2020-21 Custom Industrial Evaluation Research Plan

1 OVERVIEW

This document provides a research plan to conduct an impact evaluation of Bonneville Power Administration's (BPA's) Custom portfolio for industrial customers of Option 1 utilities. This plan addresses Domain 1 of a rolling plan with seven total domains that will address the entire custom measure and C/I/Ag Lighting portfolios (which includes all non-residential lighting and custom[1] measures). This research is being conducted by a team led by Evergreen Economics (which includes Apex Analytics and SBW Consulting) under Task Order 6.[2]

This research plan builds off of an impact evaluation plan for fiscal years 2020 and 2021 (FY2020-21)[3] developed by this evaluation team in January of 2020. This plan provides updates to the evaluation plan, additional detail on sampling and stakeholder engagement, and an updated research schedule.

Leveraging this document, our team will develop additional research planning documents to describe plans (numbered and labeled as tasks within Task Order 6) to conduct the remainder of Task Order 6 research:[4]

- Task 1b – Domain 2 – Custom portfolio for industrial customers of Option 2 utilities
- Task 2 – Strategic Energy Management evaluation
- Task 4 – FY2019 Residential HVAC Savings Analysis

1.1 SUMMARY OF FY2020-2021 IMPACT EVALUATION ACTIVITIES

Table 1 on the next page summarizes the FY2020-21 evaluation plan and indicates which portion is being covered by this first round of research.

[1] For Option 2 utilities, both lighting and custom projects are reported to BPA through the custom project pathway. For this evaluation, Option 2 custom projects are technically those projects with non-lighting end uses.

[2] This plan covers Task 1 – Custom Industrial, specifically Task 1a that is focused on Option 1 utilities.

[3] https://www.bpa.gov/EE/Utility/Evaluation/Documents/BPA_2020-21_Impact_Evaluation_Plan.pdf

[4] One additional task under Task Order 6, Task 3 - Commercial HVAC impact evaluation, has already been completed.

Table 1: Summary of FY2020-21 evaluation plan

Evaluation Areas	*Brief Summary*	*Coverage by Task Order 6*
Custom and C/I/Ag Lighting	Rolling, engineering-based evaluation.	Task 1a: Domain 1 Custom Industrial, Option 1 (this document) Task 1b Domain 2 (Custom Industrial, Option 2)
Strategic Energy Management	Persistence assessment to inform measure life and (if feasible) assessment of how capital measures affect SEM savings.	Task 2
BPA Qualified (BPAQ) Commercial HVAC	Billing analysis to support BPAQ measure assessment.	Task 3 *(research completed)*
Clark Public Utilities thermostat pilot	Billing analysis to understand program savings.	Not included in Task Order 6 (may be scoped at a later date)
FY2019 Residential HVAC Savings Analysis	Billing analysis to support BPAQ measure assessment, revisiting FY2019 impact evaluation results.	Task 4

1.2 SCHEDULE FOR 2020-2021 IMPACT EVALUATION ACTIVITIES

Table 2 on the next page shows the timeline of planning, data collection, analysis, and reporting for the FY2020-21 evaluation. The first row (Task 1a), shaded grey, is the focus of this research plan.

Table 2: Timeline of evaluation activities

Evaluation Activity		*FY2020*				*FY2021*				*FY2022*				*FY2023*			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Custom and C/I/Ag Lighting*	Option 1 Custom Industrial (Task 1a)																
	Option 2 Custom Industrial (Task 1b)																
	Option 1 Lighting																
	Option 2 Lighting																
SEM Evaluation – Persistence (task 2a)																	
SEM Evaluation – Capital (Task 2b)																	
BPAQ Commercial HVAC (Task 3)																	
(FY2019) Residential HVAC Evaluation (Task 4)																	

** Non-Industrial Custom (Option 1 and Option 2) and Energy Smart Reserve Power are planned for FY2022-23.*

2 OPTION 1 CUSTOM INDUSTRIAL RESEARCH PLAN

This research plan is intended to represent the population of measures with completed reporting[5] (COTR approval date) during the previous 12 months (as of August 2020)[6] for custom measures installed by Option 1 utility industrial customers. This research is for Domain 1 of a rolling cycle of custom and C/I/Ag Lighting portfolio research. There are two evaluation objectives:

1. Estimate first-year kWh savings including savings based on as-operated conditions (actual post-installation conditions that include any changes due to the COVID 19 pandemic) and expected conditions (had COVID-19 not occurred) for the custom industrial portfolio for Option 1 utilities and for separate portions of the portfolio as needed to understand the savings performance of important program delivery channels.
2. Develop recommendations on M&V procedures, including when savings can be reliably estimated, for custom measures, using the BPA M&V Protocol Selection Guide, including the protocol called *Engineering Calculations with Verification* (ECwV).

This evaluation is designed to be an ongoing process throughout the two-year period, establishing a model for consistently timed evaluation in future years and providing feedback to BPA on the quality of data collection and use of M&V protocols.

GENERAL SAMPLING STRATEGY

This section provides a description of the general sampling strategy for Custom and C/I/Ag Lighting projects.

BPA's QSSI policies have established a target for impact evaluation, striving for evaluations that attain a relative error of 10 percent at the 90 percent confidence level, with a minimum acceptable level of 80/20. The evaluation team-proposed sampling strategy targets a 90/10 confidence level and precision for the Custom and C/I/Ag Lighting evaluation, with approximately 80 measures sampled in FY2020 and FY2021. The sampling unit of this study is a measure, defined as a unique Technology/Activity/Practice for a single project at a distinct site (as defined by utility assigned site ID and facility address).[7] Sampling for Custom and C/I/Ag Lighting will be based on a savings stratified random sample from measures that completed the invoicing process in the previous year. This will allow the evaluation to be conducted on a rolling basis.

DOMAIN 1 SAMPLE DESIGN

This section provides the sample design for BPA's Custom portfolio for industrial customers of Option 1 utilities. This sample design is based on projects completed during the past 12 months.

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[5] Based on the date that of Contracting Officer's Technical Representative (COTR) approval.
[6] Rolling sample for Custom C/I/Ag domains will be selected based on when invoicing process is complete. Therefore, completion dates for projects will naturally include FY2020 and FY2019 and may include FY2018 due to natural delays from project completion to utility invoicing to BPA. The team will exclude any project with completion dates more than two years prior to research start.
[7] For uniformity of evaluation approach, evaluation and project resource management, and cost control, sampling is based on measure.

Through this evaluation, we expect to estimate realization rates with a sampling precision of +/- 10 percent at a 90 percent confidence level.

The Option 1 Domain 1 evaluation will include projects with a completion date between September 2019 and August 2020, excluding eight projects that started prior to 2017, as these will be less representative of the past 12 months.[8] This draft sample is based on current BPA tracking (or IS2.0) data, pulled on September 11, 2020. The sampling unit of this study is a measure (i.e., single Technology/Activity/Practice (TAP) within a project).

The sampling will be conducted with a conventional optimum allocation stratified design based on end use category and reported kWh savings for the measure.[9] We defined an excluded stratum (i.e., stratum 0) that contains very small measures; this is the group of measures that collectively account for less than 2 percent of the domain savings. Measures that represent a significant portion (more than 25%) of total reported energy savings for an end use are assigned to a priority "certainty" stratum. We consider these measures necessary for the evaluation; thus, they are not subject to random selection. The remaining measures were then allocated to two strata, defined by a lower bound of 200,000 kWh savings, separating small and large measures to ensure that our sample represents a mix of projects. We will use simple random selection up to the optimal sampling fraction in these strata, allocating one additional sample point to each of the small measure strata (i.e., strata 1 for compressed aid, motors/drives, and refrigeration) to increase the likelihood that our sample contains sufficient projects for the ECwV analysis.

Table 3 shows the number of measures and savings associated with Option 1 utilities custom industrial measures from the past 12 months by end use and strata. The sample sizes shown in the table should yield a relative precision of +/- 10 percent at a 90 percent confidence level for Domain 1 over the past 12 months. This sample of 40 projects includes six certainty sites and a stratified random sample of 34 additional measures.[10] The certainty sites will guarantee that the evaluation sample will cover at least 44 percent of the Domain 1 savings. Based on the average savings by strata, we estimate that the full sample will cover approximately 75 percent of Domain 1 savings.

[8] The invoices for these measures were submitted between September 10, 2019 and August 28, 2020. Their completion reports were approved between August 28, 2019 and August 27, 2020.
[9] In BPA taxonomy, TAPs roll up into end-use groups. Therefore, where feasible, the evaluation will attempt to roll up results into end uses for additional insight to BPA. There is insufficient sample to achieve 90/10 for each end use. However, the results by end use will allow us to investigate whether savings uncertainty is related to measure type versus project size.
[10] It would be feasible to meet the relative precision target with a smaller sample if we were to stratify by savings and measure size alone (i.e., not also by end use). The benefit of end use stratification is that we will ensure that a wider range of measures are included in the evaluation, which will be a better representation of the domain as a whole.

Table 3: Option 1 custom industrial sample design

End Use	Strata*	Reported Savings (kWh)		Number of Measures	Sample Size
		Average	Total	Count	Count
Compressed Air	0	34,785	69,569	2	0
	1	145,034	725,170	5	4
	2	371,347	1,856,734	5	3
	Certainty	1,192,160	1,192,160	1	1
HVAC	0	61,045	61,045	1	0
	1	250,264	750,793	3	2
	Certainty	966,660	966,660	1	1
Motors/Drives	0	45,857	320,998	7	0
	1	140,978	704,891	5	4
	2	572,511	7,442,643	13	7
	Certainty	5,229,873	5,229,873	1	1
Process Loads	0	14,327	28,653	2	0
	1	273,246	1,366,228	5	3
	Certainty	3,338,859	6,677,718	2	2
Refrigeration	0	42,000	209,999	5	0
	1	169,752	679,007	4	3
	2	537,259	8,058,880	15	8
	Certainty	3,509,036	3,509,036	1	1
	Total	**510,898**	**39,850,057**	**78**	**40**

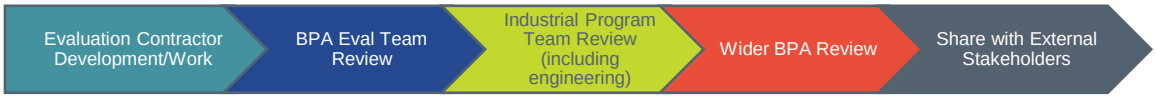
* Stratum *0* denotes the excluded measures (based on very small savings). The *certainty* measures represent a significant portion of total reported energy savings within the end use and are considered to be necessary for the evaluation and, therefore are not subject to random selection. HVAC and Process Loads have a single probabilistic stratum due to the small number of measures below the size threshold of 200,000 kWh.

SCHEDULE

The following schedule outlines key steps in the project, expected timelines, and stakeholder reviews. For more information on stakeholder processes, please see Appendix A for Contact Protocols and Appendix B for the Stakeholder Plan.

Table 4: Key project steps and stakeholder reviews

	2020				2021									
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
Research Plan, Communication Protocol, Timeline														
Sample List (and backups)														
Project Kickoff														
Project File Data Collection														
Site Specific Notifications														
End-user Data Collection														
Site Specific New Models														
Site Specific Results Workbooks														
Results Summary Workbook														
Report/Highlights/PPT														
Program Response Memos														



Throughout the project, BPA will communicate with stakeholders through multiple approaches including ad hoc meetings, email communication, webinars, weekly announcements, and evaluation website updates.

DATA COLLECTION

Our general approach to evaluation data collection is to fully leverage the data collected by the BPA Energy Smart Industrial (ESI) team and utility staff throughout the process of developing each project and to only collect additional data if needed to achieve reliable estimates of savings for the sampled measures. We will collect the necessary data as follows:

- **File review.** The file review involves extracting all project information relevant to savings estimation. This may include:
    - Measure descriptions that detail how the measure saves energy, affected systems, and determinants of savings.
    - Baseline and efficient condition inputs to the M&V savings estimation tool, trend data, cutsheets, and other design documents.
    - Reported savings values to compare against tracking data.
    - The final M&V savings estimation tool, and any other critical final documents used to document reported savings.

    - Invoices, receipts, and other data to verify incremental measure costs.
    - Data and documentation relating to non-energy benefits such as water use, wastewater, and operations and maintenance labor and materials.
    - Data used to determine non-electric energy impacts.
    - Data to inform estimates of measure life.
- **Telephone/email discussion with project engineers.** The project engineers (BPA, utility, or ESI) are another possible source of data. As needed, we will contact them by telephone or email to obtain information needed for the evaluation that was not found in the project files. These discussions will also inform practical strategies for minimally intrusive data collection from end users, and to clarify history and circumstances at the site. We will also discuss how operations may have changed as a result of the ongoing COVID-19 pandemic and if they were expected to impact savings calculations.
- **Telephone/email discussion with end users.** In some cases, it may be necessary to obtain information from the end user via telephone or email contacts. Discussions may be with operations staff or vendors to gather data baseline and post-installation conditions of affected buildings, systems, and equipment. We will also discuss how operations may have changed as a result of the ongoing COVID-19 pandemic. When necessary, these communications will be used to plan site visits or remote data collection.
- **Site visits.** Based on the file review and discussions with internal engineers, we may determine that more information is needed from inspection of affected systems and equipment, in-person interviews with operation staff, review of electrical and mechanical plans, inspection of control settings, review of manufacturers' specifications, and one-time measurements. Onsite visits may not be possible due to the COVID-19 pandemic. For projects where site visits are not possible, we will develop a more robust data collection survey that can be administered via telephone and e-mail with the appropriate end user and vendor staff. This may include greater reliance on file review findings, customer staff providing as-built plans and specifications, control system trend data and screen prints, or taking photos or videos and sending them to the evaluation team.
- **Affected system trend metering.** For custom projects, if there are insufficient trend data of critical systems to verify savings, additional metering data will be collected. In most cases, this will come from on-premise electric metering and other interval data correlated to savings such as air temperature or production levels. Interval premise data may be collected from existing onsite instrumentation or from instruments installed by evaluators and onsite operations staff. Where onsite visits are not possible, we will implement a metering plan with the assistance of onsite staff. These plans will leverage existing metering and onsite staff with the skills necessary to install preconfigured data logging equipment.
- **Billing data or interval premise trend metering.** It may be possible to evaluate savings from an end user's monthly billing data collected by the utility. Some end users may have the capability to log finer intervals of site energy consumption for this analysis.
- **Weather.** If weather data from the file review are not adequate, actual and/or typical meteorological year (TMY) weather data will be acquired for the most appropriate National Oceanic and Atmospheric Administration (NOAA) weather station.
- **Cost effectiveness parameters.** To estimate measure cost effectiveness, we collect data for measure life, incremental costs, non-electric energy use, and non-energy benefits. We rely on data found in file reviews; these will only change if there is compelling evidence found during evaluation. We will not reach out to end users solely about cost effectiveness

parameters. Other cost effectiveness parameters including discount rates, administrative costs, and avoided energy costs will use BPA-provided or, if necessary, default RTF values.

CUSTOM MEASURE ANALYSIS

We will estimate savings for sampled custom measures as described below.

SELECT RELIABLE EVALUATION MODEL

Our starting point in estimating savings is a review of the M&V model. The first step is to determine whether the M&V model conforms to the BPA M&V protocols and RTF Guidelines. It is important to note that determining compliance with a BPA M&V protocol is just the first step in reviewing an M&V model. The BPA M&V protocols and RTF Guidelines provide guidance on general approach and specific examples, but they do not provide detailed specifications for every type of efficiency improvement and affected system or equipment. Once M&V protocol compliance and best practices are determined, we will then examine the savings calculations in more detail to determine whether they provide the best practical estimate of savings.

We will conduct the model review during the file review. During this review, we will determine, relying on professional engineering judgment, whether the model, if provided with reliable input data for the savings determinants, will provide sufficiently reliable estimates of savings. An unreliable model would have a high likelihood of greater than 20 percent difference in the overall savings because of misspecification. For example, if a small variable frequency drive (VFD) measure in an industrial plant relied on whole-facility billing analysis to estimate the savings, we might consider this application inappropriate because of its high unreliability. As part of the evaluation, we would specify an evaluation model—such as post-metering for several weeks applied to manufacturers' pump curves—that would be more likely to provide reliable savings. The outcome of each model review will be a decision on whether to use the M&V model or replace it with another model when we estimate savings for the evaluation. This decision will affect what is done in subsequent steps described below.

Other areas germane to the model review include whether or not the M&V model addresses significant measure interactions, and whether or not it adequately establishes the proper baseline (current practice or pre-condition as defined in the RTF Guidelines[11] and the BPA M&V protocols). We will consider interactions significant if it is likely that the interactive effect exceeds 10 percent of the measure savings.

If the M&V model is determined to be reliable, then we will adopt it as the evaluation model, and improve its input data if necessary. If the M&V model is found to be unreliable, and thus not suitable to serve as the evaluation model, then we will either enhance or replace it. Enhancement would likely mean adding or replacing certain features, such as measure interactions, while replacement would entail a wholesale change in approach, such as using the Excel-based Energy Charting and Metrics (ECAM) tool instead of a bin model.

The approach above assumes that adequate measure information is available, and that in particular, data and analysis files are transparent and accessible. For example, if an M&V model is only available as a PDF file, then it is generally impossible for the evaluation team to assess the underlying algorithms and formulas for appropriateness and accuracy. In such a situation, it may

[11] Regional Technical Forum Operative Guidelines for the Assessment of Energy Efficiency Measures: https://nwcouncil.app.box.com/v/2018RTFOperativeGuidelines

become necessary to get further supporting details from knowledgeable staff, reconstruct the original model, or build an alternative one. Consequently, missing or inaccessible M&V models and supporting data can lead to significant costs, not only for the evaluation team to develop models from scratch and reproduce data where feasible, but also in terms of additional data collection burdens on customers. When we encounter instances where the M&V model is not functional to account for changes in savings due to evaluation findings, we will work closely with BPA, ESI, and/or utilities to obtain the necessary information.

ASSESS DETERMINANT RELIABILITY

Once the evaluation model—either the M&V model or a more reliable replacement—has been selected, we then must consider each of the model inputs and determine what level of data collection is needed to support a sufficiently reliable savings estimate, as well as data collection needed for as-expected operating conditions. In general terms, as laid out in the RTF Guidelines, key determinants of savings include, but are not limited to:

1. Hours of operation
2. Equipment efficiency at full and part-load operation
3. Control sequence and settings
4. Outside air temperature or other weather parameters
5. Production rate and schedule
6. Building occupancy
7. Time of day

During the file review, we will develop a list of critical determinants for that particular project, where critical is defined as having a significant (possibly 10 percent or more) impact on the calculated savings. We will then find the corresponding values used in the evaluation model, assess the data and/or documentation underlying those values, and determine whether we consider those values reliable. This will involve some engineering judgment. To the extent that sampled measures involve similar systems, equipment, and modeling techniques, we will ensure that consistent judgments are applied.

For instance, we may determine that hours of operation are a critical determinant for a fan control measure at an industrial facility with a weekly schedule. If the evaluation model incorporated pre-and-post metering for two weeks on a random selection of affected fans, then we may conclude that the determinant value is reliable. However, if the metering only spanned two hours, we may conclude it was unreliable, and therefore, additional onsite metering would be necessary to develop a reliable determinant value. For each measure, we will document our rationale for establishing whether determinants are reliable or not, and how the reliability will be improved if necessary. We will compare across sampled measures to ensure consistency, as well as to identify overarching trends and issues.

We will also verify determinant reliability in cases where energy efficiency performance was impacted by the COVID-19 pandemic. In the described case of a fan control measure, the facility may have added a shift due to increased production for pandemic-related essentials. We will assess determinant reliability for both the actual and as-expected scenarios.

For unreliable critical determinants, we will assess what level of data collection involving the end user would be necessary to obtain reliability for that determinant. In order of cost and complexity, these levels would be (1) telephone/email interview, (2) site visit, and (3) metering. The highest

level across all unreliable critical determinants would then determine the level of data collection for the measure.

COLLECT SUPPLEMENTAL DATA

Based on the previous step, we will determine the data collection approach for each sampled measure that will establish how data for each critical determinant are to be obtained. After our initial review, we will prepare questions, data, and model requests for key personnel. This approach may be incremental and iterative depending on availability of information and new findings, beginning with internal engineering personnel and may include utility staff, vendors, and customers. The iterative approach will adhere to the contact protocols outlined in Appendix A. Our general intent is to use the least costly and intrusive approach to obtain sufficiently reliable values—starting with telephone interviews, proceeding to a site visit if necessary, and then performing metering in the most critical instances. If data or models cannot be produced, the best available information will be used, and new models will be created for savings evaluation.

It is conceivable that certain measures could require extended metering. Hypothetical examples include (a) a fruit processing facility with seasonal production schedules, or (b) a complex HVAC controls project that requires separate summer and winter data sets to assess cooling and heating performance, respectively. Such instances would likely be rare and would be kept to a minimum because of the inconvenience to the end user, as well as the cost to the evaluation.

The data collection approach will vary based on the types of data to be collected prior to and during the site visit. For example, a site visit may involve interviews to find out about production seasons, coupled with collection of nameplate data and short-term metering. We will structure our approach to collect data efficiently, with minimal impact on the end user. The approach would also include unit sampling in situations where the measure consists of many pieces of equipment.

RUN EVALUATION MODEL

If the M&V model is deemed appropriate to serve as the evaluation model, and the critical determinant values are deemed reliable, then this step will essentially be a quality control check. If the file review uncovered any clerical or procedural errors that led to a mistaken savings value being reported, then those errors will be corrected, and the proper values will be recorded for this evaluation. If a functioning savings model is not made available to the evaluation team, a new model will be developed instead of adjusting an existing savings model. These new models will be provided to the BPA evaluation team for review. Evaluated savings will consist of running the new or existing evaluation model with as-found reliable determinant values and as-found baseline operation conditions obtained through evaluation data collection.

To account for changes in savings resulting from the global COVID-19 pandemic, savings will be calculated based on as-operated conditions described above, and expected conditions had COVID-19 not occurred. The intent is to also estimate what savings would have been in a non-pandemic year. In cases where savings are unchanged, the savings for both scenarios will be identical. We will search for self-reporting of COVID-19 impacts during file review, and inquire further if necessary, during the phone/e-mail interview steps. We will be investigating operational impacts such as: temporary or permanent facility closure, changes in operating schedule, added or removed work shifts, increased outdoor air in HVAC schedules, and any other major operations change where a savings impact greater than 5 percent is expected. For example, a hypothetical plastics production facility with new injection molding machines produces 10,000 parts per day of PPE equipment. The savings is a function of the number of parts made and reduced energy consumption per part. The evaluated efficient case and baseline will use 10,000 parts per day for the model. Prior to the

pandemic, this facility planned to make 5,000 parts per day. We will apply the same savings model with a baseline and efficient cases producing 5,000 parts per day as the planned savings model.

ESTIMATE SAVINGS USING ENGINEERING CALCULATIONS WITH VERIFICATION (ECWV)

We will also use an ECwV protocol to estimate savings for each sampled measure. Our lead engineer for the site will create a version of the site data that contains only the data needed for ECwV. In general, this will eliminate trend data obtained from sub-metering and any conclusions reached by the analysis of such data. It may also be necessary to substitute a different savings estimation model. Our team will use the ECwV model to estimate savings and compare that to the best practical evaluation model results as well as the BPA ECwV estimate, where available. We will determine the relative reliability of the two estimates. To account for changes in savings resulting from the global COVID-19 pandemic, savings will be calculated both as first year actual, and based on expected/planned operations (pre-COVID).

TREATMENT OF INTERACTIVE MEASURES

Savings achieved by one measure can affect the savings of another measure in the same project—for example, an HVAC upgrade and envelope improvements that affect the same spaces within a building. The change in envelope would reduce heating and cooling losses. How much is saved by the HVAC upgrade could be significantly lower without the envelope change. Thus, the order in which savings are estimated can make a difference for two measures (i.e., unique Technology/Activity/Practices at a single site). If the two improvements occur as part of separate projects that were completed at different times, this should not be an issue for this evaluation. Whichever measure we sample, we will account for the baseline conditions of the affected systems and equipment. If the HVAC is sampled and the envelope improvements happened first, our evaluation model will capture the envelope characteristic as part of the baseline conditions.

A problem may arise if one or more projects are completed at essentially the same time. Using information from the reporting system, we will determine whether this occurs for any of the measures in our sample. If it does, we will obtain documentation for all the interactive measures at the site so that we can determine how the M&V models accounted for the interactions. We are looking for the measure order that was assumed in estimating each measure's savings. We will use the same measure order in estimating the evaluation savings.

TIME-BASED VALUE OF SAVINGS AND COST EFFECTIVENESS

There are a number of strategies for characterizing the time-based value of savings for the sample of measures. For this evaluation, we will assign load shapes to individual measures, as the current custom project calculator uses load shapes by sector. Using ProCost, we will assign each measure, via its BPA TAP reporting code, to one of the RTF savings shapes. We will then calculate cost effectiveness and peak savings based on the generic calculator and project-specific ProCost analyses and report on any differences.

STUDY AND DOMAIN ANALYSIS

Once data collection and analysis are complete for the sample, we will compile a workbook containing all of the individual site level quantitative outputs and qualitative findings about key

drivers for deviations between evaluated savings and original savings estimates.[12] These site-level results will then be used to estimate the electric savings and cost-effectiveness for the domain and individual end uses within the domain using a ratio analysis. The current sample is stratified and designed to provide results for each of these end uses individually:[13]

- Compressed Air
- HVAC
- Motors/Drives
- Process Load
- Refrigeration

For custom measures with engineering calculations with verification (ECwV) protocol savings estimates, we will also determine when the ECwV protocol provides a reliable estimate of savings.

The ultimate output of the domain-level analysis is a series of tables and graphs in the report with the domain savings realization rates and cost-effectiveness, uncertainty around these quantitative results, sites within the sample that are driving these results, and any other key drivers of the results (e.g., three sites of X end use demonstrated a problem with baseline determination – if these baseline assumptions had been 100 percent correct, the realization rate for X end use would have been 20 percent higher). The domain analysis utilizes the site-level results to tell a larger story about what was observed and why savings deviated from our expectations; it will then be used as supporting evidence for our recommendations for the domain as a whole.

FIRST-YEAR KWH SAVINGS

We will estimate first-year savings for the domain and each end use based on the evaluation model results for the sample. Stratum-level realization rates will be extrapolated to estimate savings for the remaining population within each stratum. Evaluated and estimated savings for the individual strata will be summed to estimate the overall domain results, enabling us to calculate an overall domain-level realization rate. Results will be calculated and presented both with and without corrections for COVID-19-induced changes to operating behaviors.

RELIABLE SAVINGS FROM ECWV

As described above, we will prepare two estimates of savings for each custom measure in the sample. We will then compare the two savings estimates and examine the assumptions within the ECwV model and its inputs to assess the relative reliability of the ECwV estimate to answer these questions:

1. **Can the ECwV method be implemented to deliver both unbiased[14] and precise[15] estimates of savings?** In the domain analysis, we will compare ECwV-evaluated results

[12] This workbook will be available for BPA review as a non-public data Appendix accompanying the report.
[13] In BPA taxonomy, TAPs roll up into end-use groups. Therefore, where feasible, the evaluation will attempt to roll up results into end uses for additional insight to BPA. There is insufficient sample to achieve 90/10 for each end use. However, the results by end use will allow us to investigate whether savings uncertainty is related to measure type versus project size.
[14] Confirm total evaluated savings across sample for ECwV protocol are the same as for regular evaluation.
[15] Confirm individual measure-level ECwV and regular evaluation estimates correlate well.

against regular evaluated results to determine whether there are systematic differences between evaluated results and ECwV results and enumerate the most influential drivers of those differences observed in the individual site results.

2. **Are there issues with how BPA applied ECwV protocols?** For projects that received a BPA-implemented ECwV estimate, we will compare both ECwV evaluated results and non-ECwV evaluated results. This will include applying the Protocol Selection Guide found on page 9 of the BPA M&V Protocols Selection Guide[16] and noting whether or not ECwV was applied according to the Guide. Depending on the exact number of projects that we get with BPA ECwV estimates and the size of the difference between BPA-implemented ECwV and evaluation-implemented ECwV, we may or may not observe statistically significant differences for the domain as a whole. In any case, we will enumerate the most influential drivers of the differences observed in the individual site results to identify opportunities for improvement.

Based on these findings, we will develop guidelines for when the ECwV model will provide sufficiently reliable savings estimates, including consideration of any potential changes to the current threshold of 200,000 kWh. We will also provide recommendations for changes to BPA application of ECwV protocols.

DOMAIN TIME-BASED VALUE OF SAVINGS AND COST EFFECTIVENESS

In addition to first-year savings, the team will extrapolate individual project impacts and cost-effectiveness results to the relevant stratum, end use, and total domain using the same ratio analysis framework. Lifetime savings, non-electricity impacts, incremental costs, and peak impacts will all be provided in the body of the report or in a cost-effectiveness appendix. While multiple values will be considered for the denominator of the ratio estimation, we will start with first-year savings.

REPORTING

We will prepare a report on each domain as it is completed. The reports will document the methodology, findings, and recommendations of the domain's evaluation. Each report will include findings based on as-operated conditions and expected conditions had COVID-19 not occurred. The reports will not contain any information that could be used to identify the end users that participate in the evaluation. Further, the reports will not contain any utility-specific findings or recommendations.

The reports will be consistent with the content, transparency, and comparability guidance found in the RTF Guidelines and BPA's internal guidance on reporting and recommendations. We expect that the report will have the following structure:

1. Executive Summary
    a. Findings
    b. Recommendations
2. Introduction and Background
3. Objectives

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[16] https://www.bpa.gov/EE/Utility/measurementandverification/Documents/1_BPA_MV_Selection%20Guide.pdf

4. Methodology
    a. Data Collection
    b. Savings Estimation
    c. Delivery Channel and Portfolio Savings Estimation
5. Findings
    a. First-Year kWh Savings
6. Recommendations
    a. Opportunities to Improve M&V Savings Estimates
7. Technical Appendices and Data Products

APPENDIX A: UTILITY & CUSTOMER CONTACT PROTOCOLS

CONTACT PROTOCOLS

The evaluation team will follow general end user and utility contact protocols for each evaluation that requires the team to contact end users and utility representatives. Where utilities must provide data to BPA or where end user customer contact is required, the following communication principles are used:

- Utilities are notified of their projects included in the evaluation prior to the start of evaluation activities and provided with clear information on samples, timelines, and requirements. Utilities may reach out at this time to their customers to notify them of potential future contact by the evaluation team.
- BPA provides opportunities for utilities to understand the details of the evaluation plan and data request.
- BPA gives utilities a reasonable timeline to collect project and billing data, and uses escalation protocols if deadlines are missed, which include the BPA Contracting Officer's Technical Representative (COTR) and Account Executive (AE).
- Evaluation team provides at least one week of notice to utilities prior to any end user contact, including phone surveys and site visits.

UTILITY NOTIFICATION AND WEBINAR

Once the evaluation plan and sample have been reviewed by the BPA evaluation team and the BPA Energy Smart Industrial (ESI) team, the BPA evaluation Energy Efficiency Representative (EER) will notify utilities via email that at least one project in their territory has been selected in the evaluation sample (either the primary or secondary sample). This initial email will request the primary utility contact for the evaluation and will also include an invite to a webinar that includes utility-specific information associated with the evaluation plan.

The evaluation team will also provide detailed information to each utility about their sampled sites through a secured file transfer protocol (FTP); detail will include, for example, custom project ID, utility-assigned ID, project name, facility name, address, completion date, sampled measure (TAP), invoice number, and whether the site is primary or secondary sample.

PROJECT DOCUMENTATION OR BILLING DATA REQUESTS

BPA (and its contractors such as Energy Smart Industrial) will provide the evaluation contractor all relevant project information it has, including custom project completion files and COTR oversight documents.

If any additional information is needed beyond the available information, such as project documentation or billing data,[17] the utility will be emailed by the evaluation team (with cc's to the BPA evaluation lead and evaluation EER), and the needed files will be requested for individual projects. We expect this to be done for a small number of Option 1 projects, on an ad hoc basis as the need arises. The evaluation team will strive to combine these requests for utilities. Billing data

[17] Billing data refers to energy consumption data by customer and premise for relevant participants. Depending on the project being evaluated, the evaluation team may request billing data for the site, on an as-needed basis.

will be requested using a data template Excel workbook. This workbook will include instructions, an example, the data template to fill out, and contact information for any questions that arise. Any utility submitting data directly to the evaluation team may negotiate and execute with the evaluation team a non-disclosure agreement that meets the utility's requirements for protecting end user information. BPA's contract protects data under the language of BPA's existing contract with the evaluation firm.

While the focus will be on the required documentation or billing data, utilities may provide whatever additional data they collect to the evaluation team.

The evaluation team will provide a timeline for file delivery (typically two weeks). The utility (or BPA, if requested by the utility) will upload required files to a secure website. The evaluation team will work with utilities individually to support its data request as much as is feasible, including providing support staff to collect (scan and upload) paper files and other tasks. An extended delivery date may be requested and will be accommodated, if possible.

In order to provide timely and actionable evaluation results, the team has created an escalation protocol to be initiated should data collection efforts become significantly delayed and pose an impact to the schedule. The protocol is as follows:

1. As noted above, initial data request emails are to be sent by the evaluation team to utility contact with a copy to the evaluation EER and evaluation lead.
2. If a utility requests more time, within the agreed-upon time limit, the utility EER and utility COTR are notified by the evaluation lead.
3. If a utility misses the deadline, then the evaluation EER, utility EER, COTR, and AE are notified of the missed deadline. The utility EER and the utility AE will discuss an approach to the data collection, including potential escalation to utility management.

CONTACT OF INTERNAL PROJECT ENGINEERS

Following file review, the evaluation team will contact the internal (i.e., BPA/ESI/utility) project engineers to learn more about the project, on an ad hoc basis by the evaluation team. The discussion with the internal project engineer will:

- Answer questions regarding the project or files.
- Obtain information needed for the evaluation that was not found in the project files.
- If end user contact is required, discussion will inform the evaluation team on the history of the project and circumstances at the site and to identify the least intrusive approach for obtaining data needed by the evaluation.

PHONE SURVEYS OR SITE VISITS OF END USERS

If phone surveys or site visits are utilized, the evaluation team lead engineer will notify the utilities at least one week prior to any end user contact and provide them with a general description of information to be collected from the site. The phone survey will collect relevant information and determine the necessity of site visits. The feasibility of onsite visits will be at the discretion of the customer and the evaluation team. BPA will provide materials to support any advance contact they would like to make with end users, such as advance letters, email, or a phone call script. BPA will also provide a set of potential frequently asked questions to minimize any potential concerns by the end users.

Evaluation engineers will follow reasonable safety and privacy requirements set by end users. This includes safety training, personal protective equipment, and health screenings. Non-disclosure

agreements will be executed between Evergreen Economics and the end user as needed. The site visit will not proceed until all reasonable end user requirements for an onsite visit have been met.

SITE SPECIFIC RESULTS

If Evergreen Economics receives a request from an end user for the site-specific study results, they will respond by saying "Please contact your utility for detailed evaluation information." They will notify the utility of this request (with a cc to BPA embedded EER and the BPA evaluation team lead) and the utility may provide the site-specific results at their discretion. Once the evaluation work is complete for each utility's sampled projects or measures, and Evergreen Economics is ready to begin work on the draft report findings, Evergreen will notify the utilities that the site-specific results are ready for them to provide to end users. The findings will be contained in an Excel workbook for each measure studied. A secure download link to the site workbooks will be emailed to utilities if they request to see the results.

APPENDIX B: STAKEHOLDER PLAN

We provide a stakeholder plan PowerPoint slide deck as a separate file; this file outlines general stakeholder types and needs, stakeholder teams, primary sources of evaluation information and communication, and evaluation deliverables.

APPENDIX C: DOMAIN 1 SAMPLE

Table 5 provides the number of distinct customers (by site address and utility ID number) from each serving utility that we have selected for our primary sample and the number of additional backup sites. The backups will only be utilized if the primary contact is unavailable. Some of these customers have installed multiple measures, from one or more end use strata.

Table 5: Customers Sampled by Utility

Serving Utility	*Primary*	*Backup*
Benton PUD	1	
Benton REA	1	1
Central Lincoln PUD	1	
Centralia	1	
Clark PUD	3	2
Columbia REA	1	
Columbia River PUD	1	
Coos-Curry	1	
Cowlitz	6	2
Ellensburg	1	
Flathead	1	
Forest Grove	1	
Franklin PUD	2	
Glacier	1	
Grays Harbor PUD	2	
Heyburn		1
Hood River	1	
Jefferson PUD	1	
Lakeview		1
Lewis PUD	1	
Mason PUD3		1
No Wasco PUD	1	
Northern Lights	1	
Richland	1	1
Tillamook PUD	1	
Umatilla	5	
US Navy	1	
Total	**37**	**9**