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The Eighty Billion Dollar Energy Savings Opportunity

for Commercial and Industrial Organizations

An Edison Energy® Insight

CONTENTS

The research for this paper was commissioned by Edison Energy and was independently conducted by Menlo Energy Economics, a consultancy specializing in energy economics and business transition in the electric power sector.

Introduction

Commercial and industrial (C&I) organizations in the U.S. spend an estimated $260 billion on electricity and natural gas every year. Data show that this staggering amount of money spent on meeting the needs of our country's largest energy users can be reduced by up to $80 billion, a whopping 30% reduction on an annual basis.

Waste of this proportion would be unacceptable in any part of an organization's core operations. No plant manager could justify a 30% cost overrun on supply chain management.

Money spent on meeting the needs of our country's largest energy users can be reduced by up to $80 billion.

Similarly, no investment management company would survive long if it lost 30% of the value of its managed assets every month. So why do our nation's largest energy users, the very companies from whom we buy our cars and electronic devices, or who service our financial needs, appear to ignore this huge savings opportunity when it comes to the way they purchase and use energy? Encouragingly, the answer appears to be that they are no longer willing to let valuable capital go up their collective chimneys in the form of wasted energy and dollars.

INTRODUCTION (continued)

The journey to achieving eighty billion dollars in energy savings has already begun. New technologies are being developed that promise to significantly lower energy use and cost. Large organizations are implementing sustainability programs to reduce greenhouse gas emissions. Energy policy and the associated regulations that change the way markets behave are evolving to support a future where energy costs less and is used more efficiently. And we are just getting started.

But making the best-informed decisions about how to move forward with the right technology and service investments can be difficult without insight into the rapidly changing energy market. Organizations are looking for a trusted and independent energy advisor who can help them successfully navigate the growing complexity of the new energy future—so they can focus on their *core business*.

This is the first of two white papers that examines how the largest energy users can save significant amounts of money on their energy costs. This paper presents a macro-level view of how much energy companies use and where the opportunities are for significantly reducing those costs. A future paper will provide a more detailed, micro-level exploration of the areas within an enterprise that offer the biggest opportunities for saving energy costs.

This paper examines data from several familiar sources, including the EPA, McKinsey & Company, the Rocky Mountain Institute, and others, to explore how it is we have come to spend such a huge amount of money on energy and how that energy gets used in our commercial and industrial markets.

The paper concludes with a look at a new business model, the Managed Portfolio Solution (MaPS), which redefines the relationship organizations have with energy across their enterprise to help them develop holistic programs, mitigate their exposure to energy risk, and achieve the goal of reaching eighty billion dollars in energy savings.

Table 1. Energy use in U.S. economy, 2014 data in quads

SECTOR	QUADS	%
Residential	21.53	22
Commercial	18.34	18.6
Industrial	31.33	31.9
Transportation	27.12	27.6
Total	**98.32**	**100%**

Source: *Energy Information Administration, 2014 data*

Energy Use in the U.S. Economy

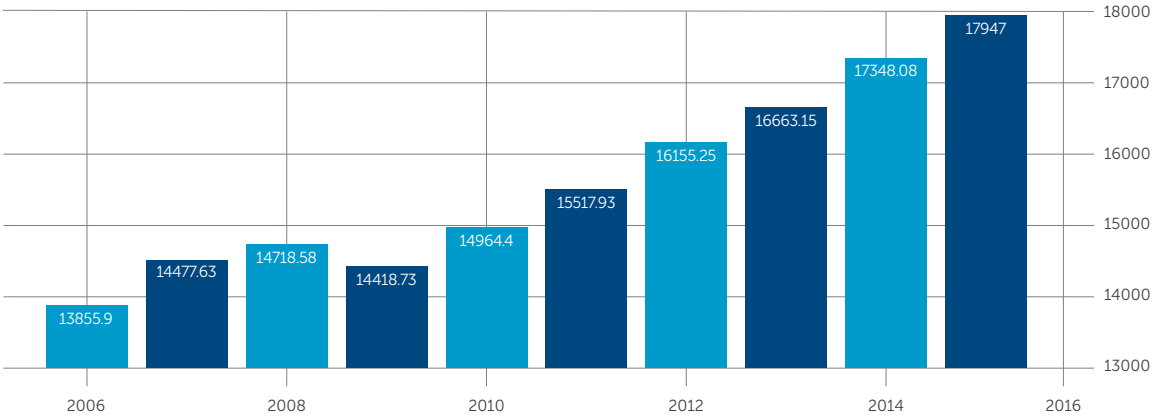
Energy consumption in the U.S. is massive. In 2014, the U.S. economy consumed 98.3 quads (quadrillion BTUs) of primary energy, energy in its raw, unconverted state such as gas, oil, solar, and wind, before it is turned into productive energy in the form of a spinning motor, heating, lighting, etc. Commercial and industrial companies represent 50% of this total. (Table 1, page 4) That same year, the World Bank estimated that the U.S. Gross Domestic Product (GDP) was $17.4 trillion (Figure 1), roughly 28% of the world economy. Historically, energy costs comprise roughly 8–10% of U.S. GDP, depending on prevailing energy prices. This, of course, includes *all* forms of energy used in *all* sectors of the economy including transportation. Using 8% as a rough number, all forms of energy cost the U.S. economy a staggering $1.4 trillion annually.

Data from the Energy Information Administration (EIA)[1] show that C&I organizations spent an estimated $260 billion ($210 billion on electricity and $50 billion on natural gas) in 2015. This figure does NOT include gasoline, other petroleum products or coal.

Some large industrial companies use coal in specific applications such as internal power generation or as part of combined heat & power (CHP) plants. Adding the cost of these fuels further increases the above estimate. This paper focuses only on electricity and natural gas consumption and savings for the largest commercial and industrial users.

With energy spending of this magnitude, it is easy to see how even small improvements in how energy is utilized to deliver useful energy services—such as powering manufacturing equipment, lighting in commercial buildings, or heating and cooling in residential and commercial sectors—can amount to significant cost savings by reducing wasted energy, improving productivity, enhancing overall process efficiency and reducing environmental emissions.

Figure 1. U.S. GDP, 2006–14, in U.S. $ billion



Source: www.tradingeconomics.com ›› World Bank

How Much of the Energy Spend Can Be Saved?

A growing number of companies are investing in long-term, off-site renewable power purchase agreements, on-site self-generation such as rooftop solar and other forms of renewable energy including biomass, biogas, agricultural waste or residue, and they are seeing reductions in their energy purchases.

C&I companies know that they can significantly reduce their energy bill. Estimates on the amount of this energy savings vary. The U.S. Environmental Protection Agency (EPA), for example, claims that companies waste as much as 30% of the energy they consume.[2] This means that C&I organizations are wasting as much as $80 billion every year. So the question is: If companies are wasting so much of their energy spend, why are they not doing more to reduce that spend, and if they did, how much could they save if they committed the resources and focus of their organization to do so?

> As much as 30% of the energy used by typical C&I companies is wasted

Why Are Companies Not Using Energy Efficiently?

For most companies, energy is not typically at the front and center of their attention. Energy is not usually regarded as being strategic to the company's mission. Jimmy Jia[3] writing in the *Harvard Business Review*, observes, "Think about a baker who uses flour to make bread. He treats flour as a critical resource tied to the bottom line. He also uses energy to make bread. Why doesn't he treat energy as a critical resource as well?"

Jia thinks the reason for the lack of better energy planning may be that, "Currently, company management is not structured to do this and will therefore struggle to strategically handle these emerging challenges around energy." He goes on to say, "At best, it can manage costs. Yet the benefits of smarter utility consumption go beyond just a smaller bill. Eliminating the 30% of unnecessary consumption can improve profitability, reduce equipment downtime, become a competitive differentiator, and lower carbon emissions. The marginal effect on profit through reducing utility costs can be significant. Every dollar saved in utility costs becomes an additional dollar of net profit."

The complexity of energy regulatory policy is another serious barrier. Consider a large company with operations in multiple states served by multiple utilities and gas companies, each with their complicated tariffs and regulations, which frequently change. It takes a lot of time and effort to identify the best tariffs and options available in each location while managing other pressing operational, logistical and marketing issues.

Eliminating unnecessary consumption can improve profitability, reduce equipment downtime, become a competitive differentiator, and lower carbon emissions.

Aside from the complicated tariffs, energy complexity has another dimension: converting energy to useful or productive forms and the associated services needed to deliver them. With rapid technological advancements taking place, most companies have a difficult time keeping up with how to maximize their output while minimizing energy, labor, material and environmental costs.

Another major obstacle to more efficient use of energy is the fact that companies do not necessarily know where to go for unbiased information and/or trusted advice. Typical vendors, equipment suppliers and even consultants and energy service companies (ESCOs) lack an independent approach to advising companies about their energy program since many are in the business of selling products or services that may not necessarily address the client's real needs.

Finally, many companies do not have easy access to capital to finance the energy infrastructure makeover that is typically required to implement the necessary energy efficiency improvements. Or they may face high internal hurdle rates of return.

A study by the Carbon Trust focused on the U.K., for example, suggests that savings of 40% or better are possible in manufacturing and other segments of the industry. (Table 2) That should not come as a surprise. What is, however, surprising is the relatively short payback periods, averaging around 2.5 years. Steve Nadel, Executive Director of the American Council for an Energy Efficient Economy (ACEEE),[4] puts the magnitude of U.S. potential energy efficiency savings somewhere in the 10–60% range. As Nadel and other studies suggest, the potential scope of energy efficiency savings in the U.S. economy is significant. Moreover, most studies conclude that the bulk of the savings can be achieved at relatively low cost and, as the Carbon Trust study shows, with relatively short payback periods.

Table 2. Energy efficiency opportunities in selected industries in the U.K.

SECTOR	Savings on annual energy spend	Payback on CapEx (years)
Manufacturing	41%	1.6
Electronics	23%	3.5
Engineering	37%	3.7
Waste	21%	1.4
Transport	48%	2
Average	**34%**	**2.44**

Source: Carbon Trust

The Scope of Energy Efficiency Savings in the Commercial Sector

An estimated 42% of America's total energy and 72% of its electricity is used in buildings—all 120 million of them. As a point of reference, total primary energy used in U.S. buildings is more than all the energy used in Japan or Russia.[5] A 2009 study by McKinsey & Company, summarized in Table 3 on page 10, presents an overview of energy use in the commercial sector along with the efficiency savings potential. Less than half of all U.S. buildings are categorized as commercial. Collectively they use a combined 8 quads of delivered or primary energy. Most of that energy is used in buildings where people work, shop, eat, worship or entertain. The sector may be further subdivided into main categories of use such as office, mercantile, education, food service, health care, lodging, warehouse, religious and various other commercial services. (Figure 2, page 11)

Figure 3 on page 11 shows where energy is used in the commercial sector. Lighting, cooling, refrigeration, water heating, and ventilation, commonly referred to as HVAC, comprise most of the energy use. Small improvements in reducing energy consumed in buildings can result in substantial savings. One study suggests that by applying the latest integrative designs, energy use in U.S. buildings can be reduced in the range of 54–69% by 2050.[6]

> Small improvements in reducing energy consumed in buildings can result in substantial savings.

Amory Lovins, an energy efficiency expert at the Rocky Mountain Research Institute (RMI), says that the fundamentals of saving energy in buildings—commercial or otherwise—are straightforward and consist of three basic steps:

- First, make the building shell as efficient as possible so there is less need for HVAC, the single biggest energy use in buildings
- Second, make the energy-using devices inside the buildings as efficient as is economically justified
- Third, operate the equipment and devices inside the buildings as efficiently as possible without sacrificing comfort, safety, productivity or convenience of the occupants

All three steps should be self-evident, yet they are rarely fully applied in practice. For example, a well-insulated building shell, appropriately sized and with the optimal orientation, will need very little energy for cooling or heating, meaning it can get by with little energy used for HVAC. Basics like the building's orientation and planting a few trees so that it is shielded from the heat of the afternoon sun can cut down significantly in HVAC load. With good lighting and efficient equipment, the building's total energy requirements can be further minimized. Add some distributed self-generation such as solar on the roof of a warehouse, office building or shopping mall, and the building(s) can approach a zero-net energy (ZNE) status as some new buildings currently do.

Numerous studies suggest that better insulation, superior windows, efficient lighting and equipment can easily pay for themselves in lower energy bills, with reasonable payback periods—which explains why they are now increasingly adopted in new buildings. There is significant energy efficiency potential in the commercial sector, which can be achieved at low cost if the focus, resources and drive to do so exist.

Table 3. Energy use in the commercial sector

	2008 Energy Use	2020 BAU Energy Use	2020 Savings Due to EE	Savings
END-USE ENERGY Trillion BTUs	6,680	8,010	2,290	**29%**
• Electricity TWh	1,330	1,660	510	**31%**
• Natural gas	1,930	2,140	510	**24%**
• Other fuels*	200	220	50	**23%**
PRIMARY ENERGY Trillion BTUs	16,330	20,010	5,970	**30%**
• Electricity**	14,110	17,570	5,390	**31%**
• Natural gas	2,010	2,220	530	**24%**
EMISSIONS Megatons CO_2e	990	1,220	360	**30%**

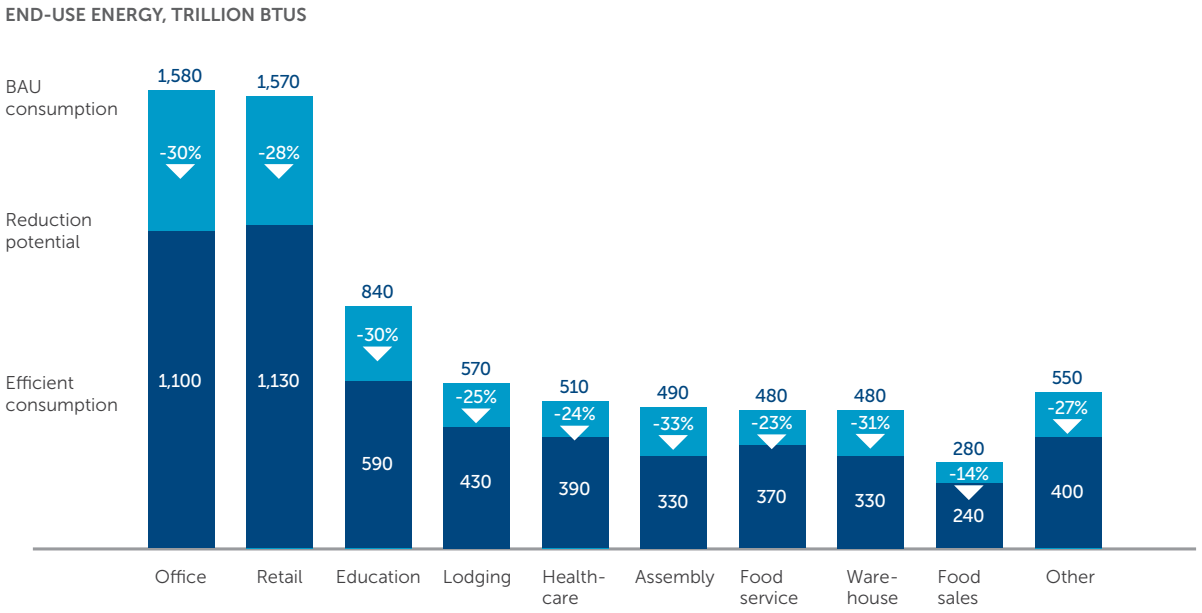
2009–2020
PV of upfront investment:
$125 billion

2009–2020
PV of energy savings:
$290 billion

2020
Annual energy savings:
$37 billion

*End-use energy is approximated as equivalent to primary energy | **Does not include CHP savings of 490 trillion BTUs
Source: *Unlocking energy efficiency in the U.S. economy, McKinsey & Company, June 2009*

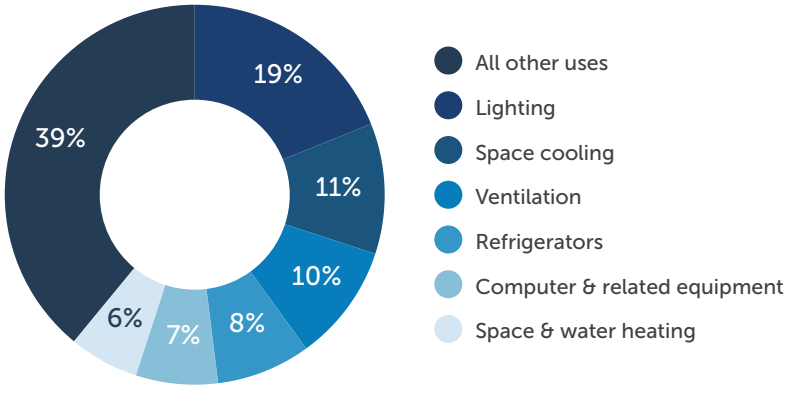
Figure 2. Energy efficiency potential in the commercial sector



Source: Unlocking energy efficiency in the U.S. economy, McKinsey & Company, June 2009

Figure 3. U.S. commercial sector electricity consumption by major end uses, 2015

36% **of commercial electricity consumption goes to lighting, heating and cooling**



Source: U.S. Energy Information Administration, Annual Energy Outlook, Table 4, September 2016

The Scope of Energy Efficiency Savings in the Industrial Sector

The U.S. industrial sector uses roughly 31 quads of energy each year. (Table 1, page 4) The two biggest uses are heating—40% of primary energy used and motor drive—another 40% of the total. It is estimated that this can be reduced by as much as 30% by 2050 applying the integrative design.[7] In contrast to the commercial sector, where energy use is predominantly defined by the square footage of buildings, industrial energy use is determined by the type of industrial processes. Moreover, no two industries are the same; so what can be said about the potential scope of energy savings in one industry, say pulp and paper, does not necessarily apply to others—few generalizations apply.

To estimate energy savings in the industrial sector, each type of industry must be individually examined and the results aggregated over the entire sector. In fact, experts suggest that such studies must be done on a case-by-case basis since each industrial company is unique in many attributes. Figure 4 on page 13 shows electricity use by type in U.S. manufacturing. Electricity used for driving motors of all types represents almost 50% of all electricity used in manufacturing.

More than two-thirds of the energy used in the U.S. industrial sector may be attributed to 11 main segments:[8]

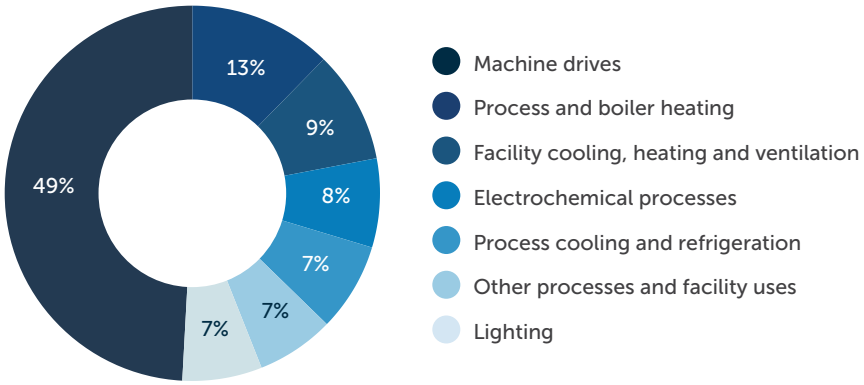
- Refining
- Chemicals
- Pulp & paper
- Food processing
- Iron & steel
- Aluminum
- Fabricated metals
- Plastics
- Transportation equipment
- Computers & electronics
- Wood products

The book, *Reinventing Fire,* by energy efficiency expert Amory Lovins and the Rocky Mountain Institute (RMI), describes major energy efficiency gains in the industrial sector, and provides estimates of the scale of savings that are practical and cost-effective. The book's assessment suggests that:

- Fossil fuels currently supply nearly 80% of the energy used by U.S. industry
- Two-thirds of industry's primary energy is used as electricity
- Approximately 52% is directly burned by using natural gas, 29% oil, 13% biomass, and 7% coal

Figure 4. U.S. manufacturing electricity consumption by major end uses, 2010

49% **of manufacturing electricity consumption goes to machine drives**



Source: U.S. Energy Information Administration, Manufacturing Energy Consumption Survey 2010. Table 5.1, March 2013

Analyzing individual sectors, the authors conclude that nearly 70% of the primary energy consumption in the U.S. industrial sector may be saved.

Just as savings in buildings can be simplified into three basic steps—shell efficiency, equipment inside the shell, and human use of the building—there are four basic steps to saving energy in the industrial sector.[9]

- First, reduce the energy used for fundamental industrial processes
- Second, identify and reduce the losses in these processes
- Third, improve the efficiency of the major devices
- Fourth, capture and utilize the wasted energy whenever appropriate and economically justified

Motors, fans, pumps, furnaces, compressors, chillers, blowers, boilers, conveyor belts, crushers—to name a few—are the big energy uses within the industrial sector. Each of these areas offers myriad opportunities to save significant amounts of energy and money. One of the biggest opportunities is the use of combined heat and power, or CHP, where a single fuel such as natural gas is used to produce both electricity and process heat—a major requirement in many industrial processes. Wide-scale use of CHP is estimated to reduce U.S. industrial energy usage by 30%—or roughly 11% of total U.S. energy consumption.

Reinventing Fire offers a few stunning examples of how little of the primary energy used in many applications ends up as useful energy services. Take a typical data center.[10] The book suggests that as little as one unit of energy ends up doing useful work, while 99% is wasted along the long value chain from the thermal power plant through the transmission and distribution network and finally to the point of delivery at the data center. Another example suggests that the end-to-end efficiency of a typical pumping system may be as little as 10% or less.

What can be done to improve this picture? *Reinventing Fire* suggests that five of the most energy-intensive U.S. industries can achieve significant improvements.[11]

- 88% in bulk chemicals
- 71% in aluminum
- 63% in cement manufacturing
- 49% in iron & steel
- 44% in pulp & paper

As these numbers suggest, the potential savings in the industrial sector is huge, which begs the question: Why aren't more companies actively pursuing programs to realize these savings?

Table 4. U.S. industrial energy use

	2010† Energy Use	2020 BAU Energy Use	2020 Savings Due to EE	Savings
END-USE ENERGY Trillion BTUs	19,290	20,530	3,650	**18%**
• Electricity TWh	1,090	1,050	190	**18%**
• Natural gas	5,370	5,850	1,040	**18%**
• Other fuels*	10,200	11,090	1,970	**18%**
PRIMARY ENERGY Trillion BTUs	27,320	28,320	5,030	**18%**
• Electricity**	11,540	11,150	1,980	**18%**
• Natural gas	5,580	6,080	1,080	**18%**
EMISSIONS Megatons CO_2e	1,660	1,710	300	**18%**

2009–2020
PV of upfront investment:
$113 billion

2009–2020
PV of energy savings:
$442 billion

2020
Annual energy savings:
$47 billion

*End-use energy is approximated as equivalent to primary energy | **Does not include CHP savings of 490 trillion BTUs
†2010 is used throughout this chapter due to data availability

Source: *Unlocking energy efficiency in the U.S. economy, McKinsey & Company, June 2009*

Barriers to Efficient Energy Use in the C&I Sector

As mentioned earlier, there are myriad reasons why many of the significant energy saving opportunities highlighted in the preceding pages are not routinely captured—even though most appear to be technically feasible and economically justified. Both the McKinsey study and *Reinventing Fire* devote considerable space to this critical issue. In the commercial sector, the main barriers to capturing energy efficiency include:

- Owner/renter disconnect
- Lack of energy efficiency monitoring/performance/reporting
- Lack of management focus on energy
- Lack of capital/hurdle rate
- Eternal distractions of other strategic priorities

Similar barriers to achieving greater energy savings exist in the industrial sector, except for the owner/renter disconnect, since most industrial companies own and operate their facilities. Some of these barriers are institutional, and need regulatory or policy changes to address. An example is the owner/renter disconnect, prevalent in nearly all rental properties such as shopping malls, office buildings or properties owned by others. It is easy to see why a renter ends up paying for inefficient energy infrastructure when the building owner has little or no incentive to invest in energy efficiency. Other barriers are endemic to the managers and operators of commercial/industrial businesses such as lack of energy focus, lack of capital and other pressing priorities competing for their limited attention and resources.

> The building owner has little or no incentive to invest in energy efficiency.

C&I organizations can address these barriers to greater energy efficiency in several ways. They can assign the responsibility to someone with sufficient resources, authority and incentives to identify and capture the saving opportunities and build the capacity to manage this complex and comprehensive energy program. Or they can outsource some or all of their needed energy services to an energy services company that works with the internal team to first design a holistic energy program and then deliver the contracted services.

Writing in the *Harvard Business Review,* Jimmy Jia says, "One solution is to appoint a Chief Utility Officer (CUO), who can centralize decision-making around utilities and rethink its role to support strategic corporate goals. The role would focus on cutting costly inefficiencies, figuring out how to use energy to deliver business outcomes, and then implementing these approaches." Jia continues, "If companies want to stop wasting valuable resources, they have to streamline the process of managing utilities and centralize decision-making authority and oversight. By using budgetary processes, managing multi-disciplinary teams, and focusing on outcomes, the CUO can reduce overspend on utilities, improve the bottom line, increase operational efficiency, and minimize environmental impact. At the end of the day, the CUO's job is to reinvest that $100-billion of wasted utilities into productive economic output."

But there are barriers that often prevent companies from building the in-house capacity needed to manage their holistic energy program. A holistic energy program involves multiple functions and disciplines that require highly skilled staffs experienced in procuring and managing energy. These are skill sets that are not core to most companies, so they would have to be recruited. This is both time consuming and costly. Yes, companies will often hire an experienced energy manager or sustainability officer. But because energy is not core to most commercial and industrial businesses, they will often balk at building big, internal staffs to manage their energy program. Additionally, the capital needed to invest in energy is hard to come by for the same reason—a company would likely rather invest its money in its core business than in energy programs even if they are proven cost-effective.

This leads to the second option—outsourcing portions of an energy program to a full-service company that can not only provide strategic advisory services, but also design, build, own, operate and maintain the full range of energy services unique to that company. Typically, these outsourced services go to ESCOs, each with a specialty in one aspect of energy management. Despite a viable business model, however, ESCOs have had limited success in capturing the full potential of energy efficiency opportunities. They remain highly fragmented and regionally based without the scale to serve a large, global company. They typically specialize in a few narrow market niches such as office lighting retrofits or HVAC upgrading. ESCOs rarely if ever have the capability or resources to take a holistic approach to energy efficiency or engage in integrated design where a C&I client's entire input/output process is examined from top to bottom, redesigned, and optimized. Lastly, ESCOs lack the ability to finance the necessary upgrading if the customer is unwilling or unable to do it with internal capital.

Changing the Energy Management Paradigm

The traditional model that defined the relationship between a user of energy and the provider of that energy has changed. Today, companies have more choices from which to acquire and manage their energy. With greater choice comes greater freedom; but it also comes with greater complexity and risk, particularly when a company's energy assets are spread across different geographies, each with different tariff and regulatory policies.

With all its financial, resource and management implications, energy can be a volatile force. How do you finally get your teams to understand the full context and financial risks of various energy initiatives across the entire enterprise while driving savings?

The answer is the Managed Portfolio Solution (MaPS) - remove the silos constraining both the vision and budget of C&I market leaders by identifying the hidden energy risks of complex energy policies, technological advancements and new products specific to their organization and clearly quantify the influence of those risks. With everyone on the same page, we are able to develop detailed portfolio solutions to protect shareholder value and drastically improve energy cost structures.

Through MaPS, C&I companies align their energy investments with business objectives and strategic goals - empowering organizational vision, mitigating risk, and exceeding long-term sustainability and cost saving targets.

The Path to Eighty Billion Dollars in Energy Savings

For a company to achieve its energy cost-savings goals while meeting sustainability and resiliency targets, choosing the right path forward is getting more complicated. Comprehensive and effective energy management requires a new way of looking at how a company uses and manages its energy. Distributed energy resources (DERs), micro-grids, off-site renewables and other new technologies give large energy users more flexibility and choice in developing a comprehensive energy program. But making the right choice is not as easy as it may appear. Most companies lack the expertise to make the most informed decisions that will lead to achieving long-term energy cost reduction.

MaPS provides a new model for companies to use as they rethink how they approach their short- and long-term energy needs, while mitigating their exposure to energy risks across their entire portfolio. Working with a trusted advisor that can provide them with unbiased advice to chart the best path forward is a way to realize the huge potential for energy cost reduction.

Achieving eighty billion dollars in energy savings over the next 10 years seems like a bold goal. Yet as we have explained in this paper, opportunities exist today for companies to start investing in the infrastructure and programs that will lead to achieving this goal.

References

1. The primary sources of information consulted for this study include the Energy Information Administration (EIA), the Edison Electric Institute (EEI) for electricity and American Gas Association (AGA) for natural gas.

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10. Amory Lovins, Marvin Odum, John W. Rowe, and the Rocky Mountain Institute (RMI), *Reinventing Fire: Bold Business Solutions for the New Energy Era* (White River Junction, VT: Chelsea Green, 2011), 139.

11. Amory Lovins, Marvin Odum, John W. Rowe, and the Rocky Mountain Institute (RMI), *Reinventing Fire: Bold Business Solutions for the New Energy Era* (White River Junction, VT: Chelsea Green, 2011), 146.

EDISON energy®

Edison Energy, an independent advisory and services company, recognizes energy is the largest unaddressed risk faced by most companies, and can exceed foreign currency, interest rate and other operational risks.

Providing advanced analytic capabilities, we create competitive advantage for global market leaders by quantifying this risk and designing the portfolio solution to protect shareholder value threatened by complex energy policies, technological advancements and new products.

Our integrated service offerings, combined with our market-leading analytics, industry expertise, and policy insights, enable us to effectively manage complex energy portfolios and deliver quality results for our clients.

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