the total resource cost perspective that includes both utility system and participants perspectives, the Policy Case results in $84 million less in net total benefits (PV) relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—would lose from a single program under the Policy Case. When the social cost of carbon is considered, the total lost net benefit increases to approximately $280 million (PV) for the state. Further, when the cost of potential health impacts is considered, the total lost net benefit due to the regressive policy increases to approximately $315 million to $370 million (PV) just from a single program year. Over multiple years, the effect of this regressive policy will be much greater.

ES Figure 3. Lost net benefits of the Policy Case relative to the Reference Case – Iowa



We also estimated non-participant net benefits that exclude benefits only accruing to participants in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $25 million less in net benefits (PV) to non-program participants.

Further, we estimated that the Policy Case results in 124 fewer job-years, $6 million less income, and $18 million more GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 4. Lifetime macroeconomic results – policy impacts for Iowa

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	(124)	(6)	18

Note: GDP and income estimates are not discounted.

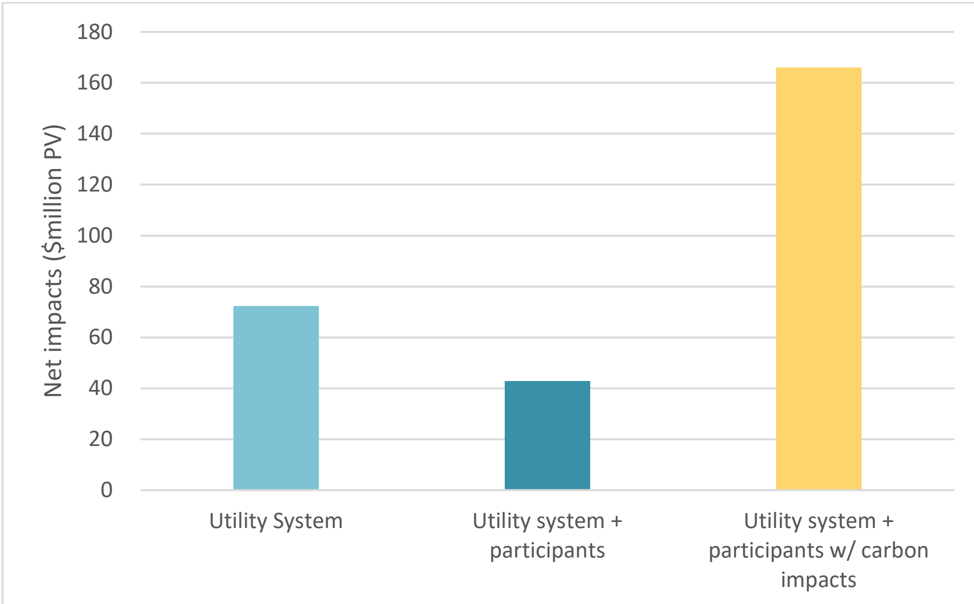
Iowa – natural gas energy efficiency

The Policy Case for Iowa on natural gas energy efficiency programs represents the status quo that has the impacts of the existing budget cap equal to 1.5 percent of the utilities' revenues. The Reference Case represents a scenario where this regressive policy does not exist today.

ES Figure 4 below summarizes the potential lost net benefits of the Policy Case relative to the Reference Case in Iowa. From the utility system cost perspective, we estimate that the Policy Case results in approximately $70 million net lost benefits (PV) relative to the Reference Case. This represents an approximate impact of the program budget cap in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers can enjoy from a single program year if the regressive policy did not exist today.

From the total resource cost perspective, which includes both utility system and participants perspectives, the Policy Case results in approximately $40 million less in net total benefits (PV) relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—would lose from a single program under the Policy Case. When the social cost of carbon is considered, the total lost net benefit increases to approximately $165 million (PV) for the state. This cost of carbon estimate includes the potential methane emission leaks from the natural gas supply system. However, our analysis of emissions from natural gas excludes health impacts. Many studies found NO_X emissions from indoor gas appliances cause serious health problems such as increased respiratory symptoms and asthma attacks. However, the quantification of such health damages from gas appliances is outside of the scope of this report.

ES Figure 4. Lost net benefits of the Policy Case relative to the Reference Case – Iowa (natural gas energy efficiency)



We also estimated non-participant net benefits that exclude benefits only accruing to participants in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $8 million (PV) less in net benefits to non-program participants.

Further, we estimated that the Policy Case results in approximately 410 fewer job-years, $20 million less income, and $20 million more GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 5. Lifetime macroeconomic results – policy impacts for Iowa (natural gas energy efficiency)

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	(409)	(22)	22

Note: GDP and income estimates are not discounted.

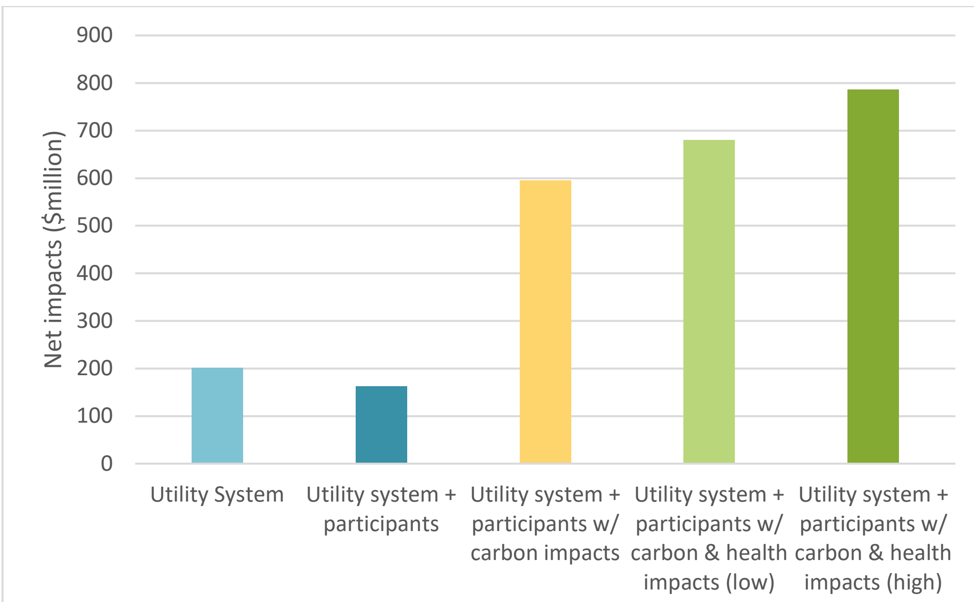
Missouri - electric energy efficiency

The Policy Case for Missouri does not represent the status quo. Instead, it represents a regressive policy or program recommendation proposed by Missouri Public Service Commission's (PSC) staff in 2018 but was not adopted. In contrast, the Reference Case represents the status quo with the proposal ultimately approved by the PSC.

ES Figure 5 below summarizes the potential lost net benefits of the Policy Case relative to the Reference Case in Missouri. From the utility system cost perspective, we estimate that the Policy Case results in approximately $200 million (PV) net lost benefits relative to the Reference Case. This represents an approximate impact of the PSC staff's proposal in the state today from a single program year if it had been adopted.

From the total resource cost perspective, which includes both utility system and participants perspectives, the Policy Case results in approximately $160 million (PV) less in net total benefits relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—would lose from a single program under the Policy Case. When the social cost of carbon is considered, the total lost net benefit increases to approximately $595 million (PV) for the state. Further, when the cost of potential health impacts is considered, the total lost net benefit due to the regressive policy increases to approximately $680 million to $790 million (PV) just from a single year program. Over multiple years, the effect of this regressive policy will be much greater.

ES Figure 5. Lost net benefits of the Policy Case relative to the Reference Case – Missouri



We also estimated non-participant net benefits that exclude benefits only accruing to participants in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $70 million (PV) less in net benefits to non-program participants.

Further, we estimated that the Policy Case results in 783 fewer job-years, $43 million less income, and $17 million less GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 6. Lifetime macroeconomic results – policy impacts for Missouri

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	(783)	(43)	(17)

Note: GDP and income estimates are not discounted.

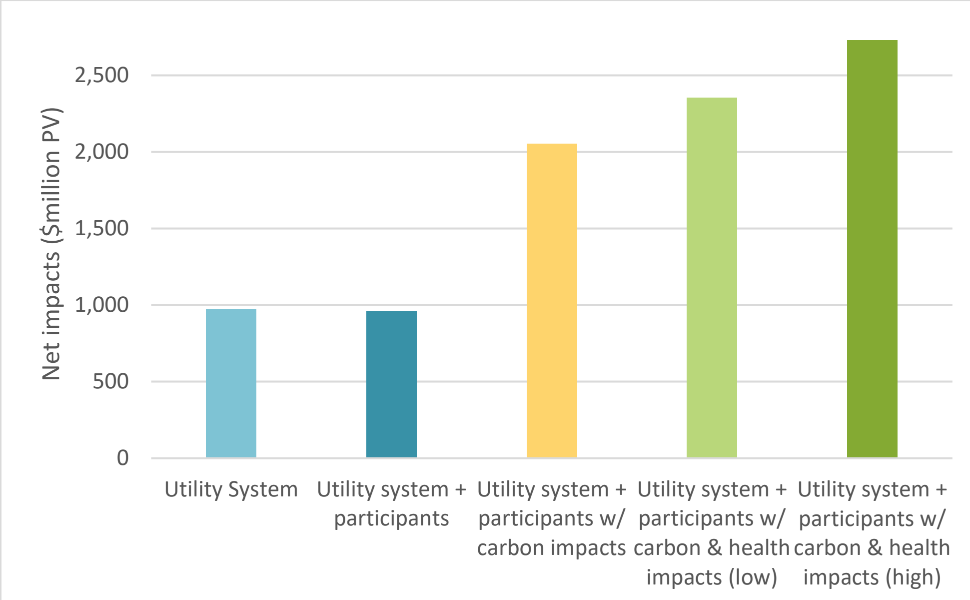
Ohio - electric energy efficiency

The Policy Case for Ohio represents the status quo that has the full impacts of the recent repeal of the state's EERS. The Reference Case represents a scenario where this regressive policy does not exist today.

ES Figure 6 below presents the potential lost net benefits due to the regressive policy under the Policy Case relative to the Reference Case in Ohio. From the utility system cost perspective, we estimate that the Policy Case results in approximately $980 million net lost benefits (PV) relative to the Reference Case. This represents an approximate impact of the repeal of the EERS policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers can enjoy from a single program year if the regressive policy did not exist today.

From the total resource cost perspective, which includes both utility system and participants perspectives, the Policy Case results in approximately $960 million less in net total benefits (PV) relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—would lose from a single program under the Policy Case. When the social cost of carbon is considered, the total lost net benefit increases to approximately $2 billion (PV) for the state. Further, when the cost of potential health impacts is considered, the total lost net benefit due to the regressive policy increases to approximately $2.4 billion to $2.7 billion (PV) just from a single program year. Over multiple years, the effect of this regressive policy will be much greater.

ES Figure 6. Lost net benefits of the Policy Case relative to the Reference Case – Ohio



We also estimated non-participant net benefits that exclude benefits only accruing to participants, in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $290 million less in net benefits (PV) to non-program participants.

Further, we estimated that the Policy Case results in approximately 5,460 fewer job-years, $300 million less income, and $296 million more GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 7. Lifetime macroeconomic results – policy impacts for Ohio

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	(5,458)	(300)	(296)

Note: GDP and income estimates are not discounted.

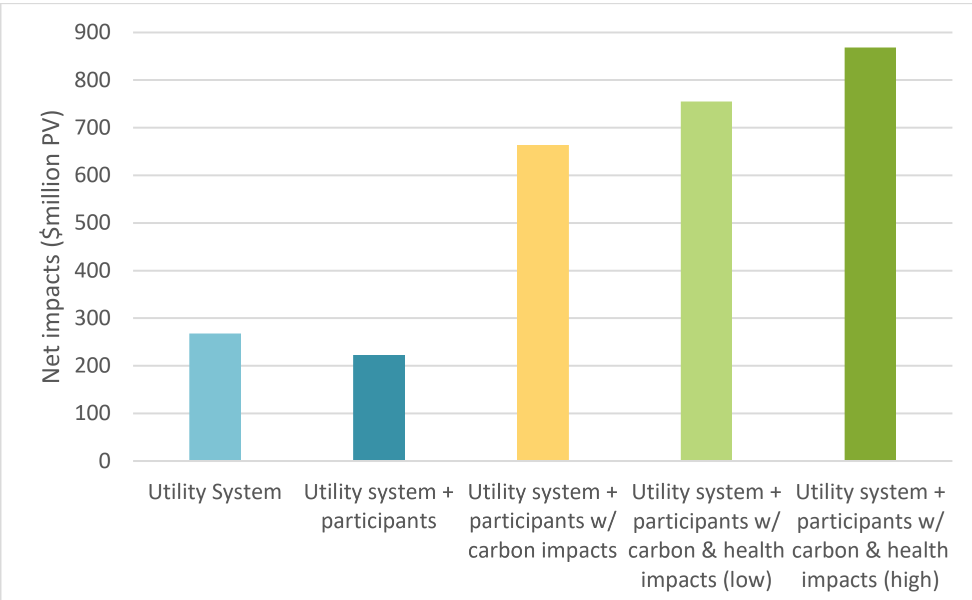
Wisconsin - electric energy efficiency

The Policy Case for Wisconsin represents a scenario with the increased funding proposed in early 2021 by Governor Evers. The proposed funding is applicable to both electric and natural gas energy efficiency programs, but our analysis focused on just electric energy efficiency programs. The Reference Case represents the current state of the state's energy efficiency program.

ES Figure 7 below summarizes the potential net benefits due to the regressive policy under the Policy Case relative to the Reference Case in Wisconsin. From the utility system cost perspective, we estimate that the Policy Case results in approximately $340 million net benefits relative to the Reference Case. This represents an approximate net benefit of the proposed budget increase in the state from a single program year.

From the total resource cost perspective, which includes both utility system and participants perspectives, the Policy Case results in approximately $220 million in net total benefits (PV) relative to the Reference Case. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—could enjoy from a single program year if the Governor's proposal had been adopted. When the social cost of carbon is considered, the total net benefit increases to approximately $660 million (PV) for the state. Further, when the cost of potential health impacts is considered, the total net benefit due to the Governor's progressive policy increases to approximately $750 million to $870 million (PV) just from a single program year. Over multiple years, the effect of this progressive policy will be much greater.

ES Figure 7. Net benefits of the Policy Case relative to the Reference Case – Wisconsin



We also estimated non-participant net benefits that exclude benefits only accruing to participants, in order to address the concerns that only participants benefit from energy efficiency programs. Our analysis found the Policy Case results in approximately $56 million in net benefits to non-program participants.

Further, we estimated that the Policy Case results in approximately 1,530 more job-years, $85 million more income, and $80 million more GDP relative to the Reference Case from a single program year over the life of the measures implemented in that year as shown in the following table.

ES Table 8. Lifetime macroeconomic results – policy impacts for Wisconsin

	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Total	1,526	85	79

Note: GDP and income estimates are not discounted.

1. INTRODUCTION

States across the Midwest have adopted or proposed various policies concerning ratepayer-funded energy efficiency programs through regulatory orders and legislative actions. Some of these policies restrict the scale of the energy efficiency programs by limiting the program funding, exempting large business customers, or even repealing an existing requirement to achieve certain levels of annual energy savings. A case in point is the repeal of the Energy Efficiency Resource Standard (EERS) in Ohio that became effective this year and virtually forced all utilities to cease operating most programs.

The impacts of these policies are immense not just on energy savings, but also on the benefits that these programs can bring to the households and businesses across each state in the region. Such benefits include energy bill savings, avoided emissions including greenhouse gases (GHG) and other air pollutants, reduced health care costs and damages, and job creation. These regressive policies essentially restricted many states and utilities from generating a substantial amount of these benefits through energy efficiency for their citizens and customers over the past several years and into the future.

Synapse Energy Economics (Synapse) was engaged by the Midwest Energy Efficiency Alliance (MEEA) to assess the impacts of recently adopted or proposed energy efficiency policies for six selected Midwestern states. We assessed the cost-effectiveness, emissions impacts, health impacts, and macroeconomic impacts, as well as affordability implications of these policies. We assessed the cost-effectiveness from different perspectives, including societal benefits (e.g., avoided costs of carbon) and non-participant benefits. We also quantified health impacts for the potential changes in morbidities and mortalities in terms of dollar amounts. Further, we assessed potential changes in the number of jobs, incomes, and gross domestic product (GDP) due to the recent energy efficiency policies. Finally, we assessed affordability implications of the policies by reviewing the potential changes in rate, bill, and program participation impacts.

The selected states are Illinois, Indiana, Iowa, Missouri, Ohio, and Wisconsin. Synapse' analysis focused on electric energy efficiency programs for all six states. For Iowa, we also assessed natural gas energy efficiency programs. For each of the states except Wisconsin, we assessed the impacts of *regressive* policies that have been adopted or proposed. In contrast, for Wisconsin we assessed the potential impact of a *progressive* policy for the state's energy efficiency program that was proposed earlier this year but was not adopted.

2. SCENARIO ANALYTICAL FRAMEWORK

This chapter provides an overview of our scenario development approach for each state and methodologies we used to assess impacts of state energy efficiency policies in five different areas: (a) utility system benefits and costs; (b) total resource benefits and costs; (c) societal benefits and costs; (d) macroeconomic impact; and (e) affordability.

2.1. Overview of State Scenario Development

We developed two scenarios for energy efficiency programs, namely the Policy Case and the Reference Case, for each of six selected Midwestern states and assessed energy, economic, and societal impacts of these scenarios for Program Year 2021. We assessed the impacts of the Policy Case relative to the Reference Case from energy efficiency measures implemented in 2021 over the lifetime of the measures. The six selected states are Illinois, Indiana, Iowa, Missouri, Ohio, and Wisconsin. For Iowa, our analysis modeled cases for both electricity and natural gas energy efficiency programs. For the rest of the states, our analysis focuses on electricity energy efficiency programs.

The two cases are defined as follows:

- **Policy Case**: For all the six states except Wisconsin, the energy efficiency program policies/laws that we assume under the Policy Case are regressive policies that have been adopted or proposed. Most of these policies are effective today. For Wisconsin, the Policy Case assumes the acceptance of a progressive policy that was recently proposed but was not adopted.
- **Reference Case**: The Reference Case for each state assumes that the policies we studied were never enacted, with the exception of Wisconsin and Missouri where the Reference Cases represent the current policy environments. The energy savings under this case are higher than the Policy Case for each state except Wisconsin, which shows the opposite results; the Policy Case for this state assumes the acceptance of the recent budget proposal to increase the program budget.

We developed energy savings and program spending assumptions for these two cases for each state mainly based on the following data sources: (a) annual energy efficiency program reports by utilities in each state; (b) program evaluation reports prepared for the utilities; and (c) the U.S. Energy Information Administration's (EIA) Form 861 database for electric energy efficiency programs and utility sales, revenue, and customer data. Detailed assumptions for the two cases are presented below for each state.

The following table provides an overview of major scenario assumptions for each state along with the utility jurisdictions included in this study. We provide details of the approach taken to develop each state policy scenario in Appendix A. The Reference year (RY) refers to the most recent historical or current year that had/has no impacts of the policies analyzed. For example, for Illinois, the key historical year that had no policy impact was in 2016. The Policy year (PY) refers to the most recent year or the current year that had/has the impacts of the policies analyzed. We developed program costs and savings estimates for the Policy Case and the Reference Case based on the historical or projected performance for these reference and policy years.

Table 1. Summary of energy efficiency program scenarios

State	Utilities	Policy	Reference year (RY)	Policy year (PY)	Major scenario assumptions
Electric energy efficiency					
Illinois	Ameren Illinois, Commonwealth Edison	Large C&I exemption	2016	2019	RY: 2019 savings + 2016 PY savings for large C&I; PY: 2019 savings
Indiana	Indianapolis Power & Light, Indiana Michigan Power, Northern Indiana Pub Serv, Duke Energy Indiana, Southern Indiana Gas & Electric	Repeal of EERS and large C&I opt-out	2013	2019	RY: 2013 savings for all sectors with current performance on peak savings (kW/MWh), measure life and costs of saved energy; PY: 2019 savings
Iowa	Alliant, MidAmerican	2% budget cap	2018	2019	RY: 2018 data; PY: 2019 data
Missouri	Evergy Metro (former KCP&L), Ameren Missouri	Staff's energy efficiency proposal (not adopted)	2021	2021	RY: 2021 approved program; PY: staff proposal
Ohio	Duke Energy Ohio, AES Ohio, AEP Ohio, Ohio Edison, the Illuminating Company, Toledo Edison	Repeal of EERS and large C&I opt-out	2014	2021	RY: 2019 savings for RES and COM and 2014 savings for IND sector; PY: no energy efficiency impact
Wisconsin	Focus on Wisconsin	Proposed 2021 budget (not adopted)	2019	2021	RY: 2019 data; PY: doubling budget and savings
Gas Energy Efficiency					
Iowa	Alliant/IPL, MidAmerican, Black Hills	1.5% budget cap	2018	2019	RY: 2018 data; PY: 2019 data

*Note: *RES, COM, IND stand for residential, commercial, and industrial sectors, respectively.*

2.2. Cost-Effectiveness Tests Used to Assess Energy Efficiency Programs

In order to assess the benefit-cost impacts of recent policies for energy efficiency programs, we employed three separate cost-effectiveness analysis frameworks. These were the Utility Cost Test (UCT), the Total Resource Cost (TRC) test, and the Societal Cost Test (SCT).

Table 2. Cost-Effectiveness Analysis Framework

	UCT	TRC Test	SCT
Electric Utility System Impacts	✓	✓	✓
Gas Utility System Impacts	✓	✓	✓
Other Fuel Impacts	-	✓	✓
Participant Impacts	-	✓	✓
Participant costs	-	✓	✓
Participant non-energy impacts	-	✓	✓
Societal Impacts	-	-	✓

Source: National Energy Screening Project. 2020. National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources. Available at https://www.nationalenergyscreeningproject.org/national-standard-practice-manual/.

A short summary of each test shown in Table 2 is provided as follows:

The Utility Cost Test: The UCT considers utility system impacts including the costs of energy efficiency programs and benefits of avoiding utility system costs (e.g., energy, capacity, and transmission and distribution, or T&D). This is the test that assesses the net present values of benefits and costs from the utility system perspective that directly affect the utility customers.[1] We developed utility system avoided costs for this study based on the recent historical market price data and the avoided cost estimates currently used by some of the utilities in the Midwest to assess energy efficiency programs. For the avoided electric wholesale energy and capacity, we examined detailed market price data from MISO (Midcontinent Independent System Operator), PJM, and SPP (Southwest Power Pool). We provide details of our avoided cost methodologies and results in Appendix B.1.

The Total Resource Cost Test: The TRC test expands the scope of the assessment from the UCT and incorporates program participant impacts. Such impacts include participants' own out-of-pocket costs to cover the incremental costs of energy efficiency measures. The impacts also include various non-energy impacts (NEI) the participants experience by participating in energy efficiency programs and implementing energy efficiency measures. Such NEIs include, but are not limited to, avoided operations and maintenance (O&M) costs, increased comfort, increased participant health and safety, increased productivity, increased aesthetics, and increased property or asset value. We provide details of NEIs in Appendix B.2. Our analysis incorporates participant NEIs that we developed based on a literature survey. Our NEI estimates range from approximately 8 percent to 15 percent of total benefits, which differ by sector and the type of fuel (electricity or natural gas). It is important to note that these NEI values are

[1] Our analysis discounts all the costs and benefits to the present values using a nominal discount rate of 2.8 percent based on the yields of recent 30-year Treasury Bills. For a detailed discussion of this discount rate, please see Synapse's 2021 study titled "Avoided Energy Supply components in New England: 2021 Report.
Table 170, page 361. Available at: https://www.synapse-energy.com/project/aesc-2021-materials.

likely to underestimate the total NEI values for program participants because our estimates do not include other NEIs such as O&M cost savings, and water savings.

The Societal Cost Test: The SCT expands the scope of the assessment from the TRC test and incorporates various societal impacts. Such impacts could include GHG emissions, other air emissions, public health damages, and job creation. As explained in the following sub-section, our analysis incorporates the impacts associated with GHG emissions and criteria pollutants. It estimates the total costs of GHG emissions avoided or increased and health care and damage costs avoided or increased due to energy efficiency programs.

2.3. Determining Societal Impacts

Synapse' analysis considered and incorporated both emissions and health impacts when assessing the societal impacts of energy efficiency programs. This is because reductions in electricity usage can cause decreases in fossil fuel generation and various emissions such as GHG emissions and criteria pollutants associated with fossil fuel generation. Reductions in on-site natural gas usage from natural gas efficiency programs also results in a substantial reduction in GHG emissions from on-site natural gas combustion, as well as reductions in methane leaks from natural gas wells through the entire natural gas delivery infrastructure. These emission reductions are important benefits to consider, as reductions in criteria pollutant emissions can lead to fewer illnesses and premature mortalities, and reductions in GHG emissions can reduce a state's contribution to global warming. We briefly describe our methodologies for determining these societal impacts below. For a more detailed description, see Appendix B.

Avoided Emissions from Power Plants: To estimate the amount of GHG emissions that could be avoided as a result of energy efficiency programs, Synapse used data from two different sources: the U.S. Environmental Protection Agency's (EPA) Avoided Emissions and Generation Tool (AVERT) and Rocky Mountain Institute's (RMI) Utility Transition Hub.[2] We used AVERT to estimate the current marginal emission rates by utility jurisdiction that energy efficiency programs could influence. We then used the data available in the Utility Transition Hub to project future marginal emission rates.

Avoided Emissions from Natural Gas Supply: Our analysis of emission impacts from natural gas supply focuses on carbon dioxide (CO_2) and methane. It excludes other emissions such as nitrogen oxide from the combustion of natural gas in buildings. For estimating CO_2 and methane emissions impacts of natural gas supply, we used emissions factors from EPA. We assumed an emission leak rate of 1.42 based on EPA's current estimate.[3]

[2] U.S. EPA. "AVoided Emissions and geneRation Tool (AVERT)." Accessed April 26. Available at: https://www.epa.gov/avert; Rocky Mountain Institute. 2021. "Utility Transition Hub." Available at: https://utilitytransitionhub.rmi.org/portal/.

[3] U.S. EPA. 2020. *Estimate of Methane Emissions from the U.S. Natural Gas Industry*. Available at: https://www.epa.gov/sites/production/files/2020-11/documents/methane.pdf.

Social Cost of Carbon (SCC): Our analysis used the SCC value developed by New York State's Department of Environmental Conservation in its guideline document titled "Establishing a Value of Carbon".[4] This SCC value considers the global impact of emissions and high-risk situations and uses a relatively low discount rate of 2 percent. The SCC was calculated using estimations from the Obama-era guidelines but used a different range of discount rates.

Avoided Health Impacts: Our analysis used EPA's CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) to estimate the health and economic benefits of reductions in fossil fuel generation for the residents of the states analyzed, as well as others impacted by the change in emissions associated with increased energy efficiency. COBRA utilizes a reduced form air quality model to measure the impacts of emission change on air quality and translates them into health and monetary effects. For this analysis, Synapse modeled avoided criteria pollutants (SO_2, NO_X, and $PM_{2.5}$) that were output from AVERT.

2.4. Macroeconomic Impacts

We used the IMPLAN model to determine the macroeconomic impacts of changes in spending on energy efficiency programs in six Midwestern states.[5] Energy efficiency programs provide incentives for consumers and businesses to invest in new appliances, equipment, and technologies that shift economic activity away from traditional energy resources. These trade-offs in turn may result in overall changes in total employment, income, and GDP statewide.

Our IMPLAN-based analysis assessed changes in spending on energy efficiency programs and measures, utility system investments, and respending patterns as described below:

Change in Spending on Energy Efficiency: Incremental energy efficiency spending, including both ratepayer-funded utility contributions and private participant contributions, spur increased direct labor (installation) activity and increased supply chain activity. Incremental investment in energy efficiency also results in an increase in utility operational/administrative activity (program overhead). Alternatively, reduced energy efficiency activities will reduce these spending activities. The impacts of the policies (or the Policy Cases) we analyzed in this study represent reductions in energy efficiency program and measure spending—except for Wisconsin where its policy represents an increase in energy efficiency investments.

Change in Spending on the Utility System: Increased investment in energy efficiency reduces both energy consumption and peak demand, resulting in decreased utility-system spending. These reductions are translated into foregone spending on energy, generation capacity, and T&D capacity. Alternatively,

[4] New York State Department of Environmental Conservation. 2020. *Establishing a Value of Carbon: Guidelines for Use by State Agencies*. Available at: https://www.dec.ny.gov/docs/administration_pdf/vocguidrev.pdf.

[5] IMPLAN is an industry standard input-output model that was developed by the Minnesota IMPLAN Group. IMPLAN allows users to assess macroeconomic impacts of various economic activities and policies across the United States.

reduced investments in energy efficiency tend to increase utility-system spending on energy, capacity, and T&D.

Change in Respending: Changes in spending on energy efficiency may precipitate changes in consumption and investment spending in the broader economy. Note that changes in energy efficiency spending may be associated with either positive or negative changes in consumption and investment spending depending on whether the net of the following two effects is positive or negative:

1. Changes in participant spending on energy efficiency
2. Changes in aggregate utility bills resulting from changes in rates and changes in overall energy consumption

2.5. Affordability Implications

Our study also assessed affordability implications of the changes in energy efficiency investments under the Policy Case for each state relative to the Reference Case. This assessment includes the following three aspects:

Rate impact: The rate impact due to energy efficiency programs is one useful metric to assess the affordability of energy efficiency investments. We estimated the expected rate impacts of energy efficiency investments (in terms of percentage of the current rate) under the Policy Case and the Reference Case by sector for each state, based on the estimated program spending on energy efficiency programs as well as the estimated changes in sales and revenue requirements due to the energy efficiency programs. Reductions in utility-system investments (avoided costs) expected from energy efficiency programs reduce revenue requirements. On the other hand, they also reduce sales and often lead to an increase in rates.

Bill impact: The bill impact due to energy efficiency programs is another useful metric to assess affordability implications of energy efficiency programs. Given the total participation counts are not available for the energy efficiency scenarios we analyzed, we estimated average bill impacts for all customers by sector for each scenario. We estimated such bill impacts by comparing the total revenue requirements with and without energy efficiency investments by sector for each scenario, which we then divided by the total number of customers.

Participation impact: We also reviewed affordability implications by assessing how program participants would change between the Policy Case and Reference Case scenarios. This assessment shows an illustrative example; we select one program example for each state with a focus on residential programs (e.g., low-income weatherization, whole-house program, residential HVAC program). In general, this illustrative assessment of participation rates demonstrates that energy efficiency programs could reach out to more customers with more energy efficiency program investments.

3. Impacts of Energy Efficiency Policies

3.1. Illinois: Electric Programs

Utility System Impacts

> **Scenarios for Illinois**
> *(see Table 1)*
>
> - Policy Case: large customer exemption
> - Reference Case: no large customer exemption

Table 3 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the program administrator cost (PAC) test perspective. The Policy Case that represents the status quo and includes the existing large customer exemption policy is expected to have:

- Approximately $930 million of total benefits in present value (PV) and $520 million of net benefits (PV) including the program cost of approximately $400 million.
- An overall benefit-cost ratio of 2.3 at the portfolio level with the benefit-cost ratio for the commercial and industrial (C&I) sector being substantially larger than the ratio for the residential sector.

In contrast, the Reference Case that has no effects from the large customer exemption law is expected to have:

- Approximately $990 million of total benefits (PV) and $574 million of net benefits (PV) including the program cost of approximately $420 million.
- The overall benefit-cost ratio of 2.4 at the portfolio level.

The benefit-cost ratios are almost the same between the two cases with the main difference in the C&I sector, which has a benefit-cost ratio of 3.1 under the Policy Case to 3.2 under the Reference case.

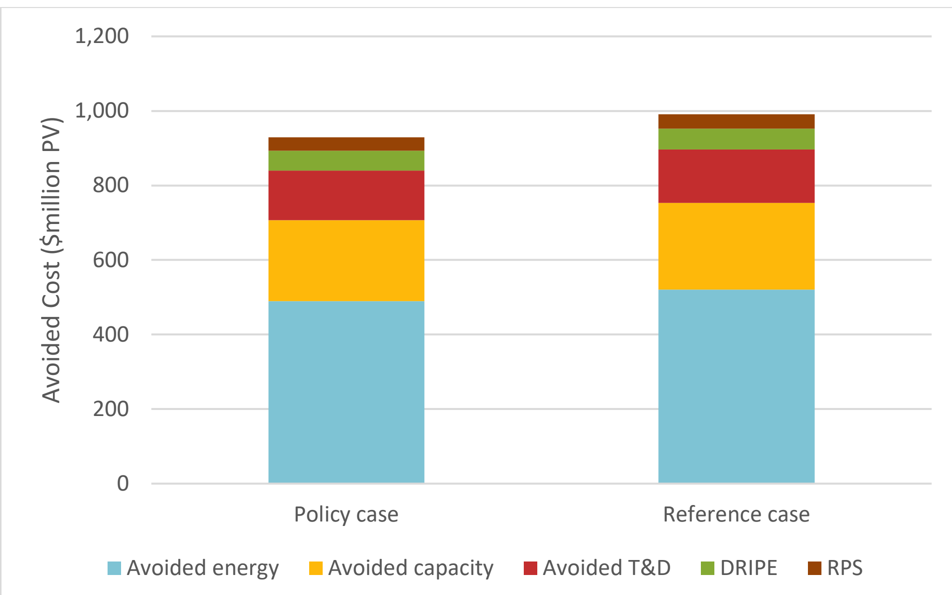
Table 3. Program impacts by case and sector: PAC Test – Illinois

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-cost Ratio
Policy case	C&I	227	704	477	3.1
	RES	172	225	52	1.3
	Total	399	929	530	2.3
Reference case	C&I	244	766	522	3.1
	RES	172	225	52	1.3
	Total	417	991	574	2.4
Delta	C&I	(17)	(62)	(44)	3.5
	RES	-	-	-	-
	Total	(17)	(62)	(44)	3.5

Our analysis found that the Policy Case has $44 million less in net benefits relative to the Reference Case, as shown in Table 3 above. This represents an approximate impact of the large customer exemption policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers can enjoy from a single program year if the regressive policy did not exist today. Over multiple years, the effect of this regressive policy will be much greater. For example, over the course of 10 years this regressive policy will result in approximately $450 million in net losses to customers.

Figure 1 below shows a breakdown of the total utility avoided costs for Illinois for the Policy Case and the Reference Case. More than half of the benefits come from the avoided energy costs. The next largest avoided cost categories are the avoided capacity and avoided T&D costs for both cases. Unlike the other states (as discussed in other state sections), the avoided capacity is substantially higher than the avoided T&D costs. The avoided costs of the state's renewable energy portfolio standard (RPS) and the impacts of wholesale energy price reduction due to energy efficiency—also known as demand reduction induced price effects (DRIPE)—together account for 10 percent of the total avoided costs. These results also represent the utility system benefits under the TRC test and SCT.

Figure 1. Breakdown of utility avoided costs by case – Illinois



Total Resource Impacts

Table 4 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case is expected to have:

- Approximately $1,050 million of total resource benefits (PV) and $380 million of net benefits (PV) including the total resource cost of approximately $670 million.
- An overall benefit-cost ratio of 1.6 at the portfolio level. The benefit-cost ratio for the C&I sector is still larger than the ratio for the residential sector under the TRC perspective, but this difference in the benefit-cost ratios is not as large as the difference we see from the utility system perspective.

In contrast, the Reference Case is expected to have:

- Approximately $1,120 million of total resource benefits (PV) and $410 million of net benefits (PV) including the total resource cost of approximately $700 million.
- An overall benefit-cost ratio of 1.6 at the portfolio level.

The benefit-cost ratios are almost the same between the two cases.

Table 4. Program cost and benefits by case and sector: TRC test – Illinois

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	455	783	328	1.7
	RES	211	264	53	1.2
	Total	667	1,047	380	1.6
Reference Case	C&I	490	851	361	1.7
	RES	211	264	53	1.2
	Total	702	1,115	414	1.6
Delta	C&I	(35)	(69)	(34)	2.0
	RES	-	-	-	n/a
	Total	(35)	(69)	(34)	2.0

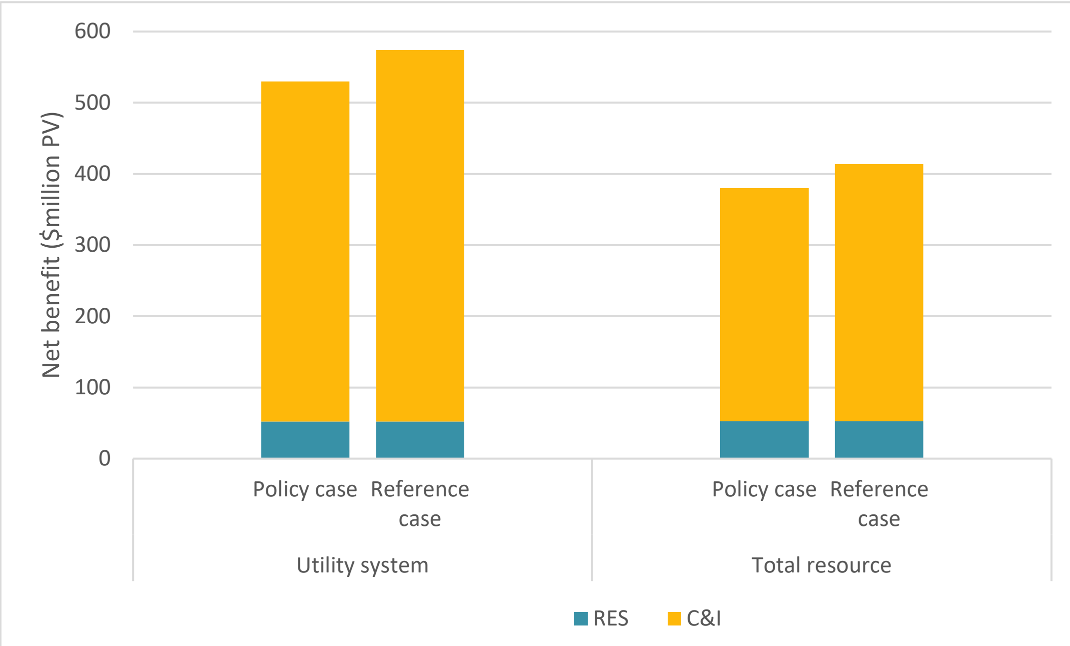
Our analysis found that the Policy Case has $34 million less in net total resource benefits in present value relative to the Reference Case, as shown in Table 4 above. This represents an approximate impact from the large customer exemption policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers—including non-program participants as well as program participants—can enjoy from a single program year if the regressive policy did not exist.

The benefits in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. As discussed in Appendix B.2, we estimate these to be 10 to 15 percent of the total resource benefits.

The TRC test should in theory also include other participant benefits, such as other fuel usage (e.g., oil, propane, natural gas), O&M costs (e.g., costs to replace light bulbs) or water savings. However, we were not able to include these additional benefits in our analysis because there was limited information available, even though some of these benefits could be substantial. While we found Ameren Illinois reported O&M savings, we did not include O&M savings in our analysis because we were not able to find similar results from other jurisdictions and it was not clear to what extent O&M savings are applicable across all the states we analyzed.[6,7]

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 2.

Figure 2. A summary of net benefits from the utility system and total resource perspectives – Illinois



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages. Emissions impacts

Table 5 and Table 6 present annual and lifetime avoided emissions for CO_2, particulate matter 2.5 microns or smaller ($PM_{2.5}$), nitrogen oxide (NO_X), and sulfur dioxide (SO_2). These values are negative

[6] Illinois Ameren reported a large amount of O&M savings which were about 19 percent of the total of avoided energy and capacity in its 2019 program evaluation. See "Appendix A: 2019 Ameren Illinois Cost-Effectiveness EE Portfolio Results (Excel)", Available at https://www.ilsag.info/evaluation-documents/final-evaluation-reports/ .

[7] While Illinois includes avoided costs of carbon for the TRC test, our analysis does not include it because the cost of carbon is not part of the standard TRC test when there is no carbon regulation. We consider the avoided carbon cost as a societal benefit and therefore address it in the following section.

because the Policy Case has fewer energy savings relative to the Reference Case, which essentially means more emissions from power plants.

Table 5. Annual avoided emissions – policy impacts for Illinois

	Annual Avoided CO2 (tons)	Annual Avoided PM2.5 (lbs)	Annual Avoided NOX (lbs)	Annual Avoided SO2 (lbs)
C&I	(26,329)	(4,582)	(27,283)	(41,673)
RES	0	0	0	0
Total	(26,329)	(4,582)	(27,283)	(41,673)

Table 6. Lifetime avoided emissions – policy impacts for Illinois

	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_X (lbs)	Lifetime Avoided SO_2 (lbs)
C&I	(231,250)	(40,247)	(239,629)	(366,016)
RES	0	0	0	0
Total	(231,250)	(40,247)	(239,629)	(366,016)

Societal costs of carbon

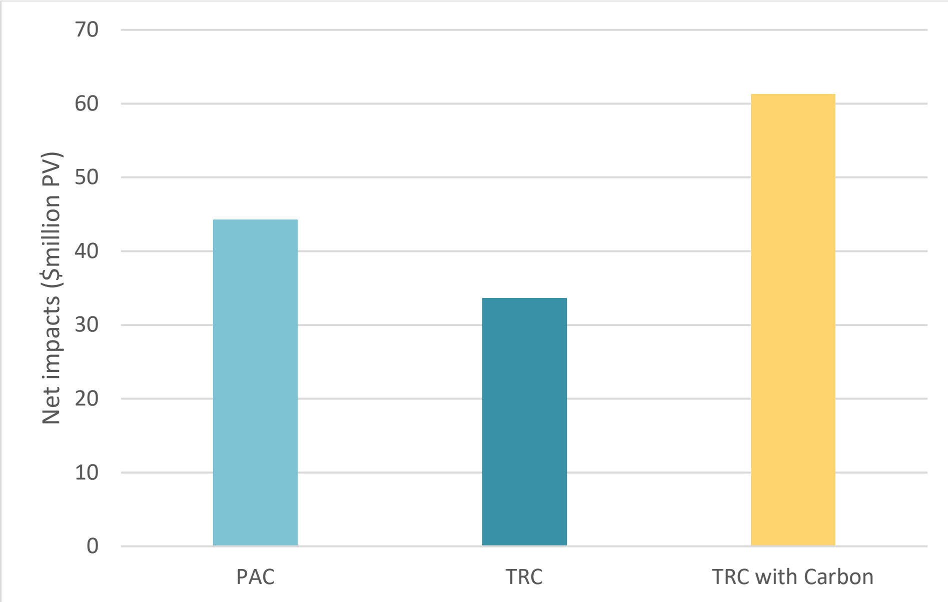
Table 7 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the social costs of carbon for the Policy Case is approximately $28 million (PV), which is approximately 40 percent of the total resource benefits. The total societal impact is estimated to be $96 million with the net societal impact of approximately $61 million (PV). This represents an additional societal cost under the Policy Case over the life of the energy efficiency measures installed in a single year.

Table 7. Program costs and benefits by sector: TRC with carbon – policy impacts for Illinois

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	(35)	(69)	(28)	(96)	(61)
RES	(0)	0	0	0	0
Total	(35)	(69)	(28)	(96)	(61)

Figure 3 presents net economic cost estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Illinois would lose $45 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic cost would be approximately $35 million. Finally, if we add the cost of carbon, the net economic cost would be as large as $60 million for the state.

Figure 3. Net economic impacts by different perspectives – policy impacts for Illinois



Health damage costs

Under the Policy Case, we estimated that the lifetime health cost impacts from a single year program operation in 2021 would be $1.5 million to $3.5 million (PV) within the state and $25 million to $57 million (PV) nationwide as shown in Table 8. As discussed in Chapter 2.3, these health impacts include avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days.

Table 8. Avoided health costs by sector – policy impacts for Illinois

	Avoided In-State Health Costs - Low ($million PV)	Avoided In-State Health Costs - High ($million PV)	Avoided Nationwide Health Costs - Low ($million PV)	Avoided Nationwide Health Costs - High ($million PV)
C&I	(2)	(3)	(25)	(57)
RES	0	0	0	0
Total	(2)	(3)	(25)	(57)

Macroeconomic impacts

Our analysis found that the Policy Case would result in an increase in spending in the construction and operation of power plants and T&D infrastructure, a decrease in spending on electricity energy efficiency measure installations, and a decrease in the respending induced from energy efficiency investments. Overall, the spending for the state would be $2 million less under the Policy Case. This results in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job loss of approximately 235 full-time equivalent (FTE) jobs,

- A net income loss of $15 million, and
- An increase in GDP of $1 million.

Table 9. Lifetime macroeconomic results – policy impacts for Illinois

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	16	134	9	18
Gas CC O&M	38	79	5	12
T&D Construction	8	63	4	8
Electricity Energy Efficiency	(35)	(295)	(18)	(13)
Residential Respending	0	0	0	0
C&I Respending	(29)	(216)	(15)	(25)
Total	(2)	(235)	(15)	1

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Impacts

Table 10 presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Due to energy efficiency programs under the Policy Case, business customers would experience a smaller rate reduction by 0.06 percent than under the Reference Case because this scenario has less spending on energy efficiency programs. On the other hand, business customers would experience a smaller amount of annual bill savings by 0.08 percent (or $9) on average relative to the Reference Case. In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Reference Case is affordable.

Table 10. Rate and bill impacts by sector and scenario – Illinois

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	0.61%	80	0.70%
	RES	1.50%	2	0.18%
Reference Case	C&I	0.67%	89	0.78%
	RES	1.50%	2	0.18%
Delta	C&I	-0.06%	(9)	-0.08%
	RES	0.00%	-	0.00%

As Illinois's policy does not affect residential customers, we did not assess participation impacts for any of the residential programs.

Non-Participant Benefits

We also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that both scenarios result in a large amount of non-participant benefits, which are $40 million under the Policy Case and $54 million under the Reference Case at the portfolio level as shown in Table 11. Thus, the Policy Case results in approximately $14 million less in net benefits to non-program participants.

Table 11. Non-participant benefits – Illinois

	Non-participant benefits ($million PV)
Policy Case	40
Reference Case	54
Delta	(14)

Note that even though the Policy Case does not include any changes to the residential energy efficiency programs, the residential customers will nonetheless experience this reduction in non-participant benefits caused by the shrinking of the C&I energy efficiency programs.

3.2. Indiana: Electric Programs

Scenarios for Indiana
(see Table 1)

- Policy Case: EERS repeal and large C&I opt-out
- Reference Case: no EERS repeal and no large C&I opt-out

Program Administrator Cost Test

Table 12 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the PAC test perspective. The Policy Case is expected to have:

- Approximately $450 million of total benefits in present value (PV) and $350 million of net benefits (PV) including the program cost of approximately $100 million.
- An overall benefit-cost ratio of 4.3 at the portfolio level with the benefit-cost ratio for the C&I sector being substantially larger than the ratio for the residential sector.

In contrast, the Reference Case, which does not have the impacts of the repeal of the EERS and the large customer opt-out policies, is expected to have:

- Approximately $560 million of total benefits (PV) and $430 million of net benefits (PV) including the program cost of approximately $130 million.
- An overall benefit-cost ratio of 4.4 at the portfolio level.

The benefit-cost ratio for the Reference Case is slightly better than the ratio for the Policy Case with the main difference in the C&I sector, which has a larger net benefit than the net benefit in the residential sector.

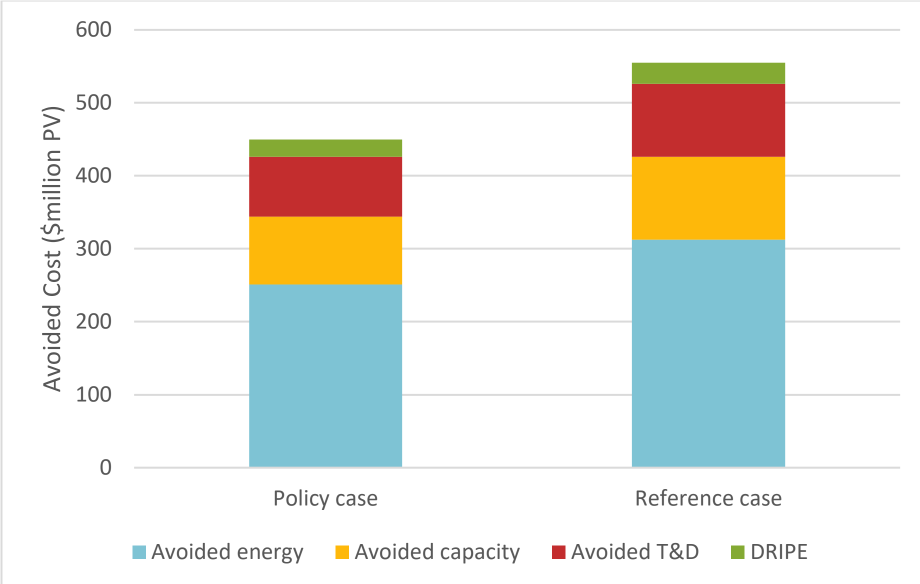
Table 12. Program impacts by case and sector: PAC Test – Indiana

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-cost Ratio
Policy Case	C&I	48	247	199	5.1
	RES	56	203	147	3.6
	Total	104	450	346	4.3
Reference Case	C&I	63	323	260	5.1
	RES	64	232	168	3.6
	Total	127	555	428	4.4
Delta	C&I	(15)	(76)	(61)	5.2
	RES	(8)	(30)	(21)	3.6
	Total	(23)	(105)	(82)	4.6

Our analysis found that the Policy Case has approximately $80 million less in net benefits (PV) relative to the Reference Case as shown in Table 12 above. This represents an approximate impact of the repeal of the EERS policy and the large customer opt-out policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers would enjoy from a single program year if the regressive policies did not exist today. Over multiple years, the effect of these regressive policies will be much greater. For example, over the course of 10 years the regressive policies will result in approximately $800 million in net losses to customers.

Figure 4 below shows a breakdown of the total utility avoided costs for Indiana for the Policy Case and the Reference Case. More than half of the benefits come from the avoided energy costs. The next largest avoided cost categories are the avoided capacity and avoided T&D costs for both cases. These results also represent the utility system benefits under the TRC test and SCT.

Figure 4. Breakdown of utility avoided costs by case – Indiana



Total Resource Cost Test

Table 13 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case is expected to have:

- Approximately $510 million of total resource benefits in present value (PV) and $315 million of net benefits (PV) including a total resource cost of approximately $200 million.
- An overall benefit-cost ratio of 2.6 at the portfolio level with the benefit-cost ratio for the residential sector being only slightly larger than the ratio for the C&I sector under the TRC perspective.

In contrast, the Reference Case is expected to have:

- Approximately $630 million of total resource benefits (PV) and $390 million of net benefits (PV) including a total resource cost of approximately $240 million.
- An overall benefit-cost ratio of 2.6 at the portfolio level.

The benefit-cost ratios are the same between the two cases.

Table 13. Program cost and benefits by case and sector: TRC Test – Indiana

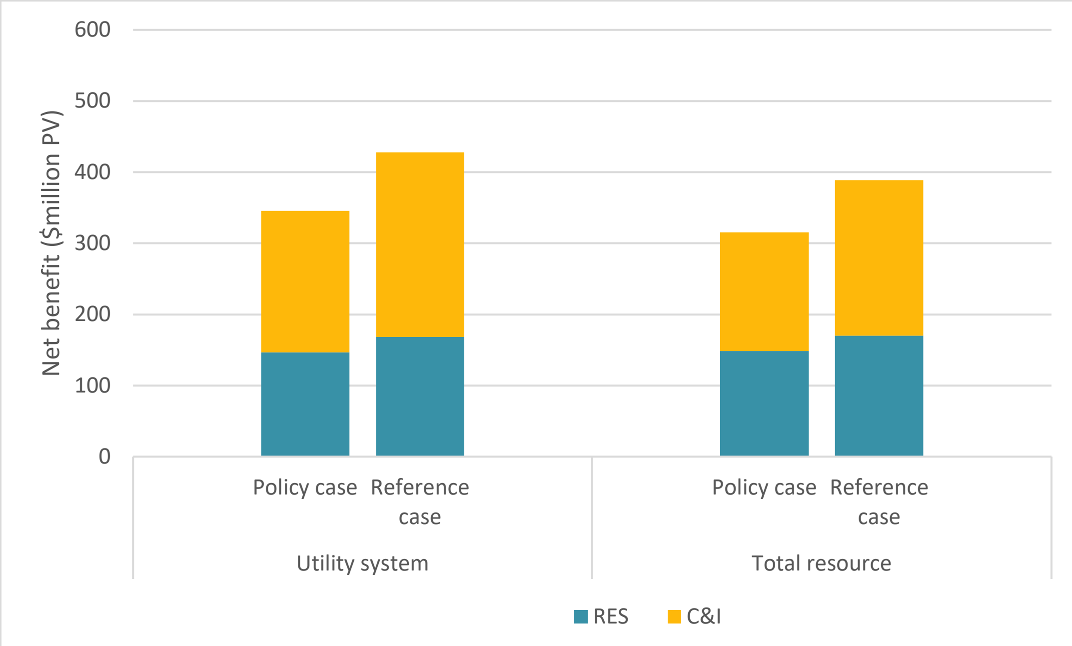
		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-cost Ratio
Policy Case	C&I	107	275	167	2.56
	RES	90	239	148	2.64
	Total	198	513	316	2.60
Reference Case	C&I	140	359	219	2.56
	RES	104	273	170	2.64
	Total	243	632	389	2.60
Delta	C&I	(33)	(84)	(51)	2.58
	RES	(13)	(35)	(22)	2.64
	Total	(46)	(119)	(73)	2.60

Our analysis found that the Policy Case has $73 million less in net total resource benefits in present value relative to the Reference Case, as shown in Table 13 above. This represents an approximate impact of the repeal of the EERS policy and the large customer exemption policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers—including non-program participants as well as program participants—could enjoy from a single program year if the regressive policies did not exist today.

As discussed in detail in Appendix B.2, the benefits in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. We took a conservative approach where we only included non-energy impacts which are estimated to be about 10 to 15 percent of the total resource benefits. These estimates exclude other benefits such as other fuel savings (e.g., oil, propane, natural gas), O&M costs (e.g., costs to replace light bulbs) or water savings.

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 5.

Figure 5. A summary of net benefits from the utility system and total resource perspectives – Indiana



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages.

Emissions impacts

Table 14 and Table 15 present annual and lifetime avoided emissions for CO_2, $PM_{2.5}$, NO_X, and SO_2. These values are negative because the Policy Case has fewer energy savings relative to the Reference Case, which essentially means more emissions from power plants.

Table 14. Annual avoided emissions – policy impacts for Indiana

	Annual Avoided CO_2 (tons)	Annual Avoided $PM_{2.5}$ (lbs)	Annual Avoided NO_X (lbs)	Annual Avoided SO_2 (lbs)
C&I	(88,687)	(15,662)	(114,587)	(155,341)
RES	(41,246)	(7,284)	(53,291)	(72,244)
Total	**(129,933)**	**(22,946)**	**(167,878)**	**(227,585)**

Table 15. Lifetime avoided emissions – policy impacts for Indiana

	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_X (lbs)	Lifetime Avoided SO_2 (lbs)
C&I	(756,321)	(133,564)	(977,190)	(1,324,736)
RES	(263,436)	(46,522)	(340,367)	(461,422)
Total	**(1,019,758)**	**(180,085)**	**(1,317,557)**	**(1,786,158)**

Societal costs of carbon

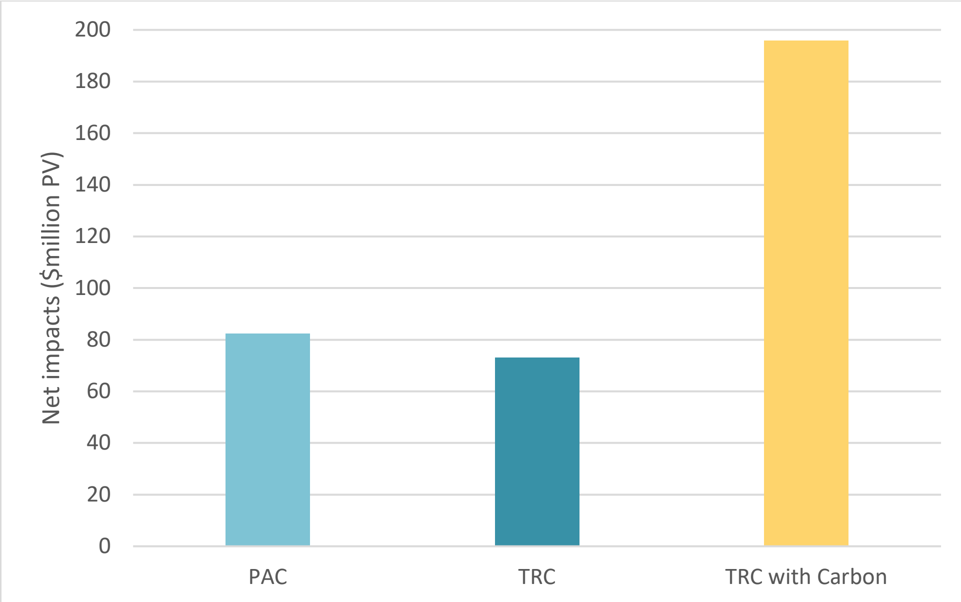
Table 16 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the social costs of carbon for the Policy Case are approximately $120 million (PV), which slightly exceeds the total resource benefits. The total societal impact is estimated to be approximately $240 million with the net societal impact of approximately $195 million. This represents an additional societal cost under the Policy Case over the life of the energy efficiency measures installed in a single year.

Table 16. Program costs and benefits by sector: TRC with carbon – policy impacts for Indiana

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	(33)	(84)	(91)	(175)	(143)
RES	(13)	(35)	(31)	(66)	(53)
Total	(46)	(119)	(123)	(242)	(196)

Figure 6 presents net economic cost estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Illinois would lose $80 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic cost would be approximately $70 million. Finally, if we add the cost of carbon, the net economic cost would be as large as approximately $195 million for the state.

Figure 6. Net economic impacts by different perspectives – policy impacts for Indiana



Health damage costs

Under the Policy Case, we estimated that the lifetime health cost impacts from a single year program operation in 2021 would be $2 million to $6 million (PV) within the state and $28 million to $64 million (PV) nationwide as shown in Table 17. As discussed in Chapter 2.3, these health impacts include avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days.

Table 17. Avoided health costs by sector – policy impacts for Indiana

	Avoided In-State Health Costs - Low ($million PV)	Avoided In-State Health Costs - High ($million PV)	Avoided Nationwide Health Costs - Low ($million PV)	Avoided Nationwide Health Costs - High ($million PV)
C&I	(2)	(4)	(21)	(46)
RES	(1)	(1)	(8)	(17)
Total	(2)	(6)	(28)	(64)

Macroeconomic impacts

Using the IMPLAN model, we estimated the expected changes in jobs, income levels, and GDP within the state under the Policy Case as shown in Table 18. Our analysis found that the Policy Case would result in an increase in spending in the construction and operation of power plants and T&D infrastructure, a decrease in spending on electricity energy efficiency measure installations, and a decrease in the respending induced from energy efficiency investments. Overall, the spending for the state would be $9 million less under the Policy Case. This results in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job loss of approximately 260 full-time equivalent (FTE) jobs,
- A net income loss of $14 million, and
- A net GDP loss of $4 million.

Table 18. Lifetime macroeconomic results – policy impacts for Indiana

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	20	180	10	20
Gas CC O&M	66	143	9	17
T&D Construction	15	126	7	13
Electricity Energy Efficiency	(46)	(234)	(13)	(10)
Residential Respending	(17)	(123)	(6)	(11)
C&I Respending	(47)	(352)	(21)	(34)
Total	**(9)**	**(260)**	**(14)**	**(4)**

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Implications

The following table presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Under the Policy Case, customers are expected to see a slightly reduced rate impact (by 0.1 percent) relative to the Reference Case. On the other hand, customers on average would experience slightly fewer bill savings from energy efficiency programs (by about 0.1 percent) relative to the Reference Case (or $1 less for residential customers and $16 less for C&I customers on average). In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Reference Case is affordable.

Table 19. Rate and bill impacts by sector and scenario – Indiana

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	0.34%	54	0.34%
	RES	0.91%	8	0.61%
Reference Case	C&I	0.45%	70	0.45%
	RES	1.04%	10	0.70%
Delta	C&I	-0.11%	(16)	-0.10%
	RES	-0.13%	(1)	-0.09%

The following table presents an illustrative example of the potential impact on participation rates between the two cases. In 2019, there were approximately 200 participants in Duke Energy's low-income weatherization program. We consider this a proxy participation rate for the Policy Case which assumes the repeal of the state's EERS policy and the large customer opt-out. The participants under this program were 3,000 back in 2013, prior to the adoption of the regressive policies. This represents about a 93 percent cut in the participation rates. We consider this a proxy participant impact under the Policy Case.

Table 20. Illustrative impacts of the Policy Case – Indiana

Utility	Case	Program Name	Participants	Source
Duke	Policy Case	Low Income Weatherization	205	2019 program data
Duke	Reference Case	Low Income Weatherization	3,000	2013 program data

Source: Duke Energy. 2020. Notice of Submission of 2020 Third Quarter Scorecard and the Year End 2017, 2018, and 2019 Scorecards. Available at: https://iurc.portal.in.gov/_entity/sharepointdocumentlocation/a46f491e-241a-eb11-a813-001dd8018921/bb9c6bba-fd52-45ad-8e64-a444aef13c39?file=43955%20DSM%204%20DEI%20Notice%20of%20Submission%20of%202020%203rd%20Quarter%20Scorecard.pdf; NiSource. 2014. Compliance Filing - Final Evaluation Report. Cause No. 42693-S1. Available at https://iurc.portal.in.gov/_entity/sharepointdocumentlocation/0ae42f17-9484-e611-8124-1458d04ea8b8/bb9c6bba-fd52-45ad-8e64-a444aef13c39?file=42693_1_7_7_20143-54-54pm.pdf:

Note: the NiSource report summarized Duke's program data because the program was part of the shared statewide 'Core' programs that existed under Indiana's EERS.

Non-Participant Benefits

Our analysis also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that both scenarios result in a large amount of non-participant benefits ($94 million under the Policy Case and $116 million under the Reference Case at the portfolio level) as shown in Table 21 below. Thus, the Policy Case results in $21 million less in net benefits to non-program participants.

Table 21. Non-participant benefits – Indiana

	Non-participant benefits ($million PV)
Policy Case	94
Reference Case	116
Delta	(21)

3.3. Iowa: Electric Programs

Scenarios for Iowa electric
(see Table 1)

- Policy Case: 2 percent program budget cap
- Reference Case: no budget cap

Program Administrator Cost Test

Table 22 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the PAC test perspective. The Policy Case is expected to have:

- Approximately $210 million of total benefits in present value (PV) and $140 million of net benefits (PV) including the program cost of approximately $70 million.
- An overall benefit-cost ratio of 3.1 at the portfolio level with the benefit-cost ratio for the C&I sector being slightly larger than the ratio for the residential sector.

In contrast, the Reference Case, which does not have the impacts of the 2 percent budget cap, is expected to have:

- Approximately $355 million of total benefits (PV) and $240 million of net benefits (PV) including the program cost of approximately $110 million.
- An overall benefit-cost ratio of 3.2 at the portfolio level.

The benefit-cost ratio for the Reference Case is slightly better than the ratio for the Policy Case, with the main difference in the C&I sector that has a larger difference in the benefit-cost ratio between the two scenarios as compared to the difference in the residential sector.

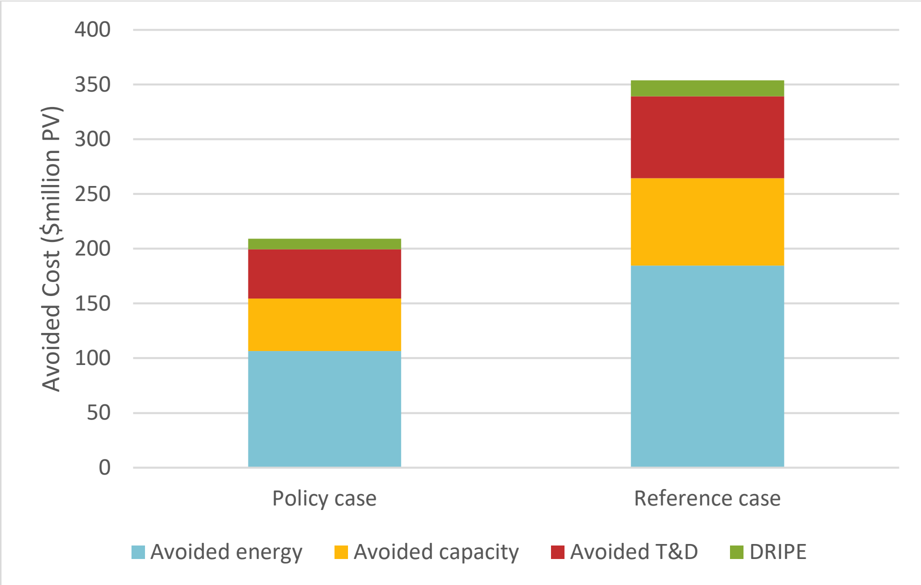
Table 22. Program impacts by case and sector: PAC Test – Iowa

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million {PV)	Benefit-cost Ratio
Policy Case	C&I	47	153	106	3.2
	RES	21	56	35	2.7
	Total	68	209	141	3.1
Reference Case	C&I	69	253	184	3.7
	RES	41	101	61	2.5
	Total	109	354	244	3.2
Delta	C&I	(22)	(100)	(78)	4.6
	RES	(20)	(45)	(26)	2.3
	Total	(41)	(145)	(104)	3.5

Our analysis found that the Policy Case has approximately $100 million less in net benefits relative to the Reference Case, as shown in Table 22 above. This represents an approximate impact for the 2 percent budget cap regulation in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers would enjoy from a single program year if the regressive policy did not exist today. Over multiple years, the effect of these regressive policies will be much greater. For example, over the course of 10 years the regressive policies will result in approximately $1 billion in net losses to customers.

Figure 7 below shows a breakdown of the total utility avoided costs for Iowa for the Policy Case and the Reference case. More than half of the benefits come from the avoided energy costs. The next largest avoided cost categories are the avoided capacity and avoided T&D costs for both cases. These results also represent the utility system benefits under the TRC test and SCT.

Figure 7. Breakdown of utility avoided costs by case – Iowa



Total Resource Cost Test

Table 23 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case is expected to have:

- Approximately $240 million of total resource benefits in present value (PV) and $100 million of net benefits (PV) including the total resource cost of approximately $140 million.
- An overall benefit-cost ratio of 1.7 at the portfolio level with the benefit-cost ratio for the residential sector being slightly larger than the ratio for the C&I sector under the TRC perspective.

In contrast, the Reference Case is expected to have:

- Approximately $400 million of total resource benefits (PV) and $180 million of net benefits (PV) including the total resource cost of approximately $220 million.
- An overall benefit-cost ratio of 1.8 at the portfolio level.

Table 23. Program cost and benefits by case and sector: TRC Test – Iowa

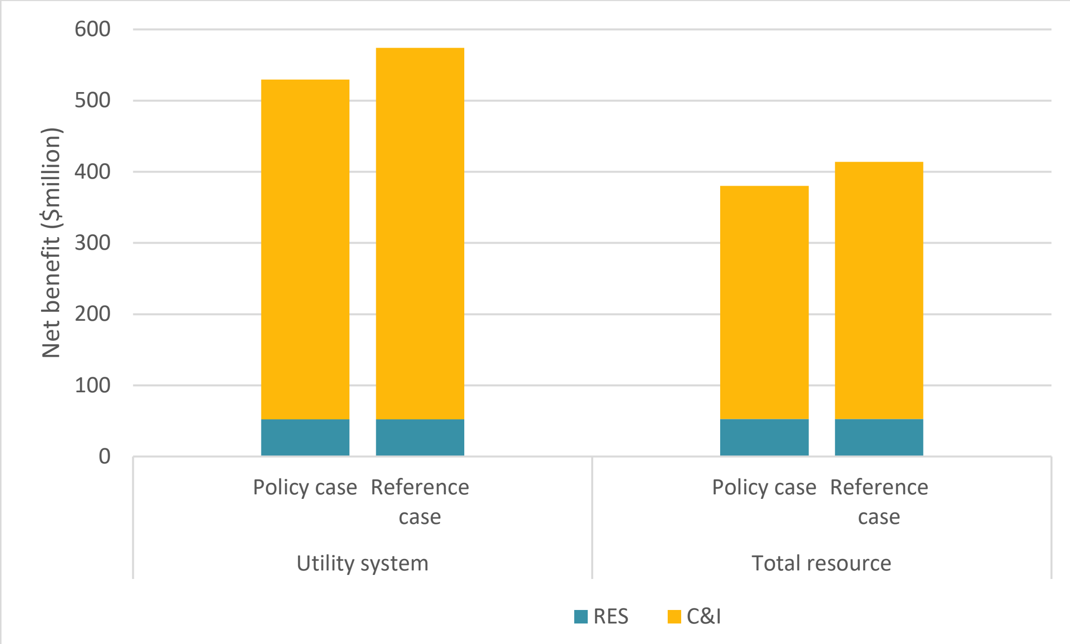
		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	105	170	65	1.6
	RES	34	66	32	1.9
	Total	139	236	97	1.7
Reference Case	C&I	153	281	128	1.8
	RES	65	119	54	1.8
	Total	219	400	181	1.8
Delta	C&I	(48)	(111)	(62)	2.3
	RES	(32)	(53)	(22)	1.7
	Total	(80)	(164)	(84)	2.1

Our analysis found that the Policy Case has $84 million less in net total resource benefits in present value relative to the Reference Case, as shown in Table 23 above. This represents an approximate impact of the program budget cap regulation in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers—including non-program participants as well as program participants—could enjoy from a single program year if this policy did not exist today.

As discussed in detail in Appendix B.2, the benefits in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. We took a conservative approach where we only included non-energy impacts which are estimated to be about 10 to 15 percent of the total resource benefits. These estimates exclude other benefits such as other fuel savings (e.g., oil, propane, natural gas), O&M costs (e.g., costs to replace light bulbs) or water savings.

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 8.

Figure 8. A summary of net benefits from the utility system and total resource perspectives – Iowa



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages. Emissions impacts

Table 24 and Table 25 present annual and lifetime avoided emissions for CO_2, $PM_{2.5}$, NO_X, and SO_2. These values are negative because the Policy Case has fewer energy savings relative to the Reference Case, which essentially means more emissions from power plants.

Table 24. Annual avoided emissions – policy impacts for Iowa

	Annual Avoided CO_2 (tons)	Annual Avoided $PM_{2.5}$ (lbs)	Annual Avoided NO_X (lbs)	Annual Avoided SO_2 (lbs)
C&I	(117,441)	(20,791)	(159,460)	(210,728)
RES	(43,075)	(7,626)	(58,487)	(77,291)
Total	**(160,515)**	**(28,416)**	**(217,946)**	**(288,018)**

Table 25. Lifetime avoided emissions – policy impacts for Iowa

	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_X (lbs)	Lifetime Avoided SO_2 (lbs)
C&I	(1,196,750)	(211,863)	(1,624,934)	(2,147,369)
RES	(384,292)	(68,032)	(521,787)	(689,548)
Total	**(1,581,042)**	**(279,894)**	**(2,146,722)**	**(2,836,917)**

Societal costs of carbon

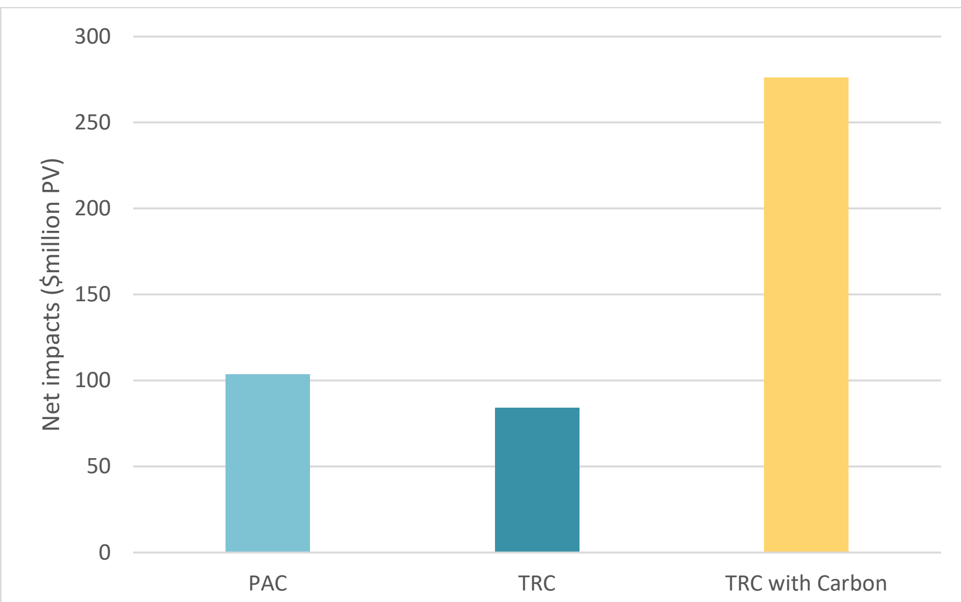
Table 26 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the social costs of carbon for the Policy Case is approximately $190 million (PV), which exceeds the total resource benefits by 17 percent. The total societal impact is estimated to be approximately $360 million with a net societal impact of approximately $280 million. This represents an additional societal cost under the Policy Case over the life of the energy efficiency measures installed in a single year.

Table 26. Program costs and benefits by sector: TRC with carbon – policy impacts for Iowa

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	48	(111)	(146)	(256)	(208)
RES	32	(53)	(47)	(100)	(68)
Total	**80**	**(164)**	**(192)**	**(356)**	**(276)**

Figure 9 presents net economic cost estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Iowa would lose $100 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic cost would be approximately $80 million. Finally, if we add the cost of carbon, the net economic cost would be as large as approximately $280 million for the state.

Figure 9. Net economic impacts by different perspectives – policy impacts for Iowa



Health damage costs

Under the Policy Case, we estimated that the lifetime health cost impacts from a single year program operation in 2021 would be $1 million to $2 million (PV) within the state and $40 million to $90 million (PV) nationwide as shown in Table 27. As discussed in Chapter 2.3, these health impacts include avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days.

Table 27. Avoided health costs by sector – policy impacts for Iowa

	Avoided In-State Health Costs - Low ($million PV)	Avoided In-State Health Costs - High ($million PV)	Avoided Nationwide Health Costs - Low ($million PV)	Avoided Nationwide Health Costs - High ($million PV)
C&I	-0.7	-1.6	-29.8	-67.3
RES	-0.2	-0.5	-9.9	-22.4
Total	**-1.0**	**-2.2**	**-39.7**	**-89.7**

Macroeconomic impacts

Using the IMPLAN model, we estimated the expected changes in jobs, income levels, and GDP within the state under the Policy Case as shown in Table 28. Our analysis found that the Policy Case would result in an increase in spending in the construction and operation of power plants and T&D infrastructure, a decrease in spending on electricity energy efficiency measure installations, and a decrease in the respending induced from energy efficiency investments. Overall, the spending for the state would be $6 million less under the Policy Case. This results in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job loss of approximately 124 full-time equivalent (FTE) jobs,
- A net income loss of $6 million, and
- An increase in GDP of $18 million.

Table 28. Lifetime macroeconomic results – policy impacts for Iowa

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	34	297	16	31
Gas CC O&M	89	314	17	31
T&D Construction	25	203	10	20
Electricity Energy Efficiency	(80)	(402)	(21)	(15)
Residential Respending	(16)	(105)	(5)	(9)
C&I Respending	(58)	(431)	(24)	(40)
Total	**(6)**	**(124)**	**(6)**	**18**

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Implications

The following table presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Under the Policy Case, customers are expected to see a slightly smaller rate impact (by 0.3 to 0.4 percent) relative to the Reference Case. On the other hand, customers on average would experience slightly fewer bill savings from energy efficiency programs (by about 0.2 percent) relative to the Reference Case (or $2 less for residential customers and $27 less for C&I customers on average). In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Reference Case is affordable.

Table 29. Rate and bill impacts by sector and scenario – Iowa

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	0.43%	46	0.39%
	RES	0.89%	4	0.37%
Reference Case	C&I	0.69%	73	0.62%
	RES	1.27%	6	0.53%
Delta	C&I	-0.26%	(27)	-0.23%
	RES	-0.38%	(2)	-0.17%

The following table presents an illustrative example of the potential impact on participation rates between the two cases. In 2019, there were approximately 4,000 participants in MidAmerican's HVAC program. We consider this a proxy participation rate for the Policy Case, which assumes the existing 2 percent budget cap. The participants under this program were approximately 17,900 in the year prior to the adoption of the program budget cap. This represents about a 78 percent drop in the participation rate. We consider this a proxy participant impact under the Policy Case.

Table 30. Illustrative impacts of the Policy Case – Iowa

Utility	Case	Program Name	Participants	Source
MidAmerican	Policy Case	HVAC	3,986	2019 program data
MidAmerican	Reference Case	HVAC	17,896	2018 program data

Source: MidAmerican. 2019. 2018 Energy Efficiency Plan Annual Report - 2018 Exhibit A - Measure Results. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=1846097&noSaveAs=1; MidAmerican. 2020. 2019 Energy Efficiency Plan Annual Report - 2019 New Plan Exhibit A - Measure Results. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=2027467&noSaveAs=1.

Non-Participant Benefits

Our analysis also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that both scenarios result in a large amount of non-participant benefits ($34 million under the Policy Case and $60 million under the Reference Case at the portfolio level) as shown in Table 31. Thus, the Policy Case results in approximately $25 million less in net benefits to non-program participants.

Table 31. Non-participant benefits – Iowa

	Non-participant benefits ($million PV)
Policy Case	34
Reference Case	60
Delta	25

3.4. Iowa: Natural Gas Programs

Scenarios for Iowa natural gas

(see Table 1)

- Policy Case: 1.5 percent program budget cap
- Reference Case: no budget cap

Program Administrator Cost Test

Table 32 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the PAC test perspective. The Policy Case is expected to have:

- Approximately $15 million of total benefits in present value (PV) and $8 million of net benefits (PV) including the program cost of approximately $7 million.
- An overall benefit-cost ratio of 2.2 at the portfolio level with the benefit-cost ratio for the C&I sector being larger than the ratio for the residential sector.

In contrast, the Reference Case, which does not have the impacts of the 1.5 percent budget cap, is expected to have:

- Approximately $130 million of total benefits (PV) and $80 million of net benefits (PV) including the program cost of approximately $50 million.
- An overall benefit-cost ratio of 2.7 at the portfolio level.

The differences in the benefit-cost ratios between the two cases indicate that the Reference Case—which has substantially more natural gas savings—is more cost-effective than the Policy Case, which has a very small amount of savings. Among the two sectors, the C&I sector performs particularly well; its expanded program scale results in a benefit-cost ratio of 3.8 under the Reference Case. In contrast, the benefit-cost ratio for the C&I sector is 2.9 under the Policy Case.

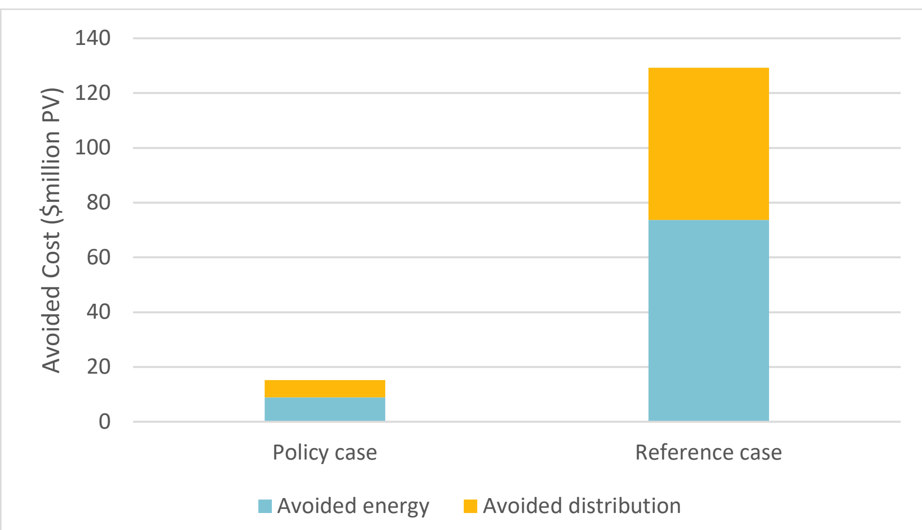
Table 32. Program impacts by case and sector: PAC Test – Iowa (natural gas energy efficiency)

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-cost Ratio
Policy Case	C&I	1	4	3	2.9
	RES	5	11	6	2.1
	Total	7	15	8	2.2
Reference Case	C&I	10	38	28	3.8
	RES	38	91	53	2.4
	Total	48	129	81	2.7
Delta	C&I	(9)	(34)	(26)	3.9
	RES	(33)	(80)	(47)	2.4
	Total	(42)	(114)	(72)	2.7

Our analysis found that the Policy Case has approximately $70 million less in net benefits relative to the Reference Case, as shown in Table 32 above. This represents an approximate impact of the 1.5 percent budget cap regulation in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers would enjoy from a single program year if the regressive policy did not exist today. Over multiple years, the effect of these regressive policies will be much greater. For example, over the course of 10 years the regressive policies will result in approximately $700 million in net losses to customers.

Figure 10 below shows a breakdown of the total utility natural gas avoided costs for Iowa for the Policy Case and the Reference Case. The avoided cost of energy (natural gas) is slightly larger than the avoided cost of distribution facilities such as gas pipelines and compressor stations. These results also represent the utility system benefits under the TRC test and SCT.

Figure 10. Breakdown of utility avoided natural gas costs by case – Iowa (natural gas energy efficiency)



Total Resource Cost Test

Table 33 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case is expected to have:

- Approximately $15 million (PV) of total resource benefits in present value (PV) and negative $1 million of net benefits (PV) including the total resource cost of $18 million.
- An overall benefit-cost ratio of 0.9 at the portfolio level with the benefit-cost ratio for the residential sector being significantly lower than the ratio for the C&I sector and less than 1.0.

In contrast, the Reference Case is expected to have:

- Approximately $140 million of total resource benefits (PV) and $40 million of net benefits (PV) including the total resource cost of approximately $100 million.
- An overall benefit-cost ratio of 1.4 at the portfolio level.

Table 33. Program cost and benefits by case and sector: TRC Test – Iowa

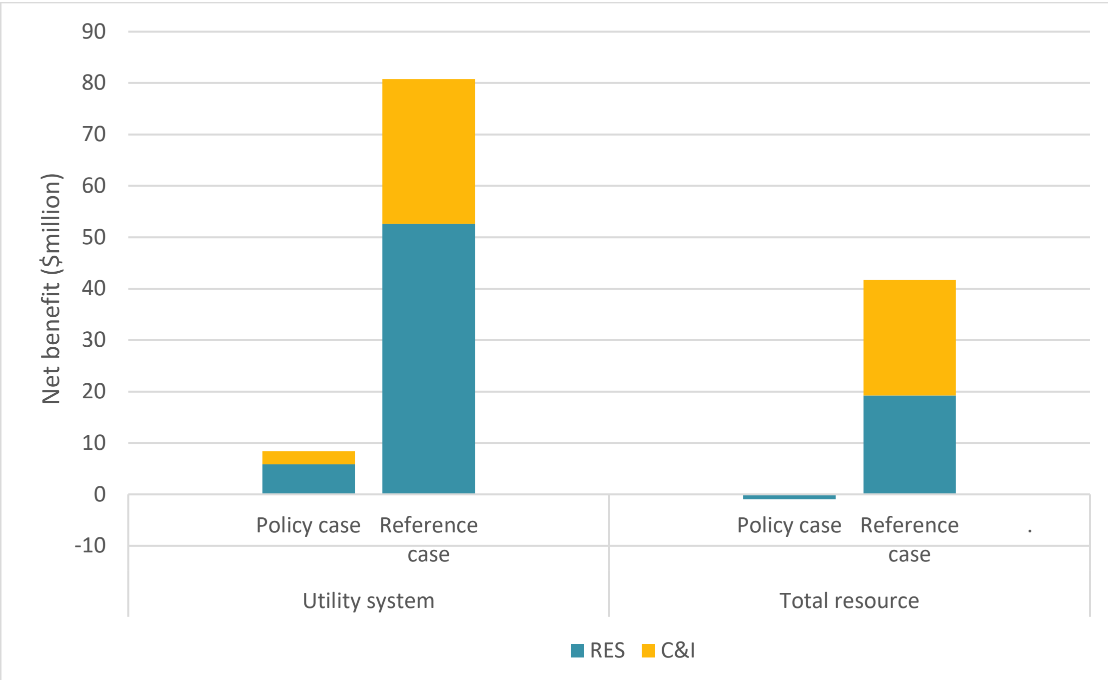
		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	2	4	2	2.3
	RES	16	13	(3)	0.8
	Total	18	17	(1)	0.9
Reference Case	C&I	19	41	22	2.2
	RES	83	103	19	1.2
	Total	102	144	42	1.4
Delta	C&I	(17)	(37)	(20)	2.2
	RES	(67)	(90)	(23)	1.3
	Total	(84)	(127)	(43)	1.5

Our analysis found that the Policy Case has $130 million less in net total resource benefits in present value relative to the Reference Case, as shown in Table 33 above. This represents an approximate impact of the program budget cap regulation in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers—including non-program participants as well as program participants—could enjoy from a single program year if this policy did not exist today.

As mentioned in Section 3.1 for Illinois and discussed in detail in Section B.2, the benefits derived in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. We took a conservative approach where we only included non-energy impacts which are estimated to be about 7.5 to 11.25 percent of the total resource benefits for natural gas energy efficiency. These estimates exclude other benefits such as other fuel savings (e.g., oil and propane), O&M costs, or water savings.

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 11. The Policy Case under the total resource perspective only shows a negative value of approximately $1 million for the residential sector as the net costs for the residential sector exceed the net benefits for the C&I sector.

Figure 11. A summary of net benefits from the utility system and total resource perspectives – Iowa (natural gas energy efficiency)



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages.

Emissions impacts

Table 34 and Table 35 present annual and lifetime avoided emissions for CO_2. These values are negative because the Policy Case has fewer energy savings relative to the Reference Case, which essentially means more emissions from natural gas usage and delivery.

Table 34. Annual avoided emissions – policy impacts for Iowa (natural gas energy efficiency)

	Annual Avoided On-Site CO_2 (tons)	Annual Avoided Leaked CO_2e (tons)	Annual Total Avoided CO_2e (tons)
C&I	(17,538)	(8,084)	(25,623)
RES	(40,819)	(18,815)	(59,634)
Total	**(58,357)**	**(26,900)**	**(85,257)**

Table 35. Lifetime avoided emissions – policy impacts for Iowa (natural gas energy efficiency)

	Lifetime Avoided On-Site CO_2 (tons)	Lifetime Avoided Leaked CO_2e (tons)	Lifetime Total Avoided CO_2e (tons)
C&I	(303,563)	(139,926)	(443,490)
RES	(706,855)	(325,822)	(1,032,677)
Total	**(1,010,419)**	**(465,748)**	**(1,476,167)**

Societal costs of carbon

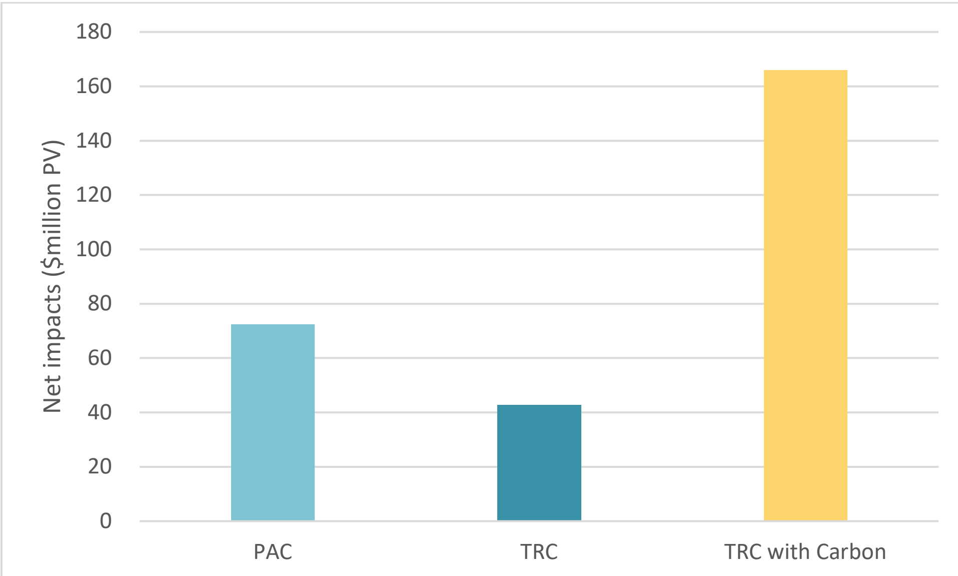
Table 36 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the social costs of carbon for the Policy Case is approximately $120 million (PV), which is slightly lower than the total resource benefits. The total societal impact is estimated to be approximately $250 million with the net societal impact of approximately $170 million. This represents an additional societal cost under the Policy Case over the life of the energy efficiency measures installed in a single year.

Table 36. Program costs and benefits by sector: TRC with carbon – policy impacts for Iowa (natural gas energy efficiency)

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	(17)	(37)	(37)	(74)	(57)
RES	(67)	(90)	(86)	(176)	(109)
Total	**(84)**	**(127)**	**(123)**	**(250)**	**(166)**

Figure 12 presents net economic cost estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Iowa would lose $70 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic cost would be approximately $40 million. Finally, if we add the cost of carbon, the net economic cost would be as large as approximately $170 million for the state.

Figure 12. Net economic impacts by different perspectives – policy impacts for Iowa (natural gas energy efficiency)



Health damage costs

Our analysis did not estimate health damage costs associated with natural gas supply.

Macroeconomic impacts

Using the IMPLAN model, we estimated the expected changes in jobs, income levels, and GDP within the state under the Policy Case, as shown in Table 37. Our analysis found that the Policy Case would result in an increase in spending in the construction and operation of power plants and T&D infrastructure, a decrease in spending on electricity energy efficiency measure installations, and a decrease in the respending induced from energy efficiency investments. Overall, the spending for the state would be $15 million more under the Policy Case. This results in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job loss of approximately 400 full-time equivalent (FTE) jobs,
- A net income loss of $22 million, and
- An increase in GDP of $22 million.

Table 37. Lifetime macroeconomic results – policy impacts for Iowa (natural gas energy efficiency)

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas Pipeline	53	531	27	60
Gas Energy Efficiency	0	(677)	(37)	(15)
Residential	(20)	(128)	(6)	(11)
Commercial and Industrial	(18)	(134)	(7)	(12)
Total	**15**	**(409)**	**(22)**	**22**

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Implications

The following table presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Under the Policy Case, customers are expected to see a slightly smaller rate impact (by 0.1 to 0.5 percent) relative to the Reference Case. On the other hand, customers on average would experience slightly fewer bill savings from energy efficiency programs (by about 0.5 to 0.7 percent) relative to the Reference Case (or $3 less for residential customers and $17 less for C&I customers on average). In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Reference Case is affordable.

Table 38. Rate and bill impacts by sector and scenario – Iowa (natural gas energy efficiency)

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	0.01%	1.5	0.06%
	RES	0.05%	0.3	0.05%
Reference Case	C&I	0.07%	18.7	0.73%
	RES	0.54%	3.6	0.57%
Delta	C&I	-0.06%	(17.2)	-0.67%
	RES	-0.49%	(3.3)	-0.52%

The following table presents an illustrative example of the potential impact on participation rates between the two cases. In 2018, there were approximately 13,000 participants in MidAmerican's High Efficiency Furnace program. We consider this a proxy participation rate for the Reference Case, which assumes no budget cap on programs. In 2019, when the budget cap was in place, the participants under this program numbered only about 5,300. This represents about a 40 percent cut in participation rate. We consider this a proxy participant impact under the Policy Case.

Table 39. Illustrative impacts of the Policy Case – Iowa (natural gas energy efficiency)

Utility	Case	Program Name	Participants	Source
MidAmerican	Policy Case	High Efficiency Furnace	5,330	2019 program data
MidAmerican	Reference Case	High Efficiency Furnace	12,972	2018 program data

Source: MidAmerican. 2019. 2018 Energy Efficiency Plan Annual Report - 2018 Exhibit A - Measure Results. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=1846097&noSaveAs=1; MidAmerican. 2020. 2019 Energy Efficiency Plan Annual Report - 2019 New Plan Exhibit A - Measure Results. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=2027467&noSaveAs=1.

Non-Participant Benefits

Our analysis also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that the Policy Case results in negative $0.5 million in non-participant benefits while the Reference Case results in approximately $7 million in non-participant benefits as shown in Table 40. Between the two scenarios, the Policy Case results in about $8 million less in net benefits to non-program participants, making a stronger case for expanding the program to serve all customers with more benefits.

Table 40. Non-participant benefits – Iowa (natural gas energy efficiency)

	Non-participant benefits ($million PV)
Policy Case	(0.5)
Reference Case	7.1
Delta	(7.6)

3.5. Missouri: Electric Programs

Program Administrator Cost Test

Table 22 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the PAC test perspective. The Policy Case, which represents the unadopted proposal by Missouri Public Service Commission's (PSC) staff, is expected to have:

Scenarios for Missouri

(see Table 1)

- Policy Case: Staff's program proposal (not adopted)
- Reference Case: program proposal ultimately approved

- Approximately $30 million of total benefits in present value (PV) and $20 million of net benefits (PV) including the program cost of just $8 million.

- An overall benefit-cost ratio of 3.6 at the portfolio level with the benefit-cost ratio for the C&I sector being substantially larger than the ratio for the residential sector.

In contrast, the Reference Case that represents the status quo (with the proposal ultimately approved by the PSC) is expected to have:

- Approximately $310 million of total benefits (PV) and $220 million of net benefits (PV) including the program cost of approximately $90 million.

- An overall benefit-cost ratio of 3.4 at the portfolio level.

The benefit-cost ratio for the Reference Case is slightly lower than the ratio for the Policy Case. This is mainly because the Policy Case has a very small amount of investment in the residential programs, for which the benefit-cost ratio is substantially lower than the ratio for the C&I programs.

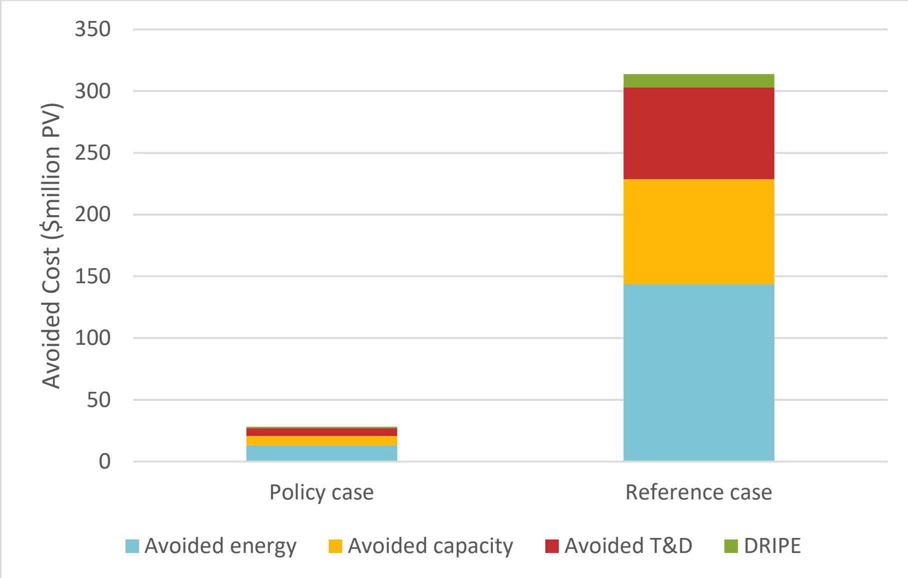
Table 41. Program impacts by case and sector: PAC Test – Missouri

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	6	25	18	3.9
	RES	1	3	2	2.5
	Total	8	28	20	3.6
Reference Case	C&I	48	201	153	4.2
	RES	44	113	68	2.5
	Total	92	314	221	3.4
Delta	C&I	(42)	(176)	(135)	4.2
	RES	(43)	(109)	(66)	2.5
	Total	(85)	(286)	(201)	3.4

Our analysis found that the Policy Case has approximately $290 million less in net benefits relative to the Reference Case, as shown in Table 41 above. This represents an approximate impact of the PSC Staff's proposal from a single program year if it had been adopted. Alternatively, this represents the amount of additional net benefits that all customers enjoy today from a single program year relative to the Staff's proposed policy if it had been adopted. Over multiple years, the effect of this proposed regressive policy would have been significantly greater. For example, over the course of 10 years the proposed regressive policy would have resulted in approximately $2.0 billion in net losses to customers.

Figure 13 below shows a breakdown of the total utility avoided costs for Missouri for the Policy Case and the Reference Case. Slightly less than half of the benefits come from the avoided energy costs. The next largest avoided cost categories are the avoided capacity and avoided T&D costs for both cases. These results also represent the utility system benefits under the TRC test and SCT.

Figure 13. Breakdown of utility avoided costs by case – Missouri



Total Resource Cost Test

Table 42 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case is expected to have:

- Approximately $30 million of total resource benefits in present value (PV) and $15 million of net benefits (PV) including the total resource cost of approximately $16 million.

- An overall benefit-cost ratio of 1.9 at the portfolio level with the benefit-cost ratio for the C&I sector being slightly larger than the ratio for the residential sector under the TRC perspective.

In contrast, the Reference Case is expected to have:

- Approximately $360 million of total resource benefits (PV) and $180 million of net benefits (PV) including the total resource cost of approximately $180 million.

- An overall benefit-cost ratio of 2.0 at the portfolio level.

Table 42. Program cost and benefits by case and sector: TRC Test – Missouri

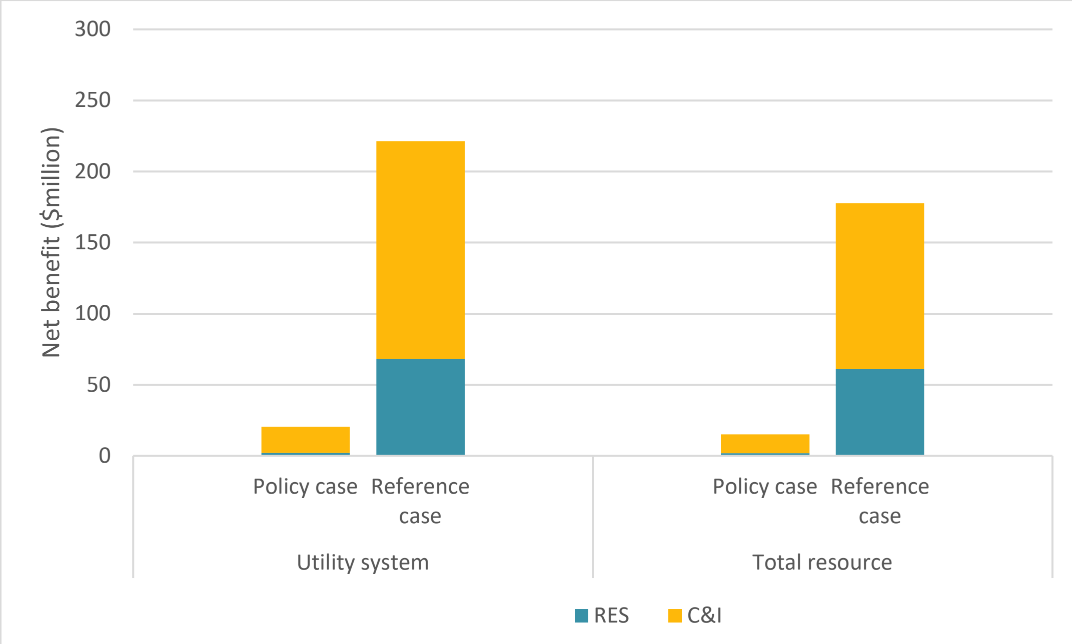
		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	14	28	13	1.9
	RES	2	4	2	1.8
	Total	16	32	15	1.9
Reference Case	C&I	107	224	117	2.1
	RES	71	132	61	1.9
	Total	178	356	178	2.0
Delta	C&I	(92)	(196)	(103)	2.1
	RES	(69)	(129)	(59)	1.9
	Total	(162)	(324)	(163)	2.0

Our analysis found that the Policy Case has $320 million less in net total resource benefits in present value relative to the Reference Case, as shown in Table 42 above. This represents an approximate impact of the PSC Staff's proposal from a single program year if it had been approved. Alternatively, this represents the amount of additional net benefits that all customers—including non-program participants as well as program participants—are enjoying today from a single program year relative to the Staff's original proposal.

As discussed in detail in Appendix B.2, the benefits in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. We took a conservative approach where we only included non-energy impacts which are estimated to be about 10 to 15 percent of the total resource benefits. These estimates exclude other benefits such as other fuel savings (e.g., oil, propane, natural gas), O&M costs (e.g., costs to replace light bulbs) or water savings.

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 14.

Figure 14. A summary of net benefits from the utility system and total resource perspectives – Missouri



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages. Emissions impacts

Table 43 and Table 44 present annual and lifetime avoided emissions for CO_2, $PM_{2.5}$, NO_X, and SO_2. These values are negative because the Policy Case has fewer energy savings relative to the Reference Case, which essentially means more emissions from power plants.

Table 43. Annual avoided emissions – policy impacts for Missouri

	Annual Avoided CO_2 (tons)	Annual Avoided $PM_{2.5}$ (lbs)	Annual Avoided NO_X (lbs)	Annual Avoided SO_2 (lbs)
C&I	(179,888)	(29,512)	(245,948)	(315,360)
RES	(116,172)	(19,059)	(158,834)	(203,660)
Total	**(296,060)**	**(48,572)**	**(404,783)**	**(519,020)**

Table 44. Lifetime avoided emissions – policy impacts for Missouri

	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_X (lbs)	Lifetime Avoided SO_2 (lbs)
C&I	(2,226,822)	(365,332)	(3,044,580)	(3,903,819)
RES	(1,347,958)	(221,146)	(1,842,970)	(2,363,091)
Total	**(3,574,780)**	**(586,478)**	**(4,887,550)**	**(6,266,911)**

Societal costs of carbon

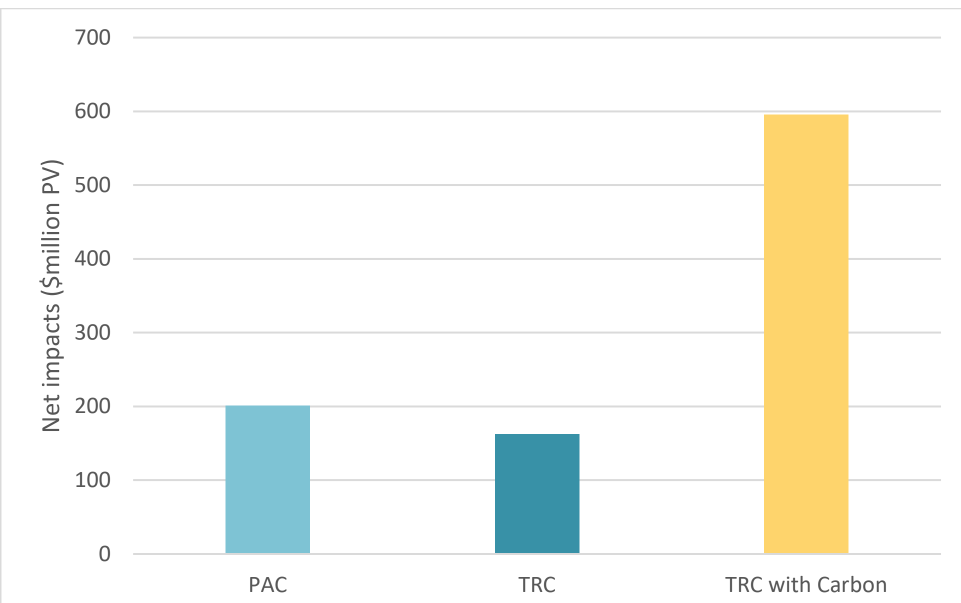
Table 45 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the social costs of carbon for the Policy Case is approximately $430 million (PV), which exceeds the total resource benefits by 33 percent. The total societal impact is estimated to be approximately $760 million with the net societal impact of approximately $560 million. This represents an additional societal cost under the Policy Case over the life of the energy efficiency measures installed in a single year.

Table 45. Program costs and benefits by sector: TRC with carbon – policy impacts for Missouri

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	(92)	(196)	(270)	(465)	(373)
RES	(69)	(129)	(163)	(292)	(222)
Total	**(162)**	**(324)**	**(433)**	**(757)**	**(595)**

Figure 15 presents net economic cost estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Missouri would lose $200 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic cost would be $160 million. Finally, if we add the cost of carbon, the net economic cost would be as large as $600 million for the state.

Figure 15. Net economic impacts by different perspectives – policy impacts for Missouri



Health damage costs

Under the Policy Case, we estimated that the lifetime health cost impacts from a single year program operation in 2021 would be $3 million to $6 million (PV) within the state and $84 million to $190 million

(PV) nationwide, as shown in Table 46. As discussed in Chapter 2.3, these health impacts include avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days.

Table 46. Avoided health costs by sector – policy impacts for Missouri

	Avoided In-State Health Costs - Low ($million PV)	Avoided In-State Health Costs - High ($million PV)	Avoided Nationwide Health Costs - Low ($million PV)	Avoided Nationwide Health Costs - High ($million PV)
C&I	(2)	(4)	(52)	(118)
RES	(1)	(2)	(32)	(72)
Total	(3)	(6)	(84)	(190)

Macroeconomic impacts

Using the IMPLAN model, we estimated the expected changes in jobs, income levels, and GDP within the state under the Policy Case, as shown in Table 47. Our analysis found that the Policy Case would have resulted in an increase in spending in the construction and operation of power plants and T&D infrastructure, a decrease in spending on electricity energy efficiency measure installations, and a decrease in the respending induced from energy efficiency investments. Overall, the spending for the state would have been $110 million less under the Policy Case. This would have resulted in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job loss of approximately 780 full-time equivalent (FTE) jobs,
- A net income loss of $43 million, and
- A decrease in GDP of $17 million.

Table 47. Lifetime macroeconomic results – policy impacts for Missouri

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	49	478	26	47
Gas CC O&M	89	312	18	32
T&D Construction	57	512	26	48
Electricity Energy Efficiency	(162)	(952)	(52)	(42)
Residential Respending	(46)	(343)	(17)	(30)
C&I Respending	(94)	(789)	(45)	(71)
Total	**(107)**	**(783)**	**(43)**	**(17)**

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Implications

The following table presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Under the Policy Case, customers are expected to see a slightly smaller rate impact (by 0.3 to 0.4 percent) relative to the Reference Case. On the other hand, customers on average would experience slightly fewer bill savings from energy efficiency programs (by about 0.2 to 0.4 percent) relative to the Reference Case (or $3 less for residential customers and $42 less for C&I customers on average). In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Reference Case is affordable.

Table 48. Rate and bill impacts by sector and scenario – Missouri

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	0.04%	6	0.06%
	RES	0.01%	0	0.01%
Reference Case	C&I	0.32%	47	0.47%
	RES	0.43%	3	0.25%
Delta	C&I	-0.28%	(42)	-0.41%
	RES	-0.41%	(3)	-0.24%

The following table presents an illustrative example of the potential impact on participation rates between the two cases. In 2019, there were 487 participants in Ameren Missouri's single family low-income program. We consider this a proxy participation rate for the Reference Case (in 2021) as the budget estimates for 2019 and 2021 are similar for the residential programs. Under the Policy Case, which assumes that the Staff's proposal had been adopted, we estimate the participation rate would be only about 15 customers assuming participants would be proportionally reduced to the reduction in savings under this case.

Table 49. Illustrative impacts of the Policy Case – Missouri

Utility	Case	Program Name	Participants	Source
Ameren Missouri	Policy Case	Single Family Low-Income	15	Synapse estimate
Ameren Missouri	Reference Case	Single Family Low-Income	487	2019 program data

Source: Opinion Dynamics. 2020. Ameren Missouri Program Year 2019 - Annual EM&V Report Volume 2. Available at: https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936298055.

Non-Participation Benefits

Our analysis also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that the Policy Case results in $7 million of non-participant benefits and the Reference Case results in $78 million of non-participant benefits at the portfolio level as shown in Table 50. Thus, the Policy Case results in roughly $70 million less in net benefits to non-program participants.

Table 50. Non-participant benefits – Missouri

	Non-participant benefits ($million PV)
Policy Case	7
Reference Case	78
Delta	(70)

3.6. Ohio: Electric Programs

Scenarios for Ohio
(see Table 1)

- Policy Case: EERS repeal and large C&I opt-out
- Reference Case: no EERP repeal and no large C&I opt-out

Program Administrator Cost Test

Table 51 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the PAC test perspective. The Policy Case is expected to have no impacts as the EERS repeal would result in no implementation of the state's energy efficiency programs.

In contrast, the Reference Case, which does not have the impacts of the EERS repeal, is expected to have considerable impacts as follows:

- Approximately $1.2 billion of total benefits (PV) and $980 million of net benefits (PV) including the program cost of approximately $185 million.
- An overall benefit-cost ratio of 6.3 at the portfolio level.

While the benefit-cost ratio for the C&I sector is substantially higher than the ratio for the residential sector, both residential and C&I programs are highly cost-effective.

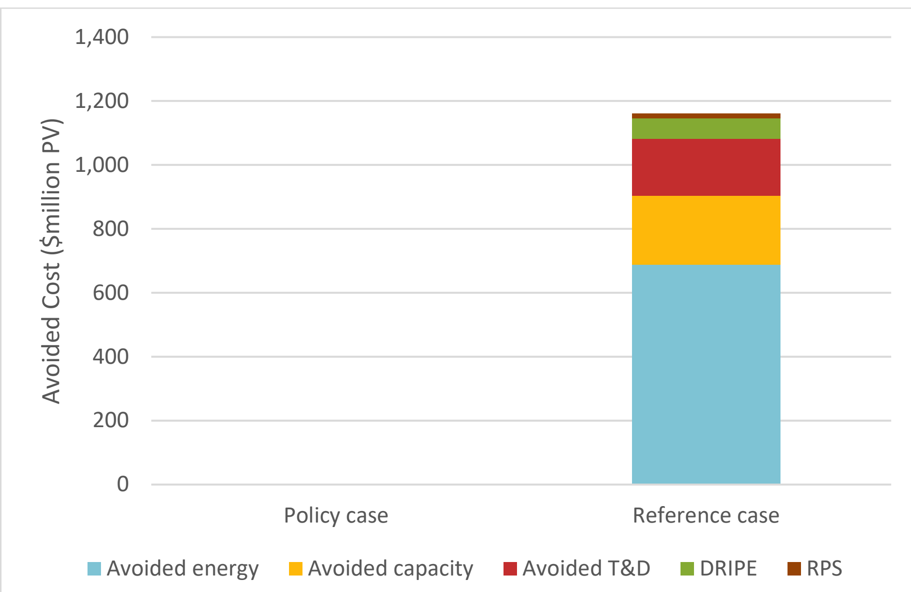
Table 51. Program impacts by case and sector: PAC Test – Ohio

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	-	-	-	-
	RES	-	-	-	-
	Total	-	-	-	-
Reference Case	C&I	94	724	630	7.7
	RES	90	436	346	4.8
	Total	185	1,160	976	6.3
Delta	C&I	(94)	(724)	(630)	7.7
	RES	(90)	(436)	(346)	4.8
	Total	(185)	(1,160)	(976)	6.3

The net benefit of negative $980 million under the Reference Case represents an approximate impact of the repeal of the EERS in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers would enjoy from a single program year if the regressive policy did not exist today (if the EERS were not repealed). Over multiple years, the effect of this regressive policy will be much greater. For example, over the course of 10 years the regressive policy will result in nearly $10 billion in net losses to customers across the state.

Figure 16 below shows a breakdown of the total utility avoided costs for Ohio for the Policy Case and the Reference Case. Approximately 60 percent of the total benefits come from the avoided energy costs under the Reference Case. The next largest avoided cost categories are the avoided capacity and avoided T&D costs. These results also represent the utility system benefits under the TRC test and SCT.

Figure 16. Breakdown of utility avoided costs by case – Ohio



Total Resource Cost Test

Table 52 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case has no impacts as it assumes no program operation.

In contrast, the Reference Case is expected to have:

- Approximately $1.3 billion of total resource benefits (PV) and $960 million of net benefits (PV) including the total resource cost of approximately $360 million.
- An overall benefit-cost ratio of 3.7 at the portfolio level.

Table 52. Program cost and benefits by case and sector: TRC Test – Ohio

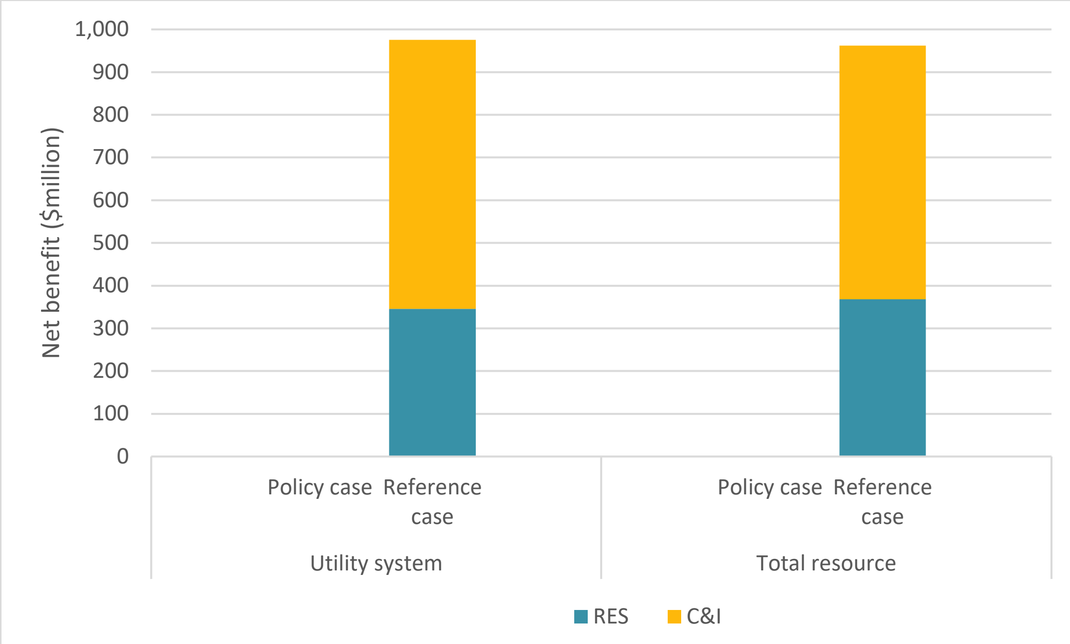
		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	-	-	-	n/a
	RES	-	-	-	n/a
	Total	-	-	-	n/a
Reference Case	C&I	210	804	594	3.8
	RES	145	513	368	3.5
	Total	355	1,318	962	3.7
Delta	C&I	(210)	(804)	(594)	3.8
	RES	(145)	(513)	(368)	3.5
	Total	(355)	(1,318)	(962)	3.7

The net benefit of negative $960 million represents an approximate impact of the repeal of the EERS policy in the state from a single program year. Alternatively, this represents the amount of additional net benefits that all customers—including non-program participants as well as program participants—could enjoy from a single program year if the regressive policy did not exist today (If the EERS had not been repealed).

As discussed in detail in Appendix B.2, the benefits in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. We took a conservative approach where we only included non-energy impacts which are estimated to be about 10 to 15 percent of the total resource benefits. These estimates exclude other benefits such as other fuel savings (e.g., oil, propane, natural gas), O&M costs (e.g., costs to replace light bulbs) or water savings.

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 17.

Figure 17. A summary of net benefits from the utility system and total resource perspectives – Ohio



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages.

Emissions impacts

Table 53 and Table 54 present annual and lifetime avoided emissions for CO_2, $PM_{2.5}$, NO_X, and SO_2. These values are negative because the Policy Case has fewer energy savings relative to the Reference Case, which essentially means more emissions from power plants.

Table 53. Annual avoided emissions – policy impacts for Ohio

	Annual Avoided CO_2 (tons)	Annual Avoided $PM_{2.5}$ (lbs)	Annual Avoided NO_X (lbs)	Annual Avoided SO_2 (lbs)
C&I	(675,522)	(117,186)	(645,255)	(1,035,537)
RES	(564,596)	(97,943)	(539,299)	(865,493)
Total	**(1,240,118)**	**(215,129)**	**(1,184,554)**	**(1,901,031)**

Table 54. Lifetime avoided emissions – policy impacts for Ohio

	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_X (lbs)	Lifetime Avoided SO_2 (lbs)
C&I	(5,444,198)	(944,431)	(5,200,269)	(8,345,648)
RES	(3,605,228)	(625,416)	(3,443,695)	(5,526,611)
Total	**(9,049,427)**	**(1,569,848)**	**(8,643,963)**	**(13,872,259)**

Societal costs of carbon

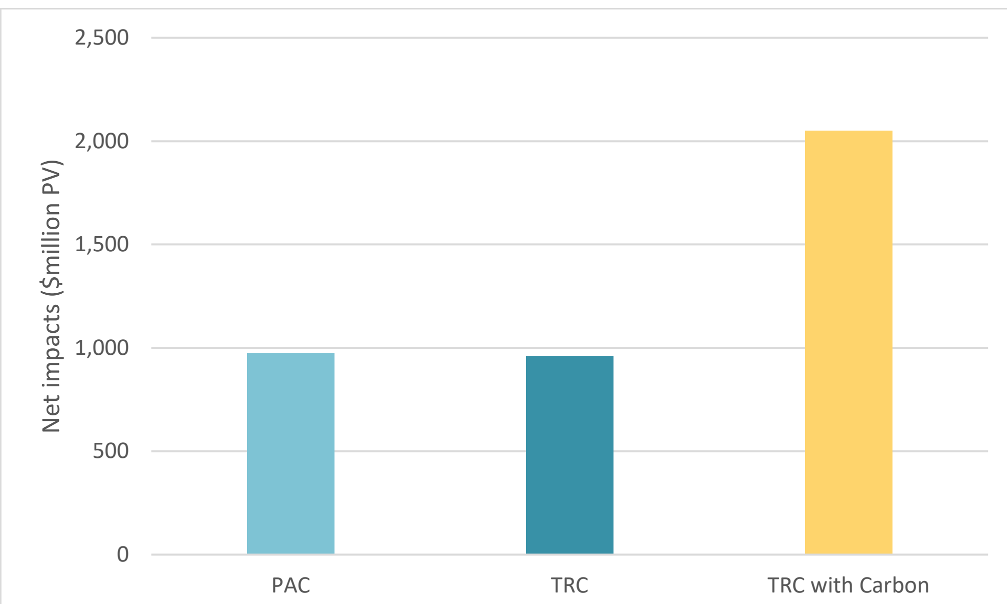
Table 55 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the social costs of carbon for the Policy Case are approximately $1 billion (PV), which are approximately 18 percent less than the total resource benefits. The total societal impact is estimated to be approximately $2.4 billion with the net societal impact of approximately $2 billion. This represents an enormous additional societal cost under the Policy Case over the life of the energy efficiency measures installed in a single year.

Table 55. Program costs and benefits by sector: TRC with carbon – policy impacts for Ohio

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	(210)	(804)	(658)	(1,462)	(1,252)
RES	(145)	(513)	(432)	(945)	(800)
Total	**(355)**	**(1,318)**	**(1,090)**	**(2,407)**	**(2,052)**

Figure 18 presents net economic cost estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Ohio would lose $980 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic cost would be approximately $960 million. Finally, if we add the cost of carbon, the net economic cost would be as large as approximately $2 billion for the state.

Figure 18. Net economic impacts by different perspectives – policy impacts for Ohio



Health damage costs

Under the Policy Case, we estimated that the lifetime health cost impacts from a single year program operation in 2021 would be $50 million to $115 million (PV) within the state and $300 million to $680 million (PV) nationwide, as shown in Table 56. As discussed in Chapter 2.3, these health impacts include avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days.

Table 56. Avoided health costs by sector – policy impacts for Ohio

	Avoided In-State Health Costs - Low ($million PV)	Avoided In-State Health Costs - High ($million PV)	Avoided Nationwide Health Costs - Low ($million PV)	Avoided Nationwide Health Costs - High ($million PV)
C&I	(30)	(67)	(177)	(399)
RES	(21)	(47)	(124)	(279)
Total	**(51)**	**(115)**	**(301)**	**(678)**

Macroeconomic impacts

Using the IMPLAN model, we estimated the expected changes in jobs, income levels, and GDP within the state under the Policy Case, as shown in Table 57. Our analysis found that the Policy Case would result in an increase in spending in the construction and operation of power plants and T&D infrastructure, a decrease in spending on electricity energy efficiency measure installations, and a decrease in the respending induced from energy efficiency investments. Overall, the spending for the state would be $650 million less under the Policy Case. This results in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job loss of approximately 5,460 full-time equivalent (FTE) jobs,
- A net income loss of $300 million, and
- A net GDP loss of approximately $300 million.

Table 57. Lifetime macroeconomic results – policy impacts for Ohio

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	92	882	51	100
Gas CC O&M	325	1,032	72	229
T&D Construction	149	1,332	71	144
Electricity Energy Efficiency	(355)	(2,021)	(115)	(106)
Residential Respending	(307)	(2,313)	(118)	(218)
C&I Respending	(552)	(4,370)	(262)	(445)
Total	**(649)**	**(5,458)**	**(300)**	**(296)**

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Implications

The following table presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Under the Policy Case, customers are expected to see a slightly smaller rate impact (by 0.4 to 1.1 percent) relative to the Reference Case. On the other hand, customers on average would experience slightly fewer bill savings from energy efficiency programs (by about 0.7 to 0.8 percent) relative to the Reference Case (or $9 less for residential customers and $90 less for C&I customers on average). In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Reference Case is affordable.

Table 58. Rate and bill impacts by sector and scenario – Ohio

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	-	-	-
	RES	-	-	-
Reference Case	C&I	0.36%	90	0.79%
	RES	1.15%	9	0.71%
Delta	C&I	-0.36%	(90)	-0.79%
	RES	-1.15%	(9)	-0.71%

The following table presents an illustrative example of the potential impact on participation rates between the two cases. In 2019, there were approximately 18,200 participants or units of recycled appliances in AEP Ohio's appliance recycling program. We consider this a proxy participation rate for the Reference Case. Under the Policy Case, we expect zero program participants due to the repeal of the EERS policy in the state.

Table 59. Illustrative impacts of the Policy Case – Ohio

Utility	Case	Program Name	Participants	Source
AEP Ohio	Policy Case	Appliance Recycling	0	Synapse estimate
AEP Ohio	Reference Case	Appliance Recycling	18,230	2019 program data

Source AEP Ohio. 2020. 2019 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs. Available at: http://dis.puc.state.oh.us/TiffToPDf/A1001001A20E15B05738I01699.pdf.

Non-Participant Benefits

Our analysis also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that the Reference Case results in a large amount of non-participant benefits at approximately $290 million at the portfolio level as shown in Table 60. This represents the amount of the lost non-participant benefits under the Policy Case.

Table 60. Non-participant benefits – Ohio

	Non-participant benefits ($million PV)
Policy Case	0
Reference Case	288
Delta	(288)

3.7. Wisconsin: Electric Programs

Program Administrator Cost Test

Table 61 shows program costs, total utility avoided costs, and net benefits as well as benefit-cost ratios for two cases based on the PAC test perspective. The Policy Case represents a scenario with the increased funding proposed in early 2021 by Governor Evers. The proposed funding is applicable to both electric and natural gas programs but our analysis focused on just electric electric energy efficiency programs. This scenario is expected to have:

Scenarios for Wisconsin

(see Table 1)

- Policy Case: Proposed 2021 budget (not adopted)
- Reference Case: no change to the budget

- Approximately $670 million of total benefits in present value (PV) and $540 million of net benefits (PV) including the program cost of just $140 million.
- An overall benefit-cost ratio of 4.9 at the portfolio level with the benefit-cost ratio for the C&I sector being substantially larger than the ratio for the residential sector.

In contrast, the Reference Case, which represents the current state of the state's energy efficiency program, is expected to have:

- Approximately $310 million of total benefits (PV) and $220 million of net benefits (PV) including the program cost of approximately $90 million.
- An overall benefit-cost ratio of 4.9 at the portfolio level.

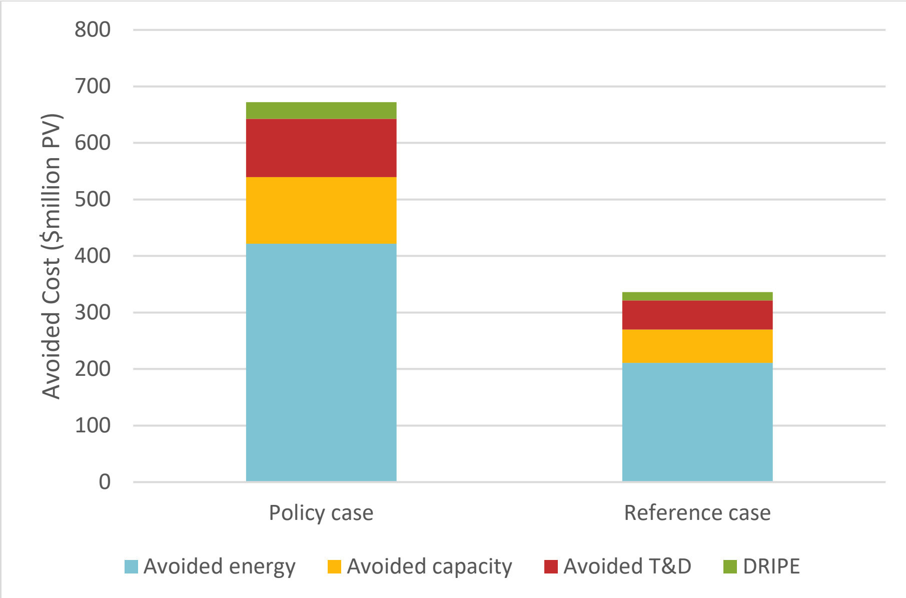
Table 61. Program impacts by case and sector: PAC Test – Wisconsin

		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	84	517	433	6.1
	RES	53	155	102	2.9
	Total	137	672	535	4.9
Reference Case	C&I	42	259	216	6.1
	RES	26	78	51	2.9
	Total	69	336	267	4.9
Delta	C&I	42	259	216	6.1
	RES	26	78	51	2.9
	Total	69	336	267	4.9

Our analysis found that the Policy Case has approximately $340 million more net benefits relative to the Reference Case, as shown in Table 61 above. This represents an approximate amount of additional net benefits that all customers could enjoy from a single program year if the Governor's proposal had been adopted. Over multiple years, the effect of this progressive policy would have been significantly greater. For example, over the course of 10 years this policy would have resulted in approximately $3.4 billion in net benefits to customers.

Figure 19 below shows a breakdown of the total utility avoided costs for Wisconsin for the Policy Case and the Reference Case. The benefits from the avoided energy costs account for more than 60 percent of the total benefits, which is higher than the share of avoided energy costs we calculated for the other five states. This is largely because Wisconsin's estimations for the level of peak reduction contributions relative to annual energy savings is lower than the levels the other states estimate. The next largest avoided cost categories are the avoided capacity and avoided T&D costs for both cases. These results also represent the utility system benefits under the TRC test and SCT.

Figure 19. Breakdown of utility avoided costs by case – Wisconsin



Total Resource Cost Test

Table 62 shows costs, benefits, and net benefits as well as benefit-cost ratios for two cases based on the TRC perspective. The Policy Case is expected to have:

- Approximately $760 million of total resource benefits in present value (PV) and $450 million of net benefits (PV) including the total resource cost of approximately $310 million.
- An overall benefit-cost ratio of 2.4 at the portfolio level with the benefit-cost ratio for the C&I sector being considerably larger than the ratio for the residential sector under the TRC perspective.

In contrast, the Reference Case is expected to have:

- Approximately $380 million of total resource benefits (PV) and $220 million of net benefits (PV) including the total resource cost of approximately $160 million.
- An overall benefit-cost ratio of 2.4 at the portfolio level.

Table 62. Program cost and benefits by case and sector: TRC Test – Wisconsin

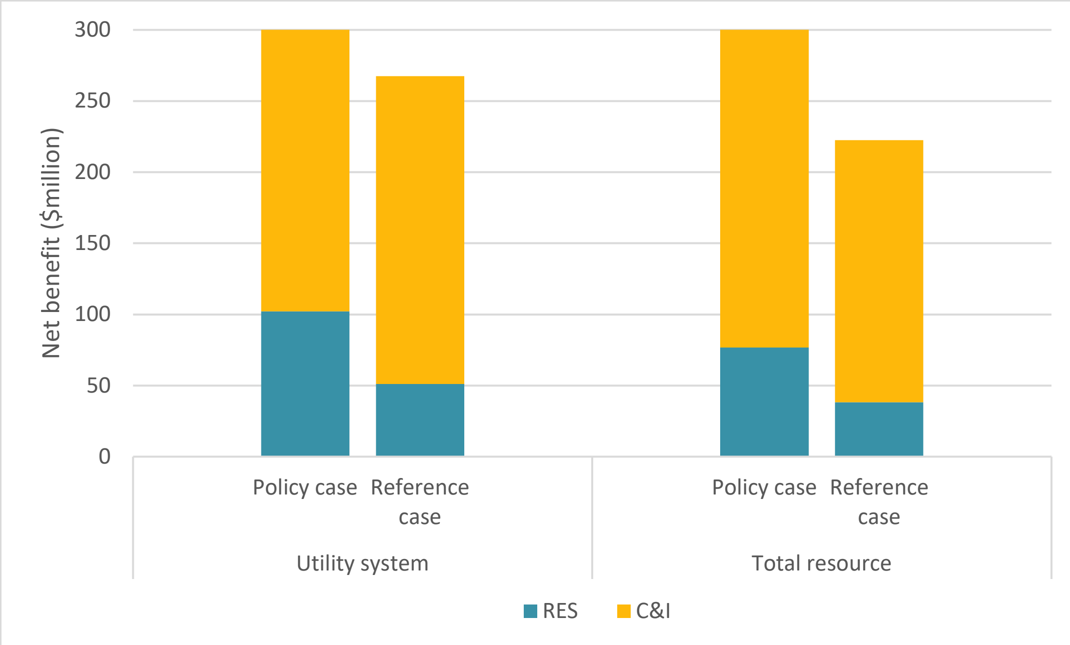
		Program Cost ($million PV)	Program Benefits ($million PV)	Net Benefit ($million PV)	Benefit-Cost Ratio
Policy Case	C&I	206	575	368	2.8
	RES	106	182	77	1.7
	Total	312	757	445	2.4
Reference Case	C&I	103	287	184	2.8
	RES	53	91	38	1.7
	Total	156	378	222	2.4
Delta	C&I	103	287	184	2.8
	RES	53	91	38	1.7
	Total	156	378	222	2.4

Our analysis found that the Policy Case has approximately $220 million more net total resource benefits in present value relative to the Reference Case, as shown in Table 62 above. This represents an approximate impact of additional net benefits that all customers—including non-program participants as well as program participants—could enjoy from a single program year if the Governor's proposal had been adopted.

As discussed in detail in Appendix B.2, the benefits in the TRC test differ from those in the PAC test in that they include participant non-energy impacts. We took a conservative approach where we only included non-energy impacts (estimated to be about 10 to 15 percent of the total resource benefits). These non-energy impact estimates exclude other benefits such as other fuel savings (e.g., oil, propane, natural gas), O&M costs (e.g., costs to replace light bulbs) or water savings.

A summary of net benefits under the total utility system and total resource perspectives is shown in Figure 20.

Figure 20. A summary of net benefits from the utility system and total resource perspectives – Wisconsin



Societal Impacts

For societal benefits, we estimated emissions impacts associated with the difference in energy savings between the two cases. Based on that difference, we determined policy impacts by estimating avoided costs for social costs of carbon and health damages.

Emissions impacts

Table 63 and Table 64 present annual and lifetime avoided emissions for CO_2, $PM_{2.5}$, NO_X, and SO_2. The Policy Case has a greater level of energy savings and thus avoids more emissions from power plants than the Reference Case avoids.

Table 63. Annual avoided emissions – policy impacts for Wisconsin

	Annual Avoided CO_2 (tons)	Annual Avoided $PM_{2.5}$ (lbs)	Annual Avoided NO_X (lbs)	Annual Avoided SO_2 (lbs)
C&I	309,508	54,673	420,402	555,290
RES	86,429	15,267	117,395	155,062
Total	**395,937**	**69,941**	**537,797**	**710,353**

Table 64. Lifetime avoided emissions – policy impacts for Wisconsin

	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_X (lbs)	Lifetime Avoided SO_2 (lbs)
C&I	2,811,497	496,640	3,818,826	5,044,123
RES	823,016	145,383	1,117,894	1,476,578
Total	**3,634,513**	**642,022**	**4,936,720**	**6,520,701**

Societal costs of carbon

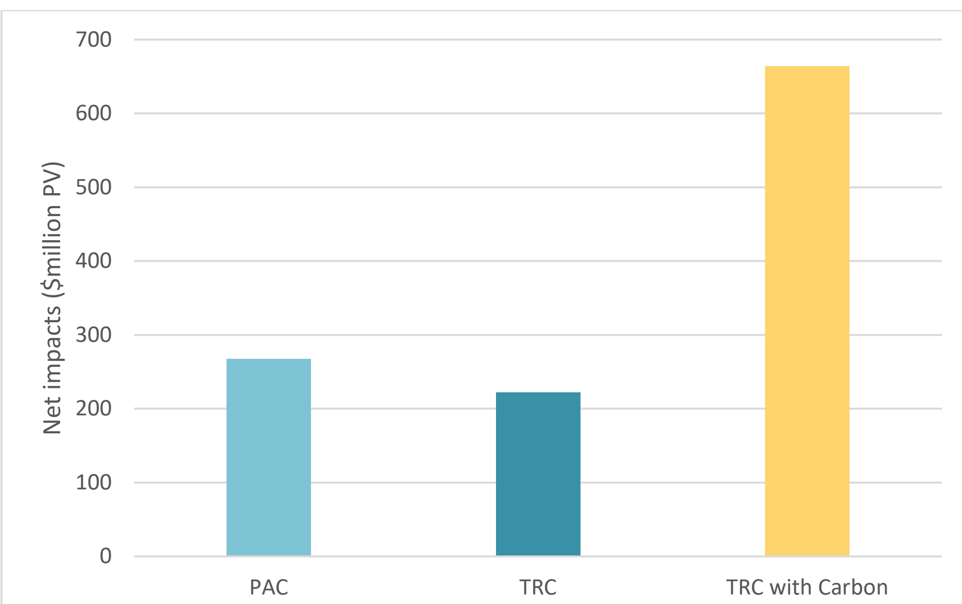
Table 65 presents costs and benefits from the TRC perspective with social costs of carbon. We estimated that the total avoided social costs of carbon for the Policy Case are approximately $440 million (PV), which exceeds the total resource benefits by roughly 16 percent. The total societal benefit is estimated to be approximately $820 million with the net societal benefit of approximately $660 million. This represents an additional societal benefit under the Policy Case over the life of the energy efficiency measures installed in just a single year.

Table 65. Program costs and benefits by sector: TRC with carbon – policy impacts for Wisconsin

	Costs ($million PV)	Benefits ($million PV)	Carbon Benefits ($million PV)	Benefits Including Carbon ($million PV)	Net Benefit ($million PV)
C&I	103	287	341	628	525
RES	53	91	100	191	138
Total	**156**	**378**	**441**	**820**	**664**

Figure 21 presents net economic impacts/benefit estimates with various perspectives for the Policy Case. Under the PAC perspective, we estimated that Wisconsin would experience $270 million in present value over the lifetime of the measures implemented in 2021 relative to the Reference Case. Under the TRC, the net economic benefit would be $220 million. Finally, if we add the avoided cost of carbon, the net economic benefit would be as large as $660 million for the state.

Figure 21. Net economic impacts by different perspectives – policy impacts for Wisconsin



Health damage costs

Under the Policy Case, we estimated that the lifetime avoided health damage costs from a single year program operation in 2021 would be $3 million to $7 million (PV) within the state and $90 million to $200 million (PV) nationwide, as shown in Table 66. As discussed in Chapter 2.3, these health impacts include avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days.

Table 66. Avoided health costs by sector – policy impacts for Wisconsin

	Avoided In-State Health Costs - Low ($million PV)	Avoided In-State Health Costs - High ($million PV)	Avoided Nationwide Health Costs - Low ($million PV)	Avoided Nationwide Health Costs - High ($million PV)
C&I	2.5	5.6	70.3	158.7
RES	0.7	1.6	20.3	45.8
Total	3.2	7.2	90.6	204.5

Macroeconomic impacts

Using the IMPLAN model, we estimated the expected changes in jobs, income levels, and GDP within the state under the Policy Case, as shown in Table 67. Our analysis found that the Policy Case would result in a decrease in spending in the construction and operation of power plants and T&D infrastructure, an increase in spending on electricity energy efficiency measure installations, and an increase in the respending induced from energy efficiency investments. Overall, the spending for the state would be approximately $160 million more under the Policy Case. This results in the following macroeconomic impacts over the lifetime of the measures installed in 2021:

- A net job increase of approximately 1,530 full-time equivalent (FTE) jobs,
- A net income increase of $85 million, and
- An increase in GDP of $79 million.

Table 67. Lifetime macroeconomic results – policy impacts for Wisconsin

	Change in Spending ($million)	Change in Job-Years	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	(32)	(289)	(17)	(34)
Gas CC O&M	(122)	(238)	(15)	(32)
T&D Construction	(44)	(368)	(20)	(42)
Electricity Energy Efficiency	156	808	45	37
Residential Respending	30	212	11	19
C&I Respending	171	1400	81	131
Total	158	1526	85	79

Note: Changes in spending, GDP and income estimates are not discounted.

Affordability Implications

The following table presents rate and bill impacts by sector and scenario in terms of percent and dollar changes relative to a case without energy efficiency programs. Under the Policy Case, customers are expected to see a slightly higher rate impact (by 0.4 to 0.5 percent) relative to the Reference Case. On the other hand, customers on average would experience slightly more bill savings from energy efficiency programs (by about 0.1 to 0.4 percent) relative to the Reference Case (or $1.4 more for residential customers and $50 more for C&I customers on average). In sum, the differences in rate and bill impacts between the two cases are very small, which implies that the expanded program under the Policy Case is affordable.

Table 68. Rate and bill impacts by sector and scenario – Wisconsin

		Annual Ave. Rate Impact (%)	Annual Ave. Customer Bill Savings ($)	Annual Ave. Customer Bill Savings (%)
Policy Case	C&I	0.94%	100	0.84%
	RES	0.84%	2.9	0.26%
Reference Case	C&I	0.47%	50	0.42%
	RES	0.42%	1.4	0.13%
Delta	C&I	0.48%	50	0.42%
	RES	0.42%	1.4	0.13%

The following table presents an illustrative example of the potential impact on participation rates between the two cases. In 2019, there were approximately 26,600 participants in Wisconsin Focus on Energy's Home Performance with Energy Star program. We consider this a proxy participation rate for the Reference Case (in 2021). Under the Policy Case, which would have doubled the savings and funding levels, we also assume that the number of participants in this program would double. The resulting participation count as an illustrative example is roughly 53,300 customers in this program under the Policy Case.

Table 69. Illustrative impacts of the Policy Case – Wisconsin

Utility	Case	Program Name	Participants	Source
Focus on Energy	Policy Case	Home performance with Energy Star	53,290	Synapse estimate
Focus on Energy	Reference Case	Home performance with Energy Star	26,645	2019 program data

Source: CADMUS. 2020. Focus on Energy Calendar Year 2019 Evaluation Report - Volume I. Available at: https://www.focusonenergy.com/sites/default/files/Annual_Report-CY_2019_Volume_I.pdf.

Non-Participation Benefits

Our analysis also estimated non-participant net benefits in order to address the concerns that only participants benefit from energy efficiency programs. We estimated non-participant net benefits by subtracting the avoided wholesale energy costs from the total net benefits. The remaining net benefits represent net benefits that accrue to all customers (including non-participants) as a result of reduced revenue requirements caused by reduced capital investments.

Our analysis found that both scenarios result in non-participant benefits. The Policy Case and the Reference Case results in $113 million and $56 million at the portfolio level, respectively as shown in Table 70. Thus, the Policy Case results in $56 million more net benefits to non-program participants.

Table 70. Non-participant benefits – Wisconsin

	Non-participant benefits ($million PV)
Policy Case	113
Reference Case	56
Delta	56

APPENDIX A. STATE SCENARIO DEVELOPMENT

A.1. Illinois

State-specific scenario assumptions

The Policy Case and the Reference Case for Illinois are defined as follows for our analysis:

- **Policy Case**: At the end of 2016, Illinois passed the *Future Energy Jobs* bill which exempted large C&I customers from paying any surcharges to and participating in the state's energy efficiency programs.[8] This law became effective in 2017 and exempted many large C&I customers from the program. The Policy Case assumes an energy efficiency program operating today that has the full impact of this customer exemption policy. This impact was estimated to be as large as 10-30 percent of utility load.[9]

- **Reference Case**: The Reference Case assumes that this large customer exemption law was not enacted, and thus the state would be able to capture former levels of energy savings from large industrial customers in 2021.

Our analysis focused on energy efficiency programs for Ameren Illinois and Commonwealth Edison (ComEd), two major investor-owned utilities in the state. These utilities account for roughly 90 percent of the statewide energy sales.

Program savings and cost assumptions

Program costs, annual energy savings, peak load savings, and lifetime savings in 2021 under the Policy Case are assumed to be the same as those in 2019. We obtained these data from the 2019 annual program evaluation reports for Ameren Illinois and ComEd.[10] For the total resource costs, which include the participants' portion of the cost of energy efficiency measures, we used the ratios of the total resource costs over the total program costs based on the performance of the programs in 2016 by Ameren Missouri.[11] We found that the total resource costs for 2019 do not appear to be reliable because they are lower than the program costs for several residential programs. Upon reviewing data for the 2016 programs by the two utilities, we determined the total resource cost data for 2016 by Ameren Missouri are more reliable to use.

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[8] *SB 2814, Public Act 099-0906.* Illinois General Assembly. Available at: https://www.ilga.gov/legislation/publicacts/99/PDF/099-0906.pdf

[9] Midwest Energy Efficiency Alliance. 2017. "New Research: Industrial Opt-Outs Undermine Energy Savings." Available at: https://www.mwalliance.org/blog/new-research-industrial-opt-outs-undermine-energy-savings

[10] Opinion Dynamics. 2020a. Ameren Illinois Company 2019 Integrated Impact Evaluation Report; Opinion Dynamics. 2020b. Ameren Illinois Company 2019 Energy Efficiency Portfolio Cost-Effectiveness Results.

[11] Applied Energy Group. 2019. Ameren Illinois Plan Cost-Effectiveness Evaluation Program Year 9.

For the Reference Case, we developed program savings and spending estimates based on the program data both in 2016 and 2019. We used the program data for 2016 to obtain and develop the energy savings estimates from large C&I customers (that would be exempted from the current customer exemption law) because 2016 is the year right before the state's large customer exemption policy became effective. For the rest of the programs, we used the same saving and cost data from the 2019 programs by the two utilities.

Table 71 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 1,730 GWh (or 1.4 percent of sales) under the Policy Case and 1,850 GWh (or 1.5 percent of sales) under the Reference Case with the difference of approximately 120 GWh (or 0.1 percent of sales). Peak load savings are 246 MW under the Policy Case and 263 MW under the Reference Case with the difference of 18 MW. Program costs are approximately $400 million (or 6.2 percent of total revenue) under the Policy Case and approximately $417 million (6.4 percent of total revenue) under the Reference Case with the difference of $17.5 million (or 0.3 percent of total revenue).

Table 71. Illinois – electric program savings and costs by scenario and sector

		Annual Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Load Savings (MW)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	1,096	12,329	158	227	455
	RES	638	3,779	88	172	211
	Total	1,733	16,108	246	399	667
Reference Case	C&I	1,209	13,351	176	244	490
	RES	638	3,779	88	172	211
	Total	1,847	17,130	263	417	702
Delta	C&I	(114)	(1,022)	(18)	(17)	(35)
	RES	-	-	-	-	-
	Total	(114)	(1,022)	(18)	(17)	(35)

As shown in the table above, the only difference is found in the C&I sector because we assumed large C&I customers participate in the energy efficiency programs under the Reference Case while we assume that no such large customers participate in the program under the Policy Case.

We took several steps to develop our estimates of energy savings from large customers. First, we estimated large customer loads in 2016 that are exempted by the exemption policy. These estimates are based on the utilities' own estimates of exempted customers in terms of a percentage of total system load and 2016 sales data from EIA 861 database as shown in Table 72 in columns (a) through (c).[12] We

[12] Ameren Illinois. 2017. Presentation to SAG January 24, 2017. Available at http://ilsagfiles.org/SAG_files/Meeting_Materials/2017/January_24_2017/AIC_SAG_Presentation_01242017.pdf; ComEd. 2017. ComEd's 2018-2021 Plan. Available at: https://s3.amazonaws.com/ilsag/ComEd_SAG_Planning_01242017.pdf

converted those numbers into a percentage of C&I load in column (e). We then assumed that these are the share of energy savings by large customers among the total C&I savings in 2016, which are shown in column (g). Finally, we estimated those large customer savings as a percentage of the C&I load. The result is 0.13 percent of the 2016 sales as shown in column (h).

Table 72. Estimate of large customer savings (% of C&I Load)

	Large Customer Load Exemption (% of Total Load)	2016 Total Load (MWh)	Estimated 2016 Large Customer Load (MWh)	2016 C&I Load (MWh)	Estimated Large Customer Load (% of C&I Load)	PY9 C&I Savings (MWh)	Estimated Savings from Large Customers (MWh)	Estimated Savings from Large Customers (% of C&I Load)
	(a)	**(b)**	**(c) = (a) * (b)**	**(d)**	**(e) = (c) * (d)**	**(f)**	**(g) = (e) * (f)**	**(h) = (d) * (g)**
Ameren	25.0%	36,353,295	9,088,324	24,823,635	36.6%	177,487	64,981	0.26%
ComEd	10.0%	88,903,412	8,890,341	60,613,563	14.7%	346,777	50,863	0.08%
Total	14.4%	125,256,707	17,978,665	85,437,198	21.0%	524,264	110,322	0.13%

We applied these percentage savings estimates to our assumed C&I sales for 2021 (based on the 2019 sales data from EIA 861 database) and estimated annual energy savings for 2021 as shown in Table 73 below. Finally, we estimated lifetime energy savings, peak load savings in kW, and program costs (also show in Table 73) using large customer-specific factors we developed based on the performance of Ameren PY9 custom program and ComEd' 2019 industrial system program.[13]

Table 73. Large customer savings and costs in 2021 for Illinois

	Assumed C&I Load in 2021 (MWh)	Estimated Annual Savings from Large Customers (% of C&I Load)	Estimated Annual Savings from Large Customers in 2021 (MWh)	Lifetime Savings (MWh)	Peak Load Savings (kW)	Program Cost ($2021)
Ameren	24,385,555	0.26%	63,834	574,506	10,116	9,835,135
ComEd	59,242,848	0.08%	49,712	447,412	7,878	7,659,371
Total	83,628,403	0.13%	113,546	1,021,918	17,995	17,494,505

A.2. Indiana

State-specific scenario assumptions

The Policy Case and the Reference Case for Indiana are defined as follows for our analysis:

[13] The reasons we used Ameren PY9 custom program and ComEd 2019 industrial system program for setting these key assumptions are that (a) we determined that Ameren's PY9 custom program provides the best available data for large customers, (b) ComEd's PY9 programs are not reliable to use because the PY9 reporting does not include peak savings or lifetime savings and (c) ComEd's 2019 reporting includes detailed data for the Industrial System program, which is still relevant for large customers even though large customers are exempted in this year.

- **Policy Case**: Indiana passed two regressive policies in a combined bill that was signed in 2014 and effective starting 2015. SB 340 allowed large C&I customers with peak demand of over 1 MW to opt out of energy efficiency program participation, while also repealing the state's energy efficiency resource standard (EERS).[14] The Policy Case assumes an energy efficiency program operating today that has a full impact of these regressive policies.

- **Reference Case**: The Reference Case assumes that both regressive policies were not enacted, and thus the state achieves a higher level of energy savings as the state achieved prior to 2015.

Our analysis for Indiana focused on energy efficiency programs for five major investor-owned utilities including Indianapolis Power & Light, Indiana Michigan Power, Northern Indiana Public Service Company (NIPSCO), Duke Energy Indiana, and Southern Indiana Gas & Electric. Together these five utilities account for roughly 75 percent of the statewide energy sales.

Program savings and cost assumptions

Program costs, annual energy savings, peak load savings, and lifetime savings in 2021 under the Policy Case are assumed to be the same as those in 2019. We obtained these program data from the EIA's 861 database.[15] Because the EIA 861 database does not include total resource cost estimates (which include the participants' portion of the cost of energy efficiency measures) we developed total resource cost estimates for Indiana based on program data we obtained from other states. More specifically, we assumed that the ratios of the total resource costs over the program costs are equal to the average ratios at the sector level based on the data we obtained from Ameren Illinois and Wisconsin's Focus on Energy. These ratios are 1.6 for the residential sector and 2.2 for the C&I sector.

For the Reference Case in Indiana, we developed program savings and spending estimates based on the 2013 level of annual energy savings for all sectors with the current performance on peak savings (kW over MWh ratio), measure life, and costs of saved energy. Such current program performance data are based on the program data for 2019 that we obtained from the EIA 861 database.

Table 74 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 715 GWh (or 0.9 percent of sales) under the Policy Case and 880 GWh (or 1.1 percent of sales) under the Reference Case with the difference of approximately 160 GWh (or 0.2 percent of sales). Peak load savings are approximately 140 MW under the Policy Case and 170 MW under the Reference Case with the difference of approximately 30 MW. Program costs are approximately $100 million (or 1.4 percent of total revenue) under the Policy Case and approximately

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[14] Senate Enrolled Act 340. Indiana General Assembly. Available at: https://www.in.gov/iurc/files/SEA_340.pdf.

[15] U.S. EIA. 2020. "Annual Electric Power Industry Report, Form EIA-861 detailed data files." Available at: https://www.eia.gov/electricity/data/eia861/.

$130 million (1.7 percent of total revenue) under the Reference Case with the difference of $23 million (or 0.3 percent of total revenue).

Table 74. Indiana – electric program savings and costs by scenario and sector

		Annual Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Load Savings (MW)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	362	4,684	52	48	107
	RES	353	2,969	88	56	90
	Total	715	7,653	141	104	198
Reference Case	C&I	473	6,119	68	63	140
	RES	404	3,402	101	64	104
	Total	877	9,520	169	127	243
Delta	C&I	(111)	(1,435)	(16)	(15)	(33)
	RES	(51)	(433)	(13)	(8)	(13)
	Total	(162)	(1,868)	(29)	(23)	(46)

A.3. Iowa

State-specific scenario assumptions

The Policy Case and the Reference Case for Iowa are defined as follows for our analysis:

- **Policy Case**: In Iowa, laws restricting the budgets for gas and electric energy efficiency programs were enacted in 2018 and 2019. SF 2311 and SF 638 both limited gas and electric program budgets to no more than 1.5 percent and 2 percent of the utilities' expected retail rate revenue, respectively.[16] The Policy Case assumes an energy efficiency program operating today that has a full impact of the law that limits program budgets.

- **Reference Case**: the Reference Case assumes that the laws that limit gas and electric program budgets were not enacted, and that the state achieves a higher level of energy savings as it achieved in 2018 when the regressive policies were not effective yet.

Our analysis for Iowa electric energy efficiency programs focused on Alliant/IPL and MidAmerican companies. These two utilities account for roughly 80 percent of the statewide electric sales. Our analysis for Iowa gas energy efficiency programs focused on Alliant/IPL, MidAmerican, and Black Hills. They account for roughly 90 percent of the statewide natural gas sales.

[16] Senate Files 2311 and 638. Iowa General Assembly. Available at https://www.legis.iowa.gov/docs/publications/LGE/88/SF638.pdf and https://www.legis.iowa.gov/docs/publications/LGE/87/SF2311.pdf

Program savings and cost assumptions – electric energy efficiency programs

Electric program costs, annual energy savings, peak load savings, and lifetime savings in 2021 under the Policy Case are assumed to be the same as those in 2019. We obtained these program data from the EIA's 861 database.[17] Because the EIA 861 database does not include total resource cost estimates, we developed our own estimates based on program data we obtained from other states. More specifically, we assumed that the ratios of the total resource costs over the program costs for Iowa are equal to the average ratios at the sector level based on the data we obtained from Ameren Illinois and Wisconsin's Focus on Energy. These ratios are 1.6 for the residential sector and 2.2 for the C&I sector.

For the electric energy efficiency programs under the Reference Case in Iowa, we assumed that program costs, annual energy savings, peak load savings, and lifetime savings program savings are equal to the program data in 2018 based on EIA 861 database.

Table 75 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 350 GWh (or 0.9 percent of sales) under the Policy Case and 540 GWh (or 1.4 percent of sales) under the Reference Case with the difference of approximately 190 GWh (or 0.5 percent of sales). Peak load savings are 70 MW under the Policy Case and 105 MW under the Reference Case with the difference of 35 MW. Program costs are approximately $70 million (or 2 percent of total revenue) under the Policy Case and approximately $110 million (3.2 percent of total revenue) under the Reference Case with the difference of $40 million (or 1.2 percent of total revenue).

Table 75. Iowa – electric program savings and costs by scenario and sector

		Annual Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Load Savings (MW)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	234	3,070	43	47	105
	RES	118	961	28	21	34
	Total	351	4,031	70	68	139
Reference Case	C&I	373	5,358	60	69	153
	RES	169	1,658	45	41	65
	Total	542	7,016	105	109	219
Delta	C&I	(139)	(2,289)	(18)	(22)	(48)
	RES	(51)	(696)	(17)	(20)	(32)
	Total	(190)	(2,985)	(35)	(41)	(80)

Program savings and cost assumptions – gas energy efficiency programs

Natural gas program costs and savings data under the Policy Case are assumed to be the same as those for the actual program achievements for 2019. Program costs and savings data under the Reference

[17] U.S. EIA. 2020. "Annual Electric Power Industry Report, Form EIA-861 detailed data files." Available at: https://www.eia.gov/electricity/data/eia861/.

Case are assumed to be the same as those for the program achievements for 2018. We obtained these program data from the three gas utilities' annual energy efficiency program reports.[18]

Program reports by Alliant and Black Hills we reviewed did not report lifetime savings. Thus, we filled these data gaps based on the data we obtained from Mid American. In addition, Alliant's reports did not provide total resource cost data. Thus, we developed total resource costs for Alliant based on the data we obtained from Mid American and Black Hills' program reports.

Table 76 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 1 million therms (or 0.1 percent of sales) under the Policy Case and 11 million therms (or 1 percent of sales) under the Reference Case with the difference of approximately 10 million therms. Program costs are approximately $7 million (or 0.9 percent of total revenue) under the Policy Case and approximately $49 million (6.2 percent of total revenue) under the Reference Case with the difference of $42 million (or 5 percent of total revenue).

Table 76. Iowa – natural gas program savings and costs by scenario and sector

		Annual Energy Savings (million Therms)	Lifetime Energy Savings (million therms)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	0.3	6	1.3	2
	RES	0.7	17	5	16
	Total	1.0	23	7	18
Reference Case	C&I	3	58	10	19
	RES	8	138	38	83
	Total	11	196	48	102
Delta	C&I	(3)	(52)	(9)	(17)
	RES	(7)	(121)	(33)	(67)
	Total	(10)	(173)	(42)	(84)

[18] MidAmerican. 2019. 2018 Energy Efficiency Plan Annual Report. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=1846096&noSaveAs=1; MidAmerican. 2020. 2019 Energy Efficiency Plan Annual Report. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=2027466&noSaveAs=1; Alliant. 2019. "IPL 2018 Annual Report_Appendix A-C and E.xlsx." Available at https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=1846180&noSaveAs=1; Alliant. 2020. "2019 Appendix A-C and E.xlsx." Available at https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=2027211&noSaveAs=1; Black Hills Energy. 2020. Black Hills Energy Natural Gas Energy Efficiency Programs - Revised Annual Report (April - December) 2019. Available at https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&dDocName=2027645&allowInterrupt=1&noSaveAs=1&RevisionSelectionMethod=LatestReleased; and Black Hills Energy. 2019. Black Hills Energy Natural Gas Energy Efficiency Programs - Annual Report 2018. Available at: https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=1862255&noSaveAs=1.

A.4. Missouri

State-specific scenario assumptions

The Policy Case and the Reference Case for Missouri are defined as follows for our analysis:

- **Policy Case**: In 2018 the Missouri PSC staff proposed a substantially scaled-down energy efficiency program portfolio for Ameren Missouri and Kansas City Power and Light (KCPL)/Evergy for 2019 through 2021.[19] The Policy Case mirrors the level of energy efficiency program investments in this staff proposal for 2021. This policy was not adopted.

- **Reference Case**: The Missouri PSC approved a program portfolio for Ameren Missouri that has approximately 10 times more budget than that proposed by the PSC staff.[20] The Reference Case assumes the approved program portfolio for Ameren and a similar level of investment for KCPL.

Our analysis for Missouri focused on energy efficiency programs for two major investor-owned utilities: Ameren Missouri and KCPL. These two utilities account for roughly 62 percent of the statewide energy sales.

Program savings and cost assumptions

For the Policy Case, we developed our program assumptions for Ameren Missouri and KCPL separately. For Ameren, we adopted the PSC staff's budget recommendation for 2021.[21] Because the PSC staff recommendation only included budget information, we developed other program data. We developed annual energy savings estimates for Ameren Missouri by applying the cost of annual energy savings ($ per kWh) under the Reference Case to the Staff's proposed budget. For KCPL, we assumed the same percentage of cost and annual savings reductions from the Policy Case for staff recommendations as were quantified for Ameren Missouri. This is because the PSC staff recommendations for KCPL did not include any budget estimate, but the recommendations in terms of program portfolio mirrored those for Ameren. We then developed lifetime savings and peak demand savings for both utilities based on the 2019 data reported in the EIA 861 database for these two utilities. Further, we assumed that the ratios of the total resource costs over the program costs for Missouri are equal to the average ratios at the

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[19] Missouri PSC Staff. 2018. *Rebuttal Report*. Appendix 2. Available at: https://efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936179224; Missouri PSC Staff. 2019. *Staff's Statement of Position*. File No. EO-2019-0132 and EO-2019-0133. Available at: https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936244669.

[20] Missouri PSC. 2018. *Order Approving Stipulation and Agreement and Granting Waivers.* File No. EO-2018-0211. Appendix A. Issued on December 5, 2018. Available at: https://efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936195032.

[21] Missouri PSC Staff. 2018.

sector level based on the data we obtained from Ameren Illinois and Wisconsin's Focus on Energy. These ratios are 1.6 for the residential sector and 2.2 for the C&I sector.

For the Reference Case, as mentioned above, we assumed the same program costs and savings for 2021 as approved for Ameren Missouri by the PSC.[22] For KCPL, we used the costs and savings data that KCPL proposed in its 2018 filing for its 2019–2021 program plan.[23] For estimating lifetime energy savings, peak load savings and total resource costs for the Reference Case, we employed the same approach as discussed for the Policy Case.

Table 77 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 30 GWh (or 0.1 percent of sales) under the Policy Case and 360 GWh (or 0.74 percent of sales) under the Reference Case with the difference of approximately 330 GWh (or 0.7 percent of sales). Peak load savings are 8 MW under the Policy Case and 93 MW under the Reference Case with the difference of 93 MW. Program costs are approximately $8 million (or 0.2 percent of total revenue) under the Policy Case and approximately $90 million (2 percent of total revenue) under the Reference Case with the difference of $85 million (or 1.9 percent of total revenue).

Table 77. Missouri – electric program savings and costs by scenario and sector

		Annual Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Load Savings (MW)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	29	409	7	6	14
	RES	4	53	1	1	2
	Total	33	462	8	8	16
Reference Case	C&I	228	3,278	58	48	107
	RES	132	1,789	35	44	71
	Total	360	5,067	93	92	178
Delta	C&I	(199)	(2,869)	(51)	(42)	(92)
	RES	(128)	(1,737)	(34)	(43)	(69)
	Total	(327)	(4,605)	(85)	(85)	(162)

A.5. Ohio

State-specific scenario assumptions

The Policy Case and the Reference Case for Ohio are defined as follows for our analysis:

[22] Missouri PSC. 2018.

[23] KCP&L. 2018. *MEEIA Cycle 3 2019-2022 Filing*. Available at: https://efis.psc.mo.gov/mpsc/commoncomponents/view_itemno_details.asp?caseno=EO-2019-0133&attach_id=2019007653.

- **Policy Case**: Ohio has passed multiple policies restricting energy efficiency programs. In 2019, the state repealed its Energy Efficiency Resource Standard (EERS), which had previously been set to achieve 2 percent annual savings for 2021–2027.[24] Furthermore, Ohio has allowed large C&I customers to opt out of energy efficiency programs since 2014.[25] The Policy Case reflects and assumes the current status of the state's energy efficiency programs, which essentially ceased to operate due to the 2019 repeal of the EERS.
- **Reference Case**: The Reference Case assumes that both regressive policies were not enacted, and thus the state achieves higher levels of energy savings before these policies were enacted.

Our analysis for Ohio focused on energy efficiency programs for six major investor-owned utilities including Duke Energy Ohio, AES Ohio, AEP Ohio, and the three First Energy utilities: Ohio Edison, the Illuminating Company, and Toledo Edison. Together these six utilities account for roughly 74 percent of the statewide energy sales.

Program savings and cost assumptions

Because the 2019 repeal of the EERS essentially stopped the operation of all existing energy efficiency programs, the Policy Case reflects this current reality by assuming no energy efficiency program operation for 2021.

The Reference Case assumes the 2019 level of program performance for residential and commercial sectors because the state utilities increased energy savings for these sectors over time under the restriction of the large customer opt-out law. For this scenario, we used program costs, annual energy savings, peak load savings, and lifetime savings as reported for 2019 in EIA's 861 database. For the industrial sector, the Reference Case assumes the 2014 annual energy savings level we obtained from the EIA 861 database. We assume that this represents the savings level right before when the large customer opt-out law was adopted. However, we used the performance of the industrial energy efficiency programs in 2019 (i.e., the costs of saved energy in $ per annual kWh savings, kW peak reduction per MWh annual savings ratio, and measure life) to determine the total program costs, peak savings, and lifetime energy savings for the industrial program for the current year to reflect more recent program performance profiles for the sector.

Table 78 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 1,800 GWh (or 1.4 percent of sales) under the Reference. Peak load savings are 278 MW under the Reference case. Program costs are $185 million (1.5 percent of total revenue) under the Reference Case.

[24] House Bill 6. The Ohio Legislature. Available at: https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-hb-6

[25] Ohio Revised Code. Section 4928.6611. Available at https://codes.ohio.gov/ohio-revised-code/section-4928.6611

Table 78. Ohio – electric program savings and costs by scenario and sector

		Annual Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Load Savings (MW)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	-	-	-	-	-
	RES	-	-	-	-	-
	Total	-	-	-	-	-
Reference Case	C&I	980	12,701	150	94	210
	RES	819	7,363	128	90	145
	Total	1,800	20,064	278	185	355
Delta	C&I	(980)	(12,701)	(150)	(94)	(210)
	RES	(819)	(7,363)	(128)	(90)	(145)
	Total	(1,800)	(20,064)	(278)	(185)	(355)

A.6. Wisconsin

State-specific scenario assumptions

The Policy Case and the Reference Case for Wisconsin are defined as follows for our analysis:

- **Policy Case**: Back in February 2021, Governor Tony Evers proposed to double the funds for the state's energy efficiency program administrator—Focus on Energy—to 2.4 percent of the utility's operating revenues (approximately $100 million).[26] The Policy Case assumes this scenario.
- **Reference Case**: The Reference Case assumes the current program performance as of 2019.

Our analysis for Wisconsin focused on energy efficiency programs operated by the Focus on Energy, which covers most of the utility jurisdictions in the state.

Program savings and cost assumptions

For the Policy Case, we assume that the program performance for annual, lifetime, and peak energy savings are also increased proportionally to the budget increase. Thus, both the program costs and savings are twice as high as those for the Reference Case.

For the Reference Case, we assumed that the current program costs and savings for 2021 are equal to those in 2019 as reported by Focus on Energy.[27] Because Focus on Energy provides energy efficiency

[26] State of Wisconsin. 2021. Executive Budget. Available at https://doa.wi.gov/budget/SBO/2021-23%20Executive%20Budget%20Complete%20Document.pdf.

[27] CADMUS. 2020. *Focus on Energy Calendar Year 2019 Evaluation Report - Volume I*. Available at: https://www.focusonenergy.com/sites/default/files/Annual_Report-CY_2019_Volume_I.pdf.

programs for both gas and electricity savings measures but does not report the breakout of the program costs by fuel, we assumed that the cost breakdown for the 2019 achievements is equal to the estimate as assumed in a 2017 energy efficiency potential study prepared for Focus on Energy by Cadmus Group.[28] This study assumed that the electric energy efficiency program budget is 64 percent of the total program budget for the 2019–2022 program cycle.

Table 79 presents program costs and performance under the two cases by sector. At the portfolio level, annual savings are approximately 940 GWh (or 1.6 percent of sales) under the Policy Case and 470 GWh (or 0.8 percent of sales) under the Reference Case with the difference of approximately 470 GWh. Peak load savings are approximately 120 MW under the Policy Case and 60 MW under the Reference Case with the difference of 60 MW. Program costs are approximately $140 million (or 2 percent of total revenue) under the Policy Case and approximately $70 million (or 1 percent of total revenue) under the Reference Case with the difference of $70 million.

Table 79. Wisconsin – electric program savings and costs by scenario and sector

		Annual Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Load Savings (MW)	Program Cost ($million)	Total Resource Cost ($million)
Policy Case	C&I	738	10,743	96	84	206
	RES	206	3,233	27	53	106
	Total	944	13,976	123	137	312
Reference Case	C&I	369	5,371	48	42	103
	RES	103	1,617	13	26	53
	Total	472	6,988	61	69	156
Delta	C&I	369	5,371	48	42	103
	RES	103	1,617	13	26	53
	Total	472	6,988	61	69	156

[28] Cadmus. 2017. *Focus on Energy 2016 Energy Efficiency Potential Study*, Appendix D, Table D-26. Available at: https://focusonenergy.com/sites/default/files/WI%20Focus%20on%20Energy%20Potential%20Study%20Final%20Report-30JUNE2017.pdf.

APPENDIX B. DETAILED METHODOLOGIES, ASSUMPTIONS, AND INPUTS

B.1. Utility System Benefits

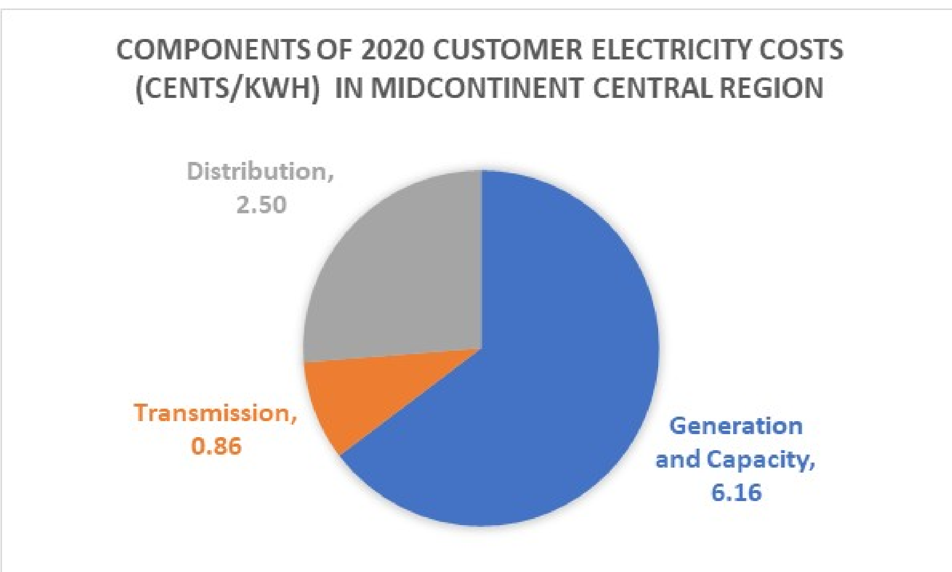
Cost Components

There are many components that make up customer electricity costs:

- Generation
- Capacity
- Transmission
- Distribution
- Renewable energy requirements
- Energy efficiency programs

The relative magnitudes of these costs differ and some are more affected than others by reductions in load associated with energy efficiency programs. The following figure based on data from the 2021 *Annual Energy Outlook* provides a rough guide to the relative magnitudes of these costs for the Midcontinent ISO/Central region that includes large parts of Indiana, Illinois, and Missouri. The total average customer cost is 9.52 cents per kWh (or $95.2 per MWh). This provides a general context for the following discussion of the avoided cost components.

Figure 22: Components of Customer Electricity Costs



Source: Annual Energy Outlook 2021.

Avoided Energy Costs

Definition

Energy efficiency measures offset the purchase of electricity from traditional sources of power generation at any given time. This is valuable from a cost perspective because reductions in the use of electricity result in lower utility revenue requirements and lower bills for customers on average. The value of this saved energy is referred to as the avoided cost per megawatt-hour (MWh) of purchasing or generating an additional MWh.

Methodology and data sources

The cost of energy in a given hour or minute is closely tied to the demand at that point in time at a particular location. Because all of the utilities of interest in this study are part of wholesale markets, we have calculated avoided energy costs using day-ahead hourly locational marginal price data from PJM, SPP, and MISO in the following way:

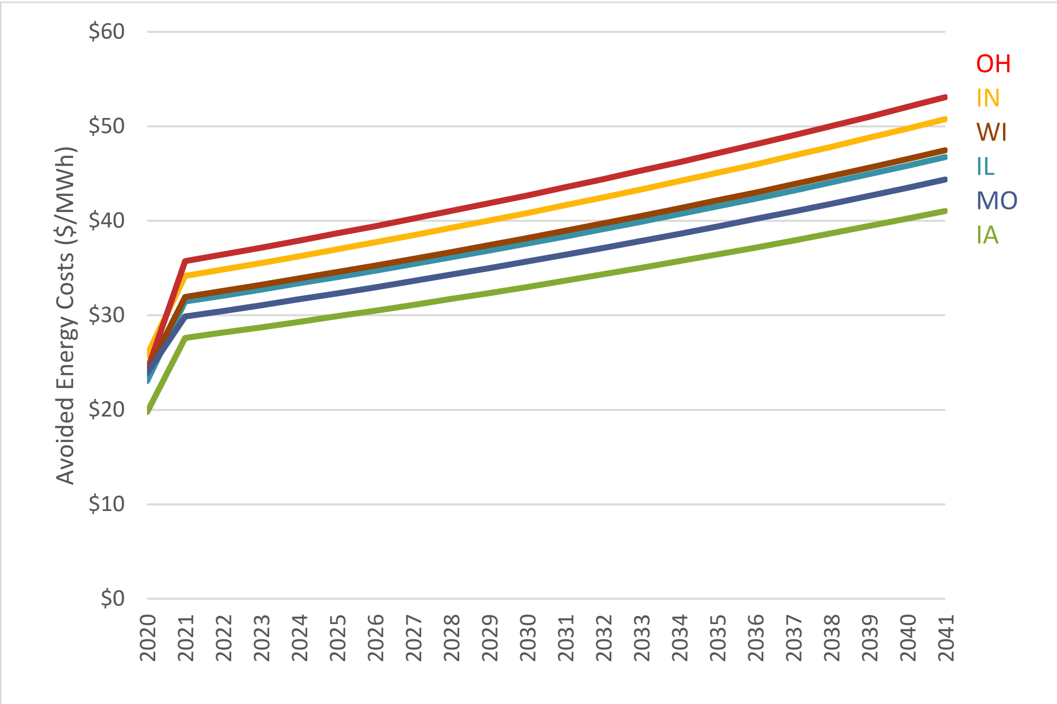
- We calculated the average wholesale energy price between 2017 to 2019 for each utility node. 2020 data was not included in the average due to lower-than-average prices caused by COVID-19.
- Because we are analyzing multiple utilities in multiple states, we used a savings-weighted average methodology to calculate statewide avoided energy cost estimates. This required us to calculate the share of energy efficiency savings that each utility of interest contributes to the total savings.
- We further adjusted the savings-weighted average price upwards by 5 percent to account for the difference between a straight average price and a load-weighted average price. The 5 percent value was calculated by comparing the annual average to the load-weighted average price using hourly load and price data from Dayton Power & Light.
- We then made a projection of wholesale energy prices for each utility node. Wholesale energy prices are uncertain for a number of reasons having to do with fuel and environmental costs, as well as other factors. Some forecasts predict substantial price increases, others not so much. We have taken a relatively conservative approach of increasing prices from current levels at the anticipated general rate of inflation of 2.0 percent.
- Finally, we adjusted the projection of wholesale energy prices by the T&D line loss factor for each state. We obtained T&D line loss factors for Illinois (11 percent), Iowa (5 percent) and Wisconsin (8 percent).[29] For the rest of the states, we used the average T&D line loss factor (8 percent) based on the factors for the three states.

[29] Guidehouse. 2020. *Evaluation of ComEd's CY2019 Total Resource Cost Test*. Available at: https://s3.amazonaws.com/ilsag/ComEd-CY2019-TRC-Report-2020-06-30-Final.pdf; CADMUS. 2020. *Focus on Energy*

Results

The resulting forecast is shown below in Figure 23.

Figure 23: Avoided Energy Costs (nominal $ per MWh)



Avoided Capacity Costs

Definition

Utilities have an obligation to operate a reliable power system capable of meeting peak demands when they occur. This includes maintaining or purchasing capacity from generating resources sufficient to meet peak demand when it occurs each summer. Energy efficiency measures that reduce peak loads reduce generation capacity requirements. This reduces the need to build new capacity and may also enable the retirement of existing facilities. The result is overall lower utility system costs and lower customer bills. The value of this saved capacity is referred to as the avoided cost per megawatt (MW) of additional generating capacity.

Calender Year 2019 Evaluation Report - Volume I. Available at: https://www.focusonenergy.com/sites/default/files/Annual_Report-CY_2019_Volume_I.pdf; IPL. 2020. "2019 Appendix D Benefit Cost Model_Electric and Gas.xlsx". Available at https://wcc.efs.iowa.gov/cs/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=latest&dDocName=2028338&noSaveAs=1.

Methodology and data sources

The need for and cost of capacity are related to the system peak demand. Typically, a utility is required to have available generating capacity or demand response resources to meet the expected peak load plus a specified reserve margin. The North America Electric Reliability Corporation (NERC) sets the reserve requirement of different regions which range from 9 to 20 percent.[30] The average is about 15 percent, which we used in this study. Regulated utilities provide the reserve requirement by building or contracting for additional generation capacity typically on an annual basis. Restructured utilities which are part of a regional transmission organization (RTO) or an independent system operator (ISO) may also acquire generation capacity in an annual auction.

For utilities that are part of the PJM system, this is known as the Reliability Pricing Model (RPM) Base Residual Auction (BRA). This auction is held three years in advance of the anticipated need for new capacity to allow time for the construction of new resources. This auction has been held for 15 years. The prices can be volatile, but for the most recent three auctions they have ranged between $76.53 and $187.87 per MW-day, depending on the location. PJM has calculated the Cost of New Entry (CONE)[31] for 2022 as a range from $269 to $329 per MW-day. However, the auction prices are substantially below those values.

MISO also has a capacity market called the Planning Resource Auction (PRA). This auction is only held one year in advance of the need. Most zones generally clear near the floor price of $4.75 per MW-day. That is not sufficient to build new capacity. MISO has calculated that the Cost of New Entry (CONE) as $257.53 per MW-day. In the 2020/2021 auction, Zone 7 (MI) cleared at the CONE price.[32] Given the extreme volatility of the MISO capacity market, we believe that the PJM market results are a better indicator of the true cost of new capacity.

The 2019 Wisconsin evaluation report gave an avoided electricity capacity cost value of $128.06 per kW-year for 2021.[33] This is equivalent to $351 per MW-day. In the recent *Avoided Energy Supply Components* (AESC) study that Synapse carried out for the energy efficiency program administrators in New England, the avoided capacity cost was $4.63 per kW-month in 2021/2022 and $2.46 per kW-month in 2024/2025 based on the ISO New England auction results.[34] This is equivalent to a range of

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[30] NERC, "2020-2021 Winter Reliability Assessment," https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_WRA_2020_2021.pdf.

[31] "PJM Cost of New Entry", April 19, 2018. https://www.pjm.com/~/media/committees-groups/committees/mic/20180425-special/20180425-pjm-2018-cost-of-new-entry-study.ashx.

[32] MISO, "2020/2021 Planning Resource Auction (PRA) Results", April 14, 2020.

[33] The Evaluation Working Group. 2020. *Quadrennial Planning Process III Evaluation Work Group Recommendation to the Commission of a Method for Calculating Avoided Capacity Costs and Additional Avoided Cost Considerations*. Available at: https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=386919.

[34] Synapse Energy Economics, et al. 2021. *Avoided Energy Supply Components in New England: 2021 Report.* Table 37.

$81 to $152 per MW-day. Given the uncertainty and the range of possible values, our study uses the PJM capacity prices as proxy for the full avoided capacity costs for the MISO region.

Starting with the current PJM BRA results through 2022, we made the following two modifications to develop our projection of avoided capacity costs for this study:

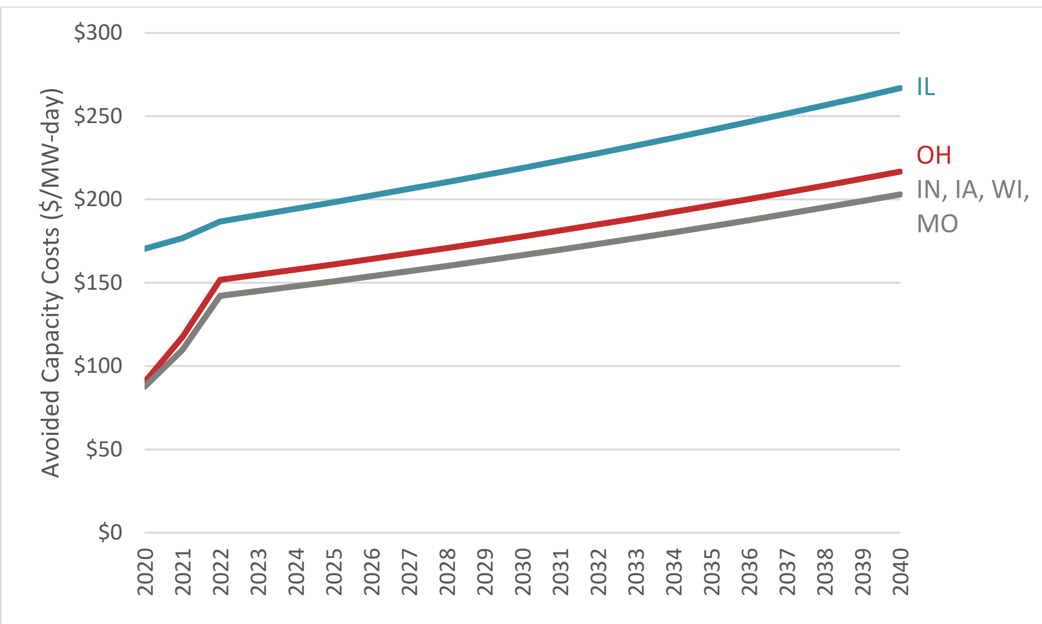
- Projection through 2040: Our analysis assumes that the avoided costs of capacity increase at the rate of inflation after 2022 through 2040.

- T&D loss factor: Our analysis adjusts the avoided capacity costs upward by a T&D line loss factor during peak hours. We assumed that the T&D loss factor during peak hours is roughly twice as high as the annual average loss factor for each state based on a 2011 study by the Regulatory Assistance Project (RAP).[35]

Results

The resulting forecast of avoided capacity costs prior to adjusting them for the T&D loss factor is shown in Figure 24 below.

Figure 24: Avoided Capacity Costs (nominal $ per MW-day)



35 RAP. 2011. *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements*. Available at: https://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-eeandlinelosses-2011-08-17.pdf.

Avoided Transmission and Distribution Costs

Definition

T&D costs represent about one-third of customers' total costs. These are mostly fixed costs much like capacity and depend on peak loads. But actual costs vary widely by location depending on how much excess capacity exists. By reducing load growth and/or reducing the load on existing infrastructure, energy efficiency can contribute to the deferral or avoidance of load-related distribution and transmission investments. This is often true even when there is excess capacity because load reductions today due to energy efficiency are closely related to or contribute to the peak loads in future years that could trigger new investments in the future.

Methodology and data sources

There are a variety of methodologies to estimate avoided T&D costs. One major approach is a system-wide avoided cost approach which is often based on historical, load-related T&D investments for the entire utility jurisdiction and the historical peak load growth. The time period for the historical data needs to be long enough to capture a long-term investment trend because T&D investments tend to be lumpy. This will provide an approximate system-wide avoided T&D investment suitable for evaluating system-wide impacts of energy efficiency programs. Another approach at the other end of the methodology spectrum is a forward-looking and location-specific approach that uses proposed or projected T&D investments at specific locations to estimate avoided T&D costs.

Our approach to avoided T&D costs is a survey of T&D avoided costs used in different jurisdictions for evaluating energy efficiency programs. Such avoided costs tend to use the former approach mentioned above. Further, our approach estimates an average value that we consider represents a reasonable proxy avoided cost for all the jurisdictions in this study.

Results

A summary of our T&D avoided cost survey is presented in Table 80. We found that the avoided T&D costs (in $2021) widely vary from $23 per kW-year (or $63 per MW-day) by Ameren in Missouri to as high as $120 per kW-year (or $329 per MW-day) by Interstate Power & Light (IPL) in Iowa, with an average of $62 per kW-year (or $170 per MW-day). While the avoided transmission cost by IPL is substantially larger than the estimate by other utilities, it is in the range of possible avoided transmission costs. For example, the previously mentioned New England AESC report evaluated avoided T&D costs and estimated a value similar to IPL's avoided transmission cost.[36] The AESC report estimated the cost associated with the Pool Transmission Facilities (PTF) that represent the major system transmission lines and arrived at a value of $87 per kW-year ($238 per MW-day) for this component.

[36] Synapse Energy Economics, et al. 2021. AESC 2021, Chapter 10.

The average T&D avoided cost is similar to our avoided capacity cost estimates. On the other hand, the variability of avoided T&D costs we found is greater than that of the capacity prices we identified in the previous section. As indicated in this table, the average avoided T&D cost estimate across the data we reviewed is $62 per kW-year. Based on this result, we used $60 per kW-year for the avoided T&D cost for all six states in our study.

Table 80. Survey of T&D Avoided Costs in the Midwest ($2021)

State	Utility	Transmission	Distribution	Total	Source
IA	Interstate Power & Light	$91	$29	$120	Mendota Group (2014)
IA	MidAmerican	$17	$42	$59	Mendota Group (2014)
IL	Commonwealth Edison	n/a	n/a	$47	Mendota Group (2014)
MN	Xcel	$16	$43	$59	Mendota Group (2014)
MO	Ameren	$6	$17	$23	Ameren MO 2017 IRP
WI	Wisconsin Focus on Energy	n/a	n/a	$66	Evaluation Working Group (2021)
Average		$32	$33	$62	

Source: Mendota Group. 2014. Benchmarking Transmission and Distribution Costs Avoided by Energy Efficiency Investments; Ameren MO 2017 IRP. Appendix C - Avoided Costs; Evaluation Working Group. 2021. Request for Comment and Memorandum Avoided T&D.

Market Price Effect

Definition

In both PJM and MISO electric energy is purchased and sold in wholesale markets. A characteristic of these markets is that clearing prices rise and fall with demand. Thus a reduction in demand will reduce the price for everyone. This is commonly known as demand reduction induced price effects (DRIPE). This can occur in both energy and capacity markets. The focus of this study is wholesale energy markets.

Methodology and data sources

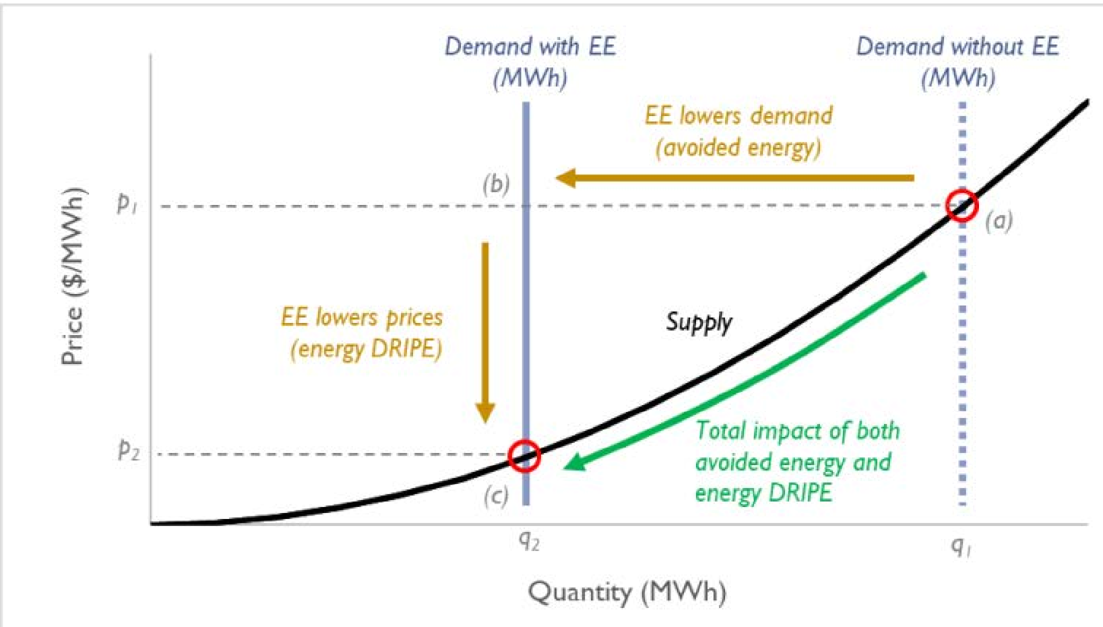
DRIPE was investigated extensively in the recent AESC report.[37] Figure 25 below shows the general mechanism of DRIPE. The AESC report provides the following explanation for this figure.

> *Whereas avoided energy (for example) describes the benefits associated with a quantity reduction, avoided energy DRIPE describes the benefits associated with a price reduction. These effects are not double-counting—in this [figure], each energy DRIPE and avoided energy (yellow arrows) are separate vector components of the aggregate effect (green*

[37] Synapse Energy Economics, et al. 2021. AESC 2021, Chapter 9, Demand Reduction Induced Price Effect {expand cite}

arrow). The total cost at point (a) is equal to $p_1 \times q_1$, while the total cost at point (c) is equal to $p_2 \times q_2$. If DRIPE were uncounted, the total cost would incompletely be calculated as the cost at point (b), or $p_1 \times q_2$.[38]

Figure 25. Illustrative example depicting avoided energy and energy DRIPE impacts



Source: Synapse Energy Economics, et al. 2021. AESC 2021 Report. Figure 46.

There are two major steps in calculating DRIPE impact. The first step is to calculate the elasticities—the ratio of the relative change in price to the change in demand. In AESC 2021 these were calculated to range from 1.35 to 1.40.[39] In 2015 a DRIPE analysis was carried by RAP for the ComEd region.[40] In that analysis a 1 percent load reduction was determined to cause a 2 percent price reduction. But the size of the area associated with the effect was uncertain. The study concluded that a 1 percent load reduction causes 0.5 percent to 1 percent price reduction in Illinois.[41,42] For this analysis we choose to use the lower elasticity value of 0.5.

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[38] Synapse Energy Economics, et al. 2021. AESC 2021, page 190.

[39] Synapse Energy Economics, et al. 2021. AESC 2021, Table 82.

[40] Chernick & Neme, “The Value of Demand Reduction Induced Price Effects (DRIPE)”, RAP, March 2018.

[41] Id, slide 14.

[42] We replicated that analysis for 2020 and got similar results.

The second step is to adjust the annual impacts over time to reflect the market fundamentals that the DRIPE savings for the customers may not be immediate or long-lived as discussed in the RAP paper. For example, the electricity purchases may be under a contract and thus the full savings may not be passed through to the customers. Further, the market will over time respond to the overall change in demand resulting in an erosion of the effects. Thus while DRIPE effects are real, they tend to be short-lived and relatively small. For our analysis, we assumed that DRIPE impacts last for 5 years and the annual DRIPE impacts decline over time due to the market hedging effect and the market mechanism to adjust prices over time.

Results

For the current calculation of DRIPE energy price effects we used a relatively conservative set of assumptions that represent as a single coefficient to estimate lifetime DRIPE impacts in terms of first year energy savings. The value that we are using is 0.97. This means that a 1 percent reduction in load will produce a lifetime market price impact of a 0.97 percent in terms of first year energy prices.

Avoided Renewable Portfolio Standard Compliance Cost

Definition

Energy efficiency measures can also reduce the cost of compliance with RPS programs, as the target of a RPS is often expressed as a percentage of sales and thus energy efficiency measures decrease the total load on the system. Thus, for states that require utilities to supply a certain percentage of load with renewable sources, energy efficiency programs provide an opportunity to avoid the associated compliance costs.

Methodology and data sources

For states with binding RPS programs (Illinois and Ohio), we used current renewable energy credit (REC) prices as an initial proxy for avoided compliance costs.[43] We also used the annual renewable energy targets defined by the Illinois and Ohio legislation. To develop an avoided RPS compliance cost, we multiplied our REC price forecast by the annual RPS targets. REC prices fluctuate year over year or within individual years. However, REC prices are expected to increase as the RPS targets become higher over time. Given the lack of REC price forecasts, we developed our own REC price forecasts. More specifically, we have taken the relatively conservative approach of increasing REC prices from their current levels at the anticipated general rate of inflation. After Illinois and Ohio reach the final targets currently defined in their RPS programs in 2026, we conservatively assume that these levels stay constant throughout the rest of the study period. While it is possible that these states will choose to increase their renewable targets into the future, it is out of the scope of this analysis to forecast what those trajectories may be.

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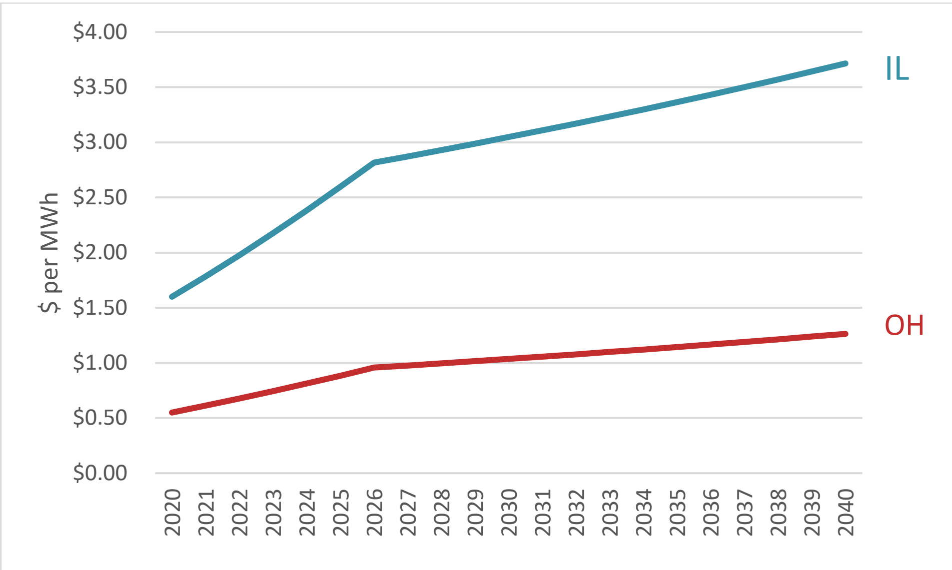
[43] Barbose, Galen L. 2021. *U.S. Renewables Portfolio Standards 2021 Status Update: Early Release.* Lawrence Berkeley National Laboratory. https://eta-publications.lbl.gov/sites/default/files/rps_status_update-2021_early_release.pdf.

Results

The results of our estimate of the avoided cost of RPS compliance are presented in Figure 26 for both Illinois and Ohio.

Figure 26. Avoided Costs of RPS for Illinois and Ohio (nominal $ per MWh)



Avoided Natural Gas Costs

Definition

Energy efficiency measures and programs to reduce natural gas consumption in buildings will reduce the cost of procuring natural gas for the entire system. While gas pipelines and other gas facilities such as CNG trucks tend to have large excess capacity, energy efficiency can also defer the timing of the construction of new facilities or avoid them entirely.

Methodology and data sources

Our study includes natural gas energy efficiency programs for Iowa. Thus, we developed avoided natural gas costs for Iowa only. We reviewed the current and historical wholesale natural gas prices for Iowa and avoided natural gas costs used by gas utilities in the state to evaluate the benefits of gas energy efficiency programs and decided to adopt the avoided costs of natural gas currently used by MidAmerican for evaluating its 2020 natural gas energy efficiency programs.[44]

[44] MidAmerican. 2021. Exhibit F - Detailed Cost Benefit Results_2057417_210429-133012. filed on April 29, 2021. Docket EEP-2018-0002.

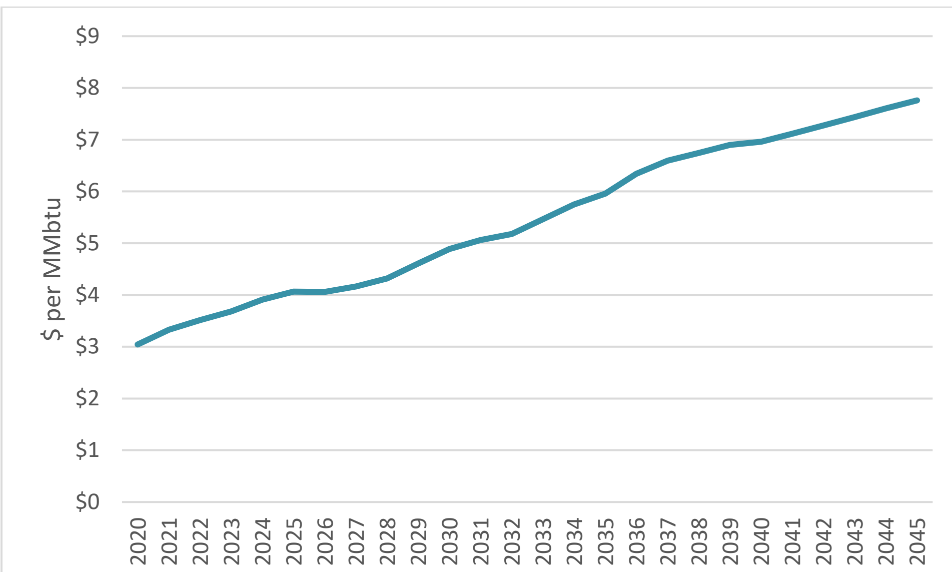
For the avoided costs of wholesale natural gas, we found that MidAmerican's estimate is reasonable as the avoided costs in early years are close to the current market price and the forecasted avoided costs tend to increase approximately by the level of the current inflation rate.

MidAmerican's analysis of its energy efficiency programs also includes the avoided cost of natural gas distribution facilities in terms of dollars per peak natural gas savings in MMBtu. Thus, we also decided to adopt this estimate to our study for Iowa natural gas programs. In order to apply the avoided cost per peak MMBtu savings, we derived the peak savings to annual savings factor based on the savings data in the MidAmerican's analysis. The resulting peak to annual savings factor is approximately 3 percent.

Results

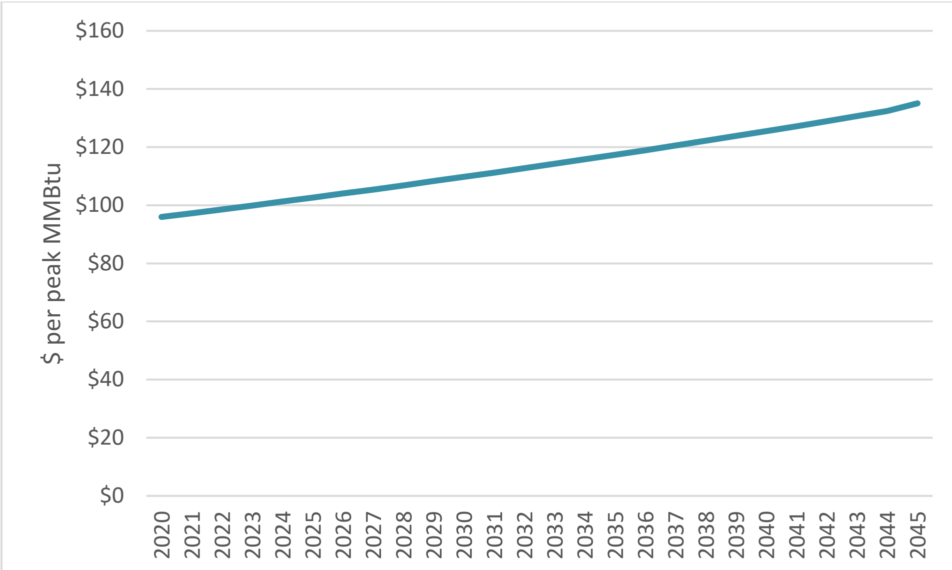
The results of our estimate of the avoided wholesale natural gas costs and the avoided natural gas distribution system costs are provided in Figure 27 and Figure 28 below.

Figure 27. Avoided Costs of Wholesale Natural Gas for Iowa (nominal $ per MMBtu)



Source: derived from MidAmerican. 2021. Exhibit F - Detailed Cost Benefit Results_2057417_210429-133012. filed on April 29, 2021. Docket EEP-2018-0002

Figure 28. Avoided Costs of Natural Gas Distribution System (nominal $ per peak MMBtu)



Source: derived from MidAmerican. 2021. Exhibit F - Detailed Cost Benefit Results_2057417_210429-133012. filed on April 29, 2021. Docket EEP-2018-0002

B.2. Participant Non-Energy Impacts

Energy efficiency measures can provide many different benefits to a home or business. Costs or benefits produced by energy efficiency measures that apply to the participant and are additional to any impacts from energy and demand savings are referred to as participant NEIs.[45]

Participant NEIs are costs or benefits beyond energy bill savings, which are typically tracked as avoided utility energy costs. Examples of participant NEIs include avoided O&M costs, increased comfort, increased participant health and safety, increased productivity, increased aesthetics, and increased property or asset value. An additional set of NEIs may apply exclusively to low-income customers. Low-income NEIs, which are the most commonly applied NEI, include benefits related to alleviating poverty, improving resiliency, and reducing home foreclosures.[46,47]

The figure below displays the number of U.S. states that account for each participant NEI (referred to be as host customer non-energy benefit, below). The NEI that is accounted for mostly commonly in cost-effectiveness testing is the additional benefits to low-income customers.

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[45] Midwest Energy Efficiency Alliance. "Non-energy benefits of energy efficiency." Available at: https://www.mwalliance.org/sites/default/files/media/NEBs-Factsheet_0.pdf.

[46] NESP. 2017. National Standard Practice Manual. Page 25. Available at: https://www.nationalenergyscreeningproject.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

[47] NESP. Database of Screening Practices (DSP). Accessed May 12, 2021.Available at: https://www.nationalenergyscreeningproject.org/state-database-dsesp/database-of-state-efficiency-screening-practices/.

Figure 29. State inclusion of NEIs

Category	Field	# States
Host Customer Non-Energy Benefits	Asset Value	6
	Comfort	5
	Economic Well-Being	4
	Health and Safety	9
	Low-Income Customers	26
	Productivity	12
	Satisfaction	1

Source: NESP. Database of Screening Practices (DSP). Accessed May 12, 2021. Available at: https://www.nationalenergyscreeningproject.org/state-database-dsesp/database-of-state-efficiency-screening-practices/

Energy efficiency program administrators may account for NEIs qualitatively (i.e. offer a non-cost-effective measure because it provides noticeable benefits) or include NEIs directly in their benefit-cost calculations. For the latter approach, the NEIs must first be quantified.

NEIs are typically quantified in one of two ways: as monetized measure-level impacts or as percent adders to utility benefits. Monetized NEIs are typically calculated through evaluation studies or customer survey reports. This more detailed approach breaks out each individual NEI (e.g. increased property value) by measure or measure grouping and assigns a value per unit of energy savings or number of participants. Many jurisdictions find this method too rigorous, and instead opt to use a percent adder. Percent adders can be applied at any benefit-cost screening level and are typically multiplied by the utility system benefits. Depending on the jurisdiction's screening practices, these values can either be applied uniformly across the portfolio or vary by sector. For instance, the low-income sector may have a larger participant NEI adder than the market rate residential sector.

The table below displays how a variety of states quantify participant NEIs. Massachusetts represents a state that quantifies NEIs at a granular level, providing dollar benefits per unit.[48] More commonly, states apply adders at the portfolio or program level. For some states, adders also vary by efficiency program fuel type (gas or electric).

[48] The values shown for Massachusetts are based on a single measure, Residential Heating and Cooling Equipment Furnace. Participant NEIs range by measure and program.

Table 81. Sample NEI values by state

NEI	Values								
	MA	WA	CO	NM	ID	IA (electric)	IA (gas)	IL (electric)	IL (gas)
By participant NEI									
Unit	*$/Unit*	*Adder*	*Adder*	*Adder*	*Adder*	*Adder*	*Adder*	*Adder*	*Adder*
Comfort	27.18								
Productivity/O&M	11.98								
Health and safety	0.87								
Asset value	379.0								
Low-income adder			20%	25%					
Total									
Portfolio adders		10%	10%	15%	10%	10%	7.5%	10%	7.5%

Sources: Program Administrators of Massachusetts: Non-Energy Impact Framework Study Report. January 23, 2018. Available at: https://ma-eeac.org/wp-content/uploads/NEI-Framework-Study-Report.pdf; Synapse Energy Economics. 2018. Value of Energy Efficiency in New York: Assessment of the Range of Benefits of Energy Efficiency Programs. Available at: https://synapseenergyeconomics.box.com/s/ur9bidedudvos4cosycoklsabdlan0vi; Idaho Power. 2019. Demand Side Management 2018 Annual Report. Supplement 1: Cost Effectiveness. Available at: https://docs.idahopower.com/pdfs/EnergyEfficiency/Reports/Supplement1.pdf.

(4) Iowa Administrative Code (IAC). Chapter 35. ENERGY EFFICIENCY AND DEMAND RESPONSE PLANNING AND REPORTING FOR NATURAL GAS AND ELECTRIC UTILITIES REQUIRED TO BE RATE-REGULATED. October 9, 2019. Available at: https://www.legis.iowa.gov/docs/ACO/chapter/199.35.pdf.

Based on a review of NEI adders in several states as shown in Table 81, we developed our estimates of NEI for our analysis. We assume that NEI values for C&I customers for electric energy efficiency are 10 percent of total benefits under the TRC test and 7.5 percent for gas energy efficiency. Given the high NEI adders for low-income customers and various NEI factors related to households (e.g., comfort, health and safety), we assume higher NEI values for residential (RES) customers, 15 percent for electric energy efficiency, and 11.25 percent for gas energy efficiency.

Table 82. NEI Values for Electric and Gas energy efficiency Programs (% of total benefits)

	Electric energy efficiency	Gas energy efficiency
RES	15%	11.3%
C&I	10%	7.50%

Source: Synapse Energy Economics.

Lastly, it is important to note that these NEI values are likely to underestimate the total NEI for program participants. One major NEI not included in this assessment is participant O&M savings. We identified that Ameren Illinois included O&M savings in its TRC analysis and the value of this NEI was nearly 20 percent of the total avoided system costs.[49] However, we were not able to find equivalent O&M savings

[49] Ameren Illinois. 2020. *Ameren Illinois 2019 Energy Efficiency Portfolio Cost-Effectiveness Results*. Available at: https://www.ilsag.info/evaluation-documents/final-evaluation-reports/

estimates from other jurisdictions and O&M savings are specific to the type of measures implemented. Thus, we decided not to include this NEI in our analysis.

B.3. Avoided Emissions and Health Benefits from Power Plants and Natural Gas Supply

Overview

Synapse' analysis also considered and incorporated both emissions and health impacts when assessing the societal impacts of energy efficiency programs. This is because reductions in electricity usage can cause decreases in fossil fuel generation and various emissions such as GHG emissions and criteria pollutants associated with fossil fuel generation. Reductions in on-site natural gas usage from natural gas efficiency programs also results in reductions in significant amount of GHG emissions from on-site natural gas combustion as well as reductions in methane leaks from natural gas wells through the entire natural gas delivery infrastructure. These emission reductions are important benefits to consider, as reductions in criteria pollutant emissions can lead to fewer illnesses and premature mortalities, and reductions in GHG emissions can reduce a state's contribution to global warming.

Avoided Emissions from Power Plants

To estimate the amount of GHG emissions and other pollutions from power plants that could be avoided as a result of energy efficiency programs, Synapse devised a methodology that used inputs from two different sources: the Avoided Emissions and Generation Tool (AVERT) and Rocky Mountain Institute (RMI)'s Utility Transition Hub.[50]

AVERT is an open-access tool built by Synapse for the U.S. Environmental Protection Agency to estimate the hourly emission and generation benefits of energy efficiency and renewable energy policies and programs. AVERT allows non-expert users to measure displaced emissions of CO_2 and criteria pollutants, and avoided generation mitigated by state or multi-state programs. For this project, we completed nine different runs of AVERT in order to capture the numerous state and balancing authority combinations of interest to this study. For example, because the utilities in Indiana are spread across MISO and PJM, we modeled the energy savings impacts separately for each RTO. In addition to specifying the region for each run, we input the annual energy reductions in GWh based on energy efficiency programs in that region. We assumed that energy savings were distributed evenly throughout each hour of the year.

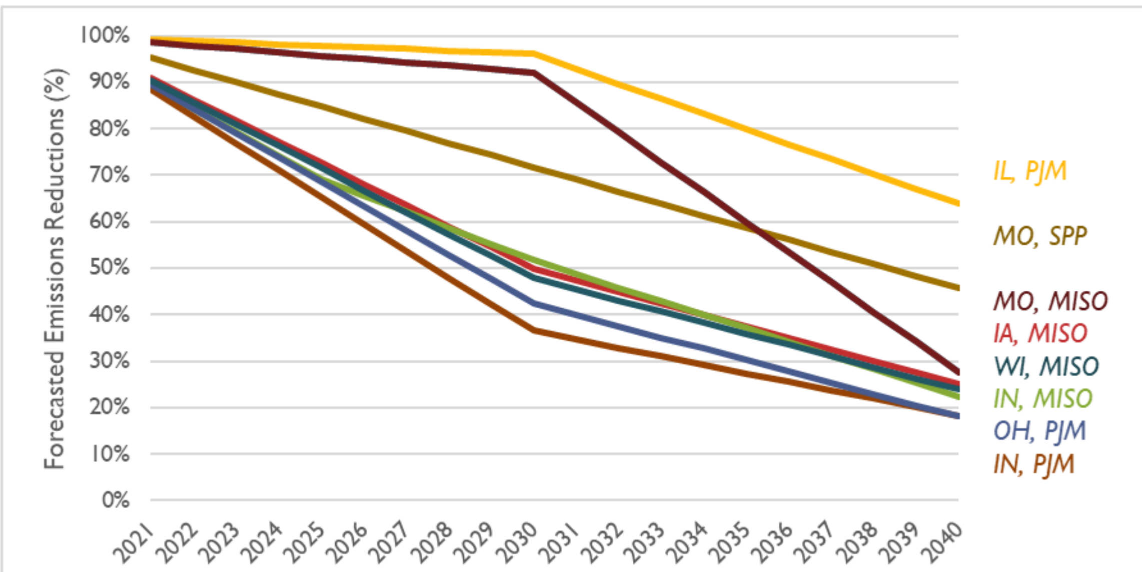
The outputs from AVERT include annual regional estimates of avoided CO_2, NO_x, SO_2, and $PM_{2.5}$ emissions as a result of reduced generation from fossil fuel units. The most recently published version of AVERT uses 2019 emissions and generation data, so the results described here capture the impacts these energy efficiency programs would have had in that historical year. While this is useful information

[50] Rocky Mountain Institute. 2021. "Utility Transition Hub." Available at: https://utilitytransitionhub.rmi.org/portal/.

for coming up with the baseline impacts of these efficiency programs, it does not reflect the avoided emissions impact these energy efficiency measures will have over the next 10 to 20 years.

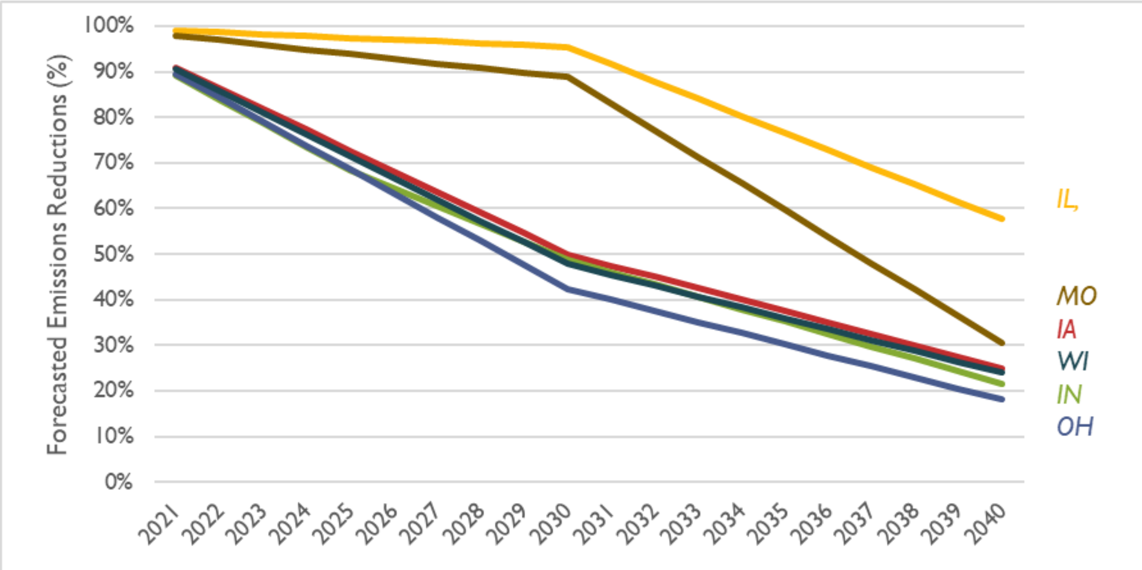
To forecast longer-term avoided emissions, we used emissions data from Rocky Mountain Institute's (RMI) Utility Transition Hub. RMI has developed projected emissions trajectories for FERC Form 1 respondents based on publicly stated targets from the Smart Electric Power Alliance's Utility Carbon Reduction Tracker. We used the Utility Transition Hub to extract data for all utilities of interest to this study.[51] With this information, we calculated annual weighted average emissions reductions factors for each load zone and for each state (See Figure 30). These factors were then applied to the 2019 avoided emissions estimates output by AVERT to develop values through 2040. This approach accounts for the impending decarbonization of the electric sector and recognizes that the future generation mix might look quite different to present-day.

Figure 30: Emissions reduction trajectories for combinations of states and wholesale market regions.



[51] Commonwealth Edison was the only utility that was not included in the RMI tool. As a proxy, we assumed a trajectory equal to half of the reduction targets published for Ameren Illinois.

Figure 31: Emissions reduction trajectories by state



These annual emissions reduction values were then used to calculate state-level cumulative emissions reductions factors (See Table 83). This allows us to calculate the lifetime emissions and health benefits over the program measure life.

Table 83: Cumulative Emissions Adjustment Factors by State

Cumulative Emissions Adjustment Factors by State						
Year	IL	IA	IN	OH	WI	MO
2021	100%	100%	100%	100%	100%	100%
2022	100%	98%	97%	97%	97%	99%
2023	100%	95%	94%	94%	95%	99%
2024	99%	93%	91%	91%	92%	98%
2025	99%	90%	88%	88%	90%	98%
2026	99%	88%	86%	85%	87%	97%
2027	99%	85%	83%	82%	84%	97%
2028	99%	83%	81%	80%	82%	96%
2029	98%	80%	78%	77%	79%	96%
2030	98%	78%	76%	74%	76%	95%
2031	98%	75%	74%	71%	74%	94%
2032	97%	73%	72%	69%	72%	93%
2033	96%	71%	70%	66%	70%	91%
2034	95%	69%	68%	64%	68%	90%
2035	94%	67%	66%	62%	66%	88%
2036	92%	65%	64%	60%	64%	86%
2037	91%	64%	62%	58%	62%	84%

Cumulative Emissions Adjustment Factors by State						
Year	**IL**	**IA**	**IN**	**OH**	**WI**	**MO**
2038	90%	62%	60%	57%	61%	81%
2039	88%	60%	59%	55%	59%	79%
2040	87%	59%	57%	53%	57%	77%

Avoided Emissions from Natural Gas Supply and Consumption

We estimated avoided emissions from the changes in natural gas usage in buildings and methane leaks in the gas supply system due to energy efficiency programs. While our analysis of emissions from power plants includes criteria pollutants and CO_2, our analysis of emissions from natural gas excludes criteria pollutants and focuses on avoided carbon and methane emissions for the purpose of estimating avoided costs of carbon. Many studies found NO_X emissions from indoor gas appliances cause serious health problems such as increased respiratory symptoms and asthma attacks.[52] However, the quantification of such health damages from gas appliances is outside of the scope of this report.

The changes in gas usage in buildings are related to the changes in emissions caused by natural gas combustion within buildings. For estimating such emission impacts, we used an emission factor of 0.0583 short ton of CO_2 per MMBtu of natural gas usage based on an estimate by U.S. EPA.[53]

For accounting for avoided methane emission leaks from natural gas wells through the entire gas delivery infrastructure, we assumed an emission leak rate of 1.42 percent based on U.S. EPA's current estimate.[54] This is a conservative estimate given that other recent studies have found higher methane emission leaks. For example, a 2018 study published in *Science Journal* found that the current emission leak rate from the U.S. oil and gas system is 2.3 percent (60 percent higher than U.S. EPA's emission rate).[55] Further, a more recent study published in 2020 by the Environmental Defense Fund evaluated methane leaks from the Permian Basin located in New Mexico and Texas and found that 3.7 percent of gas produced in this basin is leaked into the atmosphere.[56]

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[52] Seals, Brady, and Andee Krasner. 2020. *Health Effects from Gas Stove Pollution*, Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club. Available at: https://rmi.org/insight/gas-stoves-pollution-health/.

[53] U.S. EPA. "Greenhouse Gases Equivalencies Calculator – Calculations and References." Accessed June 17. 20221. Available at: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

[54] U.S. EPA. 2020. *Estimate of Methane Emissions from the U.S. Natural Gas Industry*. Available at: https://www.epa.gov/sites/production/files/2020-11/documents/methane.pdf.

[55] Alvarez et al. 2018. "Assessment of methane emissions from the U.S. oil and gas supply chain," Science. 13 Jul 2018. Vol. 361, Issue 6398, pp. 186-188. Available at: https://science.sciencemag.org/content/361/6398/186.

[56] Storrow, Benjamin. 2020. "Methane Leaks Erase Some of the Climate Benefits of Natural Gas" E&E News on May 5, 2020. Available at: https://www.scientificamerican.com/article/methane-leaks-erase-some-of-the-climate-benefits-of-natural-gas/.

We applied the methane emission leak rate to the changes in natural gas usage due to energy efficiency programs under the Policy Case and the Reference Case and estimated the total emissions impact. We then converted methane emissions into CO_2-equivalent emissions using a Global Warming Potential (GWP) factor of 32.[57]

Social Cost of Carbon

Reductions in the amount of current and future damages caused by GHGs can be associated with a monetary value, sometimes called the social cost of carbon (SCC). We estimated the impacts of carbon emissions in terms of the social cost of carbon for both electric and gas energy efficiency programs in our study.

The federal government has periodically provided recommendations for an appropriately valued SCC. The Obama Administration estimated the SCC to be $49 per short ton in 2021 dollars with an escalation over time.[58] The Trump Administration released an updated estimate of the SCC that accounted for only domestic impacts of carbon emissions and used a discount rate of 3 to 7 percent. This resulted in a cost of $1–$7 per short ton.[59] The Biden Administration has yet to provide its final guidance on the SCC but has rescinded the value proposed by the Trump Administration. Until its recommendation is released in January 2022, the Biden Administration recommended that agencies rely on the 2016 guidance from the Obama Administration.[60]

In the AESC 2021 report mentioned above, Synapse recommended that the energy efficiency program administrators in New England use the SCC value developed by New York State's Department of Environmental Conservation in its guideline document titled "Establishing a Value of Carbon."[61] At the same time, the AESC 2021 report also recommends that the use of this SCC value be reconsidered once the federal guidance is released. This NYS value was recommended because it considers the global impact of emissions and high-risk situations and uses a relatively low discount rate of 2 percent. The New York SCC was calculated using estimations from the Obama-era guidelines but used a different

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[57] Methane has a GWP of 28 to 36 over 100 years per U.S. EPA. "Understanding Global Warming Potentials" Accessed June 17, 2021. Available at: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

[58] Interagency Working Group on Social Cost of Greenhouse Gases. 2016. *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866*. Available at: https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc_tsd_final_clean_8_26_16.pdf.

[59] U.S. Government Accountability Office. 2020*. Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis*. Available at: https://www.gao.gov/assets/gao-20-254.pdf. See Page 57, Table 10.

[60] Executive Office of the President. January 20, 2021. "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis." Federalregister.gov. Available at https://www.federalregister.gov/documents/2021/01/25/2021-01765/protecting-public-health-and-the-environment-and-restoring-science-to-tackle-the-climate-crisis.

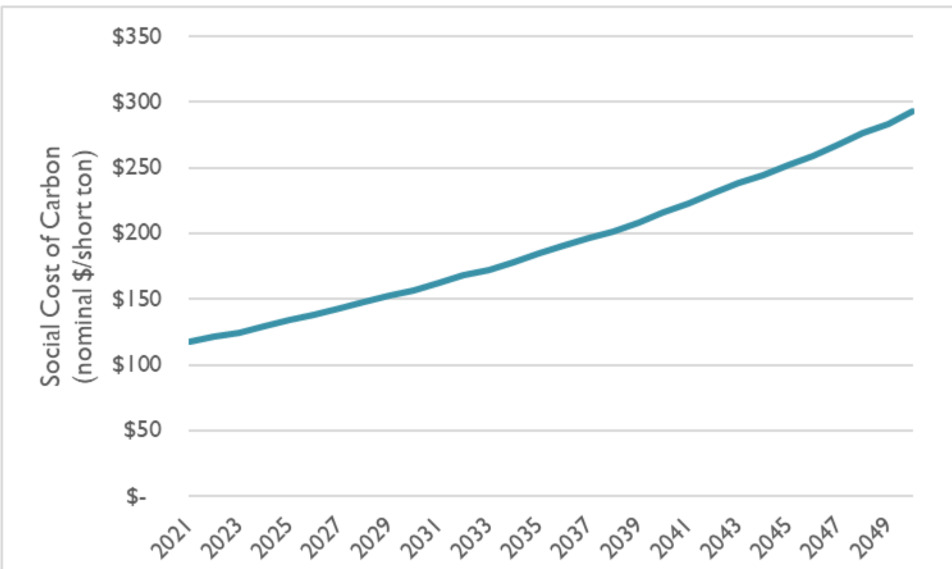
[61] Synapse Energy Economics. 2021; New York State Department of Environmental Conservation. 2020. *Establishing a Value of Carbon: Guidelines for Use by State Agencies*. Available at: https://www.dec.ny.gov/docs/administration_pdf/vocguidrev.pdf.

range of discount rates. It includes the impacts of all relevant GHG's, such as methane and NO_X in addition to CO_2. The resulting cost ranges from $116 in 2020 to $165 in 2050.

Of the six states that Synapse studied in this report, Wisconsin is one of the few that currently applies a cost of carbon to its benefit-cost calculations. In 2018, the PSC of Wisconsin issued an Order that stated that "The Commission finds it reasonable for Focus cost-effectiveness tests to continue valuing avoided carbon dioxide emissions using a market-based value of $15 per ton."[62] Illinois state law also requires its energy efficiency program administrators to include reasonable estimates of financial costs likely to be imposed by future regulations on emissions of GHGs in their TRC tests.[63] In Ameren's 2019 electric energy efficiency program, avoided GHG emissions accounted for 35 percent of total electric benefits.[64]

For our analysis, we aligned with the AESC 2021 recommendation and used the New York SCC values as shown in Figure 32.

Figure 32: Social Cost of Carbon



Avoided Health Impacts

Our analysis used U.S. EPA's CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) to estimate the health and economic benefits of reductions in fossil fuel generation for the residents of the states analyzed as well as others impacted by the change in emissions associated with

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62 Public Service Commission of Wisconsin. June 6, 2018. Quadrennial Planning Process III. Order PSC Docket. 5-FE-101, REF#: 343909. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=343909.

63 Illinois Energy Efficiency Stakeholder Advisory Group. 2017. *Illinois Energy Efficiency Policy Manual.* Version 1.1.

64 Ameren Illinois Energy Efficiency Portfolio Cost Effectiveness Results. 2019. Available at: https://ilsag.s3.amazonaws.com/Appendix-A-2019-AIC-Cost-Effectiveness-EE-Portfolio-Results-FINAL-2020-07-02.xlsx.

increased energy efficiency. COBRA utilizes a reduced form air quality model to measure the impacts of emission change on air quality and translates them into health and monetary effects. For this analysis, Synapse used modeled avoided emissions deltas (SO_2, NO_X, and $PM_{2.5}$) that were output from AVERT. In addition to taking AVERT outputs, COBRA requires users to specify an analysis year and discount rate. Synapse used an analysis year of 2023, as it is the closest of the selectable years in COBRA to the first year of our study period (2021). This means that the demographic characteristics and GDP numbers used by COBRA will be similar to their current values.

COBRA offers users the option of selecting between two discount rates: 3 percent per year and 7 percent per year. Synapse opted to use the 3 percent discount rate as it is closer to the discount rate applied elsewhere in the benefit-cost analysis and better reflects the perspective of the benefit-cost analysis toward future values.

The monetized health benefits reported by COBRA represent the sum of the values of several categories of impacts: avoided premature mortalities, avoided illnesses, and avoided lost workdays and lost minor restricted activity days (i.e., days on which activity is reduced, but not severely restricted).[65] Avoided premature mortalities are monetized using the value of a statistical life (VSL), as formulated by EPA,[66] while avoided morbidities are valued using different methodologies that account for the cost of medical care, the impact of pain and suffering, and foregone wages (though not necessarily all of these together).[67]

Results - Avoided Emissions

Using the methodology detailed above, Synapse calculated lifetime and annual avoided emissions by sector between the Reference Case and the Policy Case for each state (See Table 84). The policies we analyzed are regressive policies for all states except Wisconsin. Thus, the impacts of such policies result in increased emissions for all states except for Wisconsin.

[65] United States Environmental Protection Agency. 2021. "How Does COBRA Work?" Available at: https://www.epa.gov/cobra/how-does-cobra-work-0.

[66] U.S. EPA. 2021. "Mortality Risk Valuation." *Environmental Economics.* Available at: https://www.epa.gov/environmental-economics/mortality-risk-valuation.

[67] U.S. EPA. 2020. *User's Manual for the he Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) – Version 4.0*. Exhibit F-8. Available at: https://www.epa.gov/sites/production/files/2020-06/documents/cobra_user_manual_june_2020.pdf.

Table 84: Electric energy efficiency program – Delta by sector in emissions impacts between the Reference Case and Policy Case

		Lifetime Avoided Emissions				Annual Avoided Emissions			
State	Sector	Lifetime Avoided CO_2 (tons)	Lifetime Avoided $PM_{2.5}$ (lbs)	Lifetime Avoided NO_x (lbs)	Lifetime Avoided SO_2 (lbs)	Annual Avoided CO2 (tons)	Annual Avoided PM2.5 (lbs)	Annual Avoided NOx (lbs)	Annual Avoided SO2 (lbs)
Wisconsin	C&I	2,811,497	496,640	3,818,826	5,044,123	309,508	54,673	420,402	555,290
Wisconsin	RES	823,016	145,383	1,117,894	1,476,578	86,429	15,267	117,395	155,062
Iowa	C&I	(1,196,750)	(211,863)	(1,624,934)	(2,147,369)	(117,441)	(20,791)	(159,460)	(210,728)
Iowa	RES	(384,292)	(68,032)	(521,787)	(689,548)	(43,075)	(7,626)	(58,487)	(77,291)
Ohio	C&I	(5,444,198)	(944,431)	(5,200,269)	(8,345,648)	(675,522)	(117,186)	(645,255)	(1,035,537)
Ohio	RES	(3,605,228)	(625,416)	(3,443,695)	(5,526,611)	(564,596)	(97,943)	(539,299)	(865,493)
Indiana	C&I	(756,321)	(133,564)	(977,190)	(1,324,736)	(88,687)	(15,662)	(114,587)	(155,341)
Indiana	RES	(263,436)	(46,522)	(340,367)	(461,422)	(41,246)	(7,284)	(53,291)	(72,244)
Missouri	C&I	(2,226,822)	(365,332)	(3,044,580)	(3,903,819)	(179,888)	(29,512)	(245,948)	(315,360)
Missouri	RES	(1,347,958)	(221,146)	(1,842,970)	(2,363,091)	(116,172)	(19,059)	(158,834)	(203,660)
Illinois	C&I	(231,250)	(40,247)	(239,629)	(366,016)	(26,329)	(4,582)	(27,283)	(41,673)
Illinois	RES	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 85. Gas energy efficiency program – Delta by sector in emissions impacts between the Reference Case and Policy Case

		Lifetime Avoided Emissions			Annual Avoided Emissions		
State	Sector	Lifetime Avoided On-site CO_2 (tons)	Lifetime Avoided Leaked CO_2e (tons)	Lifetime Total Avoided CO_2e (tons)	Annual Avoided On-site CO_2 (tons)	Annual Avoided Leaked CO_2e (tons)	Annual Total Avoided CO_2e (tons)
Iowa	C&I	(303,563)	(139,926)	(443,490)	(17,538)	(8,084)	(25,623)
Iowa	RES	(706,855)	(325,822)	(1,032,677)	(40,819)	(18,815)	(59,634)

Results – Health Impacts

As previously mentioned, energy efficiency programs in a given state also have the potential to benefit other neighboring states due to the location of fossil fuel generators. For this reason, we have broken out benefits solely located in the state analyzed, as well as nationwide benefits. COBRA provides both a high and low estimate of benefits (See Table 86). The policies we analyzed are regressive policies for all states except Wisconsin. Thus, the impacts of such policies result in increased health care/damage costs for the society (except for Wisconsin).

Table 86: First Year Health Benefits

		First-year Health Benefits ($million)			
State	**Sector**	**In-State Total - Low**	**In-State Total - High**	**Nationwide Total - Low**	**Nationwide Total - High**
Wisconsin	C&I	0.3	0.8	9.6	21.5
Wisconsin	RES	0.1	0.2	2.7	6.0
Iowa	C&I	(0.1)	(0.2)	(3.7)	(8.3)
Iowa	RES	(0.0)	(0.1)	(1.4)	(3.1)
Ohio	C&I	(4.5)	(10.1)	(26.5)	(59.8)
Ohio	RES	(3.7)	(8.5)	(22.2)	(50.0)
Indiana	C&I	(0.3)	(0.6)	(2.9)	(6.6)
Indiana	RES	(0.1)	(0.3)	(1.4)	(3.1)
Missouri	C&I	(0.2)	(0.4)	(5.2)	(11.7)
Missouri	RES	(0.1)	(0.3)	(3.4)	(7.6)
Illinois	C&I	(0.2)	(0.5)	(3.3)	(7.5)
Illinois	RES	n/a	n/a	n/a	n/a

These first-year health benefits in combination with the cumulative emissions reduction factors from Table 83 were then used to calculate lifetime health benefits. The net present value of the lifetime health benefits from Table 86 are shown in Table 87.

Table 87. Lifetime Health Benefits

		Lifetime Avoided Health Benefits ($million PV)			
State	**Sector**	**In-State Total - Low**	**In-State Total - High**	**Nationwide Total - Low**	**Nationwide Total - High**
Wisconsin	C&I	2.5	5.6	70.3	158.7
Wisconsin	RES	0.7	1.6	20.3	45.8
Iowa	C&I	(0.7)	(1.6)	(29.8)	(67.3)
Iowa	RES	(0.2)	(0.5)	(9.9)	(22.4)
Ohio	C&I	(29.9)	(67.5)	(177.1)	(399.3)
Ohio	RES	(20.9)	(47.1)	(123.6)	(278.7)
Indiana	C&I	(1.8)	(4.0)	(20.6)	(46.5)
Indiana	RES	(0.7)	(1.5)	(7.6)	(17.2)
Missouri	C&I	(1.8)	(4.0)	(52.3)	(118.1)
Missouri	RES	(1.1)	(2.4)	(32.1)	(72.3)
Illinois	C&I	(1.5)	(3.5)	(25.5)	(57.5)
Illinois	RES	n/a	n/a	n/a	n/a

Results – Social Costs of Carbon

We estimated the total lifetime avoided costs of carbon emissions due to electric energy efficiency programs for each state by sector by applying our estimate of the social costs of carbon (Figure 32) to our projection of the avoided emissions from power plants over the lifetime of energy efficiency measures (Table 84). The results of this analysis are shown in Table 88 below. The policies we analyzed are regressive policies for all states except Wisconsin. Thus, the impacts of such policies result in increased costs of carbon (except for Wisconsin).

Table 88. Electric energy efficiency – Lifetime Avoided Social Cost of Carbon

Lifetime Avoided Social Cost of Carbon		
State	**Sector**	**Social Cost of Carbon ($million PV)**
Wisconsin	C&I	341
Wisconsin	RES	100
Iowa	C&I	(146)
Iowa	RES	(47)
Ohio	C&I	(658)
Ohio	RES	(432)
Indiana	C&I	(91)
Indiana	RES	(31)
Missouri	C&I	(270)
Missouri	RES	(163)
Illinois	C&I	(28)
Illinois	RES	0

We also estimated the total lifetime avoided costs of carbon emissions due to natural gas energy efficiency programs for Iowa by sector, as shown in Table 89, based on our estimates of avoided CO_2 emissions in buildings and methane leaks in the natural gas production and delivery process (as shown in Table 85).

Table 89. Gas energy efficiency – Lifetime Avoided Social Cost of Carbon

Lifetime Avoided Social Cost of Carbon		
State	**Sector**	**Social Cost of Carbon ($million PV)**
Iowa	C&I	(86)
Iowa	RES	(37)

B.4. Macroeconomic Impacts

We used the IMPLAN model to determine the macroeconomic impacts of changes in spending on energy efficiency programs in six Midwestern states. energy efficiency programs provide incentives for consumers and businesses to invest in new appliances, equipment, and technologies that shift economic activity away from traditional energy resources. These trade-offs in turn result in overall changes in total employment, income, and GDP statewide.

In this chapter, we provide an overview of the methodology used in the macroeconomic analysis, and then provide results for each of the evaluated states.

Macroeconomic Impacts and Metrics

In our IMPLAN-based macroeconomic analysis, we evaluated three different tiers of macroeconomic impacts – direct impacts, indirect impacts, and induced impacts. These categories are explained in detail below.

- **Direct impacts** are the impacts associated with construction, installation, or operations and maintenance of the measure or other energy sector resource. For example, for an increase in spending on energy efficiency, the direct impacts are those associated with the installation of energy efficient appliances and home weatherization (and not those supply chain effects associated with *manufacturing* these materials). For an increase in spending on construction of power plants (e.g., gas combined cycle plants), the direct impacts are those associated with on-site construction.

- **Indirect impacts** are the supply chain effects that follow the direct impacts. Those employed in installation or O&M jobs (direct impacts) work with materials that must be manufactured. The indirect impacts are the jobs, income, and GDP implications of material manufacturing.[68]

- **Induced impacts** are the changes in consumer spending and business investment spending in the wider economy driven by changes in labor income and household and business energy bills (this *respending* is *induced* by wage and bill effects). In this study, induced impacts result from the spending of new wage earnings (resulting from employment growth due to direct and indirect impacts), and also result from households and businesses respectively respending and reinvesting utility bill savings.

Synapse's macroeconomic analysis reported results in terms of three top-line metrics:

- **Gross Domestic Product** is the change in total value added to each state's output in goods and services within the timeframe defined by the average measure life.
- **Jobs** refers to the change in total employment within the timeframe defined by the average measure life. Jobs are reported in terms of job-years. One job-year is equivalent to a single person working full-time for a year (e.g., five job-years could be five full-time positions for one year or one full-time position for five years).

- **Income** refers to the change in earned income (including benefits) collectively received by salaried employees and proprietors of businesses (i.e., the self-employed).

[68] The extent to which these materials are produced in-state is an important determinant of indirect impacts. Synapse relied on IMPLAN's estimates for the portion of each industry's demand that is met by in-state suppliers. Synapse has also improved on the standard IMPLAN assumptions for the electricity industry by using NREL's JEDI (Jobs and Economic Development Impacts model) to develop customized spending patterns for each technology

Analytical Approach

In this analysis, energy efficiency policies were associated with three kinds of spending changes: changes in spending on energy efficiency programs and measures, changes in expenditures within the utility system, and respending of changes in disposable income resulting from new earnings and bill savings. These are discussed in detail below.

Change in Spending on Energy Efficiency

For each state but Wisconsin, the reference case was associated with an increase in spending on electricity energy efficiency. In Wisconsin, the Policy Case assumes an increase in spending on energy efficiency programs. For Iowa only, the analysis for the Reference Case also considered an increase in spending on gas energy efficiency. Incremental energy efficiency spending, including both ratepayer-funded utility contributions and private participant contributions, spur increased direct labor activity (installation) and increased supply chain activity. Incremental investment in energy efficiency also results in an increase in utility operational/administrative activity (program overhead). Alternatively, reduced spending on energy efficiency will reduce these associated effects.

Change in Spending on the Utility System

Increased investment in energy efficiency reduces both energy consumption and peak demand, resulting in decreased utility-system spending. These reductions translate into foregone spending on energy, generation capacity, and T&D capacity. Alternatively, reduced spending on energy efficiency increases utility-system spending on energy, capacity, and T&D.

Change in Respending

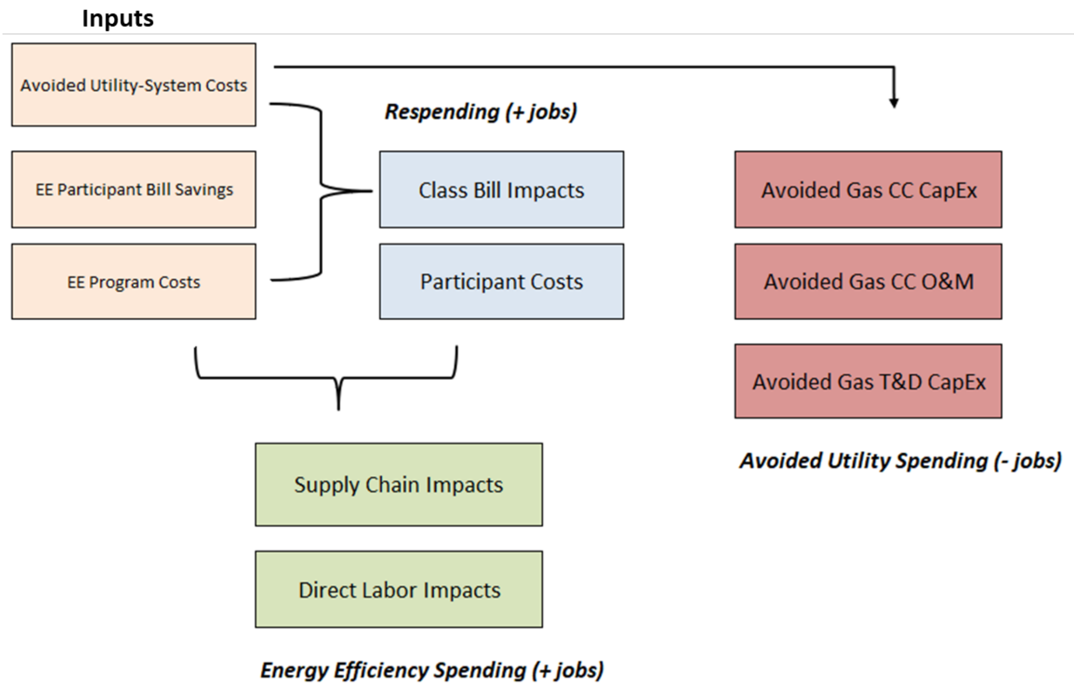
Changes in spending on energy efficiency may precipitate changes in consumption and investment spending in the broader economy. Note that for a given increase or decrease in energy efficiency spending, the respending effect may flow in either direction (positive or negative), depending on whether the net of the following two effects is positive or negative:

1. Changes in participant spending on energy efficiency.
2. Changes in aggregate utility bills resulting from changes in rates (due to changes in sales and ratepayer funding for energy efficiency programming) and changes in overall energy consumption.

For illustration, consider the case of Wisconsin, where total energy efficiency spending increases under the Policy Case. While participant spending on energy efficiency is expected to rise with total resource cost under the Policy Case (1), the aggregate utility bill effect was projected to decrease even more (2). The net result for Wisconsin is that the Policy Case is associated with an increase in respending.

The analytical approach discussed above is presented below in Figure 33.

Figure 33. Analytical approach to macroeconomic analysis of energy efficiency spending changes.



Source: Synapse Energy Economics.

Approach to Modeling Macroeconomic Impacts

To evaluate energy efficiency policy changes and their associated effects on the economy, Synapse developed "resource vectors" for input to IMPLAN. These vectors instruct IMPLAN on how to model the changes in spending on specific resources; they tell IMPLAN how money spent on each of these resources is dispersed out into the economy through each resource's supply chain. In turn, Synapse relied on IMPLAN's understanding of the general structure of the economy to determine the knock-on indirect and induced effects and the share of economic activity for a given spending change that leaks out of each state's economy.

Within IMPLAN, each of the myriad spending changes associated with a Policy Case is evaluated in isolation using a distinct vector.

IMPLAN is used principally to capture the indirect and induced effects. Estimation of direct impacts associated with installation of energy efficiency measures and construction and O&M of utility-system resources is mainly handled outside of IMPLAN.

The general approach to evaluating each spending change follows these steps:

1. The direct labor share is deducted from the total spending change.
2. The remaining value (non-direct labor share of spending change) expressed in millions of dollars is multiplied by the macroeconomic impact factors estimated by IMPLAN

through analysis of the resource vectors. This yields estimates of GDP, jobs, and income impacts associated with the given spending change. (Note that respending impacts are calculated differently.)

3. The direct labor share is divided by the average wage to yield an estimate of direct labor jobs (job-years).
4. The direct labor share is equivalent to direct labor income. No other calculations are required to determine that effect.
5. To calculate the induced impact associated with respending of direct labor wages, we rely on IMPLAN's estimate of labor wage respending impacts, which are calculated for all earners (both those on a payroll and proprietors) within a state's economy.
6. For utility system impacts—Gas CC Capex and O&M and T&D CapEx—the direct GDP impact is estimated based up the ratio of income to value-added in the given sectors, per IMPLAN's industrial data. For energy efficiency investment and respending impacts, the full scope of associated GDP effects is already captured through the IMPLAN analysis.

Below, we provide additional detail about how each spending change was analyzed.

Electricity Energy Efficiency

The electric energy efficiency resource vector used for all states in this analysis was developed mainly from the Xcel's Minnesota's 2018 Conservation Improvement Program budget.[69] This utility was selected for the quality of its detailed measure cost data and the reputation of this energy efficiency program per ACEEE's annual scorecard.[70] Below, we detail the specific steps involved in transforming budget data into IMPLAN inputs.

Step 1. Scale portfolio to TRC

The first step was to scale up Xcel's budget to reflect total resource spending. Based on our review of the ratio of total resource costs over program costs by energy efficiency program administrators in some Midwestern states (including Wisconsin and Illinois), we assumed that program costs equal half of total resource costs and scaled up all non-overhead costs (i.e., incentive values) accordingly.

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[69] Xcel Energy. *2018 Status Report & Associated Compliance Filings – Minnesota Electric and Natural Gas Conservation Improvement Program*. Docket No. E,G0002/CIP-16-115.

[70] See ACEEE Utility Energy Efficiency Scorecard. Page 12. https://www.aceee.org/sites/default/files/pdfs/u2004%20rev_0.pdf.

Step 2. Extract granular cost data from the portfolio

Xcel's budget includes measure-level cost data. We extracted utility incentive costs from the measure-level datasets. Such incentive costs typically includes both materials and labor.[71]

Step 3. Determine appropriate IMPLAN commodities

Energy efficiency portfolios typically contain a wide range of products and services (i.e., commodities). Key budget items include energy efficient lighting, energy efficient appliances, HVAC equipment, insulation, and building retrofitting, among many other things. We examined the commodities that currently exist within IMPLAN's suite of inputs and chose those that most closely matched the budget items observed in the energy efficiency portfolios.

Step 4. Allocate energy efficiency program spending to IMPLAN commodities

Next, we allocated the incentive costs from Xcel's budget to the selected IMPLAN commodities. In most cases, we allocated only the non-labor portion of spending (the fraction of incremental costs represented by equipment and/or materials) and addressed installation labor separately, as detailed in Step 5, below. While some measures could reasonably be associated with multiple different IMPLAN commodities, we placed measures in what we determined to be the most applicable commodity.

Program budgets also include non-incentive items. These are most typically items covering program administration functions. Where appropriate, these overhead items were assigned directly to IMPLAN commodities.

Step 5. Labor breakdowns by end-use

In most cases, IMPLAN commodities do not reflect installation labor, which are direct effects. As such, it is necessary to separately evaluate (outside of IMPLAN) the impacts for the share of end-use spending flowing to installers and other last-stage labor.

Installation of efficiency measures requires varied levels of labor. Some efficiency measures can be installed easily by the home or business owner (which means there are no associated direct labor jobs), while others require complicated installation procedures by skilled professionals (which imply some number of direct labor jobs created). We grouped the IMPLAN commodities into primary end-use categories to better estimate the percent of each commodity attributed to labor costs and the percent attributed to material costs.

We estimated the share of spending on each end-use category going to direct labor based on selected proxy items from each category. We selected these representative items based on their share of overall category spending and the tenability of finding labor spending information, as detailed in Table 90. We

[71] We use the incremental rather than total costs associated with efficient end-uses to account for the negative job impacts associated with foregone spending on inefficient end-uses.

developed these estimates based on a combination of literature review and our expert knowledge of energy efficiency measures.

Table 90. Overview of direct labor share methodology for end-use categories

End-Use Category	Notes	Labor Share
HVAC	Calculated from data on boilers, furnaces, water heaters, and heat pumps. Note that the heat pump labor factors were based upon water heaters employing heat pump technology, while the water heater labor factors were derived from non-heat pump water heating products. All data comes from a 2018 Navigant report.	25%
Products	This category includes efficient appliance measures. We assumed no incremental installation labor for this category.	0%
Envelope	Incremental installation labor associated with efficient envelope spending was estimated from data on the labor share of spending on blown cellulose attic insulation and residential air sealing, based respectively upon 2013 and 2011 Navigant reports.	50%
Efficient Components	The labor share for this category was determined based on an average of the incremental labor costs as a proportion of total incremental costs for five different sized Variable Frequency Drives, based on the same 2013 Navigant report.	28%
Lighting	We assumed no incremental installation labor for residential lighting. Though C&I lighting installations involve some incremental labor, they also have longer lifespans than less efficient alternatives.	6%
C&I Machinery	We estimated the percentage of incremental spending to labor for this category at 50 percent based on expert judgement an in the absence of any definitive industry standards. The majority of spending in this category goes to "retrocommissioning," a labor-intensive item.	50%
New Construction	We assumed no incremental installation labor for this category.	0%

Sources: Navigant. 2018. Water Heater, Boiler, and Furnace Cost Study (RES 19). Final Report. Prepared for: The Electric and Gas Program Administrators of Massachusetts – Part of the Residential Evaluation Program Area; Navigant. 2011. Incremental Cost Study Final Report. A Report on 12 Energy Efficiency Measure Incremental Costs in Six Northeastern and Mid-Atlantic Markets.

The direct labor percentages at the end-use category level (see Table 90) were applied to each of the items in Xcel's budget to create an appropriately weighted resource vector that reflected the share of materials (non-labor) spending going to each of the IMPLAN commodities. We also used the ratio of materials spending to total resource cost to derive a weighted-average labor share for the portfolio. This energy efficiency average labor share was then applied to input energy efficiency spending changes, as described above (see page B-27). Direct labor was estimated to be 13 percent of the total resource cost for electric energy efficiency.

Step 6. Rescale program spending to finalize vectors

Once program budget spending has been allocated to IMPLAN commodities, the resulting resource vector was rescaled so that total allocations on the vector equaled $1 million. This final step results in standardized factors for jobs, income, and GDP denominated in the same per-$1 million units across all utility programs evaluated.

<u>Gas Energy Efficiency</u>

The resource vector for gas energy efficiency was developed based on a review of the gas energy efficiency programs of three Iowa utilities: MidAmerican, Alliant, and Black Hills. Our gas energy efficiency job analysis first developed a gas energy efficiency resource vector based on a weighted average allocation of the materials (non-direct labor) portion of the total resource cost across all end uses for MidAmerican's programs that were evaluated. We then adjusted the vector based on the average ratio of the total resource cost over the program cost we modeled for all three utilities. This assessment determined that 33 percent of gas energy efficiency program total resource costs go to direct labor for the utilities.

<u>Utility-System Resources</u>

For every MWh of energy efficiency savings, a corresponding amount of generation is displaced, usually from conventional generating sources such as coal or natural gas power plants. When generation from these power plants is displaced, job losses may result due to reductions in operator time or upstream reductions in fossil fuel extraction.[72] As with MWh, for every MW of energy efficiency installed, a corresponding amount of future capacity is avoided. Since the construction of these future plants may have resulted in some level of future employment, avoiding or delaying their construction may result in job losses.

We have developed job factors for the following resources for modeling in IMPLAN:

- Natural gas combined cycle construction[73]
- Natural gas combined cycle O&M
- T&D construction

Note that we assume that energy savings from energy efficiency will displace only spending on fossil fuel generation resources and will not reduce spending on other generation resources (e.g., wind, solar, hydro, nuclear, or others).

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[72] Note that energy efficiency may also be associated with other avoided costs—and displaced jobs—associated with RPS compliance, T&D, reliability, and demand reduction induced price effects. Quantifying these factors is necessary for a truly comprehensive benefit-cost analysis or job impact analysis; however, because of their variability and regional specificity, they are not calculated here.

[73] This analysis assumes that the job impact factors associated with constructing a natural gas-fired combined cycle power plant and a natural gas-fired combustion turbine are not materially different.

To define the resource vectors for natural gas combined cycle unit construction and O&M and T&D construction, Synapse relied on spending data from the NREL JEDI model.[74] The JEDI model provides detailed, region- and resource-specific information on spending across a wide variety of categories, including mining, construction, fabricated metals, electrical equipment, and labor. Synapse translated these spending outputs from JEDI into coefficient vectors for different types of IMPLAN activities, including coal construction, natural gas construction, coal O&M, natural gas combined cycle operation, and natural gas combustion turbine operation.

While states may meet energy and generation capacity needs through procurement from out-of-state units, this macroeconomic analysis considered only impacts within each state. We used data from the EIA to estimate the shares of energy and generation capacity that each state would likely procure or install within individual states.[75]

We reviewed the avoided T&D investments for the Midwestern region as discussed in Section 0.0 and determined the share of induced or avoided T&D construction that similarly occurs or would have occurred out-of-state. We assumed that 80 percent of incremental T&D needs are situated in-state, and correspondingly, that 20 percent of T&D investment avoided by energy efficiency would otherwise have flowed out-of-state.

Respending

Rather than constructing new resource vectors, we use IMPLAN's in-built assumptions to calculate job-factors for these respending effects.

While respending and reinvestment changes resulting for rate and bill effects may be considered an induced impact of energy efficiency programming, these effects are modeled discretely as independent spending changes in IMPLAN. For the purposes of this analysis, they are reported as a separate "resource" (just like energy efficiency or natural gas construction) to allow for their easy inclusion—or removal—in other analysis as appropriate.

Macroeconomic Results

The macroeconomic results that are presented in this report represent the net effects of the spending changes under study. This approach means that results correspond to just the *incremental* gains or losses in jobs, income, and GDP in each Policy Case relative to the Reference Case.

[74] The National Renewable Energy Laboratory. "JEDI: Jobs & Economic Development Impact Models." Available at: https://www.nrel.gov/analysis/jedi/

[75] U.S. EIA. 2020. "Existing Nameplate and Net Summer Capacity by Energy Source, Producer Type and State, 1990-2019 (EIA-860)." Available at: https://www.eia.gov/electricity/data/state/.

Table 91. Macroeconomic Results for Wisconsin

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	-32	-289	-17	-34
Gas CC O&M	-122	-238	-15	-32
T&D Construction	-44	-368	-20	-42
Electricity Energy Efficiency	156	808	45	37
Residential Respending	30	212	11	19
C&I Respending	171	1400	81	131
Total	158	1526	85	79

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.

Table 92. Macroeconomic Results for Iowa (electricity energy efficiency)

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	34	297	16	31
Gas CC O&M	89	314	17	31
T&D Construction	25	203	10	20
Electricity Energy Efficiency	-80	-402	-21	-15
Residential Respending	-16	-105	-5	-9
C&I Respending	-58	-431	-24	-40
Total	-6	-124	-6	18

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.

Table 93. Macroeconomic Results for Iowa (gas energy efficiency)

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas Pipeline Construction	-53	-531	-27	-60
Gas Energy Efficiency	0	677	37	15
Residential Respending	20	128	6	11
C&I Respending	18	134	7	12
Total	-15	409	22	-22

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.

Table 94. Macroeconomic Results for Ohio

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	92	882	51	100
Gas CC O&M	325	1032	72	229
T&D Construction	149	1332	71	144
Electricity Energy Efficiency	-355	-2021	-115	-106
Residential Respending	-307	-2313	-118	-218
C&I Respending	-552	-4370	-262	-445
Total	-649	-5458	-300	-296

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.

Table 95. Macroeconomic Results for Indiana

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	20	180	10	20
Gas CC O&M	66	143	9	17
T&D Construction	15	126	7	13
Electricity Energy Efficiency	-46	-234	-13	-10
Residential Respending	-17	-123	-6	-11
C&I Respending	-47	-352	-21	-34
Total	-9	-260	-14	-4

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.

Table 96. Macroeconomic Results for Missouri

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	49	478	26	47
Gas CC O&M	89	312	18	32
T&D Construction	57	512	26	48
Electricity Energy Efficiency	-162	-952	-52	-42
Residential Respending	-46	-343	-17	-30
C&I Respending	-94	-789	-45	-71
Total	-107	-783	-43	-17

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.

Table 97. Macroeconomic Results for Illinois

	Change in Spending ($million)	Change in Jobs	Change in Income ($million)	Change in GDP ($million)
Gas CC Construction	16	134	9	18
Gas CC O&M	38	79	5	12
T&D Construction	8	63	4	8
Electricity Energy Efficiency	-35	-295	-18	-13
Residential Respending	0	0	0	0
C&I Respending	-29	-216	-15	-25
Total	-2	-235	-15	1

Note: Results presented above are aggregate over the full measure life period. All dollar figures are provided in 2021 dollars. Future year impacts have been converted to 2021 dollars but have not been discounted. Job results are provided in job-years.