Powering Success: The Holistic Impact of Comprehensive Program Support Helps Utilities and Customers Reach their Business Goals

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ABSTRACT

Commercial and industrial (C&I) non-energy impact (NEI) studies often focus on identifying and quantifying changes to business revenues and costs resulting from individual measures, rather than documenting those changes for cost-effectiveness testing and program marketing. However, failing to capture the cumulative effects of continual program participation or the interactive effects of multiple measures on business challenges may understate the true impacts of program engagement.

In practice, businesses do not operate on a program cycle or within a measure category. Rather, many organizations, such as controlled environment agriculture, manufacturing, or educational facilities, depend on interconnected systems that provide optimal environments for growing, processing, producing, and learning. Whether through providing more optimal alternatives to facility design during initial construction, on-going refinement, or major retrofit of entire processes, the combined effect of multiple energy-efficiency measures helps customers redesign systems that are more optimal for achieving their goals.

This paper presents findings from research with Consumers Energy and TRC based on how comprehensive projects can greatly improve facility designs, increasing operational efficiency and profitability of facilities overall. While this paper draws on in-depth interviews and case studies from specific sectors to characterize and quantify impacts, the methods discussed here can be applied more broadly to target other segments, as well as underserved populations. By acknowledging that factors beyond energy savings can more strongly influence behaviors, programs can connect with customers' different business priorities and production practices to influence decision-making while contributing to the improvement of energy and climate outcomes.

Introduction

C&I NEI studies have traditionally focused on quantifying separable impacts of individual measures, such as changes to operations and maintenance (O&M) costs, administrative costs, worker or equipment productivity resulting from lighting or HVAC upgrades (TecMarket Works 2007, Optimal Energy 2008, Tetra Tech 2012). While past C&I NEI studies made considerable progress in providing a more wholistic view of the value of energy efficiency (EE) programs, the focus on individual measures that result in distinct impacts overlooks the cumulative effects of continual program participation and the interactive impacts of multiple measures on businesses' operations (AEP Ohio 2016, MEEP 2021, MPA 2018, Tetra Tech 2018).

Many businesses operate within interconnected systems that EE measures can influence various aspects of their operations, from productivity and comfort to product quality and

customer satisfaction. By narrowly focusing on individual measures, past studies may overlook impacts that result from the combined effect of EE programs on businesses' overall performance and profitability.

Recognizing the importance of cumulative effects and interactive impacts is essential for accurately assessing the overall effectiveness of EE programs. Cumulative effects refer to the combined impact of multiple measures implemented over time, which can result in synergistic benefits that exceed the sum of their individual contributions. Similarly, interactive impacts consider how different measures interact with each other and with existing systems within a facility, potentially amplifying or mitigating their effects. By considering these factors, EE programs can better address businesses' evolving needs and challenges, maximizing the potential to deliver value to participants. Moreover, understanding cumulative and interactive impacts allows for more informed decision-making regarding program design, resource allocation, and strategic investments, ultimately leading to more effective and sustainable outcomes.

TRC's primary objective for this study was to investigate customer problems faced by participants in Consumers Energy's C&I EE programs. The present study incorporates both in-depth interviews and on-site visits to characterize the cumulative impacts of multiple program measures and past participation events on costs, productivity, and revenue. This paper is focused on a key finding from this study; the cumulative effects of repeated program participation and/or interactive effects of multiple measures installed through custom retrofits (or new construction) are considerably larger than the sum of individual impacts.

Consumers Energy, a Michigan utility, and TRC, a clean energy consulting firm (The Team) conducted this research to characterize actual (non-energy) business problems customers face, identify ways in which participation in Consumers Energy's C&I EE programs impact those problems, and where possible, to monetize those changes. While Consumers Energy's business programs are generally cost effective at the overall portfolio level based on energy savings alone, TRC used this study to identify and monetize impacts of EE program participation on customer's business problems for use in program design, outreach, and marketing. Consumers Energy will use this research to demonstrate the value proposition of program participation, increase customer satisfaction, and improve overall relationships with their business customers. This customer-centric approach aligns with Consumers Energy's broader commitment to improving service levels and developing solutions that effectively address customers' needs, ultimately leading to increased participation, depth of savings, and customer satisfaction.

Methodology

The Team's approach built on the accomplishments of previous C&I NEI studies by repurposing techniques for identifying, documenting, and separating impacts, but also considered interactive effects of a broader array of measures within comprehensive projects, as well as effects of continued program participation. Many of the EE measures implemented through Consumers Energy's initiatives involve large-scale custom or multi-measure projects that impact businesses' operations comprehensively. TRC designed this study to capture interactive impacts from the collection of measures installed on interconnected systems rather than trying to isolate distinct impacts from individual measures. Our approach assumes the combined impact of measures is not equal to the additive effect of individual measures. Rather the overall impact from these projects often had overall impacts that were themselves quite large and separate from the individual impacts. This holistic approach enabled a deeper understanding of how energy-efficient technologies interact within the larger context of a facility or operation, considering

factors beyond just O&M impacts. Our approach incorporated the following steps that enhanced respondent's ability to conceptualize changes to their facilities resulting from the installed measures:

1. **Sampled projects and customers whose participation included multiple measures**

To capture the cumulative effects of multiple measures or repeated participation the Team sampled projects that encompassed a mix of large-scale, custom projects, repeat participants, and prescriptive projects. This approach ensured a diverse representation of participants and assessed needs, allowing us to capture a comprehensive range of customer problems and challenges for key program segments.

2. **Incorporated industry specific differences into study design**

Recognizing that the range of measures installed, and moreover, resulting impacts were likely to vary considerably by industry, the Team separated respondents by industry, and constructed industry specific variations to interview guides that allowed business problems to vary by industry. The sample selection process targeted key sectors, including Manufacturing, Education, Agriculture, Indoor Agriculture, and Health. Within each sector, specific sub-segments were identified based on population analysis, consumption patterns, program participation, and previous non-energy impact studies. For example, the Manufacturing segment encompassed both discrete and process manufacturing, while the Education segment included elementary and secondary schools, colleges, and universities.

Understanding the diverse landscape of customer problems across different industry segments is essential for effective implementation of EE programs. Each sector presents unique challenges and priorities, shaping the way EE measures are perceived and utilized. For instance, hospitals place a premium on patient health, necessitating strict adherence to federal and state regulations governing indoor air quality. Here, well-functioning HVAC systems are not just convenience; they are vital for maintaining sterile environments in operating rooms, nurseries, and laboratories. Conversely, in manufacturing settings, concerns revolve around equipment efficiency and worker productivity. HVAC malfunctions can disrupt production lines, compromise product quality, and even pose safety hazards. Recognizing these distinctions, our research methodology considered the specific needs and challenges of each industry segment, ensuring a tailored approach to data collection and analysis. By adopting a comprehensive and tailored methodology, we aimed to provide valuable guidance for enhancing the effectiveness and reach of EE initiatives.

TRC conducted in-depth interviews with past program participants across five distinct customer segments, encompassing 40 unique measures installed across 173 instances through EE programs between 2019-2020. Each respondent was carefully selected, with consideration given to measures installed in up to two measure categories, resulting in 77 interviews. The distribution completed 70% of interviews with large business customers and 30% with small business customers. These interviews focused on issues such as worker and equipment productivity, changes in revenue and sales, reduced product loss, material costs, resource costs, and worker safety.

3. **Allowed respondents to express business problems in their own terms**

The Team asked respondents to characterize business problems that were top of mind to identify how customers think about their business and key challenges. We then framed the

impact questions in terms of those problems customers identified to put them in familiar terms that they value. This approach allowed for a more targeted and context-driven investigation into the NEIs of EE measures on customer problems.

4. **In-depth interview to capture both direct and indirect impacts**

The Team identified both direct impacts (i.e. equipment breakdowns identified as O&M cost savings) and indirect impacts (i.e. lower humidity leads to less ware, resulting in less frequent equipment failure and O&M cost savings) resulting from installed measures. When someone thinks of their HVAC system, it is unlikely they relate it to lower productivity or equipment failure. However, they do recognize that changes in ambient conditions (humidity and temperature) impact workers and equipment, as well as O&M costs and productivity. The Team's goal was to assist respondents in making these connections. To help respondents identify possible connections between the installed measures an actual business challenges, we allowed impacts to flow either directly from the installed measures, or indirectly from changes to the facility temperature, humidity, light quality, or noise that were directly linked to the installed measures.

5. **Combined interviews with on-site visits**

The Team recognized the fact that detailing the interactive effects of large custom projects or repeated participation on an overall process is an unrealistic feat for a telephone interview. Therefore, we used building scientists and engineers to conduct a series of on-site visits to document overall facility and process changes resulting from program engagement. The Team employed a high-level customer on-site visit protocol, drawing insights from preliminary findings of in-depth interviews, and leveraging lessons learned from prior NEI studies. This flexible protocol allowed researchers to tailor site visits to the unique characteristics of each customer and project, ensuring a comprehensive understanding of systems and business impacts. This interdisciplinary approach facilitated a nuanced exploration of systems and business impacts, providing a detailed picture of customer problems and impacts for case studies.

6. **Contrasted single measure, one-time participant impacts to multi-measure repeat participants**

The Team observed differences between one-time participants and repeat participants, as well as those who installed one measure versus multiple measures. Given those responses and assessments, we were able to discern how participation levels influenced outcomes. This comparative analysis provided valuable insights into the cumulative effects of EE measures, illustrating how the combined impact of multiple measures often exceeded the sum of individual impacts. This study emphasized the importance of expanding the understanding of program impacts beyond energy savings. By focusing on the broader impacts, such as improvements in operational efficiency, productivity gains, and environmental sustainability, we were able to capture a more holistic view of the effectiveness of EE initiatives, as well as assess the effectiveness of these programs in addressing customer needs and driving further actions.

Results: Comprehensive Program Support Impacts Facility Design

This section presents select findings from the Team's NEI research, specifically focusing on identifying and monetizing, not just individual changes, but cumulative changes, to non-energy business problems attributable to participation in C&I EE programs. Through an

examination of these findings, the section provides insights into the holistic impacts of EE programs on businesses' operations and profitability, highlighting the value proposition of supporting large comprehensive projects that address interconnected systems and diverse business challenges. These findings advance the understanding of how comprehensive program support can effectively drive the success of EE initiatives, enabling utilities and stakeholders to better serve their customers and achieve their business goals.

Process and Discrete Manufacturing

Process and discrete manufacturing customers prioritize continuous production, steady flow of materials, and timely delivery. While these problems are similar to discrete manufacturing, the examples show some key differences. Manufacturers rely on continuous production systems to ensure product quality, consistency, and timeliness. Process Manufacturing industries are focused on the continuous flow of materials from raw inputs to finished products requiring coordination, integration, and uninterrupted operation of equipment, personnel, and material availability. Many of the customer problems and EE solutions to those problems reflect challenges to ensuring the flow of resources to outputs is uninterrupted. Any disruption to this flow will result in revenue impacts (changes to product quality, volume, and timeliness of output), material costs, and labor productivity and availability. Many outputs from process manufacturing serve as inputs to other manufacturing, making timeliness and product quality critical to making sales and achieving the highest value/price for goods sold. The composition and quality of those products can be impacted by ambient conditions, material inputs, and time. These factors are dependent upon maintaining a highly efficient continuous flow systems requiring integration of equipment, material inputs, and labor.

NEI research typically involves modeling the various impacts of equipment upgrades to characterize their effects. For simpler projects, such as upgrading to variable speed-controlled equipment, where one-to-one impacts can be observed, this serves as a good starting point, as we will demonstrate using a variable speed drive (VSD) mold machine. However, similar to why a customer might pursue a custom project instead of just stacking together multiple prescriptive rebates, we will also explore how, for more comprehensive projects, the total NEI of a project can be greater than the sum of its parts as shown in Table 1. Next, we will discuss some of the effects we quantified during the upgrade to a VSD mold machine, contrasting this approach with a more holistic view of the interactive effects larger projects can bring.

Table 1 Additive and Interactive VSD Injection Mold Machine Impacts

	Additive Impacts	Amount	Interactive Impacts	Description
VSD Injection Mold Machine	Production speed increase	$504,000	Modern production facility instead of pole barn	Additional 20-year lifetime
	Downtime avoided	$327,600	Monitoring system	5-day schedule
	Maintenance avoided	$195,000	HVAC impacts on injection mold efficiency	Energy increased 30% less than expected

Additive Impacts Approach

Examining the direct impacts of upgrading an injection mold machine to a VSD model highlights valuable insights into solving key customer problems in the manufacturing sector, particularly in production and customer relationship management. Efficient equipment helps solve top customer problems around the need to maximize efficiency and reduce the impact of maintenance. New equipment not only improves production speed but also requires fewer repairs. Maintaining equipment productivity and efficiency is the key driver of revenue.

We heard from an injection mold manufacturer that, "We sell everything based on how many parts we can make an hour. That's how we quote them. If we don't meet our standard, we don't make money." By upgrading to a VSD injection mold machine, they were able to realize several production process benefits including a 6% increase in production efficiency, 156 hours of decreased machine downtime, and 13 fewer maintenance needs, resulting in over one million dollers of combined annual non energy benefits in terms of just productivity alone, as seen in Figure 1. Maintenance on continuous production lines is necessary but can be complicated. Key concerns included minimizing interruptions, as well as product quality and loss. When continuous flow is most important, manufacturers look for ways to do continual preventative maintenance. Also, for processes such as injection molding or pharmaceuticals, failure at any point can mean contamination or loss of all products in the system.

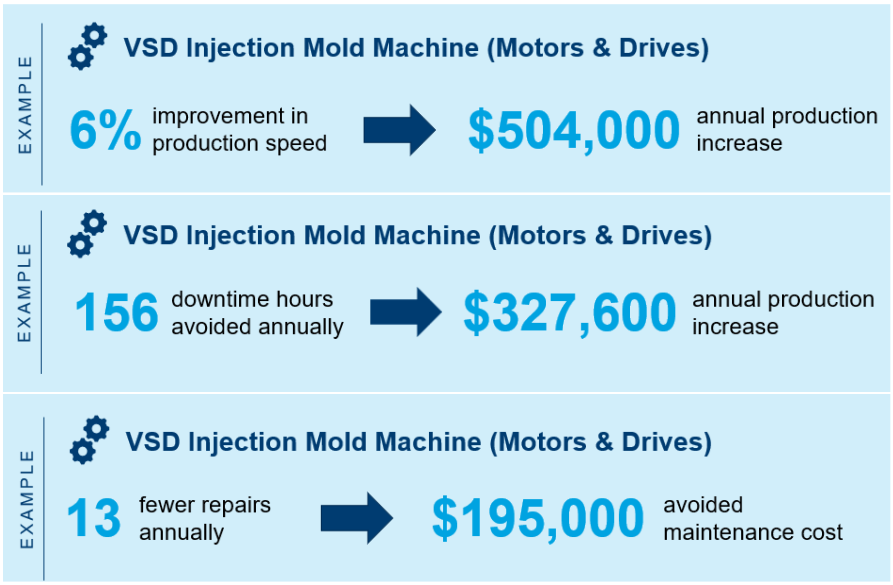

Figure 1 VSD Irrigation Non-Energy Impacts

By improving productivity of equipment, manufacturers can also better meet their customers' expectations. Programs can specifically highlight the ability to better meet customer expectations when improving productivity through this type of additive impact approach. New efficient equipment can reduce operational costs, boost sales growth, and improve competitiveness by bolstering timeliness and reliability.

Interactive Impact Approach

In addition to one piece of equipment having multiple effects, like the VSD injection mold machine discussed above, for some businesses, engaging with Consumers Energy on large

projects can have cumulative effects greater than the sum of the parts alone. We used customer site visits to dive deeper into cases where Consumers Energy helped support larger projects, to better understand the interactive effects of the upgrades. For one process manufacturer, a leading U.S. manufacturer of plastic barrier chain, we sent a building scientist and an engineer to dive deeper into the cumulative effects of engaging with Consumers Energy on the buildout of an extension to an existing manufacturing facility. The project included the following measures:

- Interior and exterior lighting
- Integrated variable speed controls on adiabatic cooler fan motors (x3)
- New high efficiency pumps (x4)
- 180-Metric Ton (x3) and 349-Metric Ton (x1) all electric VSD injection molding machines with monitoring system operating more than 4000 hours annually
- 32-Ton RTUs (x2)
- Split AC (heat pump)

Traditional NEI methods would attempt to quantify the one-to-one benefits from each of these pieces of equipment, summing them for a total impact. While there is merit in understanding the pieces of the systems, for larger projects and more complex systems, it is often the case that the cumulative effect is greater than the sum of the parts. For example, this plastics manufacturer indicated that partnership with Consumers Energy, among others, was critical in their decision to expand their production, "The state was able to give us a grant, Consumers gave us rebates for new facility and presses, we worked with community partners, and we also found some really good bank rates at the time. We were able to get all the pieces working together, and Consumers Energy was one of those partners." The manufacturer had been struggling with the decision of whether to add on another pole barn and avoid going into debt or to build a new modern production facility that would serve the company for 20 to 30 years.

While on site, our team learned about the biggest successes of the program for the customer; the new mold machine's monitoring system that enabled the manufacturer to reduce production times from 24 hours a day, 7 days a week to 24 hours a day, 5 days a week, for the same output. This win gave employees their weekends back while maintaining the same output. The manufacturer also expressed that engaging with the utility allowed financial reinvestment back into their operation, "We knew what the building was going to cost. Then we put in extras like the HVAC and the mold machine with monitoring. Those were extras that we did not have to do, but because of the Consumers Energy rebate money that was given back to us, we could put that back into the building." New equipment led to productivity gains with lower operating costs.

Additionally, we learned about the cumulative effects HVAC can have on injection mold machines. This new equipment, coupled with the maintenance of target temperatures, led to a 17% improvement in productivity metrics, measured by the average cycle time to produce 2.5 feet of plastic chain per year, resulting in potential savings of up to $600,000 annually. Even though they expanded their operations and installed HVAC systems, engaging with Consumers Energy exceeded their projections. Despite expecting their energy expenses to rise by 30-40% after doubling their size, they were pleasantly surprised to find only a 10% increase in their monthly bill. This outcome was unexpected given their concerns of facing an additional $20,000 in months bills, especially considering the added load of air conditioning. Even with the expanded production capacity and the introduction of HVAC systems, the increase in costs was far lower than they had anticipated.

For this manufacturer, engaging with Consumers Energy was vital in securing project financing. Their expansion's main challenge was the need for several million in funding, with the business providing half upfront and relying on bank loans for the remainder. However, a significant hurdle emerged when the bank offered only two thirds of the necessary funding. Yet, the manufacturer recognized the true value of the endeavor, acknowledging that an empty building in rural Michigan, held limited worth without the installed equipment. The manufacturer underscored that without utility support, this project would not have occurred, highlighting the importance of comprehensive engagement for both the customer and utility program success.

Agriculture and Indoor Agriculture

Overall, agriculture customers are concerned with bringing timely, safe, and quality products to market. This is similar to yet different from indoor agriculture customers, who are interested in growing better and more product, and achieving that from tighter environmental control. Due to their reliance on the artificial growing conditions they create, controlled environment agriculture (CEA) growers seem to be acutely aware of the interconnectedness of their systems and their business model.

Customer site visits provided a longer format to further explore the interconnectedness of the systems and the businesses. We visited indoor growers across the entire production spectrum from micro-scale craft indoor, large indoor, to a mixed production facility with outdoor, greenhouse and indoor all on one site. One customer site visit demonstrated the strengths of greenhouse and outdoor production as well as the application of techniques and equipment typically thought of as limited to indoor spaces applied to greenhouses and outdoor production as well. That farm responded to a pervasive market challenge: *how to scale a business in a rapidly changing market?* One way growers address that challenge is through more sophisticated fertigation strategies enabled by VSD pumps paired with building automation controls as shown in Table 2. Next, we will discuss some of the effects we quantified during the upgrade to VSD irrigation pumps, contrasting this approach with a more holistic view of the interactive effects projects can bring.

Table 2 Additive and Interactive VSD Irrigation Pump Impacts

	Additive Impacts	Amount	Interactive Impacts	Description
VSD Irrigation Pump	Production speed increase	$1,000,000	Rapidly pivot business model from indoor-only to incorporate greenhouse and outdoor production	Remain competitive through market compression
	Growing media reduction	$48,000		
	Runoff reduction	$547,500		
	Labor reduction	$47,450		

Additive Impacts Approach

Growers look to optimize plant growth cycles using efficient equipment. More sophisticated fertigation strategies enabled by VSD pumps combined with controls systems can

speed plant growth through a practice known as crop steering. In addition to manipulating environmental factors, crop steering often involves innovative irrigation techniques to optimize water usage and encourage root development. Growers reported that crop steering irrigation techniques could not be implemented with a constant speed pump, as shown in Figure 3.

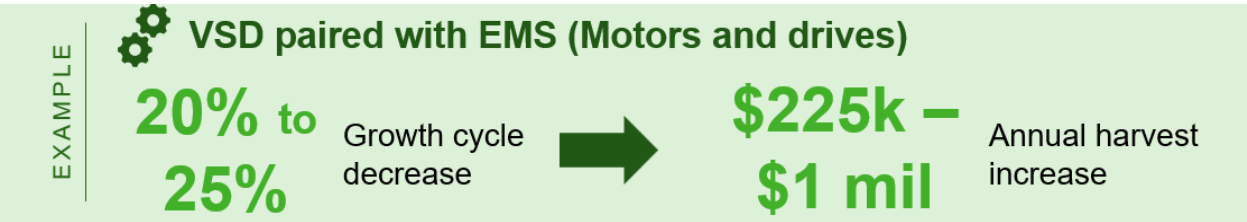

Figure 3 Yield impact of VSD paired with EMS

A variable speed pump allows for more flexible fertigation schedules. One grower characterized the impact of crop steering, "The growth speed is incredibly faster versus hand watering. The root system gets so much bigger and the plant grows so much faster." By asking follow-up questions like, how much more yield, how much quicker, how much labor was saved, how much nutrient runoff was avoided, and how much less growing media is capable of being used, our Team was able to construct a logic model to characterize those impacts, as shown in Figure 4. While these case studies did not aim to produce statistically significant NEI values, this factor was important to characterize the discrete impact of the VSD pumps.

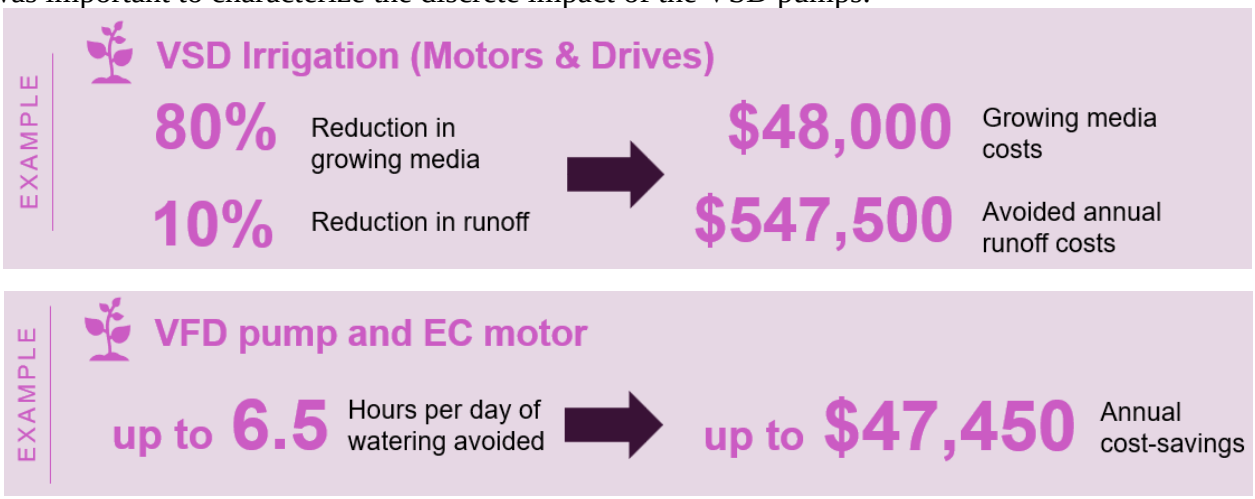

Figure 4 Operations and maintenance impacts of VFD and VSD irrigation

Interactive Impacts Approach

Since rushing to market with the intention of scaling production as soon as the first harvest cycle was completed, market demands shifted, prompting this emerging large-scale producer to restructure their business development plan based on reducing input costs while increasing production. Partnering with Consumers Energy helped them remain nimble and adapt their business development plan to rapidly changing market conditions. Their solution involved optimizing existing indoor grow rooms and applying that knowledge to scale the business around primarily outdoor and greenhouse production (instead of scaling up additional indoor spaces) through measures like HVAC, VSDs, dehumidification, lighting, and controls.

These measures not only resulted in substantial energy savings and nearly $150,000 in incentive dollars but also helped the company capture a $500/lb. price increase, a 25% yield increase, and sizable reductions in O&M costs. However, from a macro perspective, the ability to remain agile in a rapidly evolving market saved this business from going under, unlike many other producers during the compression phase of this boom-and-bust cycle.

The compression phase saw many indoor agriculture producers struggle with fluctuating market demands and rapidly changing economic conditions. Businesses that could not adapt quickly faced significant challenges, leading to closures and financial losses. The case of our partner business illustrates how leveraging energy efficiency measures can provide a crucial competitive edge. By focusing on flexibility and resilience, the business could pivot its operations efficiently, addressing market shifts without incurring prohibitive costs.

This adaptability was key in several ways. First, optimizing their existing indoor grow rooms allowed the business to maximize output without the need for immediate, costly expansions. Second, by integrating HVAC, VSDs, dehumidification, lighting, and control systems, the business improved its environmental control, leading to higher yields and better product quality. These improvements translated into direct financial benefits and enhanced the overall sustainability and competitiveness of their operations.

Moreover, the ability to switch focus from expanding indoor spaces to incorporating greenhouse and outdoor production demonstrated strategic foresight. This diversification reduced dependency on a single growing method, spreading risk and opening up new market opportunities. In essence, it allowed the business to adapt its production strategy dynamically, responding to both external market pressures and internal efficiency goals.

This holistic approach, considering both additive and interactive impacts, underscores the importance of a comprehensive strategy in business sustainability. Energy efficiency measures, when implemented thoughtfully, do more than reduce costs; they can transform business operations, ensuring long-term viability in unpredictable markets. In sum, the partnership with Consumers Energy exemplifies how targeted energy efficiency improvements can drive business agility. This case highlights the critical role of energy efficiency in not just cost savings but in enabling businesses to thrive amid economic volatility. By understanding and leveraging interactive impacts, businesses can better navigate market challenges, ensuring resilience and sustained growth.

Implications for Program Design

As utility programs evolve to meet the changing needs of customers and communities, it becomes increasingly important to consider the broader implications of program design and messaging. In this section, we explore key insights and recommendations derived from our research, focusing on three critical areas: expanding the understanding of program impacts beyond energy savings, connecting with business values and social identities, as well as influencing decision-making for improved energy and climate outcomes. Utility programs play a pivotal role in promoting energy efficiency and sustainability initiatives, but their effectiveness hinges on the ability to communicate and deliver value to diverse customer segments. By expanding the scope of program impacts beyond energy savings, utilities can better articulate the multifaceted benefits of participation, fostering greater engagement and buy-in from customers. Moreover, tailoring program messaging to resonate with business values and production practices enables utilities to connect with underserved populations more effectively, addressing their unique challenges and priorities. Finally, by emphasizing the broader influence of EE

initiatives on decision-making and climate outcomes, utilities can drive positive change at both the individual and community levels.

Analogous to the concept of re-engineering a system with multiple measures, our methodology prioritizes understanding the collective impact of interventions rather than focusing solely on their isolated effects. By taking this systems approach, we gain insights into how EE measures interact and amplify each other's benefits, leading to enhanced outcomes for customers and business communities. Ultimately, our findings underscore the importance of assessing program impacts from a holistic viewpoint, enabling utilities to leverage the combined effect of diverse measures to drive increased participation and deliver greater value to their customers. A limitation for program attribution to consider is how far can these interactive effects be claimed? At this level, program attribution may not apply. This research was completed for marketing purposes. To apply these finding to program attribution, we would need to do further research to improve the statistical validity of impacts.

Tailoring program messaging to connect with business values, and production practices is essential for targeting populations effectively. By understanding the unique challenges and priorities of these sectors, utilities can develop targeted marketing collateral that resonates with their needs and aspirations. Manufacturers' values often revolve around the ethos of innovation, efficiency, and productivity. By highlighting how EE measures contribute to these core values, utilities can effectively engage with manufacturing customers. For instance, showcasing case studies of successful EE projects in manufacturing facilities that have led to improved production processes, reduced downtime, and increased competitiveness can appeal to manufacturers' desire for innovation and operational excellence. Moreover, understanding the production practices specific to different manufacturing subsectors allows utilities to tailor their messaging accordingly. By highlighting the alignment between EE measures and the goals of businesses, utilities can craft messaging that speaks directly to the priorities and concerns of target populations, ultimately increasing engagement and participation in EE programs.

Conclusion

We explored the multifaceted impacts of EE initiatives across various sectors, including manufacturing, education, and agriculture. Through comprehensive research methods, we characterized customer problems and evaluated the changes observed after the implementation of energy-saving measures. Our findings underscored the importance of understanding the broader implications of EE initiatives beyond mere energy savings. By adopting a holistic perspective and incorporating a systems-thinking approach, we were able to uncover interconnected impacts that contribute to enhanced productivity, operational efficiency, and environmental sustainability.

The insights gleaned from this study have significant implications for the future of C&I NEI studies. Moving forward, it is essential for researchers and program designers to expand their understanding of program impacts beyond energy savings. By incorporating broader metrics such as operational efficiency, productivity gains, and environmental sustainability, future NEI studies can provide a more comprehensive assessment of the effectiveness of EE initiatives. Additionally, there is a need to adopt a more holistic approach that considers the cumulative effects of multiple measures over time, rather than focusing solely on individual interventions.

We know these impacts occur, but as an industry, we have not reached a consensus on how to consistently treat them. Establishing standardized methodologies for quantifying and

integrating these impacts into program evaluations will be crucial. Furthermore, there is an implicit need to address the potential for reducing or even eliminating incentives if these impacts prove substantial. Similar to some strategic energy management programs, where technical assistance and energy savings are sufficient, programs could focus on teaching businesses to optimize their production practices through the use of installed equipment. Efficient equipment can impact a lot more than just energy savings; it can optimize production processes and working conditions. Utilities have the opportunity to shift from being merely incentive providers to becoming true business partners, offering engineering expertise to help customers achieve broader operational efficiencies.

As we look to the future, it is imperative for program designers and policymakers to adopt a holistic approach to EE initiatives. This includes leveraging sector-specific insights to tailor outreach efforts and messaging strategies that resonate with the unique needs and priorities of diverse customer segments. By emphasizing the broader benefits of EE measures, such as improved productivity, enhanced comfort, and reduced environmental impact, utilities can foster greater engagement and participation in their programs. Moreover, policymakers play a crucial role in incentivizing holistic approaches to EE through supportive policies and regulations that encourage investment in comprehensive solutions.

By embracing a holistic perspective, considering the effects of multiple measures over time, and expanding the scope of NEI studies to encompass a broader range of impacts, we can unlock new opportunities for enhancing energy efficiency, sustainability, and resilience across commercial and industrial sectors. Through collaborative efforts and strategic interventions, we can drive meaningful change and create a more sustainable energy future for generations to come.

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