NAVIGANT

To:	Vincent Gutierrez; Erin Daughton, ComEd
CC:	Jennifer Morris ICC staff
From:	Josh Arnold; Laura Tabor; Pace Goodman Navigant
Date:	January 24, 2018
Re:	Opportunities to Advance Energy Efficiency and Demand Response Evaluation Using AMI Data

Introduction

This memo identifies key tasks for Commonwealth Edison (ComEd) and Navigant to consider to best use advanced metering infrastructure (AMI) to advance energy efficiency (EE) and demand response (DR) evaluations beyond standard practices. Tasks identified here are actionable, forward looking and emphasize pilot analyses or white papers where the benefits of using AMI are not yet firmly established in the national EE and DR community.

What is AMI and how is it new?

Time-stamped, customer level energy use data has been used in evaluation for decades. While not fundamentally changing evaluation, AMI may enable analyses that extend the benefits of evaluation beyond current practices because of three distinguishing characteristics. AMI:

1. Provides unprecedented insight into the timing of energy use (e.g., with usage data at 30-minute rather than monthly intervals),
2. Facilitates data sharing, and
3. Creates opportunities for automated analysis of energy use data.

In the demand side management industry, conversations about AMI data often conflate three major areas where AMI provides benefits: accelerating real time feedback (either through implementation, known as measurement and verification 2.0 or M&V2.0, or faster evaluation, known as EM&V2.0), improving evaluation accuracy, and growth of AMI-enabled technologies, products and services. This memo focuses on the first two areas given Navigant's role as ComEd's evaluator, and seeks to highlight areas where use of AMI may provide value beyond current approaches using monthly consumption data.

Navigant already uses AMI for evaluation purposes, especially for commercial and industrial (C&I) custom evaluation.[1] The tasks identified in this memo focus on where the distinguishing characteristics of AMI can extend the benefits of EE and DR evaluation beyond its current uses. This memo does not discuss potential advances or expansions of using general, monthly consumption data in evaluation.

Following the release of this memo, Navigant will coordinate a meeting between ComEd, Navigant and Illinois Commerce Commission staff to discuss the priority of tasks identified here and determine which items to pursue. Navigant also recommends revisiting this topic annually to summarize the findings from this research and to update and highlight additional uses of AMI for EE and DR evaluation. Pending the results of these research efforts, Navigant will consider expanding AMI-intensive evaluation approaches to a broader suite of programs and measures.

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[1] Navigant provides more details on its current use of AMI in evaluation in Appendix A.

Extending the Benefits of EE & DR Evaluation

Navigant summarizes the identified evaluation research tasks in Table 1. These tasks are grouped by research category, which aligns with the subsections below. Within the following subsections, Navigant describes the tasks in more detail.

Table 1. Summary of Research to Consider

Research Category	Research Tasks
Demand Impact Evaluation Improvements	• EE load shape research • DR evaluation with randomized study design
Technical Reference Manual (TRM) Improvements[2]	• *No research tasks identified – continue to use AMI to update TRM assumptions when practicable*
Custom & Non-TRM Evaluation Improvements	• Scheduled Meter Analytics Regression Test (SMART) screening pilot analysis • Pilot energy impact evaluation with AMI • Pilot energy impact evaluation across multiple measures with AMI
Operational Improvement	• Research best practices and explore options for automatic and streamlined data transfer of AMI with evaluators • Measurement and Verification 2.0 (M&V2.0) pilot analysis
Market Research	• Summary of concurrent market trends that could influence the use of AMI in EE and DR programs and their evaluations

Source: Navigant

Demand Impact Evaluation Improvements

One of the key, distinguishing characteristics of AMI is that it provides an unprecedented level of insight into when customers use energy. This distinguishing characteristic enables evaluators to enhance demand savings estimates from both EE and DR impact evaluations. As such, Navigant describes below in Table 2 and Table 3 research tasks that use AMI to enhance demand savings estimates from EE and DR measures. These tasks include research to update EE load shapes and suggested improvements for more accurate DR impact evaluations.

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[2] http://www.ilsag.info/technical-reference-manual.html

Table 2. Research Task Description for EE Load Shape Research

Demand Impact Evaluation Improvements	Research Task:	EE Load Shape Research
	Description:	Navigant defines EE load shapes as a normalized distribution of savings across the 8,760 hours of a year. As a normalized distribution, the sum of each hour will add to 1.0, meaning that as annual savings change, the load shape can still be applied. AMI can pair with existing, rigorous approaches, such as with sub-metering, to enhance load shape research.
	Applicable Program:	To be determined as the analysis plan is refined, but could apply to most major TRM and non-TRM measures
	Current Practice:	The current EE load shapes in IL are mostly derived from simulation models developed outside of IL with some IL adjustments.
	Benefits:	• More cost-effectively update and maintain load shapes in the IL TRM • Improve accuracy and state specificity of IL TRM load shapes • More accurately estimate cost-effectiveness for ComEd's EE and DR programs • Better support ComEd's PJM bid process, including development of winter peak coincidence factors • Better understand how and when customers use energy • Inform future EE and DR efforts
	Task Status:	ComEd has already prioritized this research to begin in 2017, and Navigant and ComEd are in the process of developing the analysis plan.
	ComEd Next Steps:	*None*
	Additional Notes:	For more information on this topic please see Appendix B.

Source: Navigant

Table 3. Research Task Description for DR Evaluation with Randomized Study Design

Demand Impact Evaluation Improvements	Research Task:	DR Evaluation with Randomized Study Design
	Description:	Randomized study design involves randomly assigning study participants to receive a DR signal (i.e., be in the treatment group) or to not receive the DR signal (i.e., be in the control group). This study design is the gold-standard for evaluation and its related research.
	Applicable Program:	Behavioral DR and DR from connected devices, such as connected thermostats
	Current Practice:	Navigant does not typically evaluate ComEd's DR programs except for one residential load control program and the evaluation approach for that program is under discussion.
	Benefits:	More accurately and cost-effectively estimate DR savings
	Task Status:	Proposed evaluation approach for Summer 2018
	ComEd Next Steps:	Coordinate with Navigant to implement this study design before 2018 DR events

	Additional Notes:	Navigant recommends ComEd apply this study design whenever practicable for DR used to achieve the Future Energy Jobs Act (FEJA) requirements.

Source: Navigant

Technical Reference Manual (TRM) Improvements

The Technical Reference Manual (TRM) determines the savings for many EE measures in Illinois, where savings are agreed upon before a program year. Within this framework, AMI or monthly energy-use data could be used to make parameter level updates to future versions of the TRM or to update realization rates embedded in the TRM equations. Navigant's current advanced thermostat evaluation research is an example of this process, where Navigant is using energy use data to update a parameter in the TRM. However, Navigant does not include any specific research tasks for TRM measures in this memo for two primary reasons:

- Many applications for using AMI to update parameters within the TRM (e.g., residential heating and cooling loads) were possible with monthly billing data and this memo focuses specifically on improvements resulting from AMI[3]
- Navigant is already using time-stamped, energy-use data to update the TRM whenever practicable (e.g., for the residential advanced thermostat research)

Custom & Non-TRM Evaluation Improvements

Custom evaluation typically involves EE measures where the savings are less predictable, which is particularly applicable to commercial and industrial EE programs, but also applies to residential programs that are not evaluated through the TRM. Navigant already uses AMI extensively for C&I custom evaluation and provides more detail on our current use of AMI in Appendix A. However, AMI could extend the benefits of EE and DR evaluation within custom evaluation through the following:

- Scheduled Meter Analytics Regression Test (SMART) screening pilot analysis
- Pilot energy impact evaluation with AMI
- Pilot energy impact evaluation across multiple measures with AMI

These research tasks are described below in more detail in Table 4, Table 5 and Table 6.

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[3] Navigant identifies below in Table 5 a research task to better understand the benefit from AMI over monthly billing data in evaluating annual energy impacts. This research currently targets non-TRM measures, but the findings could apply for TRM measures and their associated parameters as well.

Table 4. Research Task Description for SMART Screening Pilot Analysis

<table>
<tr><td rowspan="9" style="writing-mode: vertical-lr">Custom Evaluation Improvements</td><td>Research Task:</td><td>SMART Screening Pilot Analysis</td></tr>
<tr><td>Description:</td><td>Navigant's SMART screening automatically applies site-specific regression models to weather data and AMI to provide site-specific savings for a population of program participants. This first screening step enables evaluators to more carefully sample projects for engineering review when evaluating custom EE programs.</td></tr>
<tr><td>Applicable Program:</td><td>C&I custom programs</td></tr>
<tr><td>Current Practice:</td><td>Navigant typically evaluates this program by randomly sampling projects for which our engineering staff collect relevant invoices, AMI, building automation system data and other data if available to provide site and program level realization rates.</td></tr>
<tr><td>Benefits:</td><td>While Navigant already uses AMI to evaluate this program, Navigant can apply SMART screening as a first step within sampling. This can increase evaluation accuracy and reduce sample size and cost by enabling Navigant to conduct rigorous review on only those projects identified during SMART screening. SMART screening will likely work best for weather related savings, savings from changes to equipment schedules and when savings are greater than 10% of total usage.</td></tr>
<tr><td>Task Status:</td><td>Proposed pilot study to begin in 2018</td></tr>
<tr><td>ComEd Next Steps:</td><td>*None*</td></tr>
<tr><td>Additional Notes:</td><td>Navigant has used this tool to evaluate similar programs for other clients in the Midwest, and identifies here a pilot analysis to verify its applicability for ComEd.</td></tr>
</table>

Source: Navigant

Table 5. Research Task Description for a Pilot Energy Impact Evaluation with AMI

<table>
<tr><td rowspan="9">Custom Evaluation Improvements</td><td>Research Task:</td><td>Pilot Energy Impact Evaluation with AMI</td></tr>
<tr><td>Description:</td><td>Navigant would use energy data at sub-monthly intervals (e.g., daily) to estimate annual energy savings.</td></tr>
<tr><td>Applicable Program:</td><td>Residential Home Energy Reports (HER)</td></tr>
<tr><td>Current Practice:</td><td>Navigant typically evaluates this program using regression models with AMI aggregated to monthly to identify the impact of the program.</td></tr>
<tr><td>Benefits:</td><td>Unclear, and as such, Navigant identifies here a pilot analysis to use one or two waves of the HER program to determine the feasibility of Navigant's use of AMI to:
Achieve lower precision (i.e., less variation) on savings estimates
Disaggregate savings for various subsets of the population[4]
Provide faster, more automated savings estimates</td></tr>
<tr><td>Task Status:</td><td>Proposed pilot study to begin in 2018</td></tr>
<tr><td>ComEd Next Steps:</td><td>*None*</td></tr>
<tr><td>Additional Notes:</td><td>Depending on results, Navigant may apply these findings for other evaluations.</td></tr>
</table>

Source: Navigant

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[4] Navigant could investigate the impact of HER on specific substations to test the ability of AMI to facilitate savings estimates for subsets of the population, while also making steps toward greater collaboration with resource planners.

Table 6. Research Task Description to Pilot Multi-Measure Evaluation with AMI

Custom Evaluation Improvements	Research Task:	Pilot Energy Impact Evaluation across Multiple Measures with AMI
	Description:	Navigant would use energy data at sub-monthly intervals (e.g., daily) to estimate annual energy savings for multiple measures or programs within one model
	Applicable Program:	To be determined as the analysis plan is refined
	Current Practice:	Navigant typically evaluates behavioral efficiency measures one measure at a time using regression models.
	Benefits:	Impact evaluation using usage data (either AMI or monthly billing data) is well suited for portfolio-level evaluations, but the benefits of AMI could make that application more realistic.[5] This approach to evaluation could enable ComEd's EE and DR programs to be administered as a platform with a pay-for-performance type of design.
	Task Status:	Proposed pilot study to begin in 2019
	ComEd Next Steps:	*None*
	Additional Notes:	This task pairs well with Market Research (see Table 9). Through this task we'd learn about the technical feasibility of portfolio or multi-measure evaluation with AMI and through market research we'd learn whether this approach fits the processes and vision for IL. Depending on results, Navigant may apply these findings for other evaluations.

Source: Navigant

Operational Improvements

A major benefit of AMI is the potential for improved data storage and sharing infrastructure, which could facilitate streamlined data transfer and analysis. This benefit could enable more insight from AMI for business decisions and processes. To better understand how these benefits apply to ComEd's EE and DR programs, Navigant identifies the following research:

- Research best practices and explore options for automatic and streamlined data transfer of AMI with evaluators
- Measurement and Verification 2.0 (M&V2.0) pilot analysis

The ultimate objective of these tasks is to determine whether these improved tools enable ComEd to better manage its programs. More specifically, to determine if the benefits of an automated, streamlined data transfer of AMI to Navigant outweighs the additional set-up effort and to determine if insights from M&V2.0 software outweigh its cost. These tasks are described in more detail below in Table 7 and Table 8.

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[5] For more information on this concept, please see the following report:
http://www.energydataweb.com/cpucFiles/pdaDocs/1420/Res Portfolio Impacts White Paper (Final) DNVGL 1-22-2016.pdf

Table 7. Research Task Description for Exploring Options to Enhance AMI Data Transfer

Operational Improvements	Research Task:	Research best practices and explore options for automatic and streamlined data transfer of AMI with evaluators
	Description:	In this effort, Navigant will coordinate with ComEd to explore options to facilitate automatic or streamlined transfers of AMI between Navigant and ComEd.
	Applicable Program:	Any program leveraging AMI for evaluation
	Current Practice:	Navigant typically requests AMI from ComEd for specific account numbers and occasionally in unique formats.
	Benefits:	Possible long-term benefits include faster evaluation results, more frequent and enhanced evaluation insights, and reduced burden on ComEd for program-specific data requests. Navigant proposes documenting best practices and conducting preliminary testing with ComEd. This research will help determine if the long-term benefits to both ComEd and Navigant (e.g., reduced burden from avoided data requests) outweigh the initial effort.
	Task Status:	Proposed research to begin in 2018
	ComEd Next Steps:	*None*
	Additional Notes:	*None*

Source: Navigant

Table 8. Research Task Description for a M&V2.0 Pilot Analysis

Operational Improvements	Research Task:	M&V2.0 Pilot Analysis
	Description:	Navigant defines M&V2.0 as automated analysis of usage data to estimate savings from EE interventions in near-real time. These approaches are not applicable to all measures and circumstances and were possible before the proliferation of AMI, but new vendors have recently come to market and may facilitate broader use of these approaches. As such, Navigant includes this proposed research task.
	Applicable Program:	Residential weatherization program and income eligible whole-home programs
	Current Practice:	M&V2.0 is not currently applied in IL. This is in part because the TRM framework enables changes to reported savings following program year evaluations and TRM updates rather than through mid-year adjustments resulting from M&V2.0 findings, and because TRM savings are intended to reflect state-wide savings, where M&V2.0 is not commonplace.
	Benefits:	Unclear, and as such, Navigant proposes a pilot to answer the following research questions: • Does M&V2.0 help program administrators, implementers and contractors achieve higher savings? • Does M&V2.0 enable better trade ally relationships? • Can M&V2.0 reduce quality control costs for measures where savings are driven by contractor quality, such as residential weatherization? • Is M&V2.0 accurate enough to provide real, valuable insight, to enhance pay-for-performance program designs and to support innovation at ComEd?
	Task Status:	Proposed pilot study for planning to begin in 2018
	ComEd Next Steps:	Engage a vendor to launch an M&V2.0 pilot with a study design coordinated through ComEd, Navigant and the vendor
	Additional Notes:	This pilot research might benefit from a parallel effort to explore options for incorporating M&V2.0 into the TRM framework.

Source: Navigant

Market Research

In parallel to conducting research using AMI, Navigant plans to conduct secondary literature reviews, focus groups, or interviews with industry experts to better understand concurrent market trends that could influence the use of AMI in EE and DR programs and their related evaluations.

Table 9. Research Task Description to Summarize Concurrent Market Trends

Other Recommendations	Research Task:	Summary of concurrent market trends that could influence the use of AMI in EE and DR programs and their evaluations
	Description:	In this study, Navigant will summarize findings from secondary literature reviews, focus groups, and interviews with industry experts.
	Applicable Program:	To be determined
	Current Practice:	Informal and undefined
	Benefits:	Formal research around market trends can help ComEd's EE and DR team and their evaluators best prepare their programs as the power industry evolves.
	Task Status:	Proposed ongoing research to begin in 2018
	ComEd Next Steps:	*None*
	Additional Notes:	Navigant provides more information on this topic in Appendix C.

Source: Navigant

Conclusion

In summary, AMI can enable analyses that expand the benefits of EE and DR evaluation, but some potential benefits may not be practicable and the national evaluation community is still establishing an answer to the question: How can AMI best be used in EE and DR evaluations? Given this uncertainty, Navigant identifies actionable research tasks with clear objectives and research questions that will help ComEd lead the industry by answering this fundamental question.

Navigant will coordinate a discussion around the tasks identified in this memo and recommends revisiting this topic annually to summarize the findings from this research and to update and highlight additional uses of AMI for EE and DR evaluation at that time.

Appendix A. Program Impact Evaluation with AMI
This appendix summarizes current and proposed applications for AMI at the program level.

Current Impact Evaluation with AMI

The Navigant evaluation team already incorporates AMI into its evaluations. To date, Navigant plans to use AMI data for the following programs:

- Standard
- C&I Custom
- Industrial
- Data Centers
- Retro-commissioning
- Business New Construction
- Small Business

We are also using AMI for updates to some residential programs and Standard and Small Business TRM measures. AMI is used to corroborate engineering analysis findings, investigate changes to equipment operation schedules and to update measure-level parameters in the TRM.

Proposed Impact Evaluation with AMI

Navigant proposes piloting select AMI evaluation approaches with one program to gauge value before applying to additional programs. Table 10 summarizes the programs where Navigant suggests piloting these innovative approaches.

Table 10. Suggested Pilot Applications for Use of AMI in Impact Evaluation

AMI Application	Pilot Program or Program Type
EE load shape research	All programs with measures included in load shape research (load shapes will affect cost-effectiveness inputs and PJM bids)
DR evaluation with randomized study design	Pending launch of DR program evaluations per ComEd's needs
SMART Screening Pilot Analysis	C&I Custom
Energy Impact Evaluation with AMI	Residential Home Energy Reports
Multi-Measure Impact Evaluation with AMI	Fridge/Freezer Recycling, Home Energy Assessments, Multi-Family*
M&V2.0 Pilot Analysis	Weatherization

Source: Navigant
Programs where Navigant currently performs uplift analysis for HER participants.

Pending the success of these pilot evaluation studies, Navigant will consider extending one or more approaches to additional programs. Pilot evaluation methods would occur in parallel with standard evaluation approaches to reduce evaluation risk.

Appendix B. Load Shape Research

This appendix provides more detailed information on the role of AMI in load shape research.

Supporting a PJM Bid

Evaluators can use similar approaches to update the IL TRM and to support the PJM bid. However, Navigant may conduct more rigorous evaluation for measures bid into PJM.

Informing Future EE and DR Efforts

Evaluators could use AMI and load shape research to provide a variety of insight for future EE and DR efforts. For example, Navigant could investigate drivers of high demand and develop recommendations for cost-effective DR strategies. Additionally, Navigant could use load shape research to help ComEd set demand savings targets for EE and DR as well as energy savings targets. The "when" of energy use and savings is becoming increasingly important and load shape research can help utilities make informed decisions.

Methods for Using AMI in Load Shape Research

Evaluators can use AMI to enhance load shape research with three primary approaches:
1. **AMI leveraged end-use metering.** For important IL TRM measures, evaluators may be able to use AMI to provide initial load shapes with further refinement from end-use metering. This approach could reduce costs by reducing the number of site visits. It also could reduce future load shape maintenance costs by enabling evaluators to use AMI alone to update load shapes, with a previously established adjustment factor based on end-use metering.
2. **Econometric analysis.** Similar to energy impact evaluations using billing data, evaluators can use AMI to develop savings load shapes if the sample size and savings are large enough and the savings are based on a pre-existing baseline.
3. **Hourly calibrated simulation models.** Similar to calibrated simulations based on monthly usage data, evaluators can incorporate hourly data into calibration (ideally in EnergyPlus™).[6] These models can then be used to generate a variety of load shapes based on specific energy efficiency upgrades.

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[6] EnergyPlus™ has additional features not available with other simulation engines that make it best suited for calibration when using sub-monthly energy usage: https://energyplus.net/.

Appendix C. Market Trends

In developing the recommendations outlined in this memo, Navigant's research team identified concurrent market trends that could influence the use of AMI in EE and DR programs and their related evaluations.

Navigant highlights specific examples below and recommends that ComEd consider additional research around these topics:[7, 8, 9, 10, 11]

Article 1: "Energy Efficiency's Existential Crisis Is Also an Opportunity"

o Will EE and DR programs move toward pay-for-performance approaches?

o To enable EE and DR to scale up, will the industry move away from pre-agreed, deemed savings based on TRM's and towards annual estimates of actual savings where savings inherently change year to year?

Article 2: "State & Future of the Power Industry 2017"

o Are there revenue opportunities for utilities to provide an energy services platform (i.e., like the Netflix of energy services) where vendors can post applications for customers on ComEd's energy service platform? Will EE and DR move toward this business model?

Article 3: "Virtual Power Plants & Transactive Energy: How Will They Change the Energy Business?"

o How realistic are virtual power plants and how would this business model impact EE and DR?

Article 4: "Non-Wires Alternatives: What's up next in utility business model evolution"

o What kinds of opportunities are there to better integrate EE and DR with resource planning? Can EE and DR be used to prolong upgrades on targeted equipment (e.g., load-constrained substations)?

Article 5: "Illinois regulators finalize open data framework for utilities"

o What impact will an open data framework have on ComEd's EE and DR programs and their evaluations?

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[7] Article 1: https://www.greentechmedia.com/articles/read/energy-efficiencys-existential-crisis-is-also-an-opportunity
[8] Article 2: https://www.navigant.com/insights/energy/2017/state-and-future-of-the-power-industry
[9] Article 3: http://microgridknowledge.com/virtual-power-plants-defined/
[10] Article 4: http://www.utilitydive.com/news/non-wires-alternatives-whats-up-next-in-utility-business-model-evolution/446933/
[11] Article 5: http://www.utilitydive.com/news/illinois-regulators-finalize-open-data-framework-for-utilities/448127/