

Real-Time Results, Real-Time Strategy: Creating a Process for Continuous, Data-Driven Feedback on a Residential Energy Efficiency Program in New York State

Archie Kinnane, NYSERDA, New York, NY¹

Dana Nilsson, NYSERDA, Albany, NY²

Emmet Blau, Recurve, New York, NY

ABSTRACT

This paper describes the New York State Energy Research and Development Authority's (NYSERDA's) integration of near real-time analysis into the design and management of the Comfort Home market-rate residential energy efficiency program. Using utility data accessed through Electronic Data Interchange (EDI) and processed using the OpenDSM code library, NYSERDA and its data analysis platform partner, Recurve, periodically calculated impact related metrics, producing results within one to two months of each project's completion. Insights from the analysis described in this paper informed immediate modifications to program strategy, including incentive adjustments. The recurring refreshes of calculated energy savings enabled program outcomes to be tracked over time.

Throughout the implementation of this near-real time analysis project, NYSERDA also conducted a formal retrospective impact evaluation on the residential program, offering a valuable opportunity to compare results between these two analysis tracks. Results from the near real-time analysis aligned closely with results from the retrospective impact evaluation, specifically when considering the relative performance of different measure packages across the portfolio of program participants. This alignment reinforces the modifications to program strategy implemented by NYSERDA and bolsters confidence in future quick-turnaround analyses.

Introduction

NYSERDA, in partnership with its data analysis partner Recurve, integrated near real-time energy savings calculations into the implementation of a market-rate residential energy efficiency program in New York State. The Comfort Home program focused on whole home energy-efficiency retrofits and sought to streamline implementation by offering participants three standard packages, which were designed to promote electrification by making homes "heat pump ready."

Due to ambitious statewide electrification targets, such as Governor Hochul's "2 million climate ready homes by 2030" goal, NYSERDA had a strong strategic interest in generating early insights into the program, which plays a crucial role in broader statewide efforts. NYSERDA conducted analysis of this program across two tracks. One, a retrospective impact evaluation now nearing publication, was conducted across program years 2020-2023. As is widely understood, retrospective evaluations are foundational to program accountability and improvement. However, retrospective impact evaluations typically require a year or more to complete. Because of this lengthy time horizon, relying solely on retrospective evaluation can make it more difficult for program implementers to incorporate results in a timely manner.

¹ The views expressed in this paper are those of the authors and do not necessarily reflect the views of the New York State Energy Research and Development Authority.

² The views expressed in this paper are those of the authors and do not necessarily reflect the views of the New York State Energy Research and Development Authority.

This paper focuses on the second analysis track pursued by NYSERDA: an attempt to integrate near real-time data collection and analysis into ongoing program operations, leveraging rapid meter data access and transparent, replicable analytics. We define “near real-time” as producing preliminary results within one to two months of project completion and iteratively updating results on a monthly cadence. To be clear, this approach should by no means replace retrospective evaluation; instead, a more real-time analysis complements retrospective evaluations by offering early insights into program performance that help define topics for additional research and supports dynamic program management with a speed that aligns with quickly evolving program needs.

Methodology

NYSERDA and Recurve’s analysis methodology is summarized below. This methodology required strong coordination among (1) the program implementation team, (2) NYSERDA’s evaluation team, and (3) Recurve’s data integration and analysis team.

Step 1: Collect utility account numbers and participant authorization to acquire consumption data (NYSERDA program implementation team).

Applicants to the program were required to list their utility account numbers and sign a consent form authorizing NYSERDA to collect consumption data. The program implementation team further instituted processes to validate utility account numbers met certain utility-specific formatting requirements, increasing data quality substantially. These utility account numbers and authorizations were housed in a secure location and, given the sensitivity of the data, only made available to select members of NYSERDA’s evaluation team.

Step 2: Begin acquiring utility consumption data through the Electronic Data Interchange (EDI) within one month of participant authorization (NYSERDA evaluation team).

On July 23, 2001, the New York Public Service Commission issued Opinion 01-03, approving the policies and data standards for the implementation of the electronic data interchange (EDI) to provide for uniformity in the business communications between ESCOs and utilities in New York.³ Through EDI, approved ESCOs and NYSERDA can submit requests, consisting of a list of authorized utility account numbers, and automatically receive consumption data for a defined period of time prior to the request (between one and two years, depending on the utility).

NYSERDA’s evaluation team collected utility account numbers and authorizations from the program implementation team’s secure location, conducted further data cleaning to ensure only valid account numbers were being requested, and submitted data requests through EDI. The consumption data received through this process formed the basis of the analysis.

Step 3: Collect project tracking data for completed projects (NYSERDA program implementation team and NYSERDA evaluation team).

NYSERDA’s program implementation team provided project tracking data, including crucial fields such as completed Package/installed measures, installation date, and program-modeled savings values to NYSERDA’s evaluation team. These fields were filled by NYSERDA program implementers as part of project application and completion on a NYSERDA controlled database. The data schema and

³ <https://dps.ny.gov/electronic-data-interchange-edi>

naming of these fields were determined before program launch and optimized to uniquely identify projects as they progressed through program application, completion, and evaluation processes. This coordinated up-front definition of clear data structures was tailored to align with evaluation goals and metrics. NYSERDA's project tracking data schema for the Comfort Home program helped ensure the near-real time analysis framework was efficient and informative.

Step 4: Recurve ingests data and completes rapid analysis turnaround (Recurve team).

NYSERDA's evaluation team transferred project tracking data (Step 3) and participant utility consumption data (Step 2) to Recurve for analysis. Recurve developed a standardized Extract, Transform, and Load (ETL) process, which reliably combined the two data feeds and formatted them for energy savings calculation. To aid Recurve in generating an efficient ETL, NYSERDA clarified project tracking data definitions and verified unique site and project identifiers used to join together and aggregate utility consumption data. The ETL is an essential component of near-real time analysis, tying together data feeds and modifying fields to meet OpenDSM requirements (see "Analysis Framework" for more). Initial development allowed NYSERDA and Recurve to identify potential gaps or weaknesses in the program data schema, and to define supplemental fields that could be included to enhance downstream analysis. Once defined, the ETL contained all expectations for incoming data, allowing Recurve to automatically flag when newly provided project tracking data was incomplete or participant utility consumption data would not meet OpenDSM requirements. The ability to turn around the analysis quickly without sacrificing quality depended on the strong Comfort Home program data schema, Recurve's ability to communicate ETL requirements, and the experienced input of NYSERDA's impact evaluation team. This coordination also highlighted the need for consistent data throughput for future refreshes, as described in Step 5.

Step 5: Iterate (all teams).

The process described above was periodically triggered at a one- to two-month cadence. Recurve's ETL automation and savings calculation process ensured that, as long as input files were provided in a consistent format, analysis "refreshes" could be rapidly completed. Any changes to critical project tracking data, choice of unique site and project identifiers, or utility data fields (for example) would impede analysis turnaround times and require modifications to the ETL logic (Step 4). Fortunately, both the program data and utility data schema were held constant through the duration of this study.

The processes described above are represented graphically below.

Enabling Technologies and Processes

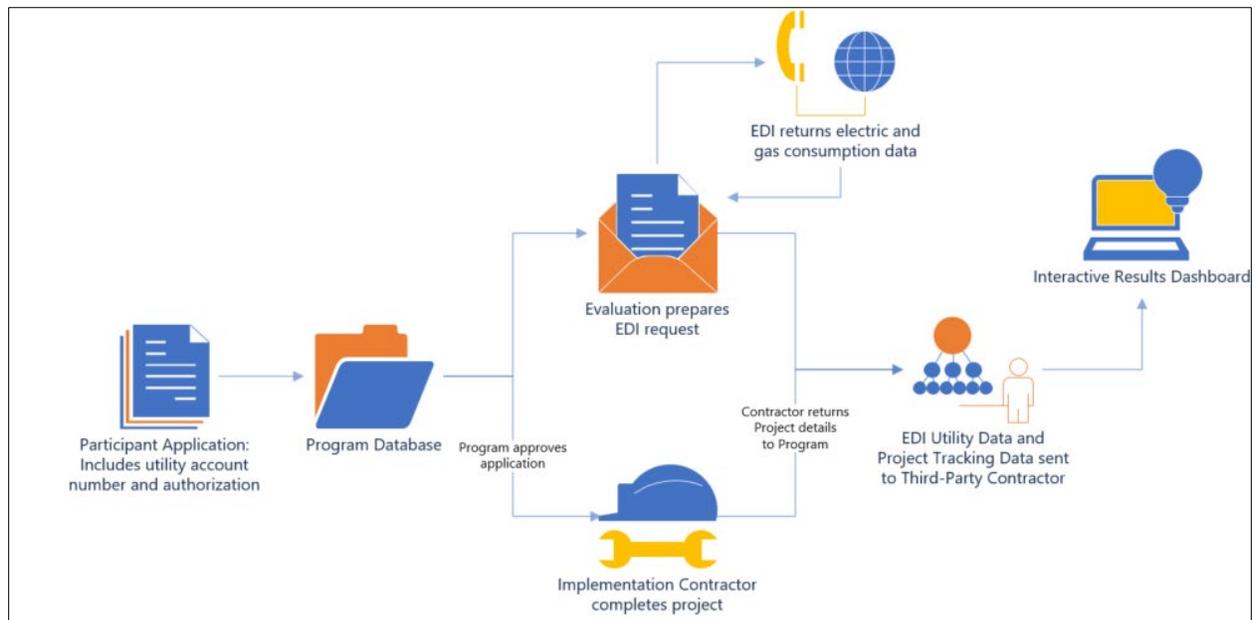


Figure 1: Data flow process.

Analysis Framework

Program measurement leveraged the OpenEEMeter python codebase, now a module of OpenDSM. OpenDSM is an expanded open-source library hosted by the Linux Foundation and developed through a public collaborative process with leadership from Recurve, which can be used to measure the impacts of demand-side programs using utility consumption data. The OpenEEMeter module compares observed post-intervention energy usage with counterfactual predictions based on historical consumption data, allowing estimation of energy savings attributable to the program's intervention. The data requirements of OpenEEMeter guided the participant consumption data and project tracking fields collected for the near-real time analysis. This study used OpenEEMeter version 4.1. OpenEEMeter produces energy savings estimates for individual meters and projects. Output metrics include:

1. Energy savings, in kilowatt-hours (kWh) for electricity, therms for gas, and million British thermal units (MMBtu) for dual-fuel savings
2. Energy savings as a percent of baseline energy consumption
3. Realization rates (comparison of program-estimated savings to measured savings)

As the measurement effort progressed, the evaluation and program teams identified new areas of interest that extended beyond the initial output metrics. For example, there was interest in additional stratifications of results across areas such as installation contractor and geography. NYSERDA also sought to understand how results would differ when only incorporating “actual” billing reads, as opposed to “estimated” reads. Here, Recurve and NYSERDA were able to quickly recognize, ingest, and analyze new data fields necessary to investigate interest areas, which shed additional light on program performance.

Once the analysis was run, output metrics were presented in Recurve’s FLEX platform, a proprietary data management and visualization software interface.

Visualizations and Dashboards

Recurve’s FLEX Programs dashboard showcased key takeaways from the analysis, including total program and project level energy savings over time. Users of the Recurve platform were able to filter down to specific subgroups (Figure 2) – such as program package, installation contractor, and utility territory – and across specified date ranges, and watch as results dynamically updated, allowing program and evaluation team members to investigate new areas of interest as they arose. For example, were projects in upstate utility regions generating a greater percentage of baseline savings than those in downstate areas? Does this differ by intervention type? Has this changed across program years? Program and evaluation team members could then follow trends in those interest areas over time (Figure 3) and assess the results down to the project-level (Figure 4). While the figures below illustrate how questions like these could be investigated, to protect program confidentiality, they represent artificial data, not actual program energy savings calculations.

The screenshot displays the 'Portfolio Filters' section of the Recurve FLEX Programs dashboard. It includes a 'Reset Filters' button at the top left. The filters are organized into several sections:

- Portfolio Filters:**
 - Program Portfolio:** Home Retrofit (dropdown)
 - Aggregator:** Select values (dropdown)
 - Intervention Active Date:** Select date range (calendar icon)
 - Measure Category:** AC System Upgrade (dropdown)
- Net Metering:** Both (selected), True, False (radio buttons)
- Low/Medium Income Flag:** Any (selected), True, False (radio buttons)
- Show only Mature Projects:** Off (selected), On (toggle)

Below these are the **Custom Filters** section, which includes:

- Current Selection:** Contractor Name (dropdown)
- Add Custom List Filter:** Select value (dropdown)
- Add Custom Date Filter:** Select value (dropdown)
- Add Custom Number Filter:** Select value (dropdown)
- Contractor Name:** Climate Comfort Cont... (dropdown)
- No Selection:** Select values (dropdown)
- No Selection:** Select date range (calendar icon)
- No Selection:** min - max (range input)

Figure 2: The analysis dashboard offered comprehensive filtering for the program, which evaluation staff could use to assess real-time performance and explore lines of further investigation.



Figure 3: Portfolio level savings calculations could be viewed over time and were responsive to dynamic filtering, allowing trends to be identified and explored on quick timelines.

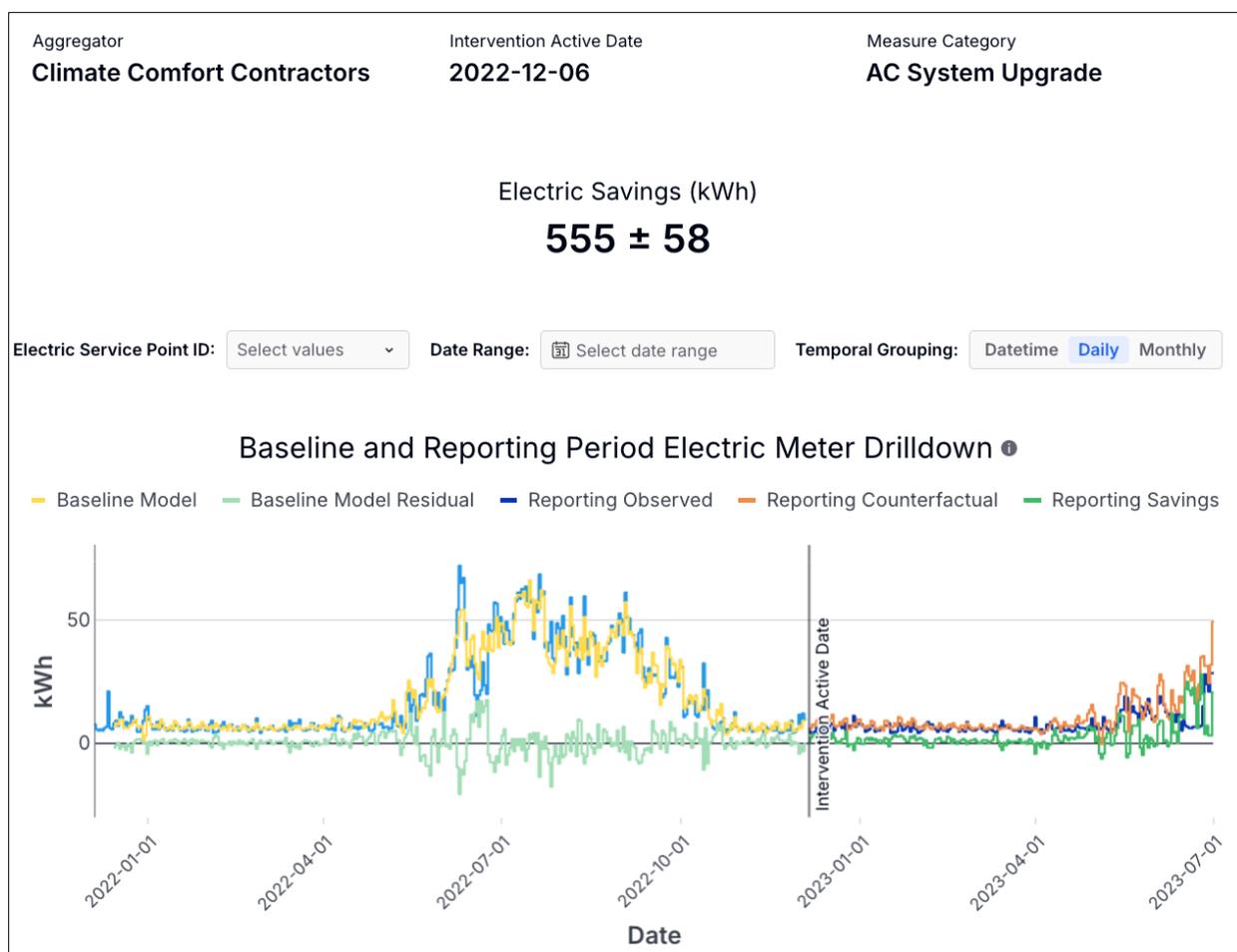


Figure 4: Drilldown views were available for each individual project, enabling program trends to be put in context and more thoroughly understood.

Application and Strategic Uses

Alignment With Formal Evaluation

This near-real time analysis identified robust energy savings, which align with results from the forthcoming retrospective evaluation. This provided early validation of the program’s effective design and implementation. There was strong directional alignment between the near-real time analysis and the retrospective evaluation, using standard impact metrics for guidance. For example, both the retrospective analysis and this near-real time analysis identified that the program package with the highest incentive did not create greater savings than packages with a lower associated incentive. This early analysis supported the program approach that supports participants most in need of comprehensive home upgrades to make ready for heat pump installation, which was later reinforced through the retrospective evaluation. While outputs from the retrospective evaluation achieved higher levels of confidence and precision and should be treated as the “ground truth” for this program, this near-real time effort proved valuable by identifying early areas of insight to inform program design.

Beyond providing early insight into program performance, the analysis also helped identify areas of uncertainty. For example, program savings estimation models were shown to produce higher variability estimates for low-usage households, leading the retrospective evaluation team to investigate the root

causes of variability in savings estimations. By identifying high-performing interventions, data anomalies, and model sensitivities ahead of the full evaluation cycle, the evaluation team was better equipped to ask the right questions and design a more impactful evaluation process.

Program Design and Decision Support

As policy ambition regarding building decarbonization and energy efficiency continues to grow, the importance of aligning analytical speed with policy and program decision-making timelines has never been greater. This analysis demonstrated how near real-time feedback can support adaptive program design and responsive decision-making. For example, early insights from this analysis informed adjustments to incentive levels offered per program package. By identifying which packages were associated with the highest metered savings and which were underperforming, program staff could reallocate incentives to support more impactful measures. These results were also considered alongside other factors like project volumes and incentive burn rates, enabling a holistic approach to resource optimization. The flexibility of the analysis also opens opportunities for more granular decision support in the future. One promising area for expansion is contractor-level performance monitoring. The dashboard includes filtering capabilities by contractor which could be used to explore patterns in energy savings by implementor. This could help inform future quality assurance strategies by identifying contractors who may benefit from additional training or support.

Additionally, the availability of credible early results also supported this program's applications for additional funding and scaling. Outputs from this analysis were used in funding applications to demonstrate early performance and helped to reinforce the value of continued investment.

Finally, the flexibility and transparency of this analysis platform also supports NYSERDA's broader strategic role. Results from this work inform NYSERDA's advisory support for stakeholders who share the same goals and/or also manage weatherization programs. The ability to share insights on program design and performance has strengthened NYSERDA's position in shaping data-driven energy efficiency efforts beyond this single program.

Limitations and Considerations

While this near-real time analysis offers valuable insights and supports more agile program decision-making, it is not a replacement for retrospective evaluation. Retrospective evaluation remains the cornerstone of regulatory reporting and long-term accountability, providing a deeper level of rigor, broader data coverage, and strong levels of technical expertise.

One key limitation of this near real-time analysis approach is the exclusion of non-metered fuels, such as fuel oil, kerosene, and wood. These fuels are used by a significant portion of New York households for primary or secondary heating. Because timely and standardized consumption data for non-metered fuels is difficult to acquire, homes that use non-metered fuels for primary or secondary heating were excluded from this analysis. However, the ongoing formal evaluation addresses this gap through targeted data collection and will provide a more comprehensive view of program impacts across all fuel types.

Additionally, the analysis relied on data obtained via the Electronic Data Interchange (EDI) process. While EDI enables quick access to meter data, it comes with some constraints. EDI typically only returns data for a limited time window and allows customers to "opt out" of having their consumption data available on the platform. Additionally, EDI provides monthly billing-interval data, which limits the granularity of temporal insights that are possible through the analysis platform when Advanced Metering Infrastructure (AMI) data is available.

Finally, another consideration is the limitations of savings calculations based on whole-building energy models, particularly when conducted without non-participant comparison groups. Without

reliable access to the non-participant meter data required to produce comparison groups, savings measurements are at risk of being impacted by exogenous effects on energy use expressed across the population. Furthermore, because whole-building models are assessing impacts at the meter, measure-specific results cannot be reliably estimated without further modeling. This meant that program staff could evaluate the relative performance of different measure packages between projects, but not the relative performance of different measures on a single project.

Taken together, these limitations do not diminish the value of near real-time analysis, but rather define the appropriate role it can play: as a complementary tool to formal evaluation that enhances responsiveness, improves program design, and lays the groundwork for deeper inquiry.

Conclusions and Future Work

This project demonstrated that near real-time analysis can serve as a powerful complement to formal evaluation. By enabling early insight into program performance, often within weeks of project completion, it helped inform strategic decisions, guide program evolution, and support NYSERDA's broader role in advancing energy efficiency across the state.

Foundational to this effort was the strong data management exhibited by program staff. Program implementation characteristics that enable more efficient data integration and quick turnaround analysis include:

1. Collect data with straightforward fields capturing all relevant project information.
2. Front-end verification of data entries. For example, program managers automatically validated that the entered utility account numbers met utility-specific requirements based on length and character type.
3. Traceable unique identifiers maintained throughout datasets.

The combination of a well-designed data hierarchy from the program and strong data integration capabilities from the third-party platform enabled seamless and rapid analysis turnaround.

Second, close and sustained collaboration between the evaluation and program teams was also key to this project's success. From the outset, both teams worked in tandem to ensure that program procedures related to data collection and management processes were aligned, streamlining the near real-time analysis process and ensuring that analysis outputs were relevant to real-time decision-making needs. This ongoing partnership helped close the feedback loop between implementation and evaluation and allowed both teams to operate with greater agility. Looking ahead, future work will focus on scaling and refining this model. Key priorities include:

1. Automating data pipelines through Application Programming Interface (API) integration and standardized workflows to enable even faster updates.
2. Replicating this collaborative structure in other programs, using this project as a blueprint for how evaluation and program teams can co-develop responsive analysis tools.
3. Standardizing this analysis procedure and interactive dashboards for reuse across other programs.

Finally, Recurve's third-party data platform and dedicated data integration team provided the third leg upon which this project's success rests, providing flexible data intake, rapid analysis turnaround, and a reliable data visualization platform.

Without contributions from and coordination between these teams, the positive feedback loops that enabled program implementation enhancement could not have been established. The list below

provides important characteristics of an efficient data integration and analysis pipeline. It is included for reference to others seeking similar results using the approaches outlined in this study:

1. Requirement for and knowledge of data security and confidentiality protocols needed for data sharing.
2. Understanding the key fields required to measure program results through the third-party data platform, and the supplemental fields without which results can't be adequately analyzed.
3. Knowledge of common data characteristics encountered within utility data, such as irregular consumption data time periods, typical units (electric and natural gas) used for different utilities statewide, possibility of estimated reads, etc.
4. Familiarity with EDI protocols and the use of EDI keys used to maintain data security. An EDI key is a unique identifier placed in the consumption data output by the EDI vendor as part of the request, and separately, fed back into the initial EDI data request that links input and output in a way that protects site specific confidentiality.
5. Proactive screening for and rapid identification of solutions to common data challenges that do not hinder progress in platform implementation.
6. Availability of technical data team to meet in real-time (within a day or two) to resolve data input/output and results questions.
7. Transparent and easy-to-access results output that can be obtained by the platform user for additional off-platform analysis if needed.

As energy efficiency and decarbonization programs continue to evolve in response to policy and climate imperatives, embedding collaborative, real-time evaluation capabilities into core operations will be essential. This project provides a model for how integrated teams and shared tools can expand evaluation's purposes from retrospective analysis into a proactive, strategic resource for program success.