Regional Assessment to Characterize Industrial End-Use Energy Consumption

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ABSTRACT

The Northwest Energy Efficiency Alliance commissioned a team of contractors to conduct the Industrial Facility Site Assessment (IFSA), a research project to quantify and qualify industrial energy consumption. The primary method for achieving this goal was through collection of end-use energy consumption data for industrial facilities throughout the four states in the Pacific Northwest.

The team assessed 82 facilities across 12 industrial sectors. The research categorized consumption for major end uses at each facility, focusing data collection on motor systems, refrigeration, process heating, and steam systems. The team mapped end-use consumption estimates to those from the Manufacturing Energy Consumption Survey (MECS). The MECS provides a standard classification system for end uses which matched the intent of this study, although it relies on nationwide, self-reported data. The team also compared IFSA energy consumption distributions against those from the MECS.

A primary goal of the project was to extrapolate from a large sample size to the regional industrial sector's energy profile. However, because of challenges related to outreach, recruitment, and analysis, the study was not successful in collecting data from a sufficiently representative set of industrial facilities. Even though not a complete success, the IFSA is, to the best of our knowledge, the first study of its kind to collect comprehensive information on this level.

The paper will provide an overview of analysis results and implementation protocols. We also examine challenges faced in drawing representative samples. From this experiential background, we present implementation recommendations for conducting effective industrial sector energy consumption studies.

Background

The Northwest Energy Efficiency Alliance (NEEA) has previously conducted stock assessments of residential and commercial buildings that provide information on the age, characterization, and energy-efficiency potential of each population within the Pacific Northwest. Currently, users of the region's energy consumption data have access to a great deal of information about how industrial facilities use energy to drive production. Nevertheless, these data have some limitations; principally that there is no centralized, comprehensive source of recently collected energy consumption data that represents Northwest industrial sites. For instance, though regional electric motor data collected by Oregon State University can be found in the Northwest Industrial Motor Database (Scott and Lott 2008), the database does not contain information about how energy is used in non-motor applications; there is little information on the management environment in which the energy is used; and there is no information on gas-based energy usage. The data are, in some cases, quite old: having been collected more than twenty years ago.

From 2013 to 2014, NEEA commissioned Cadmus and subcontractors Energy350 and Nexant to conduct the Industrial Facility Site Assessment (IFSA) to obtain equipment end-use consumption and energy management data for the industrial population. The Cadmus team collected and analyzed the information based on protocols it created for sampling, data collection, site contact, data security and confidentiality in conjunction with five working groups made up of regional stakeholders representing electric utility and related energy organizations. The IFSA was intended to provide a comprehensive and regionally representative account of energy usage characteristics in Northwest industrial facilities, which was expected to be useful to a variety of regional stakeholders.

Sample Frame Issues

The sample source for the IFSA study was entitled *Database of Northwest Manufacturers, Nurseries, and Wineries* (Helvoigt et al. 2012) (herein known as Industrial Database). As the report for the database notes, "The database is composed of information on business facilities obtained through InfoGroup[1] and augmented with information on additional business facilities collected through trade associations." The Industrial Database contained data from more than 18,000 facilities in twenty-four industry sectors throughout Idaho, Montana, Oregon, and Washington. The data included the site name, address, NAICS code, facility contact information, number of employees and value of sales. The Industrial Database development team also developed models to estimate annual electricity consumption from a subset of these variables.

The Cadmus team treated each industrial sector as a unique population, as it was unlikely there would be any relationship of energy use across sectors. Based on the feedback from the Sample Design working group, the Cadmus team targeted twelve sectors as candidates for sampling, shown in the final assessed sample in

[1]InfoGroup collects data on businesses and consumers from a variety of sources, including business directories, annual reports, phone books, county courthouse filings, SEC filings, and other sources.

Table **1**. Cadmus, NEEA, and the working group members all agreed that, due to budget constraints, the sample sizes would be too small for the end use consumption results to achieve statistical validity across the entire population for each NAICS code. The team segmented the sample into census (very large), large, medium, and small consumption facilities.

Table 1. IFSA Assessed Sites by Industrial Sectors and Strata[2]

NAICS	Industry Sector	Strata Quantity				Total (n)
		Census (n)	Large (n)	Medium (n)	Small (n)	
311	Food Manufacturing	0	2	5	2	9
321	Wood Products Manufacturing	0	5	4	5	14
322	Paper Manufacturing	0	1	3	5	9
324	Petroleum and Coal Products Manufacturing	0	0	2	0	2
325	Chemical Manufacturing	0	1	3	2	6
326	Plastics and Rubber Products Manufacturing	0	2	2	1	5
327	Nonmetallic Mineral Products Manufacturing	0	1	5	2	8
331	Primary Metal Manufacturing	1	2	1	1	5
332	Fabricated Metal Products Manufacturing	0	3	3	2	8
334	Computer and Electronic Products Manufacturing	0	1	2	0	3
336	Transportation Equipment Manufacturing	0	2	5	1	8
493	Refrigerated Warehousing and Storage	2	1	1	1	5
	Total	3	21	36	22	82

In conducting the study, we identified a number of limitations with the sample frame. The total number we drew to potentially include in the sample represented 506 facilities. Of those, we found that 77 sites were not industrial facilities, 12 sites were identified by an incorrect NAICS codes, 27 sites were inactive (having closed or transferred operations to another location), and four were duplicates. Therefore, nearly one-quarter (23%) of the total sample draw represented sites that were not appropriate for the study.

We compared this value against findings from a 2002 Department of Energy motor assessment study (Weil 2002). That study employed Dun & Bradstreet's *iMarket Marketplace* database as the sample frame. Table 1-5 of that assessment report shows that 1,432 facilities out of 4,468 in the sample (32%) either did not exist or were not qualified for the study. These results indicate industrial sample frames can be problematic and require additional work compared with the level of effort required in residential and commercial assessments.

The Cadmus team also found a large degree of variance between the assumed employment numbers in the InfoGroup sample frame and the actual employment reported by each site. The variance was particularly pronounced at sites for which the sample frame reported

[2] The original assessment target was 120 facilities.

more than 500 employees (eighteen percent of the total sample frame), as shown in

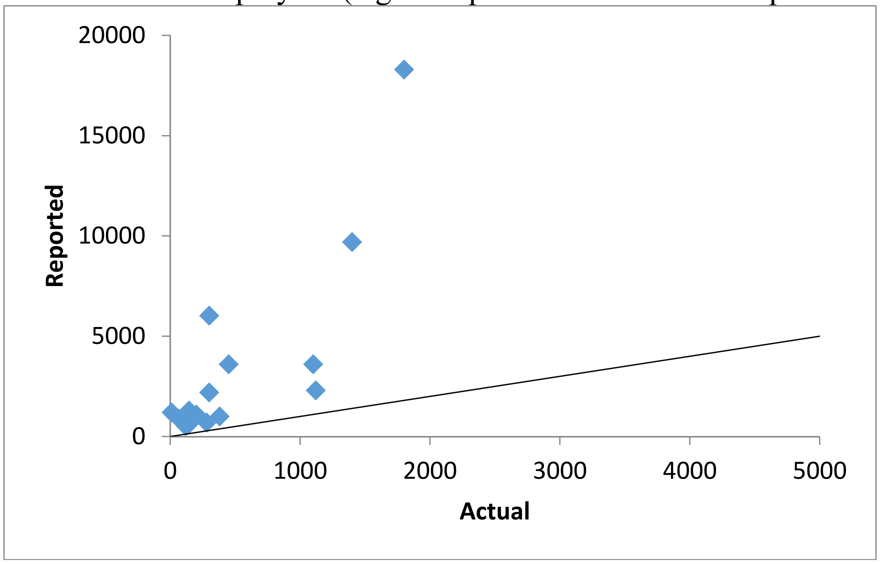


Figure **1**. The actual employment figures were generally ten to twenty percent of the reported value.

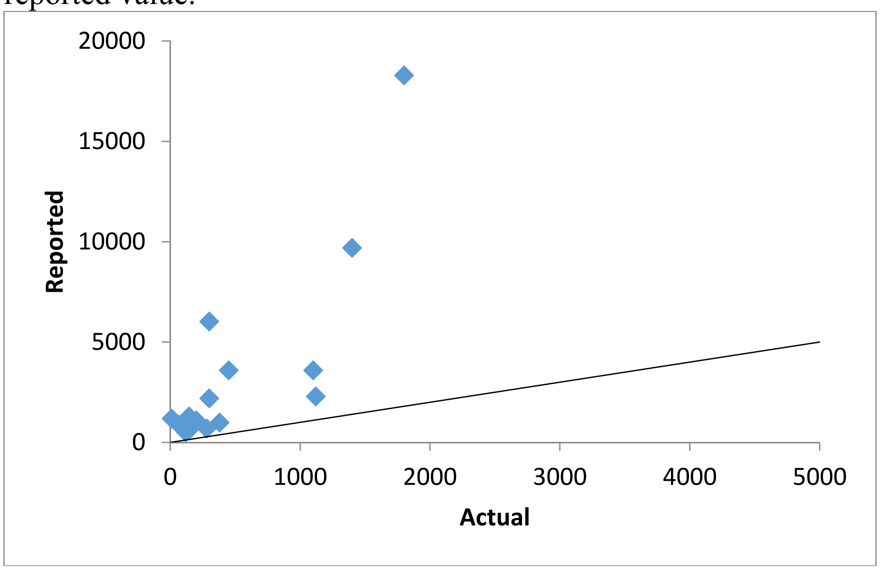
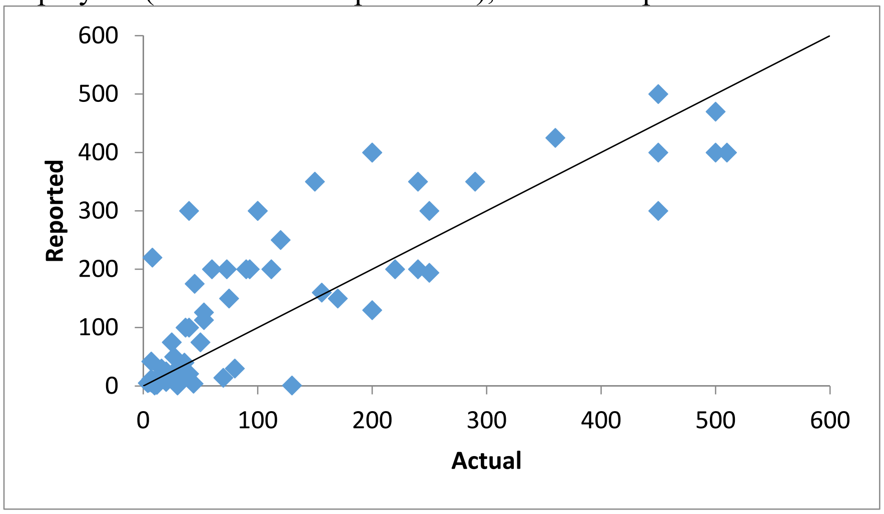


Figure 1. Employee count comparison for sites with more than 500 reported employees. Diamonds represent reported vs. actual employees, while the solid line indicates the hypothetical case in which the reported value equaled the verified value. *Source:* Cadmus 2014.

Though variance was less pronounced at sites for which the sample frame reported fewer than 500 employees (82% of the sample frame), it was still problematic. That comparison is



shown in Figure **2**.

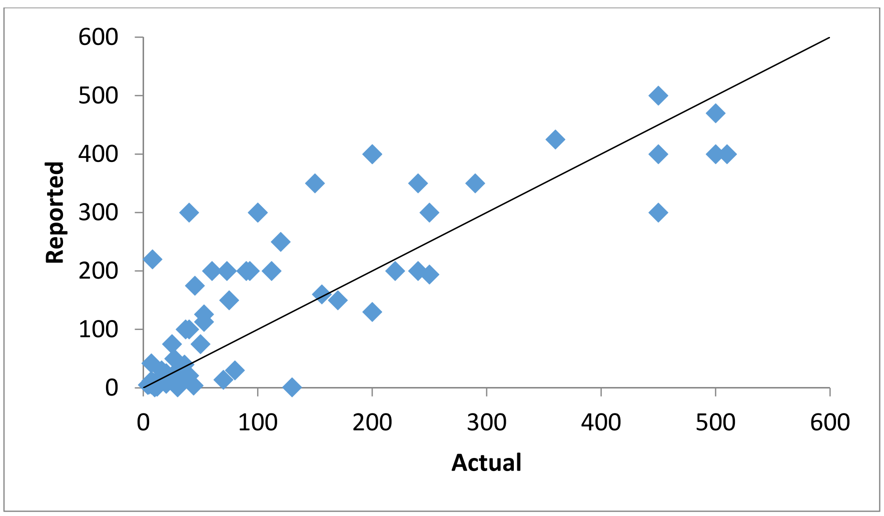


Figure 2. Employee count comparison for sites with less than 500 reported employees. Diamonds represent reported vs. actual employees, while the solid line indicates the hypothetical case in which the reported value equaled the verified value. *Source:* Cadmus 2014.

These results raised concerns for the Cadmus team on the reliability of the sample frame employment and energy consumption projections. The employment projections were one input used to develop the sample frame energy consumption estimates, which also varied by similar margins as the employment estimates. The Cadmus team's original intent was to extrapolate IFSA assessment analysis results from the sample to the overall population based on NAICS code and stratum using the number of employees. We determined this extrapolation would generate unreliable results based on the limitations we identified in the sampling frame, so we did not undertake it. The IFSA analysis results were generally representative of various industry subsector populations, but could not be extrapolated proportionally by employment numbers.

Data Collection Methodology

Through the IFSA, the Cadmus team estimated consumption for major end uses at each facility, focusing on motor systems (compressed air, material processing, material handling, pumps, and fans), refrigeration, process heating systems, steam systems, and cogeneration. These end uses typically represented the majority of energy consumption at each site. The Cadmus team outlined general data collection methods for each end use to input information obtained through the on-site assessments, which were limited to one day or less of data collection. The team relied heavily on data provided by facility contacts, such as motor logs, SCADA[3] data, production data, and submetering data, where available. We did not conduct comprehensive submetering on equipment end uses, as that level of effort was outside the scope of the IFSA.

The Cadmus team mapped the final end-use consumption estimates to end use categories established in the 2010 Manufacturing Energy Consumption Survey (MECS). MECS is a self-reported, sample-based assessment of end-use energy consumption. The MECS provided a standard, widely used classification system for the equipment end-use types under consideration in the IFSA. Using it allowed the Cadmus team to organize end uses in a consistent manner that was readily understood by many Northwest regional stakeholders. The MECS end uses are:

- Indirect Uses-Boiler Fuel
    - Conventional Boiler Use
    - CHP and/or Cogeneration Process
- Direct Uses-Total Process
    - Process Heating
    - Process Cooling and Refrigeration
    - Machine Drive (Pumps, Fans, Compressed Air, Material Handling, Material Processing, and Other Systems)
    - Electro-Chemical Processes
    - Other Process Use
- Direct Uses-Total Nonprocess (e.g., HVAC, Lighting, On-Site Transportation)

IFSA Value Proposition

A major focus of IFSA planning revolved around the value proposition for both the utilities and potential participants. IFSA working group members affirmed that the study results can provide valuable data to the region on industrial consumption patterns. However, they acknowledged that most industrial facilities may not be motivated by that knowledge.

The Cadmus team, NEEA, and the working group members suggested various approaches to create a meaningful value proposition to motivate potential participants. Cadmus condensed the proposed approaches into the following list, which was conveyed to potential participants through a FAQ document.

- Each participating facility received a site-specific report containing results of the analysis. This could be used by the participant to gain a better understanding of how

[3] Supervisory control and data acquisition (SCADA) systems remotely control equipment while also gathering and analyzing operational parameters, such as power consumption.

energy is used within their facility, as well as how it compares to their industrial sector. We included a list of identified energy efficiency opportunities with the site report.

- Participants had an opportunity to discuss potential energy efficiency improvements with an independent engineer who was not a vendor promoting a particular type of equipment.
- The end use consumption analyses could provide better methods for utilities to serve their industrial facility base with targeted efficiency opportunities based on specific sectors.
- The information could also allow the region to more effectively characterize current energy loads, plan to meet future loads, and ideally avoid expensive new power generation facilities that raise utility rates.

Energy Trust of Oregon introduced a financial incentive plan to further improve the value proposition for participants. Energy Trust of Oregon agreed to provide an additional ten percent incentive for participants to implement any one energy-efficiency measure that was identified as part of the IFSA on-site assessment.

The working group did not recommend additional financial incentives as part of the initial data collection protocol. However, during the early stages of IFSA implementation, NEEA added a $250 incentive for each site to participate in the study. NEEA made this retroactive for facilities that agreed to an assessment prior to the incentive's introduction.

Industrial Facility Access Issues

The Cadmus team commenced full implementation of the IFSA study in September 2013. NEEA and the Cadmus team coordinated to provide each utility with the list of sample sites in their service territory. Altogether, the Cadmus team completed 82 assessments out of 262 facilities (31%) that we determined were qualified. In the 2002 Market Opportunities Assessment, the contractor conducted cold calls to facilities based on Dun & Bradstreet contact information, but only completed 254 assessments out of 2,385 qualified facilities (11%). Note that in both studies the remaining sites either refused participation, could not be reached, or canceled their assessments. We believe the IFSA's higher ratio of completed assessments supports the value of the utility-centric contact model we employed.

In many cases, utilities were able to provide facility contact information, arrange conference calls with potential participants, or arrange e-mail introductions. In the case of some sampled sites, the facility's annual energy consumption was too low for the utility to warrant an account manager, and the utility did not have staff members who were directly familiar with the site. In other cases, the utility did not have staff available to conduct initial contact. In both of those situations, the utility provided consent for us to reach out directly to potential participants.

Some participants were resistant to allowing on-site assessments without additional incentives. As noted, NEEA staff approved providing a $250 gift card for each participating facility. The Cadmus team informed the facilities that the gift card was intended to be used to provide a team meal, purchase new tools or equipment, or provide some other reward for facility employees. However, there were no restrictions on how the card could be used. Some facilities became creative with the gift cards. For example, right before Christmas, one facility raffled off the gift card among its employees.

Potential participants displayed mixed reactions to the gift cards. Some appreciated the gesture and thought it appropriate to reward employees for their support of the study. Others said that $250 was a minor amount compared to their annual revenues and was not an appropriately large incentive. While some sites continued to refuse assessments, many still participated even though they did not consider the gift card to be meaningful compensation. One facility even refused the gift card, which they felt was inappropriate. The Cadmus team donated that facility's gift card to charity.

As noted previously, Energy Trust provided a coupon for an additional ten percent incentive to implement any measures identified as part of the IFSA on-site assessment. Several Energy Trust sites still refused to respond or declined to participate, but a large number stated the additional incentive did motivate them to participate. Although we were unable to verify we believe the coupon provided a strong value proposition to increase study participation.

Analysis and Results

The Cadmus team calculated end-use energy consumption through the data collection process and utility bill calibration. For reporting purposes, the team normalized the end use consumption for each stratum and NAICS code by dividing the end use consumption by the number of employees at the facility. The Cadmus team and the working group determined this process was necessary to maintain the anonymity (and associated competitive details) of each facility's consumption, although the team accepted that the normalization process could distort per site end use consumption estimates.[4]

To start, the Cadmus team redefined the NAICS code strata (i.e., census, large, medium and small) based on actual utility billing data, rather than the modeled estimates from the sample frame. Overall facility energy consumption was generally smaller than reported in the sample frame, but most of sites stayed in the same stratum within which they had originally been placed. Occasionally the team found it necessary to reassign a stratum based on a site's actual consumption.

For each NAICS code, the Cadmus team then calculated a weighted average end use consumption for each stratum based on the following calculations. Cadmus multiplied the calculated consumption by number of employees for the various end uses for each facility within a stratum. The team summed the resulting values for each end use, and divided that value by the total number of employees for facilities in the stratum. This resulted in a weighted average consumption for each end use in each stratum.

Cadmus also calculated the weighted average end use consumption for the entire NAICS code using the same process for all facilities in the NAICS code. The team further weighted each sampled facility's consumption by its representation in the overall population. For example, if the team sampled four Medium 332[5] sites out of a total population of twenty Medium 332 sites, each sample point would represent five more sites in the population. We therefore multiplied the impact of the sample by its weight in the population to develop a true weighted average.

The number of sites assessed for each NAICS code was important, as it informed the reliability of consistency level between sites that are assessed. While the results were not statistically valid, a larger number of assessed sites with relatively consistent end use consumptions implied the estimates were more reliable. For instance, the Cadmus team considered the reliability for a NAICS code that had only two sites assessed was lower than the

[4] Cadmus, NEEA, and the IFSA working groups were required to maintain facility confidentiality as a critical component to gain facility trust and gain on-site access. We accepted the normalization issues as a tradeoff.
[5] NAICS 332 is Fabricated Metal Product Manufacturing

reliability for a NAICS code with eight sites assessed. The team considers the data to be informative and useful, despite the lack of statistical validity.

The Cadmus team provided an analysis of the relative consistency of results within each three- or four-digit NAICS code within the sample.[6] The team also provided estimates of the relative level of discrepancy compared with 2010 MECS data. The team proposed three relative consistency levels between sites that were assessed for each NAICS code, as well as three levels of discrepancy between IFSA and 2010 MECS results. These levels were "high", "medium", and "low." The combination of these factors allowed the Cadmus team to assess the relative reliability of results from both IFSA and MECS, and make recommendations on which data source would be most relevant to the Pacific Northwest. These estimates are shown in Table 2. The overall results by NAICS code are shown in Table 3 on the following page.

Table 2. Relative Reliability of Data Sources by NAICS Code

NAICS	NAICS Manufacturing Description	Sites Assessed	Consistency Level within Sites Assessed	Discrepancy Level between IFSA Sites and MECS	Most Reliable Data Source
311	Food Processing	9	Medium	Medium	IFSA
324	Petroleum and Coal Products	2	Medium	High	MECS
325	Chemical	6	Low	Medium	MECS
326	Plastics and Rubber Products	5	High	Medium	IFSA
327	Nonmetallic Mineral Products	8	Low	Medium	MECS
331	Primary Metal	5	Medium	Medium	IFSA
332	Fabricated Metal Products	8	High	Low	IFSA
334	Computer and Electronic Products	3	Low	Medium	MECS
336	Transportation Equipment	8	Low	Low	Neither
493	Refrigerated Warehousing and Storage	5	High	N/A	IFSA
3211	Sawmills and Wood Preservation	3	Medium	Low	IFSA
3212	Plywood and Engineered Wood Products	6	Low	Medium	MECS
3219	Other Wood Products	5	Medium	Medium	IFSA
3221	Pulp, Paper, and Paperboard Mills	6	High	Low	IFSA
3222	Converted Paper Products	3	Medium	Low	IFSA

[6] In consultation with the working groups, we assessed several NAICS codes deemed most relevant to Northwest industry at the four-digit level to obtain more granularity in consumption differences across sub-populations. These NAICS codes were 321 (Wood Product Manufacturing) and 322 (Paper Manufacturing).

Table 3. Energy Use (MMBtu) per Employee by NAICS Code

		Weighted Average Consumption by NAICS Code														
Indirect Uses-Boiler Fuel	Fuel Type	311	3211	3212	3219	3221	3222	324	325	326	327	331	332	334	336	493
Conventional Boiler Use	Natural Gas	90	0	133	0	4,508	0	0	50	0	116	5,616	0	11	23	0
	Electricity	5	18	16	0	77	0	0	1	0	6	0	0	0	1	0
Direct Uses-Total Process																
Process Heating	Natural Gas	19	0	148	0	0	0	63	19	36	186	564	284	6	46	0
	Electricity	0	0	0	0	101	1	20	12	9	5	207	14	8	9	0
	Propane	0	0	0	0	0	12	0	0	0	0	0	0	0	37	0
Process Cooling and Refrigeration	Electricity	31	1	0	0	0	0	0	4	50	0	128	7	0	0	70
Machine Drive	Electricity	156	342	470	469	2,745	56	6	59	327	128	436	76	59	25	22
Electro-Chemical Processes	Electricity	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Process Use	Electricity	1	0	0	0	128	0	0	0	0	0	0	0	0	1	8
Direct Uses-Total Nonprocess																
Facility HVAC	Natural Gas	21	0	0	10	0	93	0	23	4	5	2	56	31	18	8
	Electricity	2	0	0	0	8	1	0	1	6	0	87	13	15	4	1
Facility Lighting	Electricity	11	5	38	65	82	9	4	7	9	17	81	13	6	8	22
Other Facility Support	Electricity	0	0	0	0	0	0	0	0	0	1	0	3	1	0	0
Other Nonprocess Use	Electricity	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Total Consumption																
	Electricity	212	367	524	534	3,041	67	30	84	401	156	938	126	90	48	123
	Natural Gas	131	0	281	10	4,508	93	63	93	40	307	6,182	340	49	50	8
	Propane	0	0	0	0	0		0	0	0	0	0	0	0	37	0
	Total Energy	342	367	805	545	7,549	160	93	177	441	463	7,121	466	139	135	132

Conclusions and Opportunities for Improvement

Through the IFSA study, the Cadmus team completed eighty-two assessments. The team found the study's implementation protocols functioned reasonably well. However, the team found it difficult to achieve the study's goals due to the sample limitations and relatively unprecedented nature of the study in the Northwest.

The final analyses by NAICS code found results that were largely to be expected. For example, the primary driver of energy consumption in sawmills was machine drive systems, specifically material processing motors. The normalized results between strata often featured significant variance, often due to different manufacturing and process requirements between four-digit NAICS codes (e.g., aerospace manufacturing and shipbuilding). Variations in employment between sites in the same NAICS codes (reflecting differences in approaches to production), particularly between strata, also introduced significant differences in the final normalized consumption.

The Cadmus team also compared weighted average energy consumption distributions against those from MECS. We often found the results to be similar in terms of proportion, although consumption comparisons varied according to the size of the IFSA sample for each NAICS codes. In general, the MECS data provided average consumption across a larger number of sites with a wider array of end uses. We found several end uses were not broadly applicable to Northwest industrial facilities. For example, many MECS distributions listed consumption for combined heat and power (CHP), cogeneration, and electrochemical processing. In the IFSA study, Cadmus found several sites employing CHP/cogeneration, but those processes used waste wood products rather than natural gas (as in the MECS data). None of the IFSA sites used electrochemical processing.

NEEA and the Cadmus team identified areas of accomplishment and opportunities for improvement after reviewing the study's implementation successes and challenges. The following represent some of the most significant opportunities for improvement we identified.

NEEA should investigate innovative means of developing a truly regional sample frame that is more accurate and better represents the industrial population. The InfoGroup sample frame limitations made recruitment more difficult and inhibited the extrapolation of sample results to the overall population. During sample draws, the Cadmus team found many facilities that were not manufacturing, misclassified by NAICS code, or inactive. The Cadmus team found sufficient discrepancies between modeled and actual electricity consumption and employment that indicated extrapolation of the results to the overall population could not be performed with reasonable accuracy. Other potential sources of industrial facility data could include the MECS (if the U.S. DOE would be willing to provide that information) or site registration lists from the Departments of Labor in targeted states.

NEEA should consider ongoing efforts to recruit large facilities to provide data for future IFSA efforts. We found it more difficult to recruit larger facilities because they are frequently targeted for utility energy-efficiency programs due to their large consumption and associated opportunities. Therefore, many have already been intensively studied, some had extensive submetering, and most large facility personnel were already aware of how their energy consumption is broken out among various end uses. Several facility contacts expressed concern that the limited nature of the IFSA on-site assessment (one day or less without metering) would yield results that were not reliable. We believe NEEA should consider funding the IFSA as an ongoing effort in conjunction with utility energy-efficiency programs throughout the region, rather than as an intermittent study every five years. Many of these large facilities will continue to receive detailed audits through utility energy-efficiency programs before the next round of the IFSA. These audits represent the best opportunity to gain detailed metering and submetering data the IFSA lacked, while also allowing NEEA to track a wider scope of end-use consumption variables. NEEA could then focus the next round of IFSA primarily on small to medium facilities that have not yet been studied in detail, and which can be more easily assessed in a limited time period without metering.

NEEA should consider expanding the IFSA budget to allow the study contractor to conduct assessments on a larger sample to ensure statistical validity. The study budget provided sufficient depth to develop and test assessment protocols, but was insufficient for a statistically valid analysis of industrial end-use consumption. The 2014 IFSA provided a good start to understanding the challenges and possibilities associated with industrial market characterization. However, a larger budget could support a larger sample size to obtain better representation of the market and extrapolate statistically meaningful results to the overall population. A larger budget could also support better quality data collection through short-term metering and multi-day assessments. The additional budget could also be used to provide incentives for industrial audit contractors to complete data collection based on IFSA protocols, provided to NEEA as interim data.

We determined field engineers should try to work with facility contacts to obtain all data from reliable, available sources in advance to the extent possible. The procedure we used to capture accurate data jeopardized completion of successful site assessments. As noted previously, SCADA trends and facility equipment inventories represent data sources with lower levels of uncertainty in end use consumption estimates. Some facility contacts offered to send the team low uncertainty data to supplement the analysis so that the field engineer would not need to perform an on-site equipment inventory. However, in some cases the facility contact did not provide the data and could not be reached for follow-up. The team therefore could not complete the full analysis and omitted the site from final results. We determined the field engineers should try to work with facility contacts to ensure the SCADA data, digital equipment inventories, etc. are available to download to a secure laptop at the time of the assessment, or uploaded to a secure FTP server. If this low uncertainty data cannot be obtained in advance or during the assessment, the field engineer should consider conducting an on-site equipment inventory supplemented with equipment operator interviews.

For future IFSA efforts, NEEA should continue to engage utility staff members through working groups, webinars, and monthly update meetings. Many times utility staff recognized the importance of the IFSA value proposition for their customers, which translated into support of the IFSA and increased study participation. This was particularly true for facilities that had not previously received energy-efficiency audits, and were therefore expected to possess potentially numerous opportunities for improvement. The Cadmus team found it easier to identify the appropriate contacts and recruit sites in coordination with supportive utility staff than through cold calls or with limited utility support. In any subsequent round, we believe example site reports from the previous IFSA should be shared with staff to highlight the value proposition for their customers. An expanded scope and depth of assessment and analysis may also improve utility staff members' perception of the value proposition.

Bonus incentives helped to increase participation. The Energy Trust of Oregon offered IFSA participants an additional ten percent incentive if they installed an energy-efficiency measure identified through the study's on-site assessment. This provision increased the value proposition for participants, and several said this incentive was their primary motivation for participating in the IFSA. Both the Cadmus team subcontractors served as program delivery contractors for the Energy Trust's Production Efficiency Program. The bonus incentive provided additional motivation for them to recruit potential participants within their geographic service territories. The field engineers were generally able to identify cost-effective energy-efficiency opportunities to pursue through the Energy Trust program. For future IFSA efforts, NEEA should coordinate with supportive utilities that may consider offering a similar bonus incentive. These incentives can spur additional participation in the IFSA study, as well as participation in the utility's energy-efficiency programs.

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