

State-to-State Baseline Comparison to Establish Existence of Market Effects in the Non-Residential Sector

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ABSTRACT

Quasi-experimental state-to-state comparison market effects research to date has been limited largely to the residential sector. Yet there are compelling reasons to believe that mature energy efficiency programs are also having effects on targeted non-residential markets. State-to-state comparison techniques can be adapted to assess market effects in the non-residential sector.

In a recently completed study of the Statewide Wisconsin Focus on Energy Business Program (program) for the Public Service Commission of Wisconsin (PSCW), KEMA assessed the evidence to date of program effects on the non-residential market that are not already being captured by the program tracking and current evaluation activities. This research established non-residential baseline estimates of market effects metrics for Wisconsin, a state with a longstanding energy efficiency program, and Illinois, a state without active energy efficiency programs¹. Supply-side surveys were conducted with the following non-residential market actors: lighting contractors, HVAC distributors, and industrial end-users (variable frequency drive (VFD) market).

The study found compelling evidence of significant market effects from the program in certain target markets. The purpose of this study was not to quantify energy savings credit towards the program's current year contract goals. However the PSCW did consider the preponderance of evidence included in this study to determine current year contract goals achievement. Furthermore the PSCW has directed the evaluation team to conduct a follow-up study of the lighting and HVAC markets with the objective of estimating a quantitative range of market effects based on the preponderance of evidence.

Introduction

Focus on Energy is Wisconsin's statewide public benefits program that offers information, advice, and financial incentives to eligible residents, businesses, farms, schools and government institutions that want to adopt energy efficient practices (WI DOA, 2007). The majority of Wisconsin residents and businesses are eligible to participate in Focus on Energy. Wisconsin's investor-owned electric and natural gas utilities are required to participate in the program and municipal and cooperative utilities are afforded the option to opt-in. In addition to the end user focused business sector² efforts, the program also has supply-side initiatives designed to target the following market channels: Lighting, HVAC, Rotary (motors,

¹ At the time this research was designed and the data collected Illinois did not have active C&I energy efficiency rebate programs targeting lighting, HVAC, and VFD applications. This paper will discuss the research implications of losing comparison states in a longitudinal study.

² The Focus on Energy Business Programs Area is divided into four primary sectors, Agriculture, Commercial, Industrial, and Schools & Government.

fans, pumps) and New Construction. This paper focuses on market effects resulting from the channel activities of the Focus on Energy Business Programs.

The *Channel Studies—Fiscal Year 2008* report (Barry et al. 2009) provides baseline estimates for the Focus on Energy Business Program market effect contract metrics and investigates other potential indicators of program market effects. The goal of this analysis was the design and implementation of quantitative processes that will enable the measurement of market effects metrics at present³ and again in three years to assess achievement over an extended period of time. The study also gathered and assessed preliminary data on a broad range of potential market effects achieved to date, as a prelude to possible future elaboration of formal indicators (i.e., quantification of energy savings). The purpose of this study was not to quantify potential program effects in terms of energy savings.⁴

The data were analyzed to:

- Assess whether there is qualitative evidence to date of program effects on the supply-side of the market.
- Assess whether those effects are likely to be small, medium, or large in relation to direct program effects on sales of efficient products and services.
- Assess the appropriateness of eventually using indicators based on these estimates of program effects for awarding credit for actual energy savings.

This paper summarizes the study's methods and results, and discusses some key challenges to be considered with this type of research. The paper includes a discussion of how the PSCW plans to use results of market effects studies, such as this study, for resource planning and to provide the program with contract goals credit.

Methodology

In addition to goals for participation and energy savings by participants, the Business Program administrator's contract has, from its inception, included performance metrics related to market effects. Contract metrics are measures of market conditions that the evaluation team, implementers, and the PSCW have all identified as appropriate indicators of potential program effects on target markets. Attainment of contract market effect metrics indicates that the program is on track with its program theory. Program administrators and regulators have not interpreted attainment of these metrics as conclusive evidence or as a basis for quantitative estimates of additional savings beyond what is tracked by the program. Further research to develop quantitative estimates of additional energy savings is the next step once (1) evidence of the existence of supply-side market effects has been established, (2) there is reason to believe the market effects are researchable, and (3) this research can be performed at a reasonable cost relative to evaluation budget and likely impact (Prahl et al. 2008).

In previous contract years, the evaluation team has assessed achievement of market effect contract metrics through data collection and analysis. Historically the contract metrics have varied from year to year and covered a wide range of technologies, markets, and sectors. This approach is not conducive to the program reaching its potential effect on markets or evaluation's ability to meaningfully measure the program's effects. Market effects require concentrated and sustained program efforts. For the current contract period⁵, the program administrator established a small number of narrowly defined long-term

³ The lighting contractor and HVAC distributor surveys were conducted in May and June 2008. The VFD end-user surveys were conducted in May – July 2008.

⁴ This point was clearly articulated in the report to avoid potential misunderstanding between the evaluation team and the program implementer that might divert attention from the study objectives.

⁵ Fiscal Year 2008, 18 Month Contract Period (18 MCP) July 1, 2007 through December 31, 2008.

market effects metrics. The narrower focus and extended time period increases the potential the program's efforts will have an effect on the market and increases the likelihood that the effect will be measurable.

The program administrator is focusing on influencing supplier and end-user practices in respect to four specific technologies.

- High-bay fluorescent lighting systems
- High efficiency rooftop units
- VFD controlled compressed air systems
- VFD controlled industrial pumps and fans.

Assessments of market effects are most useful when specific measurements taken at different points in time are compared to one another, in order to determine the extent to which the program is generating real and sustained market effects. Therefore, the Channel Studies focused on establishing baseline values for each contract metric, so that temporal comparisons will be possible in the future. It is anticipated that contract metrics will be measured again in a follow-up study to be conducted in approximately three years, which will allow for comparisons to be drawn with baseline values and overall program effectiveness to be evaluated more fully.

In addition to estimating contract metric baseline values for Wisconsin, the evaluation estimated values for the same metrics for Illinois. This paper uses the term "baseline" two ways. First, we refer to both the Wisconsin and Illinois Channel Studies results as baselines. These results will be compared with the results of the follow-up study to be completed in approximately three years. Second, in the current Channel Studies, Illinois is used as a baseline to compare where Wisconsin would have been without several years of program activity. State-to-state comparison of the change in the values for these contract metrics over time will serve as an indicator of net program effects. Illinois was chosen as the comparison state because it is comparable to Wisconsin in terms of size and composition of economic base. At the time this research was developed, Illinois lacked a comprehensive, statewide efficiency program akin to Focus on Energy's Business Programs. By estimating baseline values for both states, this research has enabled present differences to be highlighted, program effects to be elucidated and future changes in each state to be juxtaposed for comparative purposes.

The Channel Studies also examined market effects not directly caused by the program, but indirectly attributable to it. This element of the research centered mainly on supply-side effects on vendor behavior generated by the program. Nonparticipant spillover effects were investigated to a lesser extent. The Channel Studies were intended to gather and assess preliminary data on indirect program effects, as a prelude to possible future elaboration of formal indicators.

The evaluation team conducted surveys of representative samples of key market actors in Wisconsin and Illinois to establish contract metric baseline values, assess significant differences between the two states, and conduct preliminary research on supply-side effects. The surveys asked respondents about developments over the preceding twelve months, as opposed to the year 2007. This timeframe was selected in order to take advantage of the most recent and accurate market information available.

The following is the rationale for the selection of each market actor.

- **Lighting installation contractors:** Contractors were selected because they are more knowledgeable than lighting distributors about where lamps are installed. In addition, contractors can provide better market-level data than can end-users.
- **HVAC distributors:** Distributors were chosen because they are particularly knowledgeable about rooftop unit (RTU) sales. In a typical year, many HVAC contractors do not install enough new units to provide reliable market penetration estimates.
- **Industrial end-users:** Distributors are normally unaware of specific VFD applications. While vendors/contractors are more knowledgeable about VFD applications, they are a diverse group and

difficult to identify. Only end-users are both knowledgeable about VFD applications and readily identifiable and were therefore selected for surveys.

The evaluation team recognized that additional groups of market actors play important roles in each channel under study and as such represent other potentially useful sources of information. These market actors include: end-users (self-installs), manufacturers, distributors, contractors, architects and lighting designers. However, surveying additional market segments would have introduced significant methodological difficulties into the research effort, for instance, the complexities involved in combining dissimilar data samples. Expanding the scope of the surveys would have challenged practical resource constraints, including time and budgetary limits. While restricting analytical focus to the above actors necessarily excluded additional market activity and information, these actors are ideally positioned to offer key data on program effectiveness, and that focusing on them was the most efficient and effective way of achieving research goals.

Topics addressed in the survey questionnaires included the following:

- Fraction of sales/installations/recommendations that were energy efficient
- Level and type of energy efficiency promotion
- Reasons for promoting energy-efficiency
- Importance of energy efficiency to competitiveness
- Stock of energy efficient equipment
- Reasons for use of energy efficient technologies
- Sales/purchase of energy efficient technologies
- Awareness of program (Wisconsin only)
- Involvement in program (Wisconsin only)
- Influence of program (Wisconsin only)

KEMA used a ratio estimation approach to estimating market share indicators from contractor and vendor survey results. The basic rationale for this approach is that, for a variety of reasons, there exists large variation in the annual number of projects or unit sales by establishments in a given size stratum (as defined by number of employees). An estimate of market share based simply on the average of responses given (with appropriate stratum weights) would be highly inaccurate. The ratio estimation approach introduces the number of projects completed by the sample establishments directly into the computation of the market share indicator.

Results

The market effects contract metrics were operationalized, measured, and compared for high-bay fluorescent lighting systems, high efficiency rooftop units, VFD controlled compressed air systems, and VFD controlled industrial pumps and fans. First we present a summary of the major findings regarding primary metrics and a sampling of the most interesting of the supplemental metric⁶ results. Then we provide an assessment of the existence and size of program market effects.

High-Bay Fluorescent Lighting

The program has marketed and promoted high-bay fluorescent lighting for the past seven years and plans to continue these efforts. Program activities have included prescriptive incentives, training, and distribution of information. The program contract defines the “critical metric⁷” as follows, “Increase in net

⁶ The Channel Studies also estimated the market share of other energy efficient lighting, HVAC and motor technologies. Although not part of the program administrator’s contract KEMA was able to add these supplemental metrics to the Channel Studies because the market actors were already being interviewed for measurement of the primary metrics. Therefore we were able to expand the scope of this research at a minimal cost relative to the added value.

⁷ The term “critical metric” is used in the Program Metrics tables in the program administrator’s contract with the PSCW. The

Wisconsin market share of high-bay fluorescent lighting systems across all market segments compared to any increase in net market share for Illinois baseline, and to standard HID technology.” The evaluation developed indicators of this metric through a survey of electrical contractors who install commercial lighting.

Tables 1 and 2 present the metric baseline estimates for Wisconsin and Illinois, respectively. Table 1 shows that, on average, contractors in Wisconsin installed high-bay lighting equipment in 28 percent of the commercial and industrial lighting projects completed over the previous twelve months. Wisconsin lighting contractors recommended fluorescent as opposed to HID fixtures in an average 69 percent of these high-bay lighting projects, and actually installed fluorescent as opposed to HID fixtures in an average 72 percent of such projects.⁸ Table 2 indicates that Illinois contractors performed high-bay lighting installations in 25 percent of completed projects. Illinois firms recommended fluorescent fixtures in 51 percent of applicable projects. The rate of fluorescent fixture installation in Illinois was 28 percent.

Table 1. High-Bay Fluorescent Metric Baselines: Wisconsin

Wisconsin					
Operational Definition	n	Baseline Estimate	Standard Error	90% Confidence Interval	
				Lower Bound	Upper Bound
Percent of C&I lighting projects completed in past 12 months with high-bay lighting installation	60	28%	9.1%	12.9%	43.4%
Percent of high-bay lighting projects for which fluorescent as opposed to HID fixtures were recommended	59	69%	10.4%	52.0%	86.7%
Percent of high-bay lighting projects for which fluorescent as opposed to HID fixtures were installed	59	72%	9.0%	57.3%	87.3%

Table 2. High-Bay Fluorescent Metric Baselines: Illinois

Illinois					
Operational Definition	n	Baseline Estimate	Standard Error	90% Confidence Interval	
				Lower Bound	Upper Bound
Percent of C&I lighting projects completed in past 12 months with high-bay lighting installation	57	25%	4.5%	17.1%	32.0%
Percent of high-bay lighting projects for which fluorescent as opposed to HID fixtures were recommended	57	51%	11.5%	32.1%	70.7%
Percent of high-bay lighting projects for which fluorescent as opposed to HID fixtures were installed	57	28%	9.2%	12.4%	43.2%

While contract metric baseline values for high-bay lighting installation rates and fluorescent fixture recommendation rates were comparable in Wisconsin and Illinois, baseline values for fluorescent fixture installation rates differed significantly. Specifically, the difference between the states’ fluorescent fixture installation rates, with Wisconsin contractors installing efficient fixtures at a 44-percentage-point higher level than Illinois contractors, was statistically significant at the one-percent level (p -value = 0.0005). This stands as strong evidence that fluorescent lighting systems account for a substantially larger share of the high-bay lighting market in Wisconsin than in Illinois. Given that the existence of the Business Programs is one of the major differences between these two markets, it is reasonable to infer that Focus on Energy is at least partially responsible for the higher market share of high-bay fluorescent fixtures in Wisconsin.

The most interesting differences in supplemental lighting metrics⁹ included Wisconsin contractors recommending occupancy controls for 60 percent of projects compared with 21 percent for Illinois (p -value

contract metric tables from the program administrator’s contract with the PSCW are provided as an appendix to the Channel Studies report.

⁸ Installation rates may surpass recommendation rates in cases where customers instruct lighting contractors to install efficient equipment without having received a contractor recommendation.

⁹ For supplementary metrics, recommendation rates represent the percentage of total projects completed over the previous year for which high-efficiency technology was recommended, while installation rates refer to the percentage of *recommended*

< 0.0001). Similarly, the difference in occupancy control installation rates between the two states, measured at 69 percent in Wisconsin and 22 percent in Illinois (p-value = 0.0001). Although high performance T-8¹⁰ recommendations and installation rates did not differ between states, Illinois lighting contractors installed T-5 technology at a rate of 41 percent compared to 14 percent for Wisconsin contractors (p-value = 0.0118).

High Efficiency Rooftop Units

The program has promoted high efficiency rooftop units for many years through prescriptive incentives, training, and the distribution of information. The program decided to intensify its promotion of this technology in the current contract year with two important changes. The program tripled the incentive and transferred the focus of its marketing efforts to promote the technology from the end-use customers to the trade allies. The program contract defines the “critical metric” as follows, “Increase in net Wisconsin market share of high efficiency rooftop units in commercial, school, and government buildings, in comparison to increase in net market share from [the] Illinois baseline.”

Tables 4 and 5 present the metric baseline estimates for Wisconsin and Illinois, respectively. In Wisconsin, for rooftop units smaller than 65 MBh/5.4 tons, 62 percent of units sold met program efficiency standards. For units between 65 MBh/5.4 tons and 134 MBh/11.25 tons, 41 percent of sales met program efficiency standards. For units between 135 MBh/11.25 tons and 239 MBh/20 tons, 36 percent of units sold met program efficiency standards, and for units between 240 MBh/20 tons and 749 MBh/62.4 tons, 29 percent of sales met program efficiency standards.

In Illinois, for rooftop units smaller than 65 MBh/5.4 tons, 38 percent of units sold met program efficiency standards. For units between 65 MBh/5.4 tons and 134 MBh/11.25 tons, 27 percent of sales met program efficiency standards. Likewise, 27 percent of units sold between 135 MBh/11.25 tons and 239 MBh/20 tons met program efficiency standards, and 32 percent of units sold between 240 MBh/20 tons and 749 MBh/62.4 tons met program efficiency standards.

Table 4. High Efficiency Rooftop Units Metric Baselines: Wisconsin

Wisconsin						
Operational Definition	Size Category/ Efficiency Rating	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of sold units that meet program efficiency standards.	<65 MBh or <5.4 tons (11.6 EER or higher)	24	62%	9.2%	46.2%	77.7%
	65 - 134 MBh or 5.4 - 11.25 tons (11.5 EER or higher)	22	41%	9.1%	25.3%	56.7%
	135 - 239 MBh or 11.25 - 20 tons (11.5 EER or higher)	19	36%	4.5%	27.9%	43.3%
	240 - 749 MBh or 20 - 62.4 tons (10.5 EER or higher)	11	29%	7.4%	16.0%	42.6%

Table 5. High Efficiency Rooftop Units Metric Baselines: Illinois

Illinois						
Operational Definition	Size Category/ Efficiency Rating	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of sold units that meet program efficiency standards.	<65 MBh or <5.4 tons (11.6 EER or higher)	25	38%	10.0%	20.9%	55.2%
	65 - 134 MBh or 5.4 - 11.25 tons (11.5 EER or higher)	23	27%	8.4%	13.0%	41.6%
	135 - 239 MBh or 11.25 - 20 tons (11.5 EER or higher)	19	27%	8.5%	12.5%	42.0%
	240 - 749 MBh or 20 - 62.4 tons (10.5 EER or higher)	9	32%	12.1%	10.1%	54.3%

Although the baseline values for Wisconsin reported above were higher than Illinois for three of the four size categories, only one of these differences was significant at the ten percent level. The share of high-efficiency sales for the smallest size category, units less than 65 MBh/5.4 tons, was statistically larger in Wisconsin compared to Illinois, at the five percent level (p-value = 0.0463). Models in this size category meet an Energy Efficiency Rating (EER) of 11.6 or greater sold at a 24-percentage-point higher rate in Wisconsin compared to Illinois.

projects in which high-efficiency equipment was actually installed. Installation rates *do not* refer to the percentage of *total* projects in which high-efficiency equipment was installed. For this reason, installation rates may be higher than recommendation rates.

¹⁰ As defined by CEE.

The most convincing supplemental metric result was the 27 percentage point higher proportion of units with CO₂ sensors and demand control ventilation¹¹ sold in Wisconsin compare to Illinois. This difference was significant at the 5-percent level of significance (p-value = 0.0343).

Variable Frequency Drives

The program has promoted VFDs through custom incentives, training, and the distribution of information since program inception. In FY07¹², the program started offering prescriptive incentives for VFD controlled compressed air systems and VFD controlled industrial pumps and fans systems. The Channel Studies examined industrial customer adoptions of VFDs in compressed air systems and in pump and fan systems. The program contract defines the following two “critical metrics” for VFDs, “Increase in net Wisconsin market share of VFD controlled compressed air systems, compared to increase in net market share from Illinois baseline” and “Increase in net Wisconsin market share of VFD controlled industrial pump and fan flows, compared to increase in net market share from Illinois baseline.”

Establishing metric baselines for the Rotary Channel proved to be a particularly challenging endeavor, given several aspects peculiar to the market for variable frequency drives (VFDs). First, in contrast to the high-bay and rooftop unit metrics, two distinct contract metrics, one for compressed air systems and the other for industrial pumps and fans, were selected for baseline measurement. Second, from an early stage, the evaluation team recognized that important differences distinguished pump applications from fan applications, so that it was necessary to assess VFD use separately for each of these technologies. In essence, three different VFD applications, for compressed air systems, pumps, and fans, merited investigation, and measuring baseline values for each application required unique calculations and methodological refinements. Third, due both to the relative importance of the stock of VFD-eligible systems compared to the flow of such systems, and to the projected low incidence of large compressed air systems in Wisconsin and Illinois, the evaluation team gathered additional data on VFD saturation levels for all production motor applications in order to develop a more complete sense of VFD market share. This supplementary metric entailed its own unique methodological approach.¹³

Compressed Air Systems

Table 6 presents the compressed air metrics baseline estimates for Wisconsin and Illinois. For Wisconsin, 18 percent of compressed air systems were fitted with VFDs. For Illinois, 13 percent of systems were fitted with VFDs. The relatively small sample obtained by the surveys, particularly in Illinois (n = 103), effectively precluded disaggregating the results in terms of horsepower size category. Instead, the evaluation team weighted compressors by horsepower in order to take account of size variation. The metric baselines for VFDs used in compressed air systems in Wisconsin and Illinois are similar. The percentage point difference between these two estimates is not statistically significant at the 10 percent level of significance.

**Table 6. Rotary Contract Metric Baseline:
VFDs in Compressed Air Systems**

VFD Compressed Air Metric	State	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of compressed air system hp fitted with VFDs	Wisconsin	170	18%	6.7%	6.4%	28.7%
	Illinois	103	13%	5.0%	4.8%	21.5%

Industrial Fans

¹¹ Demand control ventilation controls the amount of air that is ventilated based on occupancy. The CO₂ sensors monitor the indoor CO₂ levels to ensure safe levels without over ventilating the space.

¹² July 1, 2006 through June 30, 2007

¹³ Refer to full report for more information on the development of operational definitions for the VFD metrics and supplemental metric results.

Tables 7 and 8 present fan/blower metrics baselines estimates for Wisconsin and Illinois, respectively. In Wisconsin, there is little variation in the fraction of fans and blowers fitted with VFDs. The baseline estimates range from six percent in the greater than 50 hp size category to 12 percent in the 6-20 hp and 21-50 hp size categories. The Illinois baselines range from two percent in the greater than 50 hp size category to 15 percent in the 6–20 hp size category. The metric baselines for VFDs used in fan and blower systems in Wisconsin and Illinois are similar. The baseline estimates for each size category and the total are not statistically different from each other at the 10 percent level of significance.

Table 7. VFDs in Fan and Blower Systems Metric Baseline: Wisconsin

Wisconsin						
VFD Fan or Blower System Metric	Size Category	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of fans and blowers fitted with VFDs	1 - 5 hp	99	7%	2.9%	1.9%	11.5%
	6 - 20 hp	100	12%	4.7%	4.3%	20.1%
	21 - 50 hp	97	12%	3.0%	6.7%	16.6%
	> 50 hp	96	6%	3.0%	1.3%	11.3%
	Total	101	8%	2.0%	4.4%	11.2%

Table 8. VFDs in Fan and Blower Systems Metric Baseline: Illinois

Illinois						
VFD Fan or Blower System Metric	Size Category	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of fans and blowers fitted with VFDs	1 - 5 hp	56	11%	8.0%	0.0%	24.5%
	6 - 20 hp	54	15%	7.3%	2.6%	27.1%
	21 - 50 hp	53	5%	5.0%	0.0%	13.7%
	> 50 hp	53	2%	2.3%	0.0%	6.3%
	Total	56	10%	4.7%	2.3%	18.0%

Industrial Pumps

Tables 9 and 10 present pump metrics baselines estimates for Wisconsin and Illinois, respectively. In Wisconsin, the fraction of pumps fitted with VFDs tends to be larger for the larger pump systems. Twenty-two percent of pumps in the 20–100 hp size category and over half of the pumps in the greater than 100 hp size category are fitted with VFDs. The Illinois baseline estimates have the opposite trend, with less than 1 percent of motors in the greater than 100 hp size category and 29 percent of the pumps in the 1–5 hp size categories. The smallest and largest categories are statistically different from each other at least at the ten-percent level of significance. For the 1–5 hp size category, the Illinois baseline estimate is significantly larger, while for the 50–100 hp and the greater than 100 hp size categories the Wisconsin baseline estimates are significantly larger.

Table 9. VFDs in Pump Systems Metric Baseline: Wisconsin

Wisconsin						
VFD Pump System Metric	Size Category	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of pumps fitted with VFDs	1 - 5 hp	94	8%	3.7%	2.2%	14.5%
	6 - 20 hp	94	18%	8.2%	4.7%	32.1%
	21 - 50 hp	92	10%	3.5%	4.1%	15.8%
	50 - 100 hp	92	22%	10.8%	3.5%	39.5%
	> 100 hp	92	52%	19.9%	19.4%	85.4%
	Total	94	15%	4.5%	7.4%	22.2%

Table 10. VFDs in Pump Systems Metric Baseline: Illinois

Illinois						
VFD Pump System Metric	Size Category	n	Baseline Estimate	Standard Error	90% Confidence Interval	
					Lower Bound	Upper Bound
Percent of pumps fitted with VFDs	1 - 5 hp	67	29%	11.5%	9.6%	48.1%
	6 - 20 hp	65	10%	4.5%	3.0%	18.0%
	21 - 50 hp	65	7%	4.8%	0.0%	15.3%
	50 - 100 hp	65	5%	3.6%	0.0%	11.4%
	> 100 hp	65	0%	0.1%	0.0%	0.4%
	Total	67	16%	4.9%	7.4%	23.8%

The supplemental VFD metrics estimated the fraction of motors and variable loads fitted with VFDs by size category. The smallest (1-20 hp and 21-50 hp) and the largest (>200 hp) hp categories showed no statistical difference between Wisconsin and Illinois. However a strong statistical difference between states was found for the middle two hp size categories (51-100 hp and 101-200 hp) variable loads and all motors. The Wisconsin baseline is larger in all four cases.

Additional Supply-Side Results

In addition to establishing the baselines estimates reported above, we assessed the differences between market actors in Wisconsin and Illinois in regard to indicators of awareness, knowledge, and interest in the technologies in question. These differences can provide indicators of program market effects. A brief summary of results for each channel are presented below.

Results generally support the notion that Focus has affected the market for energy efficient lighting in Wisconsin. To take one example, results indicate that Wisconsin consumers take greater account of multiple lighting equipment characteristics when selecting a technology to purchase than do Illinois consumers, as shown in Table 11. High awareness and participation levels provide strong evidence that Focus on Energy is playing a role in the differences in the energy efficient lighting markets of Wisconsin and Illinois reported above. Furthermore, we also concluded based on the survey responses that a large fraction of energy efficiency sales are likely to be untracked. This estimate was based on the vendor reported number of projects completed in the past 12 months that received a rebate as a proxy for in-program sales.

Table 11. Importance of Lighting Equipment Characteristics to Customer Selection Decisions, on Scale of 1 (= not at all important) to 10 (= very important)

On a scale from 1 to 10 where 1 is not at all important and 10 is very important, how important do your commercial customers treat the following lighting equipment characteristics when making equipment selection decisions?	State						2-tailed test of significance	
	Wisconsin			Illinois			Sig @ 90%	p-value
	n	estimate (avg)	standard error	n	estimate (avg)	standard error		
Initial cost of ther equipment	59	7.7	0.20	58	7.3	0.52	No	0.3974
Costs of operation	59	7.8	0.27	58	6.1	0.56	Yes	0.0102
Total life cycle costs	59	7.1	0.20	58	6.0	0.59	Yes	0.0979
Quality of light	59	7.8	0.27	58	6.6	0.65	Yes	0.0959
Maintenance of lighting level	59	6.0	0.66	58	5.9	0.70	No	0.9013
Ease of maintenance	59	6.2	0.42	58	5.9	0.59	No	0.7073

In regard to efficient HVAC, Wisconsin distributors overwhelmingly agreed that energy-efficient equipment sales are important to maintaining their competitive position, as shown in Table 12, and that the program has played an important role in the market share of energy efficient units sold. Furthermore, Wisconsin distributors reported increased promotion of high efficiency units and increased sales in the past two years. In addition, we estimate that 70 percent of projects are out-of-program sales. Considering the baselines results reported above, it’s reasonable to believe a large fraction of these out-of-program sales are high efficiency units. Similar to the calculation method of lighting out-program sales, the RTU out-of-program sales estimate was based on the vendor reported number of units sold in the past 12 months that received a rebate as a proxy for in-program sales.

Table 12. Importance of Energy-Efficient Equipment Sales in Maintaining Firm’s Competitive Position, on Scale of 1 (= not at all important) to 10 (= very important)

Using a scale from 1 to 10 where 1 is not at all important and 10 is very important, how important is the offer of energy efficient equipment in maintaining your firm’s competitive position? Score	State						2-tailed test of significance	
	Wisconsin			Illinois			Sig @ 90%	p-value
	n	estimate (avg)	standard error	n	estimate (avg)	standard error		
	25	9.1	0.2	26	7.5	0.5	Yes	0.0140

In regard to VFDs, findings from the end-user surveys suggest only limited nonparticipant spillover effects in the VFD market. Wisconsin end-users take advantage of VFD opportunities at slightly higher rates than Illinois end-users, as shown in Table 13, and appear to be better informed about VFD technology than are their Illinois peers. However, despite the enthusiasm of participants, relatively few Wisconsin respondents have actually taken part in specific program measures.

Table 13. VFD Opportunities Taken Advantage Of

Do you believe that your company has taken advantage of...	State				2-tailed test of significance	
	Wisconsin		Illinois		Sig @ 90%	p-value
	estimate	standard error	estimate	standard error		
All available opportunities to benefit from VFDs	21%	11.3%	9%	3.1%	No	0.3021
Most of those opportunities	14%	5.1%	15%	3.3%	No	0.9492
Some of those opportunities	10%	2.4%	9%	3.0%	No	0.8601
Few of those opportunities	7%	2.1%	6%	2.9%	No	0.8690
None of those opportunities	48%	11.2%	61%	3.2%	No	0.2671
# Respondents	176		122			

Methodological Challenges

The quasi-experimental approach proved to be an effective method of assessing the existence of market effects in Wisconsin’s non-residential lighting, HVAC, and to a lesser extent the VFD market. The market effects baseline estimates established in the Channel Studies will permit further comparisons over time as these markets continue to develop. However there are a number of key challenges associated with research into supply-side effects in the non-residential sector using quasi-experimental techniques that should be considered. These include but are not limited to the following.

- *Budget* is a consideration with all research efforts but particularly limiting for non-residential market effects research due to the need for multiple waves of data collection, the need for comparisons to cover multiple markets, the tendency for non-residential surveys to be more expensive than residential surveys, and the need to consider multiple market actors in the supply chain for inclusion. Regarding the last point, researchers often must narrow the focus to one market actor group per technology type. It may be difficult to decide which market actors to target; however interviews with the customer and entire supply chain are not often a budgetary reality.
- *The highly segmented nature of the non-residential market* (e.g.: technologies, sectors, customer size, national and regional firms) can complicate market effect research. To cope with this level of diversity, analysts must elaborate program and market theories at a high level of detail and take steps to ensure that sample design and questionnaire formulation closely reflect that theory. We believe that the time and effort put into those aspects of the study are largely responsible for whatever success we experienced in developing plausible market effects metrics.
- *Small populations* and thus sample sizes make it difficult to find statistical differences. If samples are stratified by a size determinant, as was the case with the Channel Studies, the larger business size stratum is likely to be exhausted prior to achieving the stratum quota. Increasing the number of completes using firms in the smaller size does not appreciably increase the precision of the results due to the mechanics of weighting and the reality market concentration.

- *Loss of comparison markets* is becoming increasingly problematic for quasi-experimental research in non-residential and residential sectors. There are a number of phenomenon that are contributing to this challenge that include: the development of energy efficiency programs in the no-program areas, the success of national programs such as ENERGY STAR, the promotion of high efficiency technologies by national supply-side firms, and the acceptance and commitment to energy efficiency by end-use customers with locations in both program and non-program areas. The Channel Studies was faced with this challenge late in the study design stage. Illinois served as a useful and appropriate comparison state in the present research effort; but it is unclear whether Illinois will be able to play a similar role in the second wave of data collation. A number of nonresidential energy efficiency programs have launched in Illinois in the second half of 2008, and these are likely to have impacted the Illinois market to a measurable degree by the time the next Channel Studies evaluation is conducted. Such an impact will probably shift Illinois closer to Wisconsin in terms of energy efficiency market indicators, and will render interpretation of cross-state differences considerably more difficult. It may be appropriate to consider selecting another comparable state that lacks comprehensive nonresidential energy-efficiency programs, for example, Alabama, for future baseline comparisons. Alternatively, it may be appropriate to contemplate revisions to the contract metrics to compensate for changes in Illinois. This would allow the evaluation team to build off the Channel Studies effort, further mine the collected data and utilize the constructed baselines. Energy efficiency program activity in Illinois will need to be acknowledged and methods will need to be developed to net out the Illinois program's effects.
- *Determining whether the comparison areas are truly similar is fundamental to this type of research.* The following is a list of issues that need to be considered when selecting comparison market areas.
 - Alignment of socioeconomics of the two areas (e.g. education levels, income levels, urban versus rural).
 - Climate differences between comparison areas (for weather sensitive measures).
 - Are the commercial and industrial bases similar? For example does one state have a dominant industry that is not present in the other? The Pulp and Paper industry is an example of a dominant industry in Wisconsin that is less prevalent in Illinois. There were no Illinois respondents in the Pulp and Paper Industry SIC with pump systems in the >100 hp size category. As a direct consequence the state-to-state comparison of VFDs in large pumps systems was not very informative.
 - Prevalence of demand side differences that are not associated with the existing energy efficiency program; such as, prior utility DSM activity, presence of national supply-side and end-use customer firms, and the cost of energy.
 - Self-selection bias in both the program and no-program states. Program participants and respondents that feel passionate about the topic, energy efficiency in this case, are more likely to participate in the survey compared with non-participants and potential respondents that have no strong feelings towards energy efficiency. Different techniques in the program and no-program states could be deployed to acknowledge the existence of program participants in the program state. For example, if the population is large enough the sample and or survey instrument could be designed to ensure the number of program non-participants included in the program state sample is proportionate to the population.

The above list is not insurmountable; rather the researcher should acknowledge the known differences and make the case for the comparison. For the Channel Studies, the iMarket Database of Dun & Bradstreet was used to investigate comparison markets in the Midwest¹⁴ without existing energy efficiency programs and

¹⁴ Michigan was removed from consideration because programs were anticipated to begin.

eventually used to construct the sample frames. Illinois was selected as the comparison state primarily because of the size and the composition of its economic base. Illinois's populations of electrical contractors, HVAC distributors, and manufacturing companies in the key Wisconsin SICs were deemed sufficiently large to support the planned comparisons. More specifically, we developed a motor energy per employee factor for each 2-digit SIC code included in the Industrial end-user sample frame. These industries accounted for 87 and 78 percent of total motor system energy use in Wisconsin and Illinois, respectively.

The aforementioned challenges beg the question of whether or not it is truly possible to assign attribution for market differences to the program. That is, is it reasonable to think the only difference between the program area and the no-program area is the existence of the program? The approach of the Channel Studies was to acknowledge the limitations of the research and confounding effects of comparison techniques. The goal was not to prove the causality of the market effects but to provide evidence of their existence. Secondly, in this first wave of data collection the Channel Studies did provide enough evidence to refute the null hypothesis that the program had no effect on the market. A follow-up study will look more closely at assessing attribution. Furthermore the second wave of the Channel Studies in approximately three years will provide even stronger evidence of market effects with the temporal comparisons within Wisconsin and across states.

Wisconsin Regulatory Context

A set of rules (Chapter PSC 137) to govern content, process and reporting of all rate-payer funded programs were established in response to legislative requirements. Specific metrics for indicators such as cost-effectiveness and goal achievement were left out of these rules, with the understanding that the PSCW had the authority to develop policy on metrics, including the evaluation of market effects. In practice, this left policy on standards for evaluating market effects in limbo, based on what the PSCW, the evaluation team, and the programs could agree were appropriate. The general experience so far has been one of frustration with the quality of the metrics, the lack of results that can be translated into credit for the programs, the lack of penalties for not achieving contract metrics goals, and the lack of clear PSCW policy on the standards that should be applied to evaluating market effects and the related issue of attribution. Frequent disputes over how and when market effects are measured has resulted in the context of this uncertainty. Furthermore budget limitation and research design issues have long delayed research of market effects. The Channel Studies presented an opportunity for the PSCW to put into practice what has been a sometimes frustrating process of reliably documenting market effects and ultimately attributing energy savings credit.

At the time of this writing, the PSCW is considering the translation of qualitative evidence of market effects into quantitative credit for achievement of program administrator contract goals. This method will use results from reports such as the Channel Studies to develop a case for awarding credit for a program's efforts to change the market, without obligating the PSCW to use those results to quantitatively document reliable and persistent energy savings. Effectively, bifurcation is established between the process for awarding contract energy savings goals achievement, and the more rigorous process of integrating market-induced savings into a resource planning regime. The PSCW has directed the evaluation team to design and implement a follow-up study prior to the second wave of the Channel Studies. This study will estimate a range of net market effects based on the body of evidence collected from additional data collection and the Channel Studies.

Conclusions

Quasi-experimental state-to-state methods are an effective approach to assessing and measuring market effects of non-residential programs. These methods are not without challenges however the results of these studies can produce both qualitative and quantitative evidence of market effects which can be used to inform contract goals achievement, program design and on a more limited basis be integrated into resource planning. A critical initial step is for policy makers, program implementers and researchers to reach agreement during the study planning stage on methods (strengths and limitations) and potential outcomes. Researchers must resist the pressure to produce a quantitative estimate of energy savings if such an estimate cannot be reliably estimated. In such cases, a qualitative estimate based on the preponderance of evidence or a range of quantitative estimates are more appropriate alternatives. In either case the limitations of these methods should be clearly stated.

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