Through the Funnel: Evaluating Innovation[1]

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ABSTRACT

Technology advancement and adoption critically address burgeoning energy demands and decarbonization mandates. As market potential for well-established energy-efficient technologies declines, advanced technologies must fill resulting program gaps. Innovation and Research (I&R) programs support early-stage products through the innovation funnel, enabling more to reach and transform markets. However, few funded early-stage products reach the market, and diffusion is hard to track as iterative designs address changing market needs.

New York State has supported product development for decades, addressing strategic energy needs in renewable energy/storage, grid modernization, transportation, and buildings. DNV conducted this pioneering evaluation of I&R investments on behalf of the New York State Energy Research and Development Authority (NYSERDA) to track how investments progress through different stages of success and overcome associated barriers. It provides a framework for assessing energy and non-energy impacts of products that meet the commercialization end goal. We combined long-term sales data, developer interviews, and limited end-user feedback to show how impacts grow with adoption.

The study reviewed 166 projects funded with over $100 million (2016–2020), resulting in 38 commercialized products with reported sales. Eighteen selected products with high estimated market disruption potential yielded gross consumer benefits of 9.2 times the direct investment and 61% of the total programmatic investment. This resulted in annual savings of 1.36 TBtu, a reduction in GHGs of 165,462 MTCO2e, and non-energy benefits for health, safety, productivity, and reduced waste. This analysis confirms the value of long-term I&R investments and provides a model for evaluations of similar programs.

[1] Any opinions expressed, explicitly or implicitly, are those of the authors and do not necessarily represent those of the New York State Energy Research and Development Authority.

Introduction

The U.S. electric grid was built for steady demand, not the rapid growth it faces today. Following two decades of minimal load growth, the commercial & industrial (C&I) sector is now expected to experience an annual rise of at least 2% (U.S. EIA, 2025), driven by data centers, industrial processing, and building electrification. Meanwhile, renewable generation and transportation electrification create complex transmission and distribution challenges. While demand surges, well-established energy efficiency measures such as lighting upgrades have already reached market saturation. Utilities and states must now look beyond familiar tools to manage load growth, meet decarbonization and savings targets, and maintain grid reliability.

To address these challenges, utilities and state research organizations fund Innovation and Research (I&R) programs to support emerging technologies through product development, enabling them to transform markets. I&R programs provide critical assistance to early-stage product development, supporting products as they progress through the innovation funnel to achieve market adoption. However, only a small percentage of funded early-stage products can be expected to achieve commercial success. Additionally, tracking market diffusion of early-stage products is more challenging than market-ready technologies, since initial designs are often replaced by iterative and sometimes very different technology solutions, sometimes based on market response and feedback to earlier stage products.

I&R programs make substantial investments in clean energy, on the scale of $100 million to $400 million annually per funding organization. Program administrators want to make informed investments that target products of highest potential impact per the energy, economic, or decarbonization goals of the jurisdiction. To remain relevant to the market, program administrators also need to predict the market needs and invest in product development that best addresses those needs.

Evaluation of I&R programs helps justify program investments by accurately estimating impacts and market potential of supported products over time. If an evaluation is conducted early enough and impact or market indicators assessed over time, it may also provide insights into future investment decisions, highlighting opportunities to better target investments that achieve the desired outcomes and respond to evolving market needs. Ultimately, evaluation strengthens and reinforces longitudinal data collection, deepening our understanding of program effectiveness. However, evaluation of product development poses unique challenges due to the time required for market traction, the need to pivot products to meet new market demands, and the diversity of supported technologies.

This paper confirms the value of long-term I&R investments over time and addresses these unique challenges through an assessment of the indirect impacts[2] of products funded through their development by the New York State Research and Development Authority (NYSERDA). The study provides a model for evaluations of similar programs, including a review of product impact and market potential, funded products' trajectories through the innovation funnel, and unit indirect impacts for products that have reached the market such that those impacts can grow over time.

Study background

In 2021, NYSERDA commissioned an impact evaluation to assess Innovation and Research product development projects from multiple technical areas for a sample of 166 products developed through multiple funding opportunities, with completion dates between Q1 2016 and Q4 2020.[3]

[3] This evaluation included funding portfolios such as System Benefits Charge (SBC), System Benefits Charge – Technology and Market Development (SBC4), Clean Air Interstate Rule (CAIR), Clean Energy Fund (CEF) and New York State Statutory Research and Development Funds (NYRD).

NYSERDA's I&R portfolio aims to advance the development of innovative, reliable, affordable, efficient, clean energy technologies and to increase their market acceptance and adoption. Within this portfolio, product development projects aim to support the development of commercially viable products, primarily generating benefits through the sale and use of the products, and sometimes through affecting transformative changes in markets resulting from the introduction of disruptive technologies. This focus aligns with NYSERDA's Indirect Benefits Framework, which recognizes that innovation and research investments often catalyze broader market transformation and long-term benefits. Indirect impacts refer to the energy, economic and other impacts achieved with the help of NYSERDA's support of early-stage product development, rather than from direct installation or deployment through resource acquisition programs.

This study is the first of its kind by NYSERDA, as it seeks to assess the energy and non-energy impacts of NYSERDA's support to project partners in overcoming barriers to the development of early-stage products. An early-stage product, as defined, is a service, software, or hardware device that has not yet undergone a demonstration and is not yet widely adopted in its market.

Evaluated projects were selected through at least 40 distinct solicitations. The projects are categorized into the following technical focus areas, specific to the technological progress they promote. Technical focus areas were established over time in support of New York State's climate equity and decarbonization goals.

- **Building Innovations** (NYSERDA 2025) supports the development of new technologies to reduce building emissions and energy consumption, aiming to decarbonize New York's building stock. The variety of funded technologies include energy management, lighting innovation, advanced HVAC systems, and building shell upgrades.
- **Clean Transportation Innovation** (NYSERDA 2025) enhances public transit, promotes zero-emission vehicles, and advances smart mobility to increase the adoption of electric vehicles and low-carbon transportation options.
- **Grid Modernization** (NYSERDA 2025) invests in high-performing grid, future-proofing the grid, grid flexibility, and the grid resilience needed to achieve New York State's Climate Act goals for a 70% renewable grid in 2030 and a GHG-free electric grid in 2040.
- **Renewables Optimization** (NYSERDA 2025) aims to achieve at least six gigawatts of energy storage by 2030 through the development of hydrogen, electrical, mechanical, chemical, and thermal-electric storage technologies and products.

Methodology

The overall approach to evaluating the impact of NYSERDA's product development projects is summarized in Table 1. Each product set in successive rows includes prior row selection criteria.

Table 1. Evaluation scope and data collection methods applied to product subsets

Activity	Product set	N	Scope of study	Data sources
Products population summary	All	161	Characterize projects and products, funding, timing, and responses to prior NYSERDA data collection	Project data Metrics survey NYSERDA project manager interviews
Process improvement	Developer survey respondents	109	Assess overall rates of commercialization, satisfaction, barriers, catalysts, and opportunities	Developer survey

Activity	Product set	N	Scope of study	Data sources
Market characterization	Subset with disruptive or high-impact potential	57	Characterize markets and the disruptive potential of products that already exist or are expected to create, scale, or disrupt a market	Developer survey, NYSERDA project manager interviews
Impact evaluation	Subset with sales	18	Estimate energy savings/generation, economic, and non-energy impacts through verification data and/or customer interviews	Developer In-Depth Interviews
Case studies	Subset with customer interviews or verification data	3	Detailed success stories, indirect impacts, and market characterization	Customer interviews/ Verification data

Data collection methods

- **File review** – NYSERDA maintained project data and documentation used to characterize the evaluated program population of 161 products through 166 defined development projects. DNV reviewed all available project files and other artifacts, creating data capture forms to inventory project descriptions, statements of work, progress reports, and final reports. These documents, where available, contained information on the nature of products and sometimes included intended benefits. NYSERDA provided sales information collected from developers through a twice-annual NYSERDA-administered Metrics Survey. For projects with sales, evaluators conducted secondary data collection through developer websites, evidence of product marketing, and other publicly available literature, including prior NYSERDA case studies.
- DNV conducted a one-time 25-minute online **survey of product developer firms** that received investment from NYSERDA. A total of 109 developers of the 161 projects (66%) completed surveys to provide estimates of energy, economic, and non-energy impacts, product commercialization status, feedback on satisfaction with the NYSERDA partnership, and other questions to gain insight into the experiences and barriers faced by developers of clean energy innovations.
- **Interviews with NYSERDA project managers** supplemented project files and other secondary data to identify products with known disruptive technological and/or high energy impact potential.[4] Collected data was used to rank projects according to their disruptive and impact potential.
- A subset of 18 developer survey respondents reported product sales for products and were identified by NYSERDA project managers as having high impact and disruptive potential. This subset was further evaluated to assess and characterize the energy, non-energy, and economic benefits achieved. The team **solicited purchaser lists** and requested **in-depth interviews with developers** for this subset of projects. In preparation for data collection, the team developed indirect impact evaluation method memos for each product, estimated quantitative and qualitative impacts where possible, and established a detailed understanding of the product development lifecycle and ultimate status of the product.

The data collection plan evolved to overcome gaps in project documentation and obstacles in data collection, enabling the complete story of product evolution and the impacts of funding to be told. In most cases, validated energy savings and cost data from end users or other third-party sources were not available as inputs to this study.

[4] Disruptive potential refers to a product's ability to create, scale, or disrupt a market and transform the existing market.

Impact estimation methods

DNV worked with NYSERDA staff to identify the companies for which to conduct detailed market and impact characterizations. NYSERDA staff identified companies from the set of 18 that had sales and/or were deemed to have disruptive potential. Disruptive potential was identified through the initial developer survey conducted in 2022 and through interviews with NYSERDA project managers.

A wide variety of products and markets were supported by I&R funding. The commercialized products evaluated in this study span a wide range of clean energy innovations across three main areas: advanced building technologies (like OLED lighting and mycelium-based insulation), clean transportation solutions (such as wireless EV charging and work zone safety systems), and energy storage and renewable optimization (including zinc hybrid battery systems and manufacturing process reformation). These products vary in scale from single-unit pilots to mass-market deployments. The team determined that separate market characterization strategies and indirect impact estimation methodologies were required for each product. This necessitated the **development of custom interview guides for each product**. The team developed indirect impact memoranda to document the expected qualitative and quantitative impacts of the 18 products selected for impact estimation. The memoranda included calculation methods for quantitative impacts, outlining known and unknown parameters for those calculations, and listing potential sources for those parameters.

DNV also **developed market potential memoranda** to characterize the market and estimate the potential benefits for each product, which was expected to have high disruptive potential. When drafting the strategy memoranda, the team conducted secondary research to assess what publicly available data could be used to characterize each relevant market and identify knowledge gaps that developers and end-users could fill in follow-up interviews. The strategy memoranda also identified which barriers from the 2022 Clean Energy Fund Compiled Investment Plans were addressed by NYSERDA's support for the relevant product.

DNV conducted detailed follow-up technical interviews with developers of 11 of these 18 products. The developer interviews identified products that had since been abandoned by the developer and companies that had gone out of business. The interviews also identified which products had informed the development of other products that were still being commercialized or pursued by the companies. Finally, the interviews discussed the practical and technical limits to product market applicability.

During interviews, DNV asked developers to provide contact information for **end-user interviews**. Very few developers were able or willing to provide end-use contacts. Some products had not yet been commercialized, others had non-disclosure agreements associated with their use, and others had developers with no visibility to the end-user. The team was able to talk to end-users of two products and was provided with an independent verification analysis for a third product.

The impact estimates DNV developed were based on the best available data, including publicly available third-party studies, responses from developers during in-depth interviews, and documents provided by developers after the interviews. As such, some of the key parameters used for estimating energy and economic benefits were drawn from developer companies themselves rather than from third-party sources.

Results

The results of this evaluation demonstrate that I&R program investments pay off through the significant achievements of a relatively small number of products that make their way through the development funnel to achieve commercialization. A significant challenge remains for administrators to select from possible investments such that they capture and support opportunities most likely to reach and transform the market, and to make marked impacts once they do. This evaluation both illustrates and

quantifies these achievements, providing longitudinal data for more informed strategic direction in future funding decisions.

The presented results first summarize the characteristics of the full project population and then review the status of product development progress for products whose developers shared this information. Next, the results detail the energy, non-energy, and economic impacts for a set of products selected for their high impact and/or potential for market disruption. Finally, the section summarizes feedback from product developer partners relating to process feedback and barriers to development.

Product population summary

DNV investigated NYSERDA investments and sales as an indicator of commercialization, for which data was available for all projects in the population. Of the $109 million invested in this population of projects, 13% of total NYSERDA funds resulted in sales. Sales as a measure of commercialization were reported for 23% of the 166 projects. Figure 1 illustrates the proportion of projects in each technical focus area that contributes to the 166 projects executed, and within those groups, the proportion that resulted in sales.

However, sales are not the only or even the best indicator of product development progress, since the theory of change is different between products. Different pathways to commercial and technology readiness are appropriate for different products to overcome their specific barriers, and progress along these paths often takes time. Further, some I&R projects have indirect impacts through increasing awareness of novel technologies among participants and other stakeholder groups. Increased awareness may ultimately lead to additional engagements with NYSERDA or product replications by the same or additional organizations.

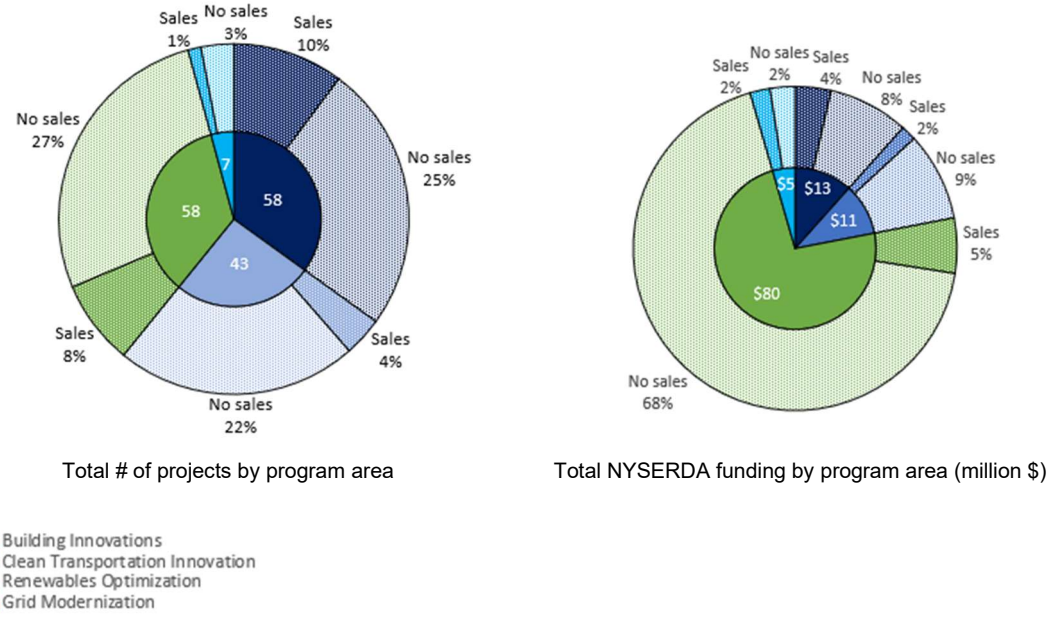

Figure 1. Proportion of projects by technical focus area with and without sales

Product pathways analysis through developer self-reports of product status

To represent the development pathways of the products in the evaluated population, the developer survey confirmed sales reported in the metrics survey, and categorized product development status as completed, ongoing, or abandoned. For products with completed or ongoing development, the survey

then asked whether developers planned to commercialize. Figure 2 illustrates the development outcomes and ongoing efforts by developer companies toward commercializing products for 109 respondents. Nearly half (48%) of products' development was completed (53 products). Another 30 products (28%) were abandoned, while another 24% continued to be developed (26 products). Within the set of products that have completed development, 35 product developers confirmed sales previously reported in the NYSERDA metrics survey, and eight products still had plans to commercialize.

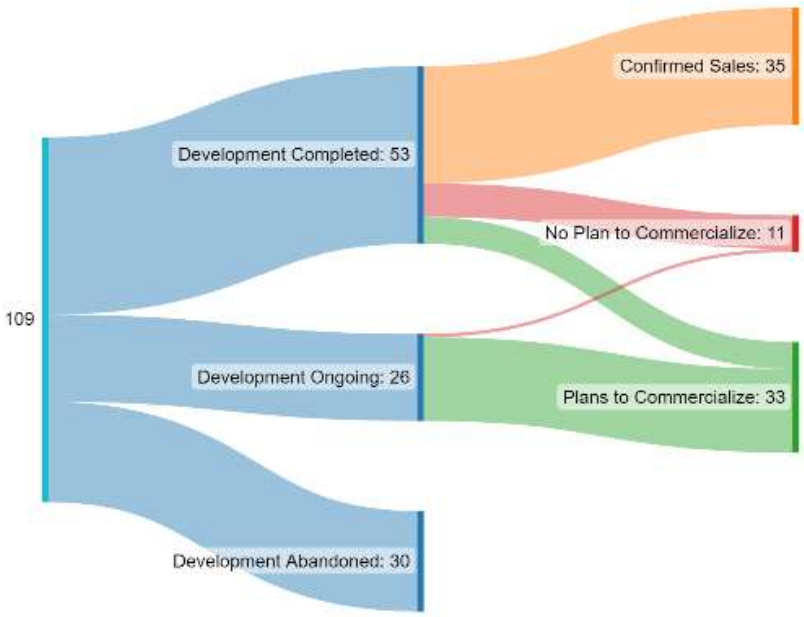

Figure 2. Product development status for all products with developer survey responses (n=109)

Estimated indirect impacts for high impact and disruptive potential products

The evaluation assessed indirect impacts of I&R funding to market disruption potential, energy, economic, and non-energy/non-economic impacts for a selection of 18 products that reported sales (through the metrics and developer surveys) and were also noted as having high disruptive potential and high impact potential in NYSERDA project manager interviews. Product development and commercialization take time, and several of these products were still in development or testing at the time of evaluation. As such, the estimated impacts herein are considered the lower bound of impacts for the 18 products, given that more products are expected to complete development and reach the market, which will affect the market. This storyline of product development, demonstration, and commercialization is depicted in Figure 3. Of the 18 products

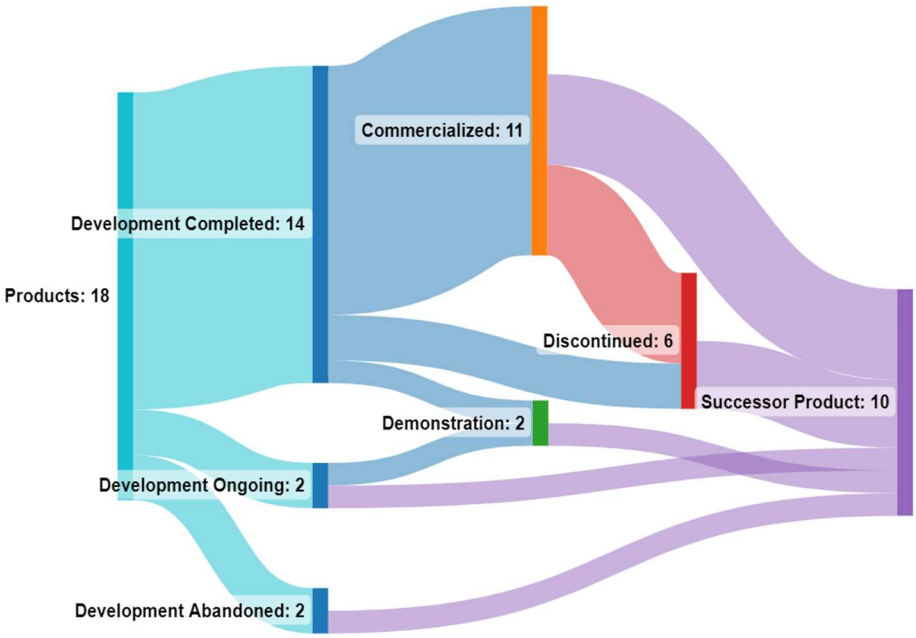

Figure 3. High impact and distruptive potential ptodcut development status

shown at the start of the flow, 10 ultimately resulted in one or more successor (next generation) products that are either in development or commercialized themselves but not included in program impacts inventories. For instance, a wireless EV charger prototype led to the development of more advanced wireless charging systems for EVs serving a broader use case. A mycelium-based material initially developed for insulation was found to be more cost effective in packaging, textiles, and other applications.

While not readily apparent from the figure, seven products (representing 15% of the cumulative sales data presented in this impact evaluation) whose development was incentivized by NYSERDA continued to be sold to the NY market; thus, indirect impacts will grow and continue to benefit the market.

Estimated indirect energy impacts

From the 11 commercialized products, energy savings resulted from eight products. Seven products resulted in electric savings, and two products resulted in fuel savings (one with both electric and fuel savings). The total annual energy savings for commercialized products within the selected product set is estimated to be 1.36 TBtu, based on sales through 2021. This energy savings translates to 165,462 MTCO2e of greenhouse gas reduction. Further, this 1.36 TMBtu/year in indirect energy impacts translates to electric savings of 289,710 MWh/year inventoried across seven products and 373,211 MMBtu/year from two projects that saved transportation fuel (gasoline and diesel). This transportation result primarily stems from a work zone safety project that prevented numerous automobile accidents, thereby reducing fuel consumption during idle time on a high-traffic interstate. Within NYS, the total electric savings are estimated to be 77,484 MMBtu/year, resulting 9,927 MTCO2e in greenhouse gas emissions reduction.

Non-energy impacts

The instances of non-energy impacts demonstrated by products in the selected set are shown qualitatively in Figure 4. Impacts were inventoried quantitatively in many cases on a product level by more refined impact categories. Productivity and health/safety impacts occurred most frequently among the selected product set. The productivity improvements include reduction in radar interference (for aircraft that must navigate over or around wind turbines), increased generator drivetrain efficiency, more versatile applications of commercial lighting technology, better optimized energy storage integration and electricity delivery, building load control and curtailment, improved EV charging user experience and adoption, avoided material defects, and high purity hydrogen generation. Health and safety impacts include improved safety, reduced hazards, enhanced air traffic safety, improved health outcomes, and fewer accidents. The mechanisms for these improvements vary, including improved lighting, reduced contamination by hazardous or infectious materials, prevention of vandalism and theft, and tools or information that enhance end-users' capability to navigate around hazards. The five products with waste reduction bridged material savings in plastics, ceramic material, e-waste, and grid-scale energy storage batteries (through both recyclable replacement technology and longer lifespans). One product aims to replace an estimated 900,000 metric tons per year of plastic packaging with compostable material.

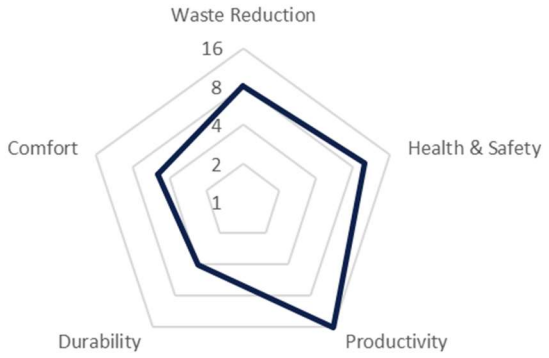

Figure 4. Overall instances of qualitative impacts by category for evaluated products (n=18)

Economic impacts

The evaluation conducted a cost-benefit analysis using information obtained through a desk review of project files and interviews with developer companies, but in most cases, validated cost data

from end users or other third-party sources were not available. As such, the benefits of this evaluation should not be used to represent a validated ROI for NYSERDA (ratepayers) or developers.

The economic impact as of the end of 2022 for commercialized products is estimated by the ratio of modeled end-user benefits to the total investment made by NYSERDA. Eighteen successful products are estimated to have returned a minimum of $66.5 million in economic impacts from a $7.23 million NYSERDA investment. Thus, gross consumer benefits are estimated to be at least 9.2 times the NYSERDA investment for the subset of products. Estimated economic benefits to end-users are limited to fuel/electric bill savings, O&M costs, avoided replacements, construction, and accident avoidance. Some of these products achieved additional benefits to consumers that we could not quantify. For instance, the developer survey responses indicated that many companies benefited from job increases due to NYSERDA funding, but this cumulative effect could not be reliably quantified. Some of the more disruptive products achieved benefits to producers through larger-scale changes in supply and demand. Furthermore, some have had an impact on secondary or related markets outside the direct product market where they have achieved additional benefits. The investment value is limited to NYSERDA funding; other funding sources, including company investments and end-user investments in the product, are not included.

The full evaluated population of products received $109.2 million in NYSERDA investment. Estimated consumer benefits for the subset of products result in 61% of the total NYSERDA investment for the full population of projects. This estimate represents a *lower bound* of the impact of the population of products' commercialization, because more products have sales than those investigated in detail, products in this pool will continue to have sales, and more products will be commercialized in the evaluated population. The full economic impact cannot be estimated without knowledge of these additional factors. A breakout of monetized and qualitative economic benefits is shown in Table 2.

Table 2. Total annual economic impacts per impact category (n=18)

Economic impact categories	Economic impact for end-users ($1,000/yr)	Additional qualified impacts (Instances)
Avoided energy bill cost	$59,083	0
Reduction in the levelized cost of energy	$0	2
Avoided replacement cost	$2,996	1
Reduced O&M cost/opex cost	$55	1
Reduced capex cost	$223	0
Reduction in product cost/system cost	$6	1
Avoided manufacturing cost (including labor)	$0	2
Avoided electric utility infrastructure cost/construction cost	$4,101	1
Total	$66,465	8

Challenges and recommendations

Evaluation of product development is unique for several reasons. Some of these challenges were overcome through the evaluation process, while others point to future potential improvements to the evaluation's assessed metrics, data collection process, and the time of evaluation relative to funding.

1. **Time to market:** It takes time for new products to gain traction in their markets and result in measurable impacts. Some products in the evaluation period may already have been adopted by the market and gained full commercialization reflected through sales – these products may continue through market adoption after the evaluation period. Other products are still in development and

expect future commercialization – the impacts of those products are prospective and cannot be verified.

Recommendation: The study team recommends early impact and market potential estimates from applicant product developers, reviewed for quality by evaluators either during application review or early in the project. Earlier estimation of impacts could guide investments concurrent to the program's review of market needs in the compiled investment plan, better informing investment decisions.

Recommendation: To capture the benefits of growth of commercialized product impacts through sales over time, continue longitudinal sales data collection from developers to estimate longitudinal benefits.

2. **Pivot of product development to adapt to new market needs:** As products are moved along development stages through funded projects, the work reveals performance or commercialization barriers that cause participants to shift course: either they discontinue development or they pivot to a new form, or even a successor product that better serves the function or the market.

Recommendation: Further research inquiry is motivated by this challenge. Participants reported that future product iterations would not have been possible without the initial program funding. Because the program influences future products' success and potentially company success, the evaluation team recommends including these indirect benefits in future evaluations.

Evaluation of product development faces similar challenges to demonstration and market transformation program portfolios, such that solutions to these evaluation challenges are transferable.

3. **Product diversity:** NYSERDA's I&R portfolio intentionally and strategically funds a wide variety of products through different stages in their development. This planned diversity in I&R investment portfolio poses challenges to evaluators because the variety of product innovations requires a variety of methodologies to evaluate effectively. This first-of-a-kind evaluation contained very few similar technologies that could use common templates for evaluation, but there were some: battery storage, fuel cells, EV charging, and lighting innovation among them.

Recommendation: Evaluation cost efficiencies could be gained through use of libraries of calculation templates and processes established in this and future I&R program evaluations. Adaptable and more automated intake of project data to define key metrics for these technologies could be used with the templates to establish a more automated system for impact estimation. Likewise, the growth of commercialized product impacts through sales over time could be used with longitudinal sales data collection from developers to estimate longitudinal benefits, increasing the benefits per $.

4. **Solicitation volume:** Many solicitations over the evaluation period had different objectives and mechanisms. The relative effectiveness of these mechanisms is difficult to judge due to the low volumes of projects awarded under each solicitation.

Recommendation: Review of product progress through the innovation funnel in this evaluation was based on sales rather than a relative technology development assessment like Technology Readiness Level or Commercial Readiness Level. Future evaluations could include standardized readiness scales to better assess early-stage funding outcomes across dissimilar technologies.

Conclusions

The impact evaluation of NYSERDA's I&R program addresses the needs of administrators of product development programs by highlighting the importance of evaluation in making informed investments. Key conclusions of the study are listed below.

1. **Overcome barriers to accurately estimate impacts:** Evaluators of I&R programs face a significant challenge in obtaining data needed to quantify energy and non-energy impacts because the programs incentivize development of a wide variety of products, because product designs frequently change during development, and because product end-users can be difficult to reach. The multi-faceted approach to data collection used in this study overcomes barriers in accurately estimating the impacts of product development projects. By using file reviews, interviews with project managers, developer surveys, in-depth analysis, literature reviews, and follow-up interviews, the evaluation team ensured that the impact estimates are comprehensive, detailed, and grounded in specific product data. Further, the study defines a process that enables programs to establish and record key details about the product used to evaluate impacts. These methods include a basis for, and a recommendation to collect key information from developers during the application process to support benefits estimation, including:
    - Describing the disruptive potential of the product and the market it will disrupt.
    - Defining a unit of sale of the product that NYSERDA is funding for development.
    - Defining the product, if any, that the incentivized product would displace or replace in the market that would serve as the performance baseline for energy or other benefits.
    - Describing the specific intended benefits of the product in terms of energy, economic, waste, health, comfort and other impacts, estimating quantities of benefits where possible.
2. **Strengthen longitudinal data collection:** Longitudinal data collection for evaluating the long-term impacts of product development is critical to understanding the full value of program investments. The evaluation's development of thorough research methods and templates for estimating benefits of products can be leveraged for ongoing longitudinal studies of product impacts. Product evaluation methodologies are rooted in industry best practices, providing product-specific impact estimation algorithms backed by concrete baseline/replaced product and innovation product data. The methods and tools can use longitudinal data collection of key parameters and sales information to produce repeat impact estimations for the portfolio over time, providing templates for future product benefits estimation for categories of similar product investments.
3. **Predict probability of development to market:** The interview guides developed for this evaluation can be used to better capture, document and analyze valuable information known to NYSERDA project managers and developers. This information includes potential impacts, disruptive potential, project success factors and barriers, development progress and trajectory, anomalies in the sales data, and future interest in facilitating evaluation and case studies.
4. **Understand the developed product's capability to disrupt and transform markets:** This evaluation depended upon the assessment of NYSERDA project managers and secondary data to understand the developed products' capabilities to disrupt markets. While the theory of change differs between products, a proposed market transformation model would help to identify this theory of

change and prepare for evaluation data collection. As a proxy, the evaluation team constructed market memos that prepared a hypothesis of transformation effected by products.

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