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White Paper

Overcoming Barriers to Achieving Energy Savings in the Industrial Sector

Nels Andersen
Mark Brown

Franklin Energy
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Prepared by:

Nels Andersen
Franklin Energy Services, LLC
403 W. Foster Street
Port Washington, WI 53074
Phone: 262-284-3838
Fax: 262-284-4003
nandersen@franklinenergy.com

Mark Brown
Franklin Energy Services, LLC
Two Appletree Square
8011 34th Avenue South, Suite 305
Bloomington, MN 55425
Phone: 612-284-3663 x2103
Fax: 952-854-5155
mbrown@franklinenergy.com

www.franklinenergy.com

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Table of Contents

1. Executive Summary ... 4

2. Potential for Energy-Savings in the Industrial Sector ... 5

2.1 The Magnitude of the Opportunity ... 5

2.2 Measures to Achieve Savings ... 6

3. Barriers Facing Program Sponsors ... 8

3.1 C&I Don't See Eye-to-Eye ... 8

3.2 Intensity Matters ... 10

3.3 Operational Hazards ... 13

3.4 Making Cents and Sense of Energy Savings ... 14

3.5 Flow Me the Money ... 16

4. Programs to Address Barriers ... 18

4.1 Programs with an Impact ... 18

4.2 Drivers of Performance ... 19

5. Conclusions ... 22

References ... 23

1. Executive Summary

This report seeks to address the potential for energy efficiency in the U.S. industrial sector and the challenges for program sponsors seeking to spur increased energy-savings investments. In addition to reviewing the magnitude and segmentation of the savings opportunity, it articulates five dimensions of barriers facing program sponsors and provides an analysis of the impacts and service offerings of the most successful utility program sponsors in driving electricity savings in the industrial sector.

Recent studies evaluating the energy savings potential in the U.S. industrial sector find that economically viable project opportunities constitute close to 20% of 2020 forecast energy consumption with the present value of savings estimated on the order of hundreds of billions of dollars. The majority of this potential, estimated at over 3.5 trillion Btus, lies in process-specific measures unique to individual industries and facilities. For example, nearly two thirds of the electricity savings potential is estimated to lie in machine drive and motor systems need to operate pumps, fans, compressors and process mechanical systems.

In seeking to spur increased investment in the industrial sector, program sponsors, including electric and gas utilities, government agencies, and third-party administrators must recognize the barriers that exist. Importantly, they must address and recognize that the majority of energy use and associated energy savings exists in specific process applications – they cannot approach commercial & industrial customers as a monolithic block and must develop programs and expertise specific to the various sectors and sub-sectors. They must also recognize that the decreasing energy-use intensity in the industrial sector indicates that the challenge is not so much about convincing industrial end-use customers of the value of energy efficiency, but rather demonstrating how the sponsor's programs provide assistance and incentives that can add value in the areas of greatest opportunity.

Additionally program sponsors must work to minimize the impact energy efficiency projects have on productivity and recognize how they can bring technical and financial resources to bear in supporting decision making and project implementation. Given that lack of capital budget funds is cited by business leaders to be the top barrier to capturing savings, program sponsors need to look for innovative financing solutions that promote paid-from-savings approaches in order to take pressure off of balance sheets, create immediate positive cash flow impacts, and mitigate the high payback expectations that come with capital budgeting decisions.

The most successful utilities are found to be achieving industrial sector impacts approaching 2.5% of sales by providing program service offerings that address these significant barriers. By employing custom incentives, providing assistance with facility assessments and project implementation, developing targeted programs, and offering financing solutions the top-performing utilities are not just increasing achieved energy savings, but also demonstrating that these value-added service offerings do not translate to sacrifices in program cost effectiveness.

2. Potential for Energy-Savings in the Industrial Sector

2.1 The Magnitude of the Opportunity

Recent studies evaluating the energy savings potential in the U.S. industrial sector highlight the tremendous potential that exists to decrease energy consumption and intensity, increase productivity, and provide attractive returns on investment. The present dollar value of the return on investment for economically attractive projects is measured in the hundreds of billions and savings are on the order of 20% according to several sources. Much of the opportunity exists in measures that can provide rapid investment payback and attractive ongoing cash flow impacts.

In its 2009 report, *Unlocking Energy Efficiency in the U.S. Economy*, McKinsey & Company estimates that NPV-positive energy efficiency potential in the U.S. industrial sector over the ten years to 2020 represents close to $442 billion in present value savings. Realizing this potential, equivalent to 18% of 2020 forecast energy consumption, is estimated to require present value investments of around $113 billion. The savings represented by this potential includes an estimated 190 terawatt hours (TWh) of end-use electricity and close to 10.4 billion therms of natural gas (McKinsey 2009).

McKinsey is not the only organization attempting to value the national opportunity. In a January 2009 report the Electric Power Research Institute (EPRI) presents an analysis of the potential for electricity savings over the coming decade and beyond. In the industrial sector EPRI estimates potential of 46 TWh in energy savings by 2020, representing close to 5% of 2020 EIA forecast demand for the sector (EPRI 2009).

The fact that the EPRI forecast represents just 24% of the McKinsey estimate for electric savings highlights the assumptions and challenges inherent in these forecasting exercises. In bridging between the two studies the majority of the difference is due to the McKinsey estimate represents all NPV-positive measure potential (i.e., economic potential) while EPRI's estimate reflects the achievable savings based on existing programs and best practices (i.e., realistic achievable potential). Secondly, the McKinsey study allows for accelerated deployment of energy-efficient technologies whereas the EPRI study is driven by replacement at end of measure life. The McKinsey study also includes additional market segments and a broader range of industrial processes and technologies (McKinsey 2009).

Despite the differences in methodologies and assumptions, both estimates represent vast opportunities for energy efficiency in the industrial sector. Taking into account studies from other sources, the EPRI estimates are found to be the more conservative estimate. For example, multiple state-level studies conducted by the American Consortium for an Energy-Efficient Economy (ACEEE) in recent years point to industrial sector savings on the order of 20% to 25% (Chittum et al. 2009).

The potential for industrial end-use customers to realize savings of these magnitudes presents attractive opportunities to drive bottom-line impacts, thereby improving profitability and competitiveness. Furthermore, for the utility, government agency, and third-party administrator program sponsors seeking to assist customers and achieve their program's energy-savings goal this potential highlights the very real opportunities that exist in the industrial sector.

Figure 1 – Industrial Sector Segments and Energy Use – EIA 2006 MECS Survey Findings

Industry Sector	Total Energy Consumption (Trillion Btu)	Total Net Electricity Consumption (GWh)	Total Natural Gas Consumption (Billion cu. ft.)	Total Industry Size (Dollar Value Added, 2006 $ Billion)	Number of Establishments Purchasing Electricity
Petroleum and Coal Products	3,396	60,149	825	$126	1,913
Chemicals	3,040	182,541	1,280	$95	7,157
Paper	2,354	122,168	461	$81	4,256
Primary Metals	1,745	139,985	568	$87	4,166
Food	1,186	78,003	618	$237	15,045
Nonmetallic Mineral Products (e.g., Glass, Cement)	1,105	44,783	446	$63	11,428
Autos and Other Transportation Equipment	479	57,704	242	$282	7,640
Wood Products	445	28,911	84	$43	10,458
Fabricated Metal Products	397	42,238	234	$153	35,272
Plastics and Rubber Products	336	53,423	124	$91	10,538
Textiles/Apparel/Leather Products	267	28,198	109	$53	11,902
Machinery	204	32,733	82	$170	17,075
Pharmaceuticals and Medicine	156	24,566	75	$243	1,749
Computer and Electronic Products	141	27,542	44	$201	9,292
Beverage and Tobacco Products	109	9,480	40	$78	1,592
Electrical Equip., Appliances, and Components	87	12,870	40	$48	3,886
Printing and Related Support	85	13,005	38	$57	20,126
Miscellaneous Manufacturing	66	9,677	24	$110	15,605
Furniture and Related Products	60	9,362	16	$55	10,941
Total	**15,658**	**977,338**	**5,350**	**$2,273**	**200,041**

Source: Energy Information Administration, 2006 MECS; Establishment data from 2002 MECS

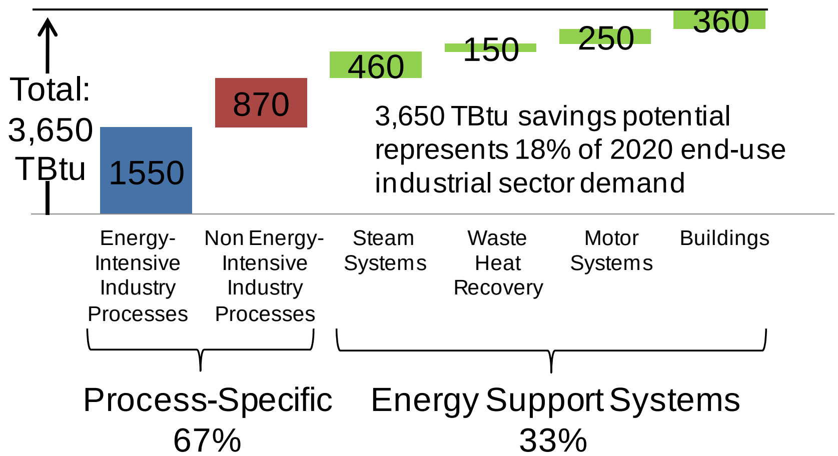
2.2 Measures to Achieve Savings

While long-term potential studies attempt to quantify the aggregate sector opportunity, the reality of achieving demand-side energy savings is the accumulation of impacts that occur one customer and one project measure at a time. As highlighted in Figure 1 above, the industrial sector itself is comprised of highly diverse sub-sectors with a range of technologies, asset vintages, and challenges unique to the individual businesses competing to produce, refine, formulate, and manufacture cost-effective products at their facilities.

The studies that have developed estimates of the sector potential are derived from a bottom-up analysis of the opportunity to apply specific energy-saving measures based on the penetration of existing technologies and the economics, in terms of costs and benefits, of measure installation.

In its analysis of the potential for energy savings in the industrial sector, McKinsey finds that nearly two thirds of the 3,650 trillion Btu opportunity exists with process technologies, particularly in the industries categorized as 'energy-intensive' by the EIA's National Energy Modeling System Industrial Demand Module (Figure 2). Industries included in the energy-intensive category include the production of food, paper, chemicals, cement, glass, and metals including iron, steel, and aluminum (EIA 2010).

Figure 2 - Total Industrial Energy Savings Potential
2020 End-Use Energy (Trillion Btu)



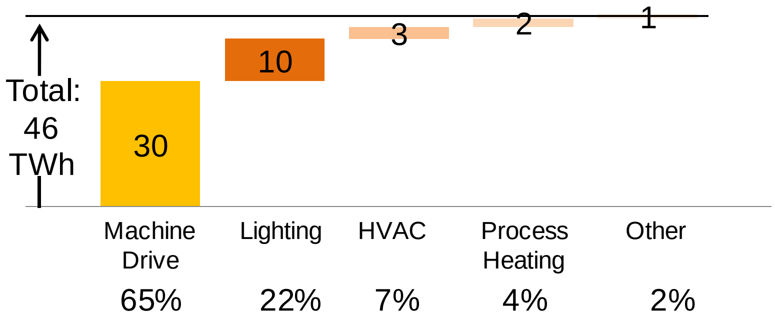
Source: McKinsey & Company, 2009

Of the one third of industrial energy-savings potential attributable to non-process related energy support systems, around half of the 1,220 trillion Btu savings opportunity exists in steam systems and related waste heat recovery measures. Building systems measures such as lighting, and HVAC (heating, ventilation, and air conditioning) equipment account for just 10% of the total and 30% of the support systems segment.

The implications of the opportunity segmentation to program sponsors is that in order to maximize achievable savings potential, conservation programs must seek to provide technical assistance, education, and financial incentives that will help industrial customers identify and implement measures to drive savings in the process technologies unique to their industry and facilities. This is likely to require flexibility in incentives design and delivery and a cultivation of sector-specific expertise.

Further insight into the measures to achieve savings is provided in EPRI's segmentation of potential for electric savings. The majority of savings opportunity is in the process-specific machine drive and motor systems needed to operate pumps, fans, compressors, and process mechanical drive systems (Figure 3).

Figure 3 - Industrial Sector Electricity Energy Savings Potential – 2020 End-Use Energy (TWh)



Source: EPRI, 2009

In order to fully address the sector's achievable potential, conservation program sponsors must design incentives that stimulate investments in these machine drives systems. It is also important for program sponsors not to ignore the large magnitude of savings potential in building support systems such as lighting and HVAC that are more likely to escape the scrutiny of industrial businesses whose process systems account for the majority of energy use. Achieving savings in these areas may involve more education and assistance in order to draw attention to these periphery opportunities that are likely to offer attractive investment returns.

3. Barriers Facing Program Sponsors

Given the identified potential that exists and the attractiveness of returns, the challenge for program sponsors hoping to spur increased adoption of energy efficiency measures is to recognize the barriers that can get in the way of maximizing impacts. This section identifies five important dimensions of industrial sector characteristics and implications to program effectiveness.

3.1 C&I Don't See Eye-to-Eye

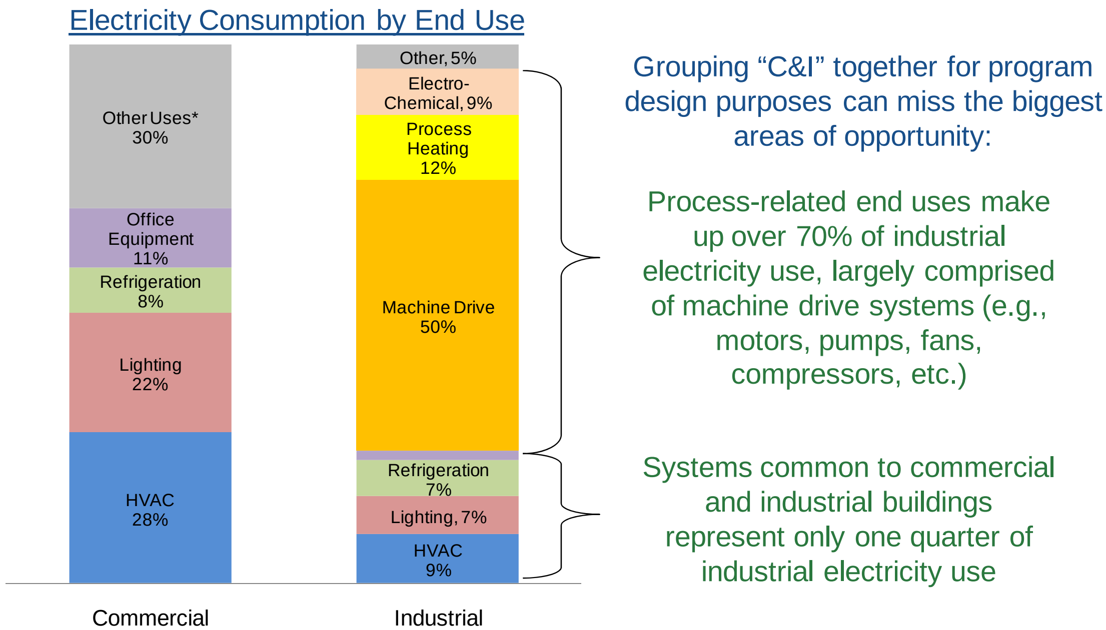
A major potential pitfall for program sponsors addressing the industrial sector is a failure to recognize the large differences in energy-use profiles between commercial and industrial customers. By offering programs that address the specific needs of the industrial customer segment and its sub-sectors, program sponsors have a much greater opportunity to provide attractive energy efficiency measures and maximize investments in energy savings.

Ratepayer-funded energy efficiency program sponsors provide a portfolio of programs to address the needs of their respective customer sectors. Nearly all sponsors will segment between residential and non-residential sectors in defining these portfolios. The latter category of programs targeting non-residential customers is often referenced as "C&I" (or "C/I"), shorthand for commercial and industrial. It is clearly essential to address the needs of residential customers with a separate portfolio of programs given the vast differences in housing structures as compared to those that facilitate industry and commerce. What is less clear – particularly in a paradigm on the electric side where lighting projects abound because of their rapid payback and universal application – is a need to further segment C&I program offerings to address the unique needs of the industrial sector.

One of the challenges in making this distinction is that the lines between commerce and industry are rather fuzzy. Many of the sub-sectors identified in NAICS-based (North American Industry Classification System) definitions of the "commercial" sector by the Energy Information Administration's National Energy Modeling System (NEMS) - retail, health care, education, hospitality, etc. – are industries in their own right. Likewise, businesses that are designated by EIA to fall into the major sub-sectors classifications in the "industrial" sector – energy-intensive manufacturing (e.g., food, chemicals, metals), non-energy-intensive manufacturing (e.g., metal-based durable goods, wood products, etc.), and nonmanufacturing industries (e.g., agriculture production, livestock, mining, etc.) – all require commercial real estate facilities and have administrative and overhead functions housed in office space.

Despite the overlap, when looking at the energy-use profiles of the two sectors, there are clear differences. Figure 4 illustrates the energy end-use profiles for electricity consumption for both commercial and industrial facilities on a metadata level.

Figure 4 – End Use Electricity Consumption Profile by Sector

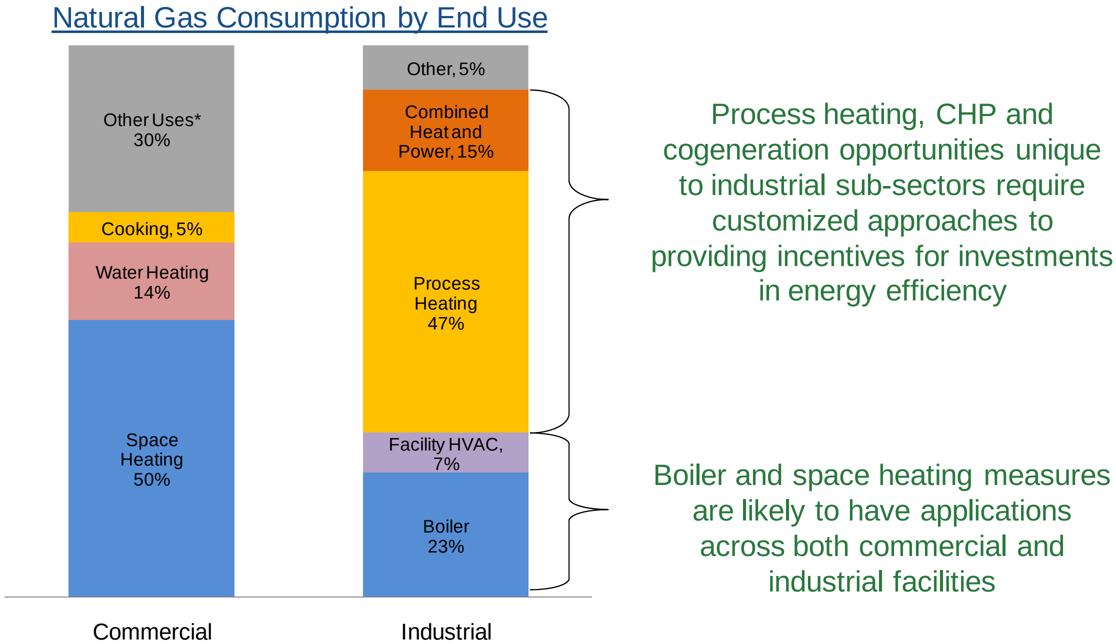


Source: Energy Information Administration
** Other Uses for commercial buildings includes miscellaneous uses, such as service station equipment, automated teller machines, telecommunications equipment, and medical equipment.*

As noted above, the industrial sector profile is dominated by process-related uses, while common building systems represent only around one quarter of industrial energy use. When no differentiation is made between C&I segments, there is the potential for missed opportunities on multiple fronts. First, the program sponsor may not have designed enough flexibility in the incentive structures and project support resource to address a customer's process-specific needs. Secondly, the sponsor may find it more difficult to gain traction with industrial customers on measures that address only small segments of their energy use profile (e.g., lighting, etc.) while their priority for investing in energy efficiency measures may rest with more process-centric applications. Depending on the energy-intensity of the industry and customer processes, these differences may be more or less acute.

With respect to natural gas consumption, a similar difference between the commercial and industrial sector profiles exists (Figure 5). While both segments may be well served with programs addressing boiler measures, industrial customers are also more likely to have additional process heating requirements that present significant opportunities to gain efficiencies.

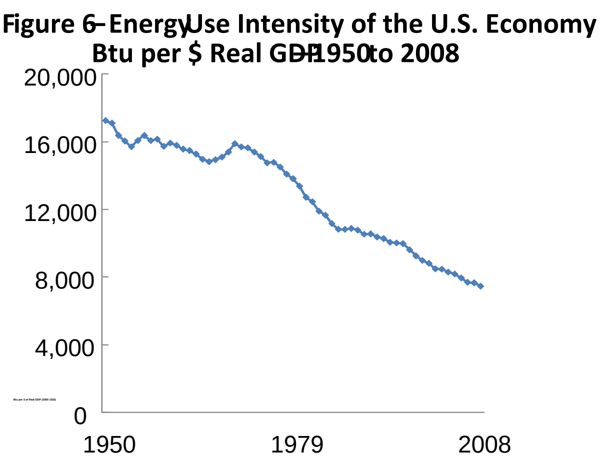
Figure 5 – End Use Electricity Consumption Profile by Sector



Source: Energy Information Administration
** Other Uses for commercial buildings includes miscellaneous uses, such as pumps, emergency generators, and combined heat and power.*

Waste heat recovery measures including combined heat and power (CHP) systems present a separate set of risks, uncertainties, and financial constraints to tackle in deploying measures to gain efficiency. While opportunities for CHP do exist in the commercial sector, the vast majority of the opportunity exists in industrial facilities, particularly larger plant sites with significantly greater waste heat generation.

3.2 Intensity Matters



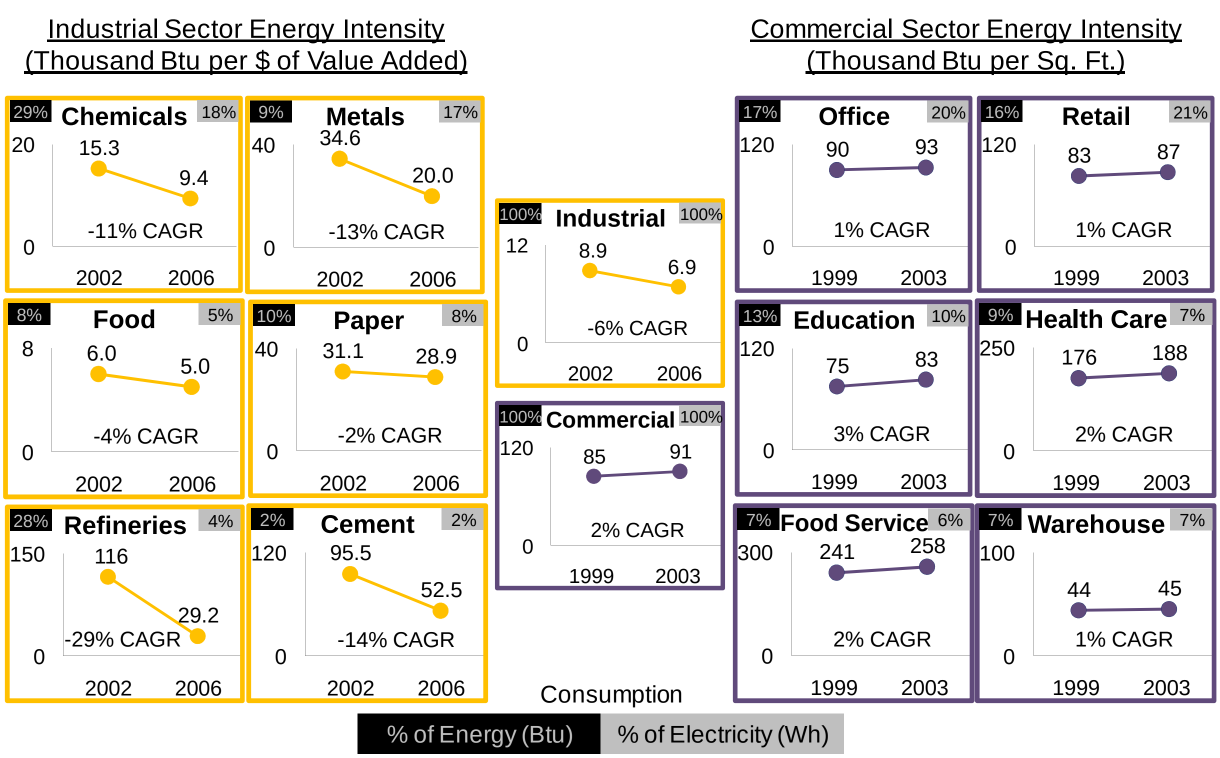
Source: EIA, Bureau of Economic Analysis

For decades the U.S. economy has been on a downward trend with respect to energy intensity (Figure 6). This is a function of both the move away from a more manufacturing-oriented economy to one that is dominated by service industries as well as the increasing gains in energy-use intensity among the various sectors, particularly in the industrial sector.

A more granular analysis of the energy-use intensities of various industries and segments can be developed from the information provided in two of EIA's end-use consumption surveys (Figure 7). The Commercial Building Energy Consumption Survey (CBECS) and the Manufacturing Energy Consumption Survey (MECS) are each conducted every four years. Currently the 2003 CBECS data and the 2006 MECS data are the most recent data sets to be published.

The survey data reveal that over the four years from the 2002 to 2006 MECS surveys, the energy intensity of the industrial sector in aggregate – as measured on a thousand Btu per dollar of value added – declined 23%, or at a 6% compound annual growth rate (CAGR). While an analogous Btu per dollar value added approach is not available given the nature of the commercial market segments (e.g., office buildings, schools), examining the Btu per square foot of floor space for the commercial sector shows an increase from 85 thousand Btu per square foot in 1999 to 91 thousand Btu per square foot in 2003, the most recent year for which CBECS data is available. This growth translates to a 2% annual growth rate for commercial building energy-use intensity as measured on a per square footage basis. Despite the apples to oranges comparison in energy intensity units, it remains clear that the energy intensity of the industrial sector has been declining dramatically while commercial buildings are seeing energy use hold steady or increase slightly.

Figure 7– Sub-Sector Energy Intensity Trends in Recent EIA Surveys



Source: Energy Information Administration

Examining the sub-sector data reveals even more about the trends experienced in the industrial sector. The largest rates of decline are observed in the most energy-intensive industries. The oil refining industry, which constitutes 29% of total industrial sector energy consumption (though only 4% of electricity use), experienced a dramatic decrease in energy-use intensity equivalent to a 29% annual rate of decline. Data on cement manufacturing shows a 14% annual rate of decline. The chemicals and metals industries which combine to account for more than 35% of electricity and total energy use in the industrial sector both experienced double-digit annual declines in energy intensity. The decreases were less severe in the food and paper industries which experienced annual declines of 4% and 2% respectively.

The implications to program sponsors of the declining industrial energy intensities are several-fold. First, it is a clear indicator that, perhaps even more so than in other sectors, there is a clear focus on energy efficiency in the industrial sector. Given the energy-use profiles, particularly in the most energy-intensive industries, it is not surprising that efficiencies related to process technologies are responsible for the large majority of these improvements in efficiency. As older, less efficient, plant and equipment assets are retired or replaced, newer, more efficient processes account for a greater proportion of industry capacity. Program sponsors should consider this in their approach to the industrial sector. It is not so much about convincing industrial end-use customers of the value of energy efficiency, but rather of demonstrating how the sponsor's programs provide assistance and incentives that can make a difference in the areas of greatest opportunity.

Secondly, while the biggest challenge for utilities and other program sponsors may be finding ways to assist with process-specific technologies, the focus on the customer's core activities and associated energy use may obscure the attractive investment opportunities that exist in support systems such as lighting and building HVAC which though not as significant a portion of the energy-use profile still may deliver meaningful cash flows and rapid paybacks. The program sponsor must balance between relevance to core process needs and encouraging participation in more general building system measures.

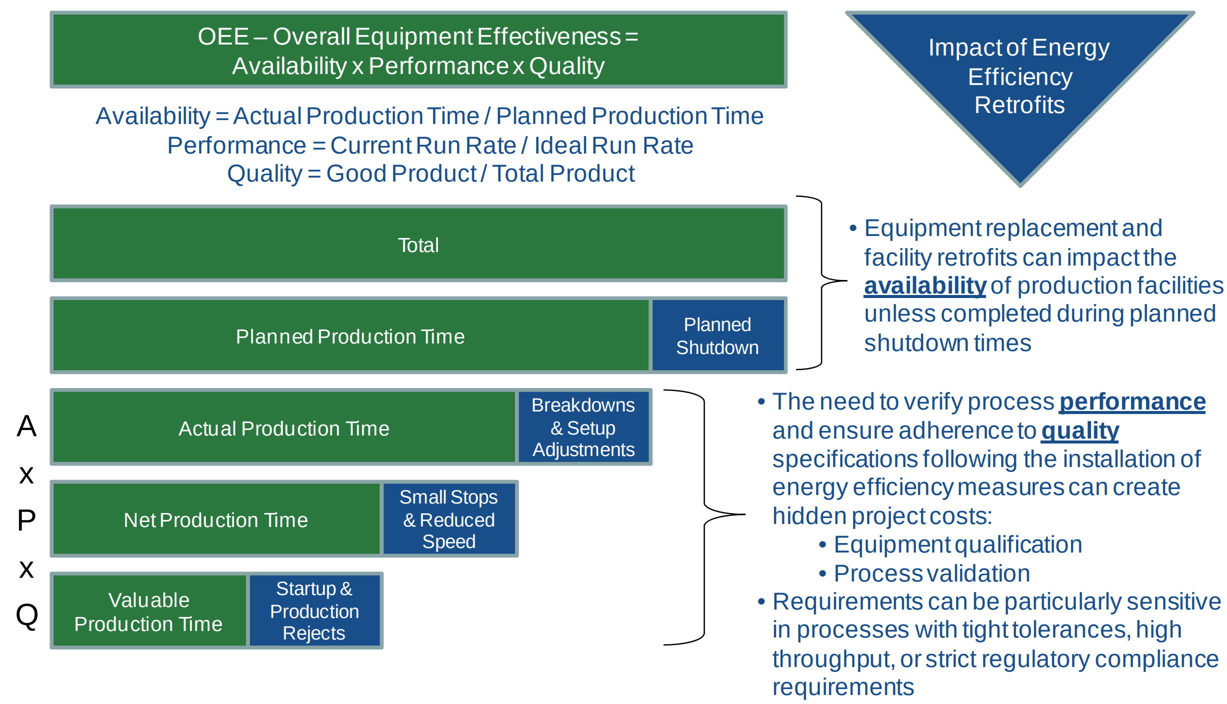
Finally, it is important to note the perspectives that many in the industrial community are likely to hold regarding the value of ratepayer-funded and systems benefits programs. In industries with intensive energy needs and sophisticated energy management processes, these programs can be viewed as placing a burden on the industrial sector in the way of surcharges that increase energy bills in order to subsidize investments in other customer sectors (e.g., residential, commercial) that are seeing growth in energy consumption. The result of these inclinations is the push for opt-out options and self-directed programs that a recent ACEEE study reports to have resulted in at least 17 states with active self-direct programs, particularly for large industrial customers (Chittum et al. 2009). Only by demonstrating that the program offerings for the industrial customers create value and bring new resources to bear in enabling and accelerating energy efficiency improvements will sponsors be able to gain the support of customers that have a track record showing their ability to drive down energy-use intensity.

3.3 Operational Hazards

A third barrier to energy efficiency program adoption and penetration in the industrial sector comes in the conflicts presented by the very improvements that will deliver increased energy savings. The installation of energy efficiency measures involves retrofitting facilities, replacing equipment, and recalibrating control systems. All of these activities represent two of the least desirable consequences for any process or facility owner – capacity utilization and variation. In other words, time and uncertainty are negatively impacted by the installation of equipment that improves energy efficiency.

In order to put this into perspective it is helpful to make use of a framework for productivity measurement. One of the most commonly employed measures of production process efficiency to gauge plant performance and asset utilization is OEE, which stands for overall equipment effectiveness. The OEE model and its component measures are illustrated in Figure 8.

Figure 8 – OEE – Overall Equipment Effectiveness Model for Plant Performance Measurement



The OEE measure is the product of three sub-components: Availability, Performance, and Quality. Availability represents the time that an asset (e.g., facility, production line, equipment unit) is available for production; it represents the proportion of planned production time that is actually used for production when accounting for the process and equipment breakdowns, setups, and adjustments. Within that available production time, Performance reflects how productive an asset is in producing output relative to its ideal design capability; if a process or piece of equipment has to run slower or has frequent faults or stops, performance suffers. Finally, Quality reflects the proportion of output that is acceptable based on existing product and process quality specifications. If a process is producing defective outputs and wasted materials, this will be reflected in a lower quality level.

Taken together the three factors of the OEE measure reflect an asset's overall productivity, which has very real consequences in terms of cost effectiveness and ultimately competitiveness and profitability of the business. To the extent that energy efficiency retrofits and measures pose a threat to this productivity, they will be rightfully met with stiff opposition.

The most obvious way in which energy efficiency improvements can interfere with plant and equipment productivity is by creating scheduling conflicts as facility retrofits and installations compete with scheduled production, decreasing availability. It is essential for program sponsors to work with industrial end-use customers to mitigate such conflicts in order to minimize true project costs. Where possible, seeking to complete retrofits and equipment replacements during planned shutdowns is one way to avoid interruptions.

A second, and less obvious impact, comes with respect to the performance and quality dimensions of productivity and the OEE measure. While some upgrades will no doubt enhance equipment performance and reliability, there is a risk that the opposite can be true. Even if new equipment functions flawlessly and does not introduce added delays or breakdowns, new process parameters – from heat transfer to motor speeds to process pressures – can have unforeseen impacts on process outputs. For this reason it is likely that retrofits to many industrial facilities will come with the foresight of a requirement to verify that the process changes do not have any adverse impact on process performance and product quality. Such activities, including development and execution of equipment qualification and process validation protocols, can consume substantial time and resources, creating hidden costs to pursuing energy efficiency improvements.

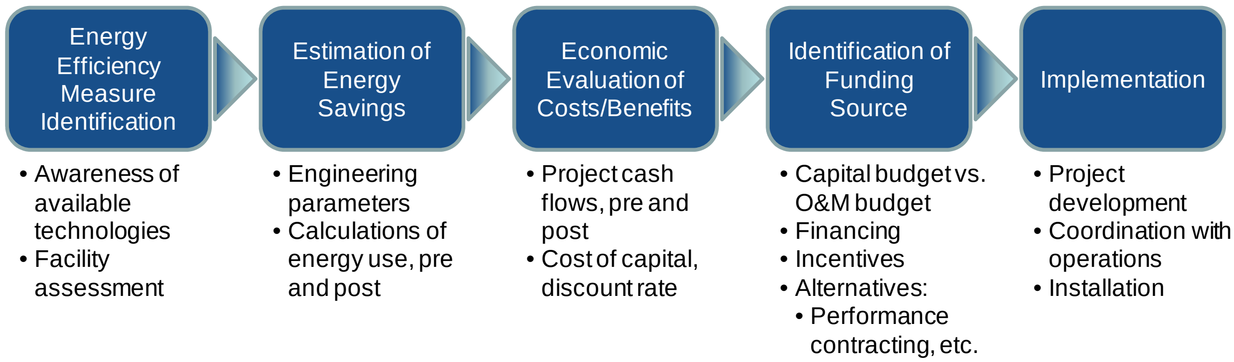
The most successful program sponsors and implementers will be mindful of these considerations throughout their engagements with industrial end-use customers. Understanding the potential for impacts on production area schedules and performance and developing a proactive plan with the customer will both gain the trust of the process owner and help to ensure that steps are taken to ensure that productivity is maximized and hidden costs do not emerge later.

3.4 Making Cents and Sense of Energy Savings

Another significant barrier to pursuing energy-saving measures is presented by the need to mobilize resources to execute across all aspects of the energy efficiency project cycle. It is in this area that sponsors have the opportunity to provide education, technical assistance and financial incentives and solutions to help end-use customers take advantage of the opportunities that exist in their facilities.

The typical energy efficiency project involves several of the steps illustrated in Figure 9, from facility assessments that identify energy efficiency measures to the estimation of the achievable savings and the translation to economic terms that are essential for funding and implementation decisions.

Figure 9 – Energy Efficiency Project Process Flow



Each step in the process requires a particular set of skills in order to identify, quantify, and communicate opportunities. Not all of these skill sets are likely to reside in the customer's own organization, particularly with respect to the technical knowledge to identify opportunities, quantify savings potential, and implement energy efficiency measures. Furthermore, the wide range of incentives at the utility, local, state, and federal levels in the current market can pose a daunting challenge to end-use customers with little available time and capacity outside of their core business functions.

Program sponsors that find ways to identify customer needs throughout the project process and bring valuable resources and skills to bear will help customers to see energy efficiency opportunities through to completion and realize the shared benefits.

Many of the program innovations that are seen in the current market are a testament to the focus on program sponsors on meeting these needs. In the case of energy efficiency measure identification this means support of energy management business processes to promote a focus on energy-saving opportunities and the provision of audit and assessment services to catalog and quantify the impact of potential measures. More utilities are found to be providing design and additional technical assistance to develop project opportunities and provide customized incentives to offset measure costs.

On the funding dimension, utilities and third-party administered programs are offering innovative financing mechanisms and helping customers connect to opportunities to access public funding sources and other financial incentives.

The ability of end-use customers to manage the technical aspects of project development, make decisions, and secure funding can be a function of the organization's size and complexity. As illustrated in Figure 10, smaller business may benefit from streamlined decision making and the potential for low-cost benefits from adopting energy management practices. However, they are less likely to have individuals internal to their organization with the technical skills to execute all aspects of energy efficiency retrofit project management and they are more likely to have challenges accessing capital to fund improvements. Meanwhile, large businesses have fewer technical and financial barriers, but can be burdened by multiple layers of decision making and the separation of finance functions, including capital budgeting decisions.

Figure 10 – Business Size as a Factor in Pursuing Energy Efficiency Project Opportunities

	Enablers	Barriers
Smaller Businesses	• Single decision maker (likely) • Absence of formalized energy management practices presents opportunities for O&M efficiencies	• Less likely to have internal technical expertise, resources • Lack of access to capital, ability to self-finance measure costs
Larger Businesses	• Greater access to capital, financing options • Internal technical expertise, resources (facilities/energy management, engineering)	• Multiple layers of decision making • Separation of facilities management, finance functions • Focus on core business activities

3.5 Flow Me the Money

Facility retrofits and equipment replacement constitute investments that return lower facility and/or process energy-use intensity, reducing energy bills and other operations and maintenance expenses. They require an upfront commitment of capital and resources in order to realize benefits in the form of future cash flows. While projects may present an attractive payback and return on investment, these benefits cannot be realized without the ability to overcome the "first-cost" barrier of the initial capital requirement.

Feedback from business executives indicates that the first-cost barrier is among the most significant hurdles to realizing energy savings in the commercial and industrial sectors. The 2010 Energy Efficiency Indicator report published by Johnson Controls and the International Facility Management Association (IFMA) provides insights from a survey of more than 1,400 North American business leaders responsible for managing energy use in commercial and industrial facilities. Asked to identify their top barrier to capturing energy savings in their organizations (Figure 11), 38% of respondents identified lack of capital budget making it the top response ranking above concerns about ROI and the scarcity of technical expertise (JCI/IFMA 2010).

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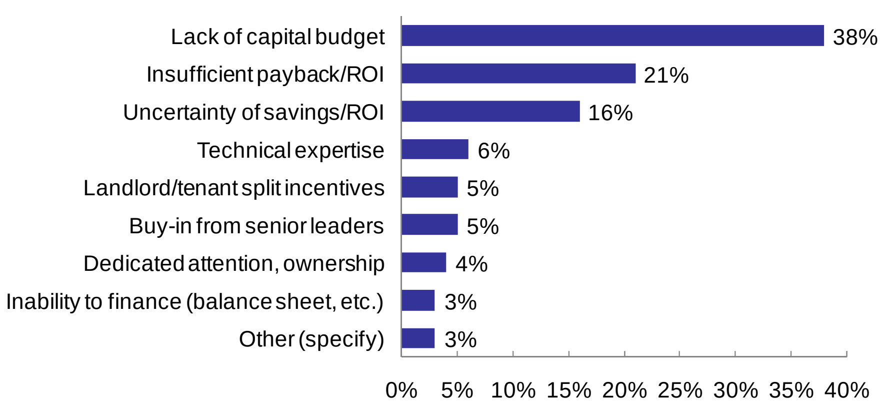
- **Figure 11 – Identified Barriers to Investment in Energy Efficiency**

What is the top barrier to capturing energy savings in your organization?



Source: Johnson Controls/IFMA, 2010 Energy Efficiency Indicator, N=1,435

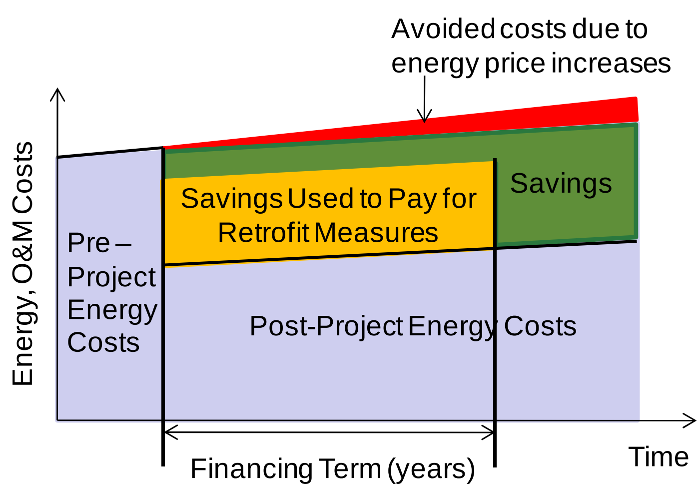
While lack of capital being a barrier to investments in energy efficiency is to be expected, the solutions to addressing it can be less obvious. As with the acquisition of any asset, the ability to make investments in property, plant, and equipment for the purposes of achieving energy savings are a function of a business's financial health including its balance sheet and cash flow performance. Whether the business has cash and other liquid assets to apply to project implementation costs or the capital structure and creditworthiness to access capital markets and financing vehicles will dictate the options available to make investments and the associated cost of funds.

To the extent that the positive cash flow benefits of the energy efficiency measures can be leveraged in sourcing funding, industrial sector and other end-use customers may find attractive alternatives to self-financing or the use traditional financing mechanisms such as loans and leases. Such mechanisms, including performance contracting – which makes use of performance guarantees and special financing vehicles – can provide a paid-from-savings solution that uses energy savings cash flows to cover the repay the cost of retrofits without having to incur a first-cost barrier. These solutions, with mechanisms akin to operating leases, can in certain situations be structured to avoid or limit balance sheet impacts while adhering to and upholding accounting standards and guidelines.

Recent innovations to leverage liens on property tax bills, known as property-assessed clean energy, or PACE financing and even utility on-bill financing solutions can also enable low-cost, long term financing that removes first-cost barriers and is attractive to both the end-use customer and financial institutions. While more commonly used to support residential project opportunities, these mechanisms hold significant potential for commercial and industrial facilities, with small businesses being the most obvious potential beneficiaries.

The concept of the paid-from-savings model of project financing is illustrated in Figure 12.

Figure 12 – Paid-From-Savings Energy Efficiency Project Financing



A paid-from-savings solution requires that financing terms and interest rates allow obligation repayments to be covered by the free cash flows from energy savings. Striking a balance between credit risk and payment capacity is essential for these programs to succeed. They require cost-effective energy savings measures on the one hand and financial institutions comfortable with the risks involved on the other. Energy efficiency programs involving successful financing solutions will bring both to bear in assisting customers in identifying and pursuing project opportunities.

Further increasing the need for alternative financing mechanisms are the payback demands from business executives making capital budgeting decisions regarding potential energy efficiency investments. The Johnson Controls/IFMA survey finds that 44% of decision makers require a payback of less than three years on all energy efficiency investments – a payback requirement that translates to over a 20% internal rate of return (IRR) if only five years of benefits are considered, and 30% if the benefits horizon is extended to ten years (JCI/IFMA 2010). The McKinsey study cites expert interviews providing anecdotal evidence that paybacks of less than 2 years (41% IRR at a 5-year benefit horizon, 49% at a 10-year horizon) were not uncommon among businesses in middle of the most recent economic downturn (McKinsey 2009). Capital budget-neutral approaches to energy efficiency financing that impact business financial metrics only in terms of positive cash flows from energy savings can go a long way to circumventing the challenge of elevated hurdle rates.

4. Programs to Address Barriers

Hundreds of sponsor organizations provide programs offering to stimulate investments in energy efficiency measures among industrial energy consumers. Primary among these sponsor organizations are the electric and gas utilities that administer ratepayer-funded programs to help their end-use customers reduce energy consumption and meet mandated savings goals and resource planning objectives. By comparing the results achieved by these organizations to the types of incentives and assistance provided, insights can be gained into what program strategies lead to higher levels of savings and the consequences to cost effectiveness.

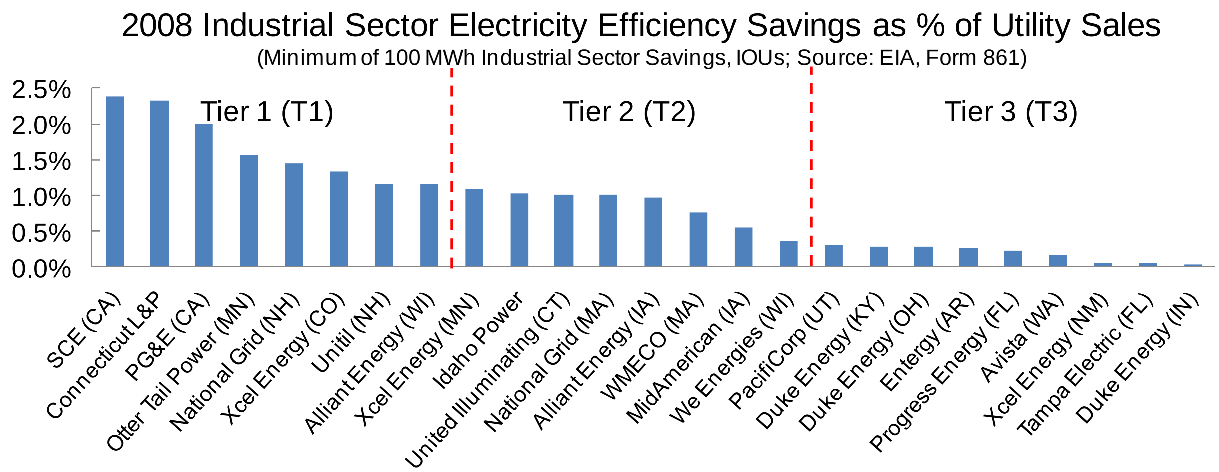
4.1 Programs with an Impact

Data reported annually by electric utilities to the EIA on Form 861 provides the opportunity to examine sector-level impacts including the incremental savings attributable to programs serving end-use customers in the industrial sector. Recently data for 2008 was made available.

Among investor-owned electric utilities (IOUs), twenty-five were found to have reported industrial sector impacts of more than 100 megawatt hours (MWh) in 2008. This represents less than a quarter of the 109 utilities reporting energy efficiency program results. When comparing these savings to the utilities' reported sales for industrial sector customers, the impacts were found to range from as high as 2.4% (Southern California Edison) to as little as 0.03% (Duke Energy Indiana) among IOUs with at least 100 MWh in industrial-sector savings.

The range of savings for these twenty five utilities is illustrated in Figure 13 below. For the purposes of exploring the drivers of program impacts, the utilities are grouped into three "tiers" of results based on arbitrary limits to create groups of 8 to 9 utilities, with Tier 1 ranging from 1.2% to 2.4%, Tier 2 from 0.4% to under 1.2%, and Tier 3 under 0.4% of sales.

Figure 13 – Investor-Owned Utility Programs Achieving Greater Than 100 MWh in the Industrial Sector



Source: Energy Information Administration

Again it is worth noting that even the utilities in the Tier 3 grouping are among the top quartile of U.S. IOUs in terms of the magnitude of industrial sector savings. By limiting the analysis to those utilities with at least 100 MWh of savings, comparisons can be made of the attributes of established programs.

4.2 Drivers of Performance

The twenty five investor-owned utilities with the highest industrial sector savings each offers a portfolio of programs combining financial incentives and technical assistance to varying degrees. While all programs at a minimum provide prescriptive rebates for measures such as energy-efficient lighting equipment, HVAC equipment, pumps and motors, additional incentive structures and technical services are often available to assist customers and enable investments in energy efficiency projects.

Custom incentives provide flexible financial incentives often determined by a project's estimated or measured energy savings. Audits and assessments are often available to inspect facilities and generate lists of viable measures to achieve savings. Some utilities offer enhanced technical and design assistance, even project management resources to coordinate between contractors and facilities operations. Somewhat less common are programs that provide financing solutions, either via low-cost loans or performance contracting services to remove first-cost barriers. Additionally, targeted programs for small businesses and those specific to motors serve to address sizable but distributed opportunities. Building commissioning and operator certification programs focus on the large untapped opportunities to optimize building automation performance and provide training and education to increase facility energy management capabilities.

Figure 14 outlines the 2008 service offerings identified by the authors in reviewing the program offerings of these 25 utility program sponsors.

Figure 14 – Program Services Offerings among IOUs with >100 MWh of Industrial Sector Savings

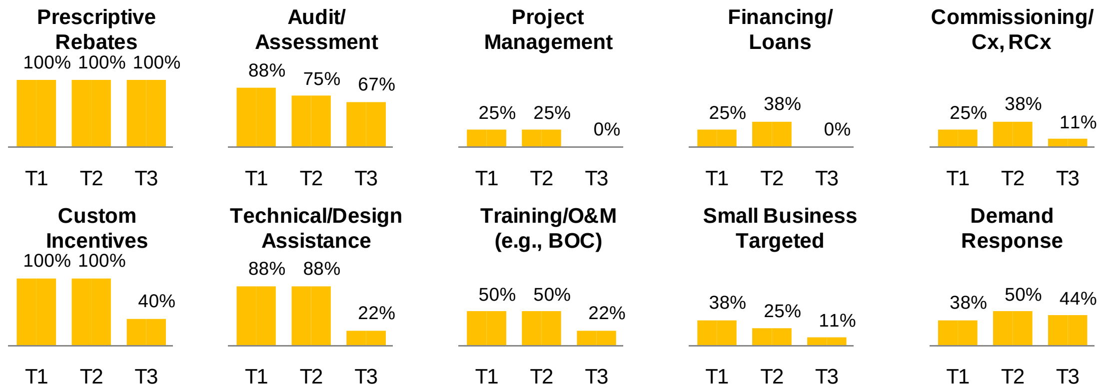
	Rank	2008 Industrial Program Savings (% of Sales)	Prescriptive	Custom	Financing (Loans)	Audits/ Assessment	Technical/Design Assistance	Project Management	Targeted Small Business	Commissioning, Retrocommissioning	Training / O&M (e.g., BOC)	Performance Contracting	Demand Response	Motors Program (In Addition to Measure Rebates)
SCE (CA)	1	2.4%	●	●		●	●	●	●			●	●	
Connecticut L&P	2	2.3%	●	●	●	●	●			●	●		●	●
PG&E (CA)	3	2.0%	●	●		●	●		●		●	●	●	
Otter Tail Power (MN)	4	1.6%	●	●										●
National Grid (NH)	5	1.5%	●	●		●	●			●				●
Xcel Energy (CO)	6	1.3%	●	●		●	●		●		●			
Unitil (NH)	7	1.2%	●	●		●	●							
Alliant Energy (WI)	8	1.2%	●	●	●	●	●	●			●	●		●
Xcel Energy (MN)	9	1.1%	●	●		●	●		●				●	
Idaho Power	10	1.0%	●	●		●	●							
United Illuminating (CT)	11	1.0%	●	●	●	●	●		●	●	●		●	●
National Grid (MA)	12	1.0%	●	●						●				●
Alliant Energy (IA)	13	1.0%	●	●	●		●	●			●	●		
WMECO (MA)	14	0.8%	●	●		●	●				●			●
MidAmerican (IA)	15	0.5%	●	●	●	●	●	●		●			●	●
We Energies (WI)	16	0.4%	●	●		●	●				●		●	●
PacifiCorp (UT)	17	0.3%	●	●		●	●			●				
Duke Energy (KY)	18	0.3%	●											
Duke Energy (OH)	19	0.3%	●											
Entergy (AR)	20	0.3%	●	●		●	●		●				●	
Progress Energy (FL)	21	0.2%	●			●								●
Avista (WA)	22	0.2%	●	●		●							●	●
Xcel Energy (NM)	23	0.1%	●	●		●					●			
Tampa Electric (FL)	24	0.1%	●			●							●	●
Duke Energy (IN)	25	0.0%	●								●		●	

Source: Franklin Energy review of program offerings

Examining the prevalence of these various energy efficiency program service offerings across the three tiers of utilities reporting significant industrial sector savings highlights a number of correlations between achieved savings and the types of methods employed by program sponsors. Figure 15 shows the percentage of utilities in each tier (as illustrated in Figure 13) offering specific services in 2008.

It is not surprising that the Tier 1 and Tier 2 utilities are found to have more robust service offerings, clearly distinguished from Tier 3 utilities where the majority of sponsors do not offer the custom project incentives or any significant technical assistance. In addition to these services provided to create flexibility in addressing specific facility and process opportunities, Tier 1 and Tier 2 sponsors also distinguish themselves as more often offering training to develop customer energy management competencies, commissioning and retro-commissioning services to optimize building performance, and project management services to see projects through to completion and minimizing operational impacts.

Figure 15 – Summary of Program Service Offerings by Savings Tier

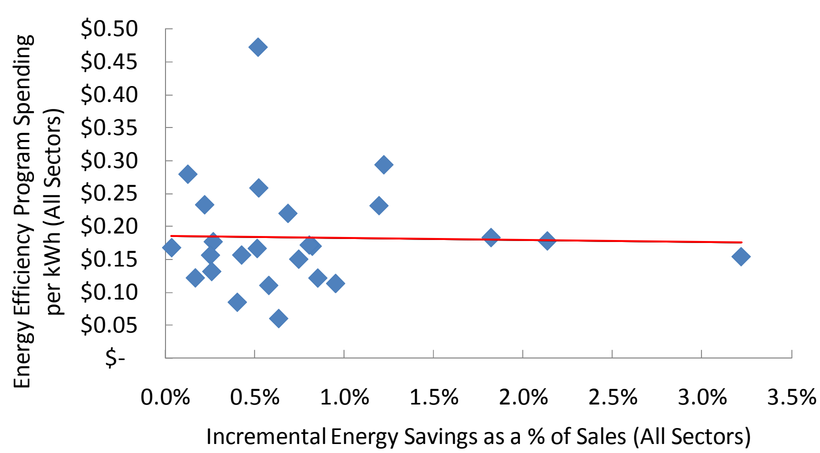


Financing solutions essential to addressing the barrier presented by lack of capital budgets is found in only a minority of the Tier 1 and Tier 2 sponsors and not at all among those sponsors identified in the Tier 3 category. Given the acute need identified in the lack of available capital, this is a clear area of opportunity among all sponsors including most of the highest-performing sponsors.

Load management and demand response programs are not found to have any higher prevalence in the higher Tier programs suggesting that such programs may have limited influence in driving consumption savings.

An important question to ask is whether higher levels of energy savings come at a higher cost relative to the energy savings generated. Figure 16 compares the achieved energy savings to the $ per kWh of program costs for the 25 utility sponsors included in above analysis. Though budget data is not reported specific to the industrial sector, total portfolio nonetheless serves as a useful proxy. There is not found to be a significant correlation between energy savings and cost of savings, refuting the assertion that increased spending per kilowatt hour is needed to achieve savings on the order of 1 to 2%.

Figure 16 – Program Cost Effectiveness vs. Energy Savings as % of Sales



Source: Energy Information Administration

5. Conclusions

Empirical evaluations highlight the tremendous opportunity for increased industrial sector exists in the U.S. economy, with the potential to save as much as one fifth of forecast energy use in ten years. Realizing these savings could mean hundreds of billions of dollars in savings and increased productivity to the U.S. economy.

Program sponsors acting to meet their goals and objectives can achieve higher levels of savings by recognizing the major barriers and challenges that exist to spurring increased measure adoption among industrial sector end-use customers. Among the important lessons for sponsors to recognize and incorporate into their program portfolio designs are the following:

1. Major differences exist in the energy-use profiles across commercial and industrial sectors and sub-sectors. To address the largely process-specific opportunities that exist at industrial facilities, sponsors must provide flexible incentives and specialized technical assistance.
2. The track record of declining energy-use intensity in the industrial sector highlights the challenge of sponsor programs to be a relevant to the energy management areas of greatest concern to customers.
3. Sponsors should recognize the potential for energy efficiency projects to conflict with customers' short-term productivity objectives and be proactive in seeking ways to minimize adverse impacts and expose hidden costs early in the project development process.
4. The capability of customers' to identify opportunities and translate those opportunities into economic benefits and financing decisions varies. Recognizing where resources can serve to enable assessment and decision making processes will help to maximize the potential to realize energy savings.
5. Lack of capital budgets is the top barrier to increased adoption of energy efficiency measures. To the extent that sponsors can provide paid-from-savings financing options that remove first-cost barriers, more industrial customers are likely to pursue energy-saving measures.

The most successful program sponsors are employing service offerings that embrace these realities and mobilize resources to overcome the barriers that exist. The empirical evidence from their experience suggests that significant opportunity to enhance program offerings and increase energy savings can be achieved without compromising cost effectiveness.

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