

## MEMORANDUM

To: Technical Advisory Committee (TAC)  
From: Focus on Energy Potential Study Team  
Subject: Potential Study Data Collection Sample Design  
Date: August 10, 2016

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This memo provides the final data collection sample design for the Wisconsin Focus on Energy potential study. This design is based on feedback and information received from TAC members. Our design is broken out by these sectors: residential single family and manufactured homes, residential multifamily, commercial and schools/government, industrial, and agricultural.

### *Overview of Sampling Plan*

We have requested utility data and will be drawing from their customer databases to recruit participants for this data collection effort. Table 1 represents Cadmus' final sampling plan for each sector, and for both data collection tasks (site visits and phone or web surveys). The following sections of this memo provide Cadmus' sampling methodology and details of our approach for each sector. This includes details of each survey (as identified in Table 1), confidence and precision, coefficient of variation (CV), and overall approach. Cadmus' data collection effort will seek to produce estimates that achieve 90% confidence with  $\pm 10\%$  precision for the key market segments for residential and commercial (and school/government) sectors. Based on the study priorities and budget allowance, our target for industrial and agriculture will seek to produce estimates that achieve 90% confidence with  $\pm 12.5\%$  precision for the identified market segments.

Each data collection activity is defined below:

- **Site Visit:** A site assessment will collect comprehensive information on building characteristics, energy-consuming end uses (i.e., HVAC equipment, lighting inventory, server room closets, etc.), and equipment efficiencies.
- **Detailed Survey:** A phone survey or web survey (depending on the availability of email information from utilities) will collect information on building characteristics, demographics, and general information on energy-consuming end uses such as fuel type, equipment type, and estimate equipment age. In addition, we will collect information on the customers' attitudes

towards energy efficiency and willingness to adopt efficiency measures. The typical length for a detailed survey would be 15 to 20 minutes.

- **Short Survey:** A phone survey or web survey will be limited to only general building characteristics, demographics, and customers’ attitudes towards energy efficiency and willingness to adopt efficiency measures. The detailed equipment data will be collected as part of the site visits instead of over the phone. The typical length for a short survey would be 5 to 10 minutes.
- **Expert Interview:** A phone interview with industrial subject matter experts (specific industry experts) to assess general baseline data. These industry experts have backgrounds in pulp and paper, ethanol, metal manufacturing, general process manufacturing, food manufacturing, and refrigeration. The typical length for an interview would be 20 minutes.

**Table 1. Final Sample Design by Segment Type**

Sector	Segment/Strata	Site Visit Sample	Detailed Characterization Survey Sample	Short Survey (Willingness to Pay) Sample	Expert Interview Sample
Residential	Single-Family and Manufactured	100	0	100	0
	Multifamily	70	0	70	0
Commercial and School/Government	School K-12/Universities	70	0	70	0
	Commercial and Government Offices	70	0	70	0
	Other	0	70	0	0
	Grocery (Supermarket/Convenience)	0	70	70	0
	Health Care (Hospitals/Out Patient)	0	70	0	0
	Lodging	0	70	0	0
	Restaurant	70	0	70	0
	Retail	70	0	70	0
	Warehouse	0	70	0	0
	Industrial	Large Industrial (>1 MW)	0	0	Up to 70
Small Industrial (<1 MW)		Up to 45	0	0	
Agricultural	Dairy	Up to 45	70	0	0
	Other	0	70	0	0
<b>Total</b>		<b>540</b>	<b>490</b>	<b>520</b>	<b>Census</b>

## Sector and Segment Sample Design Approach

### Residential Single Family and Manufactured Homes

Cadmus will leverage Focus' *Residential Longitudinal Lighting Study* to collect additional information from approximately 100 single family homes (estimate includes attrition from the original sample). While on site Cadmus will already be collecting sufficient lighting data to inform the potential study. Cadmus will collect other additional data such as mechanical equipment, appliances, building shell, electronics, and other equipment categories identified in "WI Site Visit Primary Data Collection Items.xlsx". This is a low-cost solution for the potential study, as Cadmus already planned for these revisits under the current evaluation.

Manufactured homes represent a relatively small portion of Wisconsin homes (approximately 4% according to Census housing data). Cadmus plans to use primary data from the *2016 Minnesota Manufactured Homes Characterization Study*<sup>1</sup>. This study included a telephone survey of roughly 600 manufactured households and detailed on-site data collection at another 100 manufactured homes.

Cadmus will conduct phone or web surveys to assess customers' willingness to adopt energy efficiency measures, their attitudes on energy conservation, and additional general building characteristics from a random sample of single family and manufactured homes.

Cadmus' residential single family and manufactured homes sample design is presented in Table 2. As stated earlier, we are aiming to achieve 90/10 for each key market segment/strata to account for detailed characterization of the major equipment and shell categories. However, we are not aiming to have 90/10 on specific technology categories like heat pump efficiencies since a small portion of the population in Wisconsin have heat pumps.

**Table 2. Residential Single Family and Manufactured Homes Sample Design**

Segment/Strata	Data Collection Type	CV*	Sample Size	Confidence Level	Estimated Relative Precision
Residential Single Family	Site Visit	0.6	100	90%	±10%
Residential Single Family and Manufactured Home	Short Survey	0.6	100	90%	±10%

\*In a recent study for Northwest Energy Efficiency Alliance's (NEEA) 2011-2012 Residential Building Stock Assessment, Cadmus found that the average CV for single family home types was approximately 0.6. We propose to use this CV to best capture variability within this home type.

### Residential Multifamily

Multifamily data can be difficult to collect via phone/web surveys, since tenants often do not know the details of the building and mechanical characteristics. Upon review of all the secondary data available (such as the 2012/2013 Minnesota Multifamily Characterization Study and program data), Cadmus concluded that we require primary data be collected through on-site visits.

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<sup>1</sup> Final report expected to be released in September 2016.

The residential multifamily sample design is presented in Table 3, with the sample size of 70 representing the minimum number of buildings to be sampled to achieve the desired confidence and precision targets. Cadmus will determine the number of sub-units to sample per building according to resident response rates and the availability of residential units for measurement. In prior studies, we have typically sampled between one and three units per building. The determination of how many units per building will depend on availability and time – and not necessarily proportional to the size of the building. Where there are multiple buildings we will randomly select one and capture data. Depending on the utility data available, we may further stratify the multifamily sector by the distribution of energy sales (e.g., small and large energy use), which can be used as a proxy for building size. This will account for differences found in small (4-9 unit), medium (10-30 unit), and high rise (31+) properties.

**Table 3. Residential Multifamily Sample Design**

Segment/Strata	Data Collection Type	CV	Sample Size	Confidence Level	Estimated Relative Precision
Residential Multifamily	Site Visit	0.5	70	90%	±10%
	Short Survey	0.5	70	90%	±10%

### Commercial and School/Government

We will combine the primary data collection effort across both commercial and school/government sectors since the building types overlap. With that said, the commercial and school/government sectors contain a diverse set of segments with various building characteristics, end uses, and building sizes. Based on our analysis of the utility data and conversations with TAC members, office, retail, education (K-12 and universities) and restaurants are segments with large overall population and energy sales that would benefit from more granular data collection. For the remaining building types (such as health care, grocery, lodging, warehouse, and other), we will conduct detailed phone or web surveys to gather baseline information. Table 4 presents the commercial and school/government sample design.

**Table 4. Commercial and School/Government Sample Design**

Segment/Strata	Data Collection Type	CV	Sample Size	Confidence Level	Estimated Relative Precision
Commercial and Government Offices	Site Visit	0.5	70	90%	±10%
	Short Survey	0.5	70	90%	±10%
Retail (Big box, small retail, etc.)	Site Visit	0.5	70	90%	±10%
	Short Survey	0.5	70	90%	±10%
School K-12/Universities	Site Visit	0.5	70	90%	±10%
	Short Survey	0.5	70	90%	±10%
Restaurant (Sit down, fast food, etc.)	Site Visit	0.5	70	90%	±10%
	Short Survey	0.5	70	90%	±10%
Health Care (Hospitals/Out Patient)	Detailed Survey	0.5	70	90%	±10%
Lodging (Hotel, motel, B&B, etc.)	Detailed Survey	0.5	70	90%	±10%

Segment/Strata	Data Collection Type	CV	Sample Size	Confidence Level	Estimated Relative Precision
Grocery (Supermarket/Convenience)	Detailed Survey	0.5	70	90%	±10%
Warehouse (Refrigerated and non-refrigerated warehouse)	Detailed Survey	0.5	70	90%	±10%
Other (Assembly, museum, religious, airport, etc.)	Detailed Survey	0.5	70	90%	±10%

## Industrial

It can be very challenging to gather meaningful primary data from the industrial sector, due to the diverse number of industries within Wisconsin and budget constraints. Cadmus plans to identify small industries of less than 1 MW to conduct a random sample of 45 site visits and will apply the primary data collection results across small segments. We will stratify the larger industries of 1 MW or greater; based on feedback from the LEU Program, these sub-segments would likely be pulp and paper, food manufacturing, primary metals, ethanol, machinery, plastics, and water/wastewater. For LEU participants, Cadmus will leverage existing LEU audit data, the Focus *Industry Energy Best Practice Guidebooks* (for metal casting, plastics, ethanol production, pulp and paper, water/wastewater), and the U.S. Department of Energy Industrial Assessment Center data. In addition, we will interview subject matter experts (specific industry experts) to assess general baseline data within these large energy users. Table 5 presents the industrial sample design.

**Table 5. Industrial Sample Design**

Segment/Strata	Data Collection Type	CV	Sample Size	Confidence Level	Estimated Relative Precision
Large Industrial (>1 MW)	Interview	-	Census (~5 to 10)	-	-
Small Industrial (<1 MW)	Site Visit	0.5	45	90%	±12.5%
Large & Small Industrial	Short Survey	0.5	70	90%	±10%

## Agricultural

Cadmus' general approach for the agricultural sector is to focus on dairy as the primary segment for site visits. We based this decision on two factors: (1) dairy is the largest agricultural segment and (2) there will be less seasonality constraints with visiting dairy sites in the summer and fall than visiting crop/irrigation farms. We will supplement the site visit data with phone surveys for all agricultural segments.

Table 6 presents the agricultural sample design. We are also considering installing light loggers at dairy farms to enhance hour-of-use assumptions for the Technical Reference Manual, improve the evaluation process, and support the potential study.

**Table 6. Agricultural Sample Design**

<b>Segment/Strata</b>	<b>Data Collection Type</b>	<b>CV</b>	<b>Sample Size</b>	<b>Confidence Level</b>	<b>Relative Precision Target</b>
Dairy	Site Visit	0.5	45	90%	±12.5%
All Agriculture	Detailed Survey	0.5	70	90%	±10%