Outsourcing Energy Performance: Its Potential For Industrial Energy Efficiency Programs

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Executive Summary

Energy service outsourcing is a business relationship that allows an industrial facility to transfer responsibility for one or more energy functions—such as steam, compressed air, water treatment, lighting, or other activities—to a vendor. A contractual agreement establishes an ongoing scope of work subject to periodic renewal. The service is typically intended to relieve host facilities of the cost and effort of sustaining reliable energy-related operations. As an ongoing relationship, outsourcing is distinct from energy performance contracts for the design and installation of energy improvement projects, where vendor involvement terminates as projects reach stabilized operation.

Energy efficiency contributes to industrial competitiveness by reducing waste and associated costs. Reduced energy consumption eases stress on regional energy generation and distribution infrastructures. The environmental consequences of energy waste are reduced proportionately.

This report evaluates outsourcing as a way to achieve the energy efficiency program goals of industrial corporations, utility customer energy efficiency programs, regulators, and similar regional authorities. While industrial and other large facilities undertake energy service outsourcing primarily to ensure the reliability of energy performance, it can also enhance their energy efficiency.

Some energy efficiency program administrators may consider becoming direct providers of energy service outsourcing. A more likely approach is for these administrators to influence and support the market for outsourcing as provided by vendors already serving the industrial community. This report describes business models and considerations for providing and consuming outsourced energy services. Any energy efficiency program that seeks to promote energy service outsourcing should be aware of these issues.

At first glance, outsourcing appears to address all the classic impediments to industrial energy efficiency by providing some combination of capital and expertise to perform common energy functions. Closer examination, however, reveals risks to both parties in an outsourcing relationship. Broadly speaking, these risks come up in (1) the determination of adequate quantities and quality of service provision, (2) the accuracy of performance measurement, (3) assurances and contingencies for failure to provide (or consume) a prescribed level of service, and (4) mutually acceptable terms for cost recovery and related financial accounting of liabilities if capital investment is involved. Potential outsource providers and consumers alike may be intimidated by these considerations.

None of this is to imply that energy service outsourcing is impossible to pursue. Many isolated examples of its implementation exist; some are described in this report. Based on a literature review and interviews with 41 experts—both energy users and solution suppliers—we conclude that outsourcing can be a viable business solution for industrial facilities. Regional energy efficiency resource acquisition programs may find it advantageous to foster the market for these services. Doing so will require substantial program support to educate and develop the market.

Introduction

The industrial sector—which accounts for almost one third of total U.S. energy consumption—figures prominently in the cost and scale of energy generation and supply infrastructure. To the extent that industrial facilities can make more efficient use of energy, the need to build and maintain energy generation, transmission and distribution infrastructure is reduced accordingly. Energy efficiency also provides competitive advantages to industrial facilities, thanks to waste reduction and enhanced productivity.[1] Industrial sector energy efficiency is among the lowest cost energy resources available (Aden et. al. 2014).[2] The policy challenge is to encourage industrial energy choices that offer mutual benefits to industrial companies and regional economies.

Untapped efficiency potential is still found in all consumer sectors despite decades of energy efficiency programs conducted by and on the behalf of energy consumers. Some of the causes of this unrealized potential are unique to the industrial sector—and to small- and medium-sized facilities in particular. Conflicting priorities and accountabilities, plus a lack of energy optimization skills, bespeak many industrial facilities' inability to fully address energy waste. Added to this are hurdles—technical, cultural, and financial—that discourage capital investment in efficient new equipment. It is from this impasse that energy service outsourcing emerges as a potential solution.

Outsourcing is a contractual agreement that allows one business to delegate a specific function to another organization. An industrial facility that outsources its energy functions to an outside party can reduce costs, improve reliability, and/or—through capital cost amortization—obtain new equipment. Relying on outsourced energy services relieves the industrial host facility of potential distractions from its core business priorities. The barriers to outsourcing energy functions are not insignificant. Nevertheless, it can be feasible under certain circumstances.

This report is primarily addressed to energy program administrators who are developing regional energy acquisition policies and programs, and who are evaluating outsourcing as a way to achieve industrial sector program goals. The discussion is also relevant to potential providers and consumers of energy services. If regulatory direction permits it, an energy program administrator may directly participate as a provider of outsourced services. A more likely approach is for energy program administrators to rely on the vendor community of equipment manufacturers, distributors, and engineering consultants.

Note that this report contains significant discussion of the business considerations in starting and maintaining energy service outsourcing. If energy efficiency programs wish to

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[1] A gross estimate of energy value lost by the U.S. manufacturing sector is $80 billion in 2006 dollars (see Appendix D). At the time of this report's writing, ACEEE is compiling data on the non-energy benefits of industrial energy efficiency improvements.

[2] In other words, it costs less to reduce the amount of energy consumed per unit of industrial output than it costs to supply a similar unit of energy that is consequently wasted.

encourage the industrial sector to use outsourced energy services, then program administrators should be aware of the marketing, financial, and legal issues that lessen industry's appetite for the concept. Knowledge of these dynamics will allow administrators to more effectively plan and budget for any facilitation efforts. In addition, industrial companies may to some extent hold energy efficiency program administrators liable for the consequences of failed or problematic outsourcing deals, if in fact such deals were facilitated by energy resource acquisition programs. Thus energy efficiency program administrators should anticipate possibly contentious issues.

Methodology

This report is the culmination of an extensive literature review and interviews with 41 industry experts on energy service outsourcing. The interviews plus the literature review provide the facts presented in the discussion. The respondents included:

- 5 independent consultants, advisors, and trade group professionals
- 20 energy solution providers
- 16 industrial facility/energy management professionals

Interviews were conducted by email and telephone, mostly during the summer of 2013.[3] Respondents were asked to recount their experience with the practice of energy outsourcing, and to describe what they felt were its positive and negative aspects. They were also asked to describe any outsourcing business models familiar to them, and to list the technologies that they felt were suitable for outsourcing.

Definitions

To frame the discussion, certain terminology should be clarified.

The *industrial sector* consists of all business enterprises—each with facilities consisting of one or more buildings and related structures per site—where heating, cooling, pressure, chemical reactions, and motive power are used for manufacturing purposes, i.e., to convert raw materials into intermediate or final consumer goods.

A *host facility* is any industrial building and its related physical assets operated for manufacturing purposes, one or more of whose energy-related functions could be outsourced to a vendor.

An *energy program*, as referenced in this report, describes any effort to optimize regional energy supply and demand balances. Typically conducted under the direction of regulatory authorities, energy programs address market failures that could potentially lead to energy waste or supply shortages, or otherwise inflate the cost of energy supplies. Energy programs may be administered by a utility company, a government energy office, or a nonprofit

[3] Interview requests were issued to 390 individuals. Ten percent of those contacted contributed useful responses.

organization chartered to implement regional energy policies. *Industrial energy programs* are scoped specifically to optimize energy use in the industrial sector.

Energy efficiency programs are efforts to advance technologies and practices that reduce energy waste; such programs are usually designed to engage different economic sectors.

The term *energy resource acquisition program* is increasingly used in North America to emphasize the diversity of energy supply sources and ensure that the amount of energy saved through energy efficiency is counted along with all other supply options.

An *energy (efficiency) program administrator* is an organization tasked with promoting energy efficiency that contributes to regional energy supply and demand balances. Per regulatory direction, energy program administrators facilitate energy efficiency measures whenever and wherever they are the most cost-effective energy supply option. These administrators may consider implementing energy outsourcing (1) with their own resources or (2) by fostering the practice in a regional community of equipment vendors, engineering consultants, and other providers of energy solutions.

Energy service outsourcing is a business model that transfers some or all energy performance responsibilities to a vendor who replaces what has traditionally been an in-house activity for industrial facilities. Energy service outsourcing is not to be confused with energy performance contracts.[4] To date, outsourced energy functions have included plant utilities such as compressed air, boilers and related systems, water treatment, lighting systems, and other technologies. Facilities often pursue outsourcing to enhance reliability or to simply reduce the work burden of their staff. Energy efficiency gains may be a consequence of enhanced reliability, or sometimes even the primary goal of outsourcing. In an effective agreement, the vendor (1) reduces the cost of achieving a prescribed level of service, or (2) provides new value otherwise unattainable by the host. The contract formats and terms spelling out mutual rights and responsibilities vary widely across agreements. The vendor is compensated for units of service delivered (e.g., cubic feet of compressed air) on an ongoing basis, subject to periodic contract renewal. Profit is built into the vendor's service fee.

The classic form of contract is a *shared savings* agreement, where the vendor assumes the costs and responsibilities for providing a prescribed service. In other words, the vendor will collect as compensation a share of the savings or other value it has created. More recently, shared savings agreements have fallen out of favor due to the high cost of vendor-provided capital. Energy service providers increasingly serve as implementation and operations contractors rather than providers of capital (Elliott 2013).

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[4] An energy performance contract (ESP) as provided by an energy service company (ESCO) is a construction-oriented service. The ESP generates cost savings from the host facility's energy system of choice, usually through asset replacement or substantial overhaul. The ESCO designs and installs the new system, then ensures its initial operation until the system achieves stabilized operating status. During this process, the vendor's compensation is derived from the energy savings it creates. After stabilization is achieved, the ongoing operations responsibility reverts to the host (Owens 2001).

An *outsourcing vendor* can be any business that seeks to provide energy services on a contract basis. For most of these entities, energy services have evolved from a preexisting business model. Vendors include consulting engineers as well as manufacturers and distributors of equipment such as steam traps, boilers, and air compressors. The vendor population could potentially include the utility companies that distribute electricity and gas commodities, as well as the related government, nonprofit, and similar entities that are chartered to implement energy resource programs.

The outsourcing discussion in this report focuses on the disposition of discrete, major energy systems within the control of individual industrial facilities.[5]

COINCIDENCE OF BUSINESS INTERESTS: FORMULA FOR SUCCESSFUL ENERGY OUTSOURCING

CEMEX, an international cement manufacturer, described its "Air over the Fence" compressed air outsourcing experience in a 2011 report. CEMEX sought to shift its compressed air operations entirely to a vendor (Kaeser). From CEMEX's perspective, the vendor would function much as a water or power utility, but with compressed air as the commodity. The total shift of compressed air duties effectively placed air "over the fence," i.e., it isolated air responsibilities from CEMEX's core process activities.

By handing air functions to Kaeser, CEMEX tapped into the vendor's expertise to improve the quantity, quality, reliability, and cost of compressed air operations. Another goal was to reduce capital expenditure for non-core assets. The outsourcing arrangement relieved CEMEX of maintenance, spare parts, inventories, and other logistical concerns. Kaeser provided new assets, which CEMEX has the right to purchase at the end of the contractual period. Other contractual details (fee structure, capital recovery terms, defaults and remedies, etc.) were not described in the report.

The vendor's technology solution included the installation of centralized monitoring and control apparatus to facilitate prompt maintenance responses. Performance guarantees were predicated on the use of backup systems, preventive maintenance, and contractual penalties for failure to deliver prescribed services.

CEMEX piloted this concept at one Mexican plant in 2006. Since then, and by 2012, the outsourcing model was replicated in five existing U.S. facilities and one new one. The average monthly kWh (electricity) savings to outsourcing efforts at these six plants ranged from 23% to 64%, with overall compressed air energy costs reduced from 18.5 to 17 kW/100 CFM (Dusi 2013).

[5] "Major energy system" describes any assemblage of equipment that performs a discrete, energy-intensive industrial task. For example, a boiler is the central asset (or prime mover) accompanied by an array of ancillary fans, pumps, pipes, valves, and related equipment that, in its entirety, comprise a steam system. These elements may be obtained as individual components, but are organized collectively as a system to suit the unique needs of an individual facility.

Background: Industrial Sector Business and Energy Needs

The industrial sector is generally familiar and comfortable with using vendors and consultants to design and build new energy-consuming facilities. However, for reasons described in this report, the outsourcing of operational responsibilities is far less prevalent. When it does occur, industry is generally more amenable to the segmented outsourcing of plant utilities, that is, an agreement serving a portion of a plant utility system as opposed to total system outsourcing (Risko 2013).

MARKET PRECEDENTS FOR INDUSTRIAL ENERGY OUTSOURCING

Industrial interest in outsourcing remains difficult to measure, especially among small and medium-sized facilities. In some instances, proprietary concerns prevent corporations from discussing their use of outsourced services. In others, lack of awareness may be the main culprit: while front-office managers are generally familiar with outsourcing concepts, facility managers are probably less informed. Similarly, decision makers within the same facility may vary widely in their understanding of energy performance and its business impacts.

No statistics are available on the actual number of energy service outsourcing arrangements, either past or current. Evidence collected for this report suggests that energy service outsourcing is not widespread as a component of North American energy policy and programs. Whether deserved or not, many industrial facility managers remain wary of energy service proposals in the wake of the 2001 Enron debacle (Spates 2013). On the other hand, the industrial sector has become accustomed to outsourcing janitorial, cafeteria, payroll, warehousing, and similarly noncritical services over the past three decades.

Energy outsourcing is more often practiced in Europe and Japan, often by communities of industrial, commercial, and residential facilities served by centralized thermal distribution systems (Garforth 2013; Henry 2013; Johnson 2013). Central energy systems are similar to outsourcing only in the sense that they relieve large energy consumers of many day-to-day energy responsibilities. While central systems pose great potential for regional energy resource planning, that subject is beyond the scope of this report.

More relevant to this discussion is the experience of Ireland, which over the last two decades has fostered a regional market of energy service outsourcing to aid in economic development (Liggan 2009). This energy outsourcing market was developed as part of a larger strategy to provide the infrastructure needed to attract and retain industrial activity.

PROCESS AND SUPPORT ASSETS

At the facility level, energy performance reflects the design, selection, maintenance, and operation of plant utilities, in addition to the direct operation of the manufacturing processes themselves. Traditionally, industrial facilities have assumed all these responsibilities, dedicating internal capital and labor accordingly. Within each industrial facility, there is a critical distinction between the *process*—assets directly devoted to making revenue products—and plant utilities that provide indirect *support* such as lighting, compressed air, steam systems, cooling towers, and many other functions.[6] The dividing line between process and plant utility functions varies across facilities, or even among facilities of the same company that produce identical products.

This distinction has management implications for control and accountability. Industrial managers are extremely protective of the process assets upon which their core business relies (Brockway 2013; Togna 2013). But even support assets require time, labor, and investment. For simple lack of these scarce resources in both areas, small- and medium-sized industrial facilities are especially challenged to reconcile their energy performance with other pressing business priorities.

OUTSOURCING RATIONALE AND RESULTS

Ocean Spray's Bordentown, NJ fruit juice processing facility outsourced its powerhouse steam and refrigeration functions to Armstrong Service, Inc. in 2006. The plant's existing steam supply/demand balance was insufficient to meet swings in production, leading not only to wasted energy, but to production stoppages. Seeking relief, Ocean Spray outsourced powerhouse management, operation, maintenance, and repair.

Outsourcing was pursued with five objectives: to reduce the cost of goods sold, improve powerhouse reliability, enhance workplace safety, ensure regulatory compliance, and facilitate continuous improvement.

The plant exceeded its goal of $500,000 in annual energy and waste reduction, and it realized a rise in productivity due to enhanced reliability. Greater reliability, accompanied by costs savings, allowed the plant to churn out more production with a greater profit margin per unit (Harney 2008).

When the Time Is Right For Energy Outsourcing

Customers' receptivity to energy service outsourcing is likely to depend on conditions that are unique to their facility and that change over time. When operating with limited resources, top management may declare that core business processes are the first priority (Kaminski 2013; Liggan 2009; MacDonald 2002; Owens 2001; Stowe 2013). But as facility managers become more accustomed to using vendor services for episodic maintenance and repair, these business relationships may pave the way for ongoing service and operations support. The idea of outsourcing plant utilities becomes more attractive as facility managers become hard pressed to ensure system reliability, or when operating costs escalate appreciably. That being said, managers may place greater value on reliability impacts than on energy cost reduction when evaluating outsource opportunities in these situations (Hager 2013; Perry 2013; P. Willis 2013).

[6] The 41 interview respondents for this report were asked to indicate technologies that they thought were suitable for outsourcing. The results are shown in Appendix C.

Reliability, time, cost, and quality are driving concerns for most manufacturers (Castellow 2013; Crowther 2013). Most facility managers will claim that they already do all they can to be energy efficient (Johnson 2013). Industrial managers may temporarily achieve reliable, cost-effective operations with a workable balance of capital, labor, and technology. But this balance can erode over time as senior staff retire, and as technologies and process requirements evolve more quickly than existing staff can master them. Administrative or accounting policies change for strategic corporate reasons, posing unanticipated consequences for facility managers' staffing, budgeting, and procurement habits. Outsourcing may emerge as an expedient solution in light of the biases, fears, and career aspirations of facility managers who find themselves pinched between limited resources and changing priorities.

Business culture also establishes longstanding expectations for maintenance staff. For example, maintenance teams may simply be paid not to fail, a strategy that eschews efficiency per se. Should a change I n facility ownership or management lead to a new emphasis on efficiency, incumbent staff may chafe at the new direction. Outsourcing may then be the solution (Schoeneborn 2013; Stowe 2013).

Consider also the need to replace assets upon breakdown or the end of economic life. While facilities may be capable of maintaining existing assets, they may be hard pressed to replace old systems due to a scarcity of capital, a reluctance to adopt new technologies, or both. Certain outsourcing business models allow facilities to obtain new equipment to which a vendor retains ownership while also performing maintenance and repair duties. The outsourcing scope may evolve further to provide routine operations duties. The outsourcing business model allows the host facility to pay a fee per unit of energy service delivered, be it pounds of steam, cubic feet of compressed air, or some guaranteed measure of availability for any supply of energy service.

Business Conditions Conducive To Energy Outsourcing

Energy service outsourcing is more practical in some business situations than in others. When sizing up the market for industrial energy service outsourcing, it is of little use to categorize prospects by industry, assuming for example, that all corrugated box manufacturers are inclined to view energy service outsourcing equivalently simply because their facilities are technically similar. A more meaningful approach to segmenting the potential consumers of outsourced energy services follows here.

PROCESS CONFIGURATION

Each industrial facility presents unique opportunities to transfer thermal resources among process components. Also, the physical design and layout of a process may provide unintentional opportunities to harness waste heat and reapply it within the same facility. This "opportunity fuel" may be harnessed by equipment made available through an outsourcing deal (Casten 2013). Also, is the asset inside or outside the facility fence? Asset placement has implications for accountability, shaping the host's appetite for outsourcing. Some facilities are figuratively knocking down fences to achieve operational synergies with neighbors (Risko 2013). As the footprints of plant utilities expand in this way, so too will the potential gains that can be achieved through outsourcing.

ASSET UTILIZATION

Any energy support asset operating at high load factors is ideal for harnessing consistent energy savings over time. Utilization rates approaching 100% are preferred (Casten 2013). Steady value creation is the key to achieving the capital recovery cost of an outsourced asset. The economic viability of outsourcing declines directly with rates of asset utilization and operating hours.

TIMING

Some respondents suggest that greenfield (i.e., new construction) opportunities are fertile ground for outsourced services. Outsourcing that includes the provision of a vendor-owned asset helps to relieve the new facility owner of construction cost overruns (Liggan 2009; Perry 2013). Similarly, newly built industrial facilities sometimes lack optimal design and commissioning of their energy systems. Energy outsourcing vendors have been enlisted to address these issues during construction (Hager 2013).

CAPITAL ASSET MANAGEMENT

Some respondents point to end-of-life episodes where asset replacement is necessary but capital is scarce. Facility managers reach a point when they are tired of breakdown repairs. Similarly, outsourcing equipment ownership becomes more attractive once the existing asset is thoroughly depreciated.

CORPORATE IDENTITY

Manufacturing companies can be generally classified by their business orientation, which has direct implications for their receptiveness to energy service outsourcing:

- Some are process oriented, with facilities geared to achieve continuous production of some bulk commodity—think of product outputs delivered by tanker or railroad hopper car. For these manufacturers, production facilities are strategic to business success and are therefore subject to close scrutiny and control. Such facilities are often, but not always, unreceptive to energy service outsourcing.
- Some companies are research oriented, with an emphasis on intellectual property. Good examples are found in the pharmaceuticals industry. Their success is predicated on small batches of high-value products, where the consequences of production failure are extraordinarily high. Energy service outsourcing is valued in these instances for the assurances provided by functional redundancies (Roberts 2013).
- Marketing-oriented industrial companies are those focused on the provision of consumer goods. Their market-facing orientation allows them to outsource production and fabrication duties in their entirety. These companies may seek to improve their sustainability credentials for marketing reasons. Energy service outsourcing tends to align well with this business orientation (Hager 2013).

BUSINESS CULTURE

Industrial facility managers' job accountabilities are closely tied to the successful use of facility assets. Outsourcing means forfeiting some measure of control and potential loss of site expertise relative to production needs. When training staff, process equipment is often given priority over support assets (Perry 2013). Outsourcing may be acceptable for functions that are perceived as mundane or otherwise a distraction from core business (Ambach 2013; Brockway 2013; Davis 2013; Gustashaw 2013; Owens 2001; Schoeneborn 2013; Thompson 2005).

MANAGEMENT CAPACITY, CONFIGURATION, AND ATTITUDE

Organizations may be more amenable to outsourcing if they have some previous experience with the practice in non-energy contexts (Perry 2013). Many industrial managers are already comfortable with outsourcing analysis, design, engineering, and operating functions (Davis 2013). Energy service outsourcing is more likely to work for enterprises that have empowered, influential facilities managers who believe in the concept and will facilitate its implementation. It helps for the facility to have forward-thinking leadership and staff who are not afraid to change the status quo (Hager 2013). An owner-managed business may be more amenable to outsourcing simply because investment decision-making is consolidated in the owner (Perry 2013).

Facilities with a substantial in-house energy management skill set may be more resistant to outsourcing (Stowe 2013). Still, many facilities lack the bandwidth to perform the analysis needed to upgrade or expand their mechanical systems. Outsourcing may also be a practical solution when facility management teams cannot reach a consensus for capital investment priorities. On the other hand, resistance to outsourcing may be difficult to overcome when, for example, the service solution raises costs and efforts for one department while the savings accrue to different department (Hager 2013).

Appendix A provides a checklist to evaluate the viability of an outsourcing agreement for a single industrial facility.

ENERGY SAVINGS WITH EQUIPMENT UPGRADES

McCormick & Company is known primarily for producing spices and allied food products. McCormick's Baltimore facility outsources its chilled water facility to Constellation Energy. Through this arrangement, Constellation has provided capital for asset replacement and bears responsibility for ongoing operations and maintenance. McCormick claims to have achieved a 75% reduction in electricity consumption, while also claiming a $1 million rebate incentive from the local utility, Baltimore Gas & Electric. While McCormick pays a monthly fee for this service, no details are available to describe fee structure, defaults, remedies, and so forth (Blankman 2013).

Scope of Energy Service Outsourcing

DBOOM PHASES

Any major energy system requires design, construction (build), ownership, operation, and maintenance—a sequence known within the energy service trade by the colloquial acronym DBOOM. Theoretically, a large industrial entity could perform all DBOOM phases internally with its own resources. However, most industrials find it expedient to outsource some portion of this process, normally the design and construction duties. Some business models even allow a vendor to own the assets located within the industrial facility. Depending on the host facility's priorities, outsourced energy services might include some or all of the DBOOM phases (Liggan 2009; Loucks 2013; Risko 2013). Table 1 describes the nature and business considerations involved in each step of the DBOOM sequence.

Table 1. Outsourcing considerations for DBOOM stages

Stage	Description	Outsourcing considerations
Design	Creation of mechanical system plans to meet the prescribed needs of a production process. The design stage strikes a balance among the objectives of function, reliability, and cost.	Does the facility retain the expertise needed to quickly and cost effectively perform design functions? By what protocol do the vendor and host react to changes in the facility's energy needs?
Build	The construction of physical assets needed to accomplish design objectives	Is there an internal engineering staff with the requisite skills and ability to keep current with construction technologies? Does the outsource vendor fully understand host facility needs?
Own	Vendor retains title to assets that will operate in a host facility over multiple years. The host's investment capital can be applied to more critical needs. In some cases, ownership of the host's existing assets is transferred to the vendor in return for a cash infusion. Alternatively, the vendor provides new assets. In either case, capital cost recovery is embedded in the service fee.	If the host facility does not own the assets, then the cost of service paid by the host must provide amortized capital recovery to the vendor/owner. What are the consequences if accounting rules for ownership change? If a vendor-owned system is provided with a clause allowing eventual purchase by the host, do contract provisions ensure that the asset's integrity will be maintained in the interim?
Operate	Provision of ongoing operational service according to prescribed standards	Can the host rely on the vendor to achieve operational and maintenance goals? What is the effective delineation of responsibility (firewall) between the host and the vendor? How flexible are energy performance requirements in light of changes to the manufacturing product mix? How do contractual terms and conditions remediate either party's failure to perform as expected?
Maintain	Preventive, diagnostic, and remedial repair services to ensure operational reliability	Are current staff prepared to perform preventive or remedial repairs on support assets? Are maintenance routines adjustable to reflect changes in plant volume and product mix?

SEGMENTED OUTSOURCING

At one extreme, an industrial facility may outsource all of its plant utilities in their entirety. This arrangement delegates to a vendor the control and responsibility for a powerhouse and its associated assets. In a more focused approach, the vendor is assigned total system responsibility for one energy function. A further refinement is to outsource only segmented responsibilities for a single system.

The segmented outsourcing format allows the host to pay for prescribed services, including testing, repair, consulting, or any other technical tasks that the host cannot regularly and effectively accomplish. As opposed to total system responsibility, the segmented approach is less likely to encounter resistance from host staff who are sensitive to their potential loss of control (Risko 2013). This approach may also allow the host facility to engage in energy resource acquisition programs. Specifically, segmented service scopes may be ideal for pursuing energy monitoring, diagnostics, and implementation tasks consistent with the fulfillment of certified energy management standards. Outsourcing in this manner is particularly relevant to the enterprises that cannot find staff with the requisite skill set, or if there is merely a reluctance to make a long-term hiring commitment (Elliott 2002; Imel, Gromacki, and Magoon 2009). With the segmented approach, asset ownership operations, and (perhaps) maintenance remain entirely within the host's purview. The vendor may provide advice and analytical support, but all performance responsibility ultimately accrues to the host.

DEMAND-SIDE VERSUS TOTAL SYSTEM OUTSOURCING

Also germane to energy outsourcing is the functional divide between service supply and demand. "Supply" describes the prime movers that generate the steam, hot water, or other energy media. "Demand" encompasses points of use where the host applies these energy media to process activities. Distribution functions connect supply with demand. For example, compressed air service in its entirely would begin with supply coming from the compressors which may be located in isolation but adjacent to the manufacturing process that they serve; distribution lines disperse compressed air from the compressors to various work spaces located throughout the manufacturing facility. "Demand" describes the many functions of workspace appliances that tap into the air distribution network.

Energy savings potential is derived from the entire continuum, from supply through distribution to end-use demand. When the hosts are protective of the process realm, the vendor may not be able to address demand-side efficiency opportunities. Limiting the scope of the vendor's energy service restricts energy saving opportunities. As shown in table 2, these limitations have mixed implications for both parties' business goals (Perry 2013).

Table 2. Pros and cons of energy outsourcing scopes that cover less than total system operation

Stakeholder	Positives	Negatives
Host	Minimizes the risk (whether real or perceived) of loss of control over facility assets. Host retains flexibility of equipment use in response to changing business conditions.	Reduces savings potential. Host required to maintain technical service support for applications outside the realm of the outsourcing agreement.
Vendor	Makes it easier to abide by performance guarantees because the scope omits end-use functions that accrue to host staff (typically beyond the vendor's control).	Reduces the overall revenue potential if compensation is predicated on savings only.
Energy efficiency program administrator	Most implemented energy savings measures are supply oriented and so more amenable to monitoring and verification than end-use applications. Supply-oriented improvements are more likely to be embedded in equipment changes, one-time projects that are easily counted against program targets and rebate provisions. Program administrator's culpability for promoting energy service outsourcing is minimized in those instances where an industrial facility seeks restitution for the results of a failed outsourcing initiative.	Fails to capture full energy savings potential because demand applications are excluded from the scope. This limited focus is generally at the expense of continuous improvement.

Outsourced services can achieve at least some industrial energy efficiencies, with the easiest savings attained on the supply or generation side. The host may be satisfied with the increased reliability of supply, but energy savings may remain limited. Conversely, an aggressive pursuit of energy savings will require more intrusion into end-use practices, where industrial managers are hesitant to forfeit control, and vendor access is less welcome. Targeting greater energy savings is more likely to require capital investment in equipment upgrades. Therefore outsourcing agreements may reflect a trade-off: when a scope is limited to supply functions with minimal intrusion on the host's span of control, service guarantees are easier to fulfill and costs per unit of service are minimized (Henry 2013). Without equipment upgrades, each additional unit of savings is more difficult to guarantee. In this sense, incremental energy savings may be achieved at a rising marginal cost. The scope of an outsourcing agreement reaches its practical limit when the marginal cost of service reaches parity with the host's internal cost to achieve the same task.

In contrast, a total system approach, designed from its inception to encompass a plant utility's entire supply-demand continuum, is more likely to achieve scale economies of effort, often achieving a declining marginal cost for energy optimization. The total system approach can also help circumvent the organizational impediments to implementing energy solutions.

These considerations reinforce the value of total system approaches to energy optimization. For any plant utility, a total system balance is a prerequisite for identifying full savings potential and for formulating any performance guarantees. This implies that, if maximum energy efficiency is indeed its purpose, an outsourcing work scope should embrace the total system to the greatest practical degree. But for many industrial managers, fear and caution will conspire to limit the vendor's scope while allowing only incremental steps. The consequences place limitations on performance guarantees and savings achievement.

Barriers

PROCESS AND STRUCTURAL PARAMETERS

In some cases, facility managers resist outsourcing because of the physical layout and demands of their process. Compressed air systems, for example, may be closely integrated with process activities, physically and operationally, or they may be functionally isolated. The closer the degree of process integration, the more likely that industrial managers will retain control of these assets (Crowther 2013; Garforth 2013; Gustashaw 2013; Henry 2013). In addition, industrial facilities have highly variable operating parameters for mechanical systems. Although performance specifications for these systems are often moving targets (Fegley 2013; Kaminski 2013), their intricacies may be crucial to product quality, and are therefore central to host management interests. Such vested interests may prevent many host managers from even considering an outsourcing arrangement.

FINANCIAL CRITERIA

Corporate depreciation, asset management protocols, and managerial cost accounting responsibilities shape a host's receptiveness to outsourced energy services. Day-to-day energy management may occur at the facility level, but ownership of these assets may accrue upward to the business unit of the corporation. If so, professional interests in cost accounting are divided (Brockway 2013). Central to this issue is the assignment of tax benefits resulting from asset ownership. Two extreme examples illustrate the range of considerations and outcomes for adopting an energy outsourcing solution.

In the first scenario, the host currently operates assets that are not yet fully depreciated. New, efficient assets could provide energy savings accruing to the facility-level operating budget, with payback achieved over a couple of years. However, replacing the current asset would cause a write-off of the asset's undepreciated balance, causing an immediate capital loss, resulting in current-year diminution of shareholder value. The host comptroller's professional risk exposure may be the deciding factor: it is easier to live with energy waste hidden in the operating budget than to explain a one-time capital write-off from the balance sheet. An energy service outsourcing proposal that offers to install upgraded, vendor-owned assets may be rejected for this reason, even if the operating staff support the concept (Perry 2013).

The second scenario holds the facility manager accountable for cost control and involves the benefit of owning depreciation. The current energy system is fully depreciated, or alternatively, has suffered terminal breakdown. Several aspects of this scenario may bode well for an outsourcing solution. The host may wish to purchase the new equipment with its own capital investment. Outsourcing solutions could allow the vendor to (1) perform design-build installation only, with the host assuming stabilized operational responsibility, (2) provide operations and maintenance, with energy service delivered at a prescribed and guaranteed cost per unit, or (3) provide both of the above. If the host retains ownership of the asset, it can claim the depreciation as a tax shield, plus enjoy any operational cost savings provided by the vendor. If the vendor owns the asset, the outsourcing service fee (energy, maintenance, and capital recovery charges) may be counted by the host as an operational expense, and it is therefore a tax-deductible cost of doing business (Brockway 2013).

In a variation of the second scenario, the host facility manager's cost accountabilities can make a crucial difference. For example, a plant manager may be held accountable for any combination of (1) cost of goods sold, (2) utility and other overhead costs, and (3) capital expenditure. Assignment of these costs varies throughout industry, and sometimes across facilities of the same company. In the scenario where a facility manager is responsible for cost of goods sold but not for utility costs, it is very unlikely that the manager will welcome an outsourcing service that effectively converts energy service into a fee that accrues to cost of goods sold (Perry 2013).

ACCOUNTING AND INVESTMENT LIMITATIONS

Accounting rules seek to reveal debt obligations that may be otherwise disguised on corporate balance sheets.[7] For example, these rules establish that a vendor-owned asset provided on site for the sole benefit of a host must appear as an asset on the host's balance sheet (Brockway 2013; Casten 2013; Togna 2013).[8] Accountants vary in their interpretation of these rules. In many companies, accounting leaders caution against such vendor agreements, fearing that these obligations will restrict their capacity to acquire additional debt in the future. On the other hand, prohibiting vendor-owned equipment effectively restricts the supply of capital in the market, with the net effect of raising the cost of available capital. As capital costs rise, investments become less likely to earn projected returns. Higher capital costs can reinforce a bias toward mundane, low-cost technologies, so-called safe choices that may preclude the acquisition of advanced, efficient alternatives.

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[7] These rules were the consequences of the Enron scandal, culminating in the Sarbanes-Oxley legislation. Note that they apply to publicly traded corporations, not to privately held companies.

[8] By accounting convention, every balance sheet asset must reflect a matching value as equity or a liability (i.e., a debt balance).

ENERGY OUTSOURCING FROM THE SMARTEST GUYS IN THE ROOM

Energy service outsourcing was a sideline pursuit of Enron during the late 1990s. While the company ran afoul of the law primarily for its accounting and wholesale power market manipulations, its retail energy efficiency business unit grew from concept to $250 million in gross profit in three years, maintaining a portfolio of thousands of energy projects for approximately 25 Fortune 500 companies.

Key to Enron's operation was a probabilistic pricing methodology that allowed deal brokers to effectively estimate, monetize, and securitize energy savings for sale in commodity markets. Deals would replace older assets with newer, more efficient alternatives. Actuarial databases of energy project performance allowed brokers to estimate *ex ante* energy savings. To entice customers, Enron would typically offer an upfront cash advance to be counted against the anticipated savings. Customers paid a monthly fee for Enron's operations and maintenance service plus amortization of capital costs. Unfortunately, these deals were amortized over many years—and Enron would collapse before the deals could be completed (Kromer 2014).

ORGANIZATIONAL INERTIA

Proposals may have to be sold both up and down the chain of command in the host facility. Receptiveness is a function of management structure. Hurdles can be institutional in nature, evidenced by inertia that is reinforced by habit or perhaps an unwillingness to create the turmoil that comes with change. A corporate energy manager working independently of facility managers may welcome outsourcing proposals, while facilities with an existing energy management structure in place may be particularly resistant. So are those facilities with collective bargaining agreements that protect existing labor interests (Jackson 2013; MacDonald 2002; Perry 2013). It may take several years for a proposal to navigate the internal vetting process, but once the relationship is proven in one facility, it should more easily spread to other sites within the same company (Perry 2013). Conversely, managers tend to have long memories, and will resist a proposal if they have had bad experiences in the past with similar concepts (Castellow 2013; Gustashaw 2013; Owens 2001). Also, outsourcing agreements are not practical for enterprises with dynamic production changes or questionable long-term stability of operation or ownership (Perry 2013; Roberts 2013).

BUSINESS PHILOSOPHY AND CULTURE

Every business leader exercises personal judgment and biases which shape their initial receptiveness to the energy outsourcing concept. Many business leaders are uncertain of the cost-benefit balance and feel that the value in question is not worth the effort, especially if the remedy involves an unfamiliar business approach (Castellow 2013; Crowther 2013). Industrial decision makers often prefer to own and operate their own equipment, especially if it is mission critical (Togna 2013). Industrial staff are interested primarily in equipment reliability and regulatory compliance, with efficiency being a secondary concern (Hager 2013). Given this interest, some managers do not trust a service that posits efficiency before reliability. Furthermore, many managers believe (or need to make others believe) that the facilities in their control have already eliminated waste, which leads to a categorical rejection of any proposed energy efficiency initiatives (Johnson 2013).

Barriers to outsourcing are often cultural. In the eyes of some facility managers, energy outsourcing amounts to a forfeiture of control, and perhaps one's professional destiny. Few managers are willing to accept the risk and effort that come with implementing new business models, especially if the objectives are in question. There are several reasons for this. Chronically short of time and resources, industrial facility managers are loath to make major changes unless something breaks down. Then there is the matter of trust: these managers tend to rely on a small number of local vendors or consultants with whom they have developed long-term relationships. Other qualifications aside, this suggests that those trusted vendors are well positioned to enter the market for outsourced energy services.

Business Models

Outsourcing is a malleable business concept, adaptable to meet a variety of business, economic development, and energy resource acquisition needs. A successful outsourcing arrangement allows facility managers to confidently transfer selected functions to a vendor organization. Instead of being involved in one-time transactions, the vendor and host become partners with mutual interest in the ongoing viability of facility operations. Industrial hosts have come to expect a certain level of reliability, functionality, and maintenance support from the traditional utility provision of electricity, natural gas, and water. They expect outsourcing services to provide energy services for in-plant utilities that are similarly cost effective, reliable, and expedient (Dusi 2013; Garforth 2013; Johnson 2013). The challenge is to formulate terms of agreement that satisfy the business interests of both partners (Davis 2013; Risko 2013).

The baseline for considering an outsourcing agreement is the host facility's current cost for the self-provision of energy services, such as pounds per hour of steam, cubic feet per minute of air, diagnosis/maintenance labor cost per unit, labor cost of in-house technical expertise, and so forth (Hager 2013; Perry 2013; Risko 2013). The outsourcing vendor's challenge is to provide a prescribed service that compares favorably to the current in-house function. The proposed service should be cheaper, be more reliable, contribute to greater productivity, or some combination of these (Durko 2013).

A facility wishing to outsource a particular energy function could proceed as follows:

1. Perform a procurement search for a service provider.
2. Issue an award to a suitable vendor.
3. Facilitate the vendor's implementation of improvement measures.
4. Monitor vendor performance according to a mutually acceptable measurement protocol.
5. Manage the ongoing vendor relationship, attending to routine administration as well as approval and remediation tasks as needed.
6. Administer changes in the outsource agreement's performance criteria as needed, following a mutually agreeable management of change (MOC) protocol.

The outsourcing vendor would:

1. Compile baseline cost and consumption measures of the current asset or system.
2. Draft a proposed scope of work, performance guarantee, realistic performance metrics and thresholds, and fee structure for the host's approval.
3. Install new equipment (if applicable and approved through MOC procedure).
4. Perform ongoing performance monitoring and verification.
5. Attend to maintenance and repair needs per the agreement's scope.
6. Record performance results to measure value created.
7. Invoice (usually monthly) for ongoing performance.

If the purpose of an outsourcing agreement is simply to reduce the operating cost of existing assets, the agreement's economic viability rests with the vendor's ability to achieve cost savings—and a profit margin—through optimized use of labor, energy, expertise, and other variable inputs. For example, the vendor may provide labor that matches the effectiveness of the existing staff at a lower price. Alternatively, the vendor may provide superior (and perhaps more costly) expertise per labor-hour supplied, with the labor cost more than offset by reductions of energy and related expenses. If so, the vendor accomplishes tasks with fewer hours compared to in-house labor. This structure may compare favorably to using in-house labor that incurs hourly costs even when "at rest" while waiting for remedial task orders (MacDonald 2002).

If ongoing, the outsourcing agreement could be subject to periodic renewal. Alternatively, the agreement may include a prescribed termination date. In any case the agreement should describe terms for early termination by either party and the value and disposition of assets upon termination (Brockway 2013; Perry 2013; Peterson 2001). Similarly, the contract should provide remedies for adjusting the value of vendor assets sold to the host upon termination, should those assets exhibit extraordinary wear and tear while in the vendor's custody (Risko 2013).

HEDGING CONSTRUCTION COSTS AND RISKS

Manufacturers may obtain outsourced energy services that focus exclusively on the design and construction stages of energy projects. For new construction as well as renovations and expansions, cost overruns and on-time performance are typical concerns. Outsourcing solutions may help in a couple of ways. First, the vendor may simply be better prepared than the host's engineers to perform design-build duties. Second, the installation of vendor-owned assets can help to keep new construction budgets on target (Perry 2013).

ASSET REPLACEMENT

One simple capital investment approach was designed for a small, privately held facility. Third-party finance has funded the installation of a new asset. According to the agreement, the outsourcing vendor retains title to the asset for a contractually stipulated number of months, after which ownership reverts to the host. While the agreement is active, the vendor is responsible for asset installation and operating performance. For compensation, the vendor collects a monthly fee derived from any energy savings achieved relative to a baseline performance measure. This deal is predicated on the vendor's due diligence up front: the vendor was convinced that the savings potential would be enough to recover all capital and operational costs within the prescribed term. The agreement provides an early buy-out option to terminate the vendor's involvement, if the host desires to do so. The buy-out fee covers the vendor's outstanding capital balances (Fisher 2013).

SYSTEM UPGRADES AND REHABILITATION IN LIEU OF MAJOR CAPITAL INVESTMENT

In some cases energy outsourcing has been tailored to optimize existing assets, for example, the rebalancing of steam or compressed air systems. As a consultative maintenance service, this approach can be a cost-effective alternative to capital investment or ownership transfer, if in fact the existing assets are of sufficient integrity (Risko 2013).

POWER PURCHASE AGREEMENTS (PPAS)

This business model allows a vendor to bundle capital, labor, maintenance, and energy into a single, levelized cost per unit of energy service delivered over multiple years. The service can provide energy units of any form. Input prices may be known at the time of contract inception, but variance can be expected over time. A remedy for this variance is to leave energy out of the scope (Hager 2013), or simply to limit the term of agreement (Roberts 2013). Alternatively, fuel cost adjustment clauses may address energy price variance over a longer period. This means, for example, that a component of the unit price for compressed air will vary with the price of electricity inputs.

Benefits of the PPA format are mixed. It is good for the vendor, who needs a reliable pricing mechanism to recover the cost of committed service resources. Solidified this way, the vendor's commitment satisfies the host's need for reliable and competent service. From an energy saving standpoint, however, PPA formats may be counterproductive. When vendor compensation varies directly with units of service delivered, the vendor prefers to deliver more rather than less service. In some cases, the PPA format would encourage steady, if not increased energy consumption.

Conversely, the PPA format may allow a risk-sensitive host, through its vendor, to adopt new or advanced technologies deemed not yet suitable for direct investment. In the latter case, the PPA approach could be used to test equipment at one facility before replicating the installation at remaining sites. Similarly, a PPA may allow the implementation of assets demanded by evolving safety or emissions regulation.

PROVISION OF AVOIDED ENERGY

A facility could offset some of its current energy consumption by purchasing units of avoided energy. "Avoided energy" is the volume of energy purchases made redundant by implementing energy efficiency measures. To accomplish this reduction, a vendor installs and owns an energy-efficient asset, leveraged by third-party finance. The vendor's action allows the host to reduce its volume of energy consumed. The mix of capital, labor, and maintenance (plus vendor profit) required to avoid energy consumption is amortized across the volume of energy saved. The result is a per-unit cost to save energy that compares to the existing per-unit cost to buy energy. The cost to save a unit of energy should be less than the host's current cost to obtain the same unit of service (Martin 2013).[9]

There are three basic variations of this business model:

(1) Contract language fixes the fee per service unit provided for a multi-year period. The vendor guarantees the host a cost per unit of service that is consistently lower than the host's current cost threshold. The host collects the difference between the current benchmark cost per unit and the vendor's fee per unit. The vendor assumes the risk of maintaining costs below fees. This implies that the vendor must have sufficient financial strength to endure periods of underperformance. Similarly, the vendor may backstop its commitment by obtaining insurance that pays the difference should costs of service exceed fee revenue (Kaminski 2013).
(2) The host pays a fixed fee per unit of service while a percentage of the savings value is shared with the vendor. The vendor's fee includes little if any profit margin. The vendor's compensation is derived from, and varies with, the magnitude of savings achieved (Davis 2013).
(3) The vendor and host agree to a scope with explicit targets for normalized energy reduction. Based on its own analysis of the host facility, the vendor declares the optimized consumption target and the cost to provide energy service. If this is to the host's liking, an agreement provides vendor compensation derived from the actual savings. This format assures the host of achieving energy reduction while the vendor has the incentive to continuously pursue improvement opportunities (Davis 2013).

A certain tension underlies any business model that relies on energy savings to compensate the vendor. Specifically, the easiest energy savings are usually found in the first year. The longer the relationship, the harder it is for the vendor to make money. This reality is one reason why vendors prefer to install new, efficient equipment. An outsourcing proposal that retains the host's existing assets may limit the vendor's ability to generate viable cost savings (Martin 2013; T. Willis 2013). The agreement's term in years reflects capital recovery amortization, effectively establishing a long-term commitment with a stable fee structure.

INSURANCE FOR PROCESS FAILURE

Some industrial enterprises are exposed to large financial risks if they fail to deliver products of sufficient quality or in sufficient quantity. In the case of pharmaceutical manufacturing, the consequences of process failure may extend beyond lost revenue to include punitive damages for the human suffering caused by the failure to provide products. If insurance policies are not suitable, manufacturers may install process redundancies, relying on assets that can be activated from standby mode if needed. Acquiring and maintaining standby assets, such as a backup boiler, may be achieved through an outsourcing agreement in some instances. This approach imposes a high cost per

[9] For example, consumption may be avoided at a cost per unit that is 85 percent of the current cost to consume. Avoided energy, in this example, is purchased at $0.85 on the dollar.

unit of energy delivered. While not suitable for achieving energy efficiency, it contributes to a risk management strategy for manufacturers of high-value products (Roberts 2013).

UNLOCKING INCREMENTAL ENERGY VALUE

Many industrial facilities are deemed to function adequately per the design limitations prevailing at the time of their construction. Subsequent analysis may reveal opportunities to recapture energy waste that was originally taken for granted. Such measures may be contingent on incremental asset installation or reconfiguration (Casten 2013). One example is a steam chiller installed in a dairy processing facility to complement an existing boiler (Bessette 2013). This configuration not only meets simultaneous heating and cooling needs, it balances the boiler's load factor, effectively improving the economic return of the boiler asset. However the chiller is an incremental, non-core investment that is harder to justify when the existing assets are not broken. Management may be more amenable to this capital expenditure through an outsourcing agreement (Perry 2013).

ALIGNING BUSINESS INTERESTS

In general, industrial facilities expect outsourcing agreements to guarantee the reliable provision of energy service. The price of outsourced service provision will vary directly with the degree of certainty demanded. For any single energy function, each additional increment of energy savings is increasingly difficult to guarantee without incurring extra effort and cost. In other words, the last unit of energy saved is probably the most expensive to achieve. The scope of an outsourcing agreement may strike a compromise: the vendor's base rate may reflect investment cost recovery, basic maintenance, and base load energy only. For example, the service agreement may declare base energy consumption to be 50-60% of peak volume; base volume and basic maintenance are billed under take-or-pay provisions. The remaining peak (or "trim") energy services are billed at a supplemental rate only as they are incurred, as are unplanned maintenance events (Casten 2013; Perry 2013).

What makes energy outsourcing agreement mutually viable for the vendor and the host facility? In an operational sense, it is an agreement that creates consistent value commensurate with its underlying fee structure. This suggests services for assets with high utilization rates, i.e., when assets perform close to their full capacity all the time. In the larger business sense, the viable agreement is one in which the vendor's goals are aligned as closely as possible with those of the host facility. If the host seeks guaranteed flexibility, supply, and quality of energy inputs, whereas the vendor's goal is to maximize profit, the possibility of long-term mutual satisfaction is in doubt (Risko 2013).

TAKE-OR-PAY PROVISIONS

Service contracts often impose a take-or-pay provision, which obligates the host to provide a steady cash flow across billing periods. In other words, the host must pay for a contractually prescribed amount of energy services, even if the facility's demand for service falls with its production level (Perry 2013; Roberts 2013). The arrangement is fair to the vendor, who makes a durable commitment of resources to comply with the service agreement. At the same time, it can be onerous to the host facility if it needs to scale back its production in response to poor economic conditions. If anything, take-or-pay arrangements would tend to encourage consumption, running counter to energy efficiency goals.

MANAGEMENT OF CHANGE

Management of change (MOC) provisions establish the guiding principles, procedures, controls, and penalties for causing performance changes relative to a prevailing scope of work for energy outsourcing. Changes to asset ownership, configuration, and maintenance responsibilities are only one dimension. Fees and rates are similarly subject to change, especially as the host's energy needs vary with product mix, market evolution, regulatory responsibilities, and prevailing economic conditions. Terms for early termination of the relationship may also be included. While changes to outsource agreements cannot be prescribed in advance, MOC clauses establish the protocol for arriving at mutually agreeable amendments.

Positive Business Outcomes and Advantages

Despite obstacles and risks, energy service outsourcing has a number of benefits that coincide with industrial business needs. A beneficial outsourcing arrangement relieves the host facility of the effort needed for—and ideally, reduces the cost of—obtaining reliable, energy-intensive services. Depending on the scope of the agreement, the vendor's energy service provides some combination of energy inputs, capital, labor, and expertise. In return, the host facility may enjoy operating cost reductions, access to new technologies, and perhaps enhanced reliability and productivity. The host firm can then focus its scarce internal resources on core business requirements.

In addition, efforts to measure a facility's real-time energy performance can reinforce its productivity management. Energy awareness training will support maintenance and reliability goals while at the same time fostering leadership development. Outsourcing vendors can be tasked with the implementation of energy certification standards as well as regulatory compliance measures. In some situations, outsourcing deals can place vendor-owned assets within customer facilities, providing capital budget relief. When it supplies capital assets, an outsourcing deal is as much a financing mechanism as it is an operating solution. This approach requires the involvement and acquiescence of managers over and above the boiler room (Davis 2013; Durko 2013; Feustel 2013; Hager 2013; Risko 2013; Spain 2013).

The following more fully developed ideas were provided by interview respondents. There are no data on the extent to which each idea has actually been implemented.

Replacement of failed or outdated equipment. An outsourcing agreement may allow a capital-constrained facility to quickly install new equipment without a large up-front expenditure. Capital recovery costs can be amortized in monthly fees (Kaminski 2013; Owens 2001; Perry 2013).

Asset right-sizing. Industrial processes are subject to overcapacity, especially when process equipment is employed intermittently. This problem becomes acute when there are no longer steady revenue streams to support long-term capital cost amortization. Outsourcing agreements that provide capital assets may be a solution to this problem, in deals where the vendor's capital cost recovery is independent of the host's cash flow.[10] Benefitting from the vendor's asset management service, the facility may achieve efficient load factors by using proper scales of equipment for limited production runs (Davis 2013; Perry 2013).

Evolution to advanced technologies. When the vendor retains ownership and performance responsibility for a new energy system, the host is relieved of the operational risks that new technologies may impose. This arrangement allows the host facility to become familiar with potentially advantageous new technologies that are not yet fully commercialized (Stowe 2013).

Speed. Technology, knowledge, and opposing priorities sometimes conspire to prevent facility staff from reacting quickly to energy improvement opportunities. Outsourcing may be the most expedient solution in these situations (Johnson 2013; Martin 2013).

Access to expertise. With staff rosters already trimmed to the barest essentials, industrial facilities are often lacking the talent or the time to optimize non-core energy assets. An outsourcing agreement can provide talent to fill this void (Fields 2013; Jarrell 2013; Owens 2001; Roberts 2013).

Reduction of headcount (labor savings). Some outsourcing agreements transfer staff as well as assets from the host facility to the vendor. This approach is consistent with corporate directives to reduce human resource costs (Feustel 2013; Kaminski 2013; Owens 2001; Schoeneborn 2013). Similarly, some host facility managers seek to calibrate their use of labor with seasonal changes or fluctuation in production levels. Outsourcing deals can facilitate the flexible provision of labor (Elliott 2002; MacDonald 2002).

Economic development and business retention. Outsourcing agreements can provide the labor, expertise, and capital needed to sustain or improve an industrial facility's economic viability. In Ireland, the manufacturing sector has widely adopted maintenance and facilities outsourcing, stimulating outsourcing as an industry unto itself. In turn, the strength of outsourcing activity makes the country a more attractive location for new facility construction (Liggan 2009).

[10] This may happen when, for example, the vendor offers modular assets that can be easily moved from one installation to another.

Cost reduction. Simply put, a dollar saved is a dollar earned. If a corporation has already pursued outsourcing as a way to reduce other noncritical operating costs, it would be logical to consider it for plant utilities.

Cost performance. Once an outsourcing agreement is in place, it may enhance host managers' awareness of cost performance. The rationale is this: certain duties performed with in-house resources may be loosely accounted as overhead cost functions. Low accountability begets poor cost control. But when they outsource specific functions, managers receive unprecedented documentation of performance costs. A monthly invoice for an energy service demands scrutiny, perhaps leading to more frugal use of that service (Martin 2013).

Balance sheet improvements. An outsourcing deal that transfers asset ownership to a vendor effectively removes the asset and its equivalent liabilities from the host's balance sheet. A host facility may enjoy a cash infusion by selling system assets to the vendor. All else being equal, this improves the host's key financial metrics such as return on assets and the ratio of equity to assets (Johnson 2013).[11]

Tax advantages. Transfer of asset ownership to a vendor reduces the host's property tax basis. Under the appropriate accounting regime, an outsourcing agreement that reformulates both service and capital amortization into a monthly fee that the host facility treats as an operational expense may increase deductible operating expenses and reduce tax burdens accordingly (Kaminski 2013; Owens 2001).

Regulatory compliance. Emissions and safety compliance are integral to facility management agendas. Failure to comply can have costly business consequences. Energy service outsourcing can be tailored to address these concerns, with energy savings being a secondary benefit that helps defray the cost of service. Boilers are an example of industrial technology subject to extensive regulatory scrutiny. Emission control requirements embodied in the U.S. Environmental Protection Agency's (EPA) Boiler MACT Rule apply to qualified boilers (Bessette 2013; Roberts 2013).[12] This rule requires owners to perform extensive energy assessments of these assets in 2014, with follow-up assessments in ensuing years. If a facility is amenable to securing outsourced energy services for the purposes of reliable and efficient asset operation, it should be a simple matter to add compliance duties to the scope of services (Jarrell 2013; Perry 2013).[13]

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[11] Beware, however, of additional considerations described in the paragraph "Accounting and Investment Limitations" in the Barriers section above.

[12] The EPA published the Boiler MACT (maximum achievable control technology) rule in 2013. The rule establishes thresholds for reducing hazardous air pollutants resulting from fossil fuels combusted by large boilers. See http://www.cibo.org/pubs/industrialboilermact.pdf.

[13] It should be noted that attempts to outsource an asset to avoid or transfer compliance obligations have been ruled illegal.

Self-direct energy efficiency programs. Some states allow industrial facilities to opt out of regional energy resource acquisition programs. In response, energy program administrators are initiating optional program formats intended to sustain industrial participation. Self-direct options give industrial energy consumers more control over the fees they pay to fund energy efficiency programs. While given the ability to redirect a significant proportion of energy program fees back into their own facilities, industrial customers are still bound (in the more robust self-direct programs) to measure and report their self-directed energy improvements. Herein lies the opportunity to craft outsourcing solutions that add measurement and verification (M&V) tasks to the scope of efficiency attainment. Energy efficiency programs that adopt this approach could declare that energy service outsourcing fees count as an eligible self-direct program investment. If so, the charges allowed for outsource service fees could be tied to energy savings, perhaps capped in total or on a $/kWh basis. Vendors may be responsible for M&V reporting requirements.

Energy monitoring, verification, and performance certification. Energy optimization is derived in part from information technologies and procedural disciplines. Many industrial facilities still lack the will or capacity to monitor, document, and verify their energy use, a discipline referred to as "metrology." In some instances outsourcing arrangements may be a suitable way to introduce metrology, especially to small and medium-sized facilities (Feustel 2013).

Industry certification. The appropriate energy outsourcing scope can facilitate the implementation of ISO 50001 or similar certification standards (Jarrell 2013). An ideal engagement would allow one vendor to serve multiple facilities of the same company.

Outsourcing as an Alternative to Capital Investment

Perhaps the most intriguing aspect of energy service outsourcing is its potential to substitute for capital investment. In addition to providing energy, labor, and maintenance support, outsource vendors may also offer new assets to replace broken-down or otherwise inefficient equipment. If replacement assets are provided, capital cost recovery is a key component of energy service fee determination. Capital finance, energy and variable operating costs, and a profit margin for the vendor must be amortized together into a monthly fee. For the proposed deal to be acceptable to the host, this fee must be sufficiently below what it costs the host to attain equivalent service with its internal resources.

ENERGY SERVICE OUTSOURCING: CAPITAL INVESTMENT IMPLICATIONS

The promise of obtaining vendor-owned equipment may be initially attractive to cash-strapped facility managers. To understand, consider new-car finance. Some car dealers offer financing terms to arrive at a monthly payment that fits the customer's budget. The desperate customer obtains a low monthly payment obligation in exchange for greater overall expenditure, amortized over a longer time period, at a higher interest rate.

Industrial facility managers are often like the desperate car buyer. Their "boiler-room" needs rarely compete well against core business operations for investment capital. Additionally, these managers live in a calendar-driven world, largely unconcerned with profit or rates of return on investment. Their accountabilities are shaped by production targets and budgets. Accordingly, facility managers evaluate investments by simple payback, the time needed for their budget to be replenished by cash-flow savings. Business exigencies demand an ever-shorter payback on investment: a 12-month payback is better than 24; 6 months are better than 12.

In response, the outsourcing vendor offers the holy grail of paybacks: zero months. How? By using vendor-owned assets, the host facility circumvents an up-front capital expenditure and its payback test. Instead, the host pays a service fee—an operating cost—that is sufficiently inflated to compensate the vendor for capital investment.

Potential conflict underlies this apparent congruence of interests. Can the host maintain its production levels, and by extension, its payments for energy service? Can the vendor endure early termination of a service agreement before its capital costs are recovered? Should the host accept—indirectly through a service fee—a higher cost of capital? These are only a few of the issues that should be addressed in the terms and conditions of an energy outsourcing contract.

Several variations on capital investment via outsourcing are evident:

- The vendor can purchase the host facility's energy asset, thereby providing them with a cash infusion in addition to relieving them of the operations and maintenance of those assets. In this instance, the vendor is confident of the existing equipment's performance integrity. Value is created by applying the vendor's superior operations and maintenance expertise.
- The vendor installs, owns, operates, and maintains new assets on the host's behalf to replace failed, inefficient, or unreliable equipment. This is the likely remedy for a facility that lacks the necessary investment capital to directly purchase a replacement. The outsourcing agreement may include an option for reverting asset ownership to the host after some period of time. This arrangement is similar to a capital lease.
- Similar to the previous example, the vendor retains title to new assets provided to the host. In this instance, assets satisfy new construction or expansion needs. This arrangement is especially attractive when host organizations are under pressure to keep construction budgets under control.

Accounting concerns cannot be ignored. Vendor ownership of assets and multiyear cost recovery present strategic balance sheet implications for the hosting corporation.[14] Many industrial enterprises have limits on the volume of debt that they can carry, reflecting restrictions imposed by their current long-term lenders. To the host's financial stakeholders, an outsourcing proposal with amortized capital costs creates an obligation that may be perceived as a form of debt. One issue is the time horizon for capital recovery. When lending large blocks of capital, lenders tend to seek long-term finance opportunities. This arrangement is workable when, for example, an asset with a 20-year economic life is amortized over 20 years. The problem is that many industrial enterprises have a planning horizon of no more than three to five years. Competitive forces may cause them to shy away from long-term commitments (Russell 2013). This mismatch of time horizons is a dilemma for the industrial energy performance outsourcing market. Capital availability is not the problem; the issue is crafting finance (capital recovery) terms that suit both the lender and the industrial facility (Bessette 2013; Casten 2013; Johnson 2013; O'Hagan 2013; Togna 2013).

The cost of capital is just as important. Debt, when secured by collateral, costs less than unsecured debt. If the host's existing debt obligations forbid acquiring additional secured debt, this effectively precludes a straightforward financing deal, where the host takes title to the new asset that then serves as collateral to secure the obligation to repay the lender. Alternative outsourcing proposals therefore assign asset ownership to the vendor for the duration of the agreement, with contractual terms for asset care and eventual transfer to the host at the end of the agreement term (Risko 2013). Still, a vendor-owned asset is placed for the sole benefit of the host. The asset's economic potential is limited to the host's viability, a situation that causes lenders to charge a premium for capital invested in this manner. The host's finance officers will compare these rates to their own weighted average cost of capital (WACC). Very often, the host's WACC will be lower than the rate offered through unsecured debt finance. This poses another hurdle: finance directors are hesitant to accept finance deals when capital costs (interest rates) exceed their internal cost of capital (Casten 2013).

Cost recovery for vendor-owned assets placed in host facilities can take many years. In the meantime, the host facility may be forced to alter or terminate its business operations, setting up the potential for a stranded asset whose cost is not yet fully recovered. This justifies the inclusion of termination clauses in outsourcing agreements that establish a range of early termination fees corresponding to a time scale (Risko 2013).

Termination issues and remedies may be perceived as relevant to the host facility and vendor only. However energy efficiency program coordinators attempting to foster the market for energy service outsourcing may choose to issue capital performance guarantees

[14] Concerns here are shaped by the Federal Accounting Standards Board (FASB), which establishes legal guidelines for corporate financial reporting. These guidelines will determine whether leases for equipment upgrades must be treated as loans on customers' balance sheets. At the time of this report, the standards for leased-assets accounting are still subject to interpretation and revision.

that effectively lower the amount of termination fees. The net effect would be to increase the attractiveness of outsourcing to providers and consumers alike.

Yet another consequence of debt finance in the context of energy-efficiency investments is the assignment of any rebates or incentives offered by energy program administrators. Rebate amounts can be significant—in some cases equal to the first year's contract fees (Perry 2013). The vendor that retains title to an asset placed through an outsourcing agreement will probably want to claim any rebates. Energy efficiency program administrators can design and prioritize rebate provisions to reward facilities with outsourcing agreements that achieve superior energy optimization.

The capital investment dimension effectively elevates energy service outsourcing into the realm of finance. What was once a boiler-room discussion is now more likely to engage the host's corporate decision makers. This dimension has implications for the outsourcing provider's marketing approach and sales cycle, i.e., the length of time to identify, develop, and close deals.

Risks

Outsourcing agreements attempt to correctly anticipate—in advance of their ratification—the appropriate scope of work and all relevant costs and levels of service to be provided. Of course, actual performance eventually varies from baseline estimates (Owens 2001). As the host's production levels vary with product markets, so does the facility's volumetric demand for energy services. Add to this the wide variation in operating conditions and priorities across industries and even among facilities of the same company, and it should be apparent that energy outsourcing contracts need to be customized to suit individual facilities (Hager 2013; Johnson 2013; Perry 2013).

To many industrial organizations, outsourcing proposals may combine a number of new and presumably risky concepts. First, there is the unease that comes with forfeiting control—and professional destiny—to vendors (Bessette 2013; Schoeneborn 2013). If production requirements change, forcing a change or replacement of assets, what recourse is available to the host whose current assets are locked into a long-term cost recovery agreement (Castellow 2013)? What happens if assets transferred to host ownership have deteriorated significantly while under vendor care due to insufficient maintenance (Risko 2013)? If the outsourcing agreement assigns asset ownership and maintenance responsibilities to the vendor, how are repair and replacement decisions synchronized with the host (Martin 2013)? Add to this the possibility that the

OUTSOURCING DEALS DON'T ALWAYS WORK

In the late 1990s, Coral Site Advantage, an aspiring outsource vendor, attempted to aggregate a series of "alliance partners," each addressing a specific plant utility system. These included Allied Signal for cogeneration, York for HVAC systems, Calgon for water treatment, Armstrong Services for steam, and Onsite Energy for technical services. Implementation for one (unnamed) facility was never fully accomplished, in part because coordination among the vendors proved to be difficult, but also because the Enron scandal broke at this time, effectively causing the host to abandon the effort (Spates 2013).

vendor may be introducing new technologies with uncertain impacts on process integrity. Few industrial managers want to be the guinea pig for new technologies, especially when the outsourcing agreement amortizes assets over long cost-recovery periods (Casten 2013).

SHOPPING FOR SERVICE PROVIDERS

The host should perform due diligence on the vendor before entering an outsourcing agreement. In choosing an energy service vendor, the host should consider the vendor's reputation, experience, performance record, scope of services offered, capacities to supervise, skills of the contract workforce, labor relations, strength of project management, and finally, price (MacDonald 2002). A financially weak vendor poses risks to the host. Suppose a vendor has secured third-party finance to pay for the assets placed on the host's site. If the vendor goes bankrupt, the lender could demand liquidation of the assets, effectively removing them from the host facility. Similarly, a poorly run vendor organization may not be able to maintain quality of service. Does the contract language provide remedy for these and other lapses (McDonald 2002; Perry 2013)?

CRITICAL COST INFORMATION

Some industrial managers rely on internal analyses to accomplish their investment choices. When making a baseline measure of current operating costs, managers may unwittingly use inaccurate or incomplete data (Bessette 2013). A fully loaded cost accounting of asset use would include overhead and contingencies such as maintenance, insurance, finance payments, and provision for backup in case of breakdown (Perry 2013). The energy service vendor should anticipate these contingencies, especially when providing performance guarantees. These considerations manifest in the per-unit cost of service.

Cost elements that are easily overlooked include the following.

Unscheduled downtime. If production equipment fails, products are not being generated, and revenue is being forfeited. Lost earnings are a consequence—and a cost—of relying on aging equipment. In equilibrium, the cost of downtime that the host would incur without vendor service will just match the vendor's premium-for-performance guarantee. Predicting these costs for contractual purposes is challenging.

Unbudgeted replacement and/or repair. Managers can rely on aging assets, but they need to compensate by maintaining a replacement reserve. In some situations they can rent backup equipment. These costs add an equivalent component to the outsource vendor's service fee.

Adverse impacts on product quality. Even if equipment malfunctions do not lead to downtime, they can still cause degradations of product quality. The food processing and pharmaceutical industries provide good examples. The consequences of production failure begin with lost revenue. Additionally, as mentioned above, the host corporation may also be exposed to punitive liabilities caused by the consumer's use of substandard products. At worst, the failure to deliver effective products may damage the producer's market and brand reputation (Roberts 2013). This risk exposure is a key objection to outsourcing any responsibility that affects the safety and production performance of the host (Risko 2013).

Labor for maintenance. Will it be in-house staff, with accompanying overhead and benefits, or will labor be covered in the vendor's fee?

Ancillary power or water costs. Some energy applications require ancillary inputs. A boiler is a good example. Not only does it require combustion fuel, but auxiliary fans and pumps require electricity, and water must be purchased, treated, and discharged all at some cost. Add to this fixed costs such as insurance, licenses, and mandated compliance testing requirements. These responsibilities manifest in the outsource vendor's fee.

Space management consequences. Outsourcing arrangements may lead to the physical reconfiguration of assets. This is not always a cost, but sometimes a potential windfall for the host when space becomes available for expanding revenue-making activities.

LOSS OF INSTITUTIONAL KNOWLEDGE

By outsourcing an energy function, the host facility will in some way forfeit control. As a vendor assumes responsibility for a system, the host should avoid losing the related expertise; doing so would be disastrous should the outsourcing agreement need to be cancelled (Elliott 2002; Liggan 2009; Owens 2001; Schoeneborn 2013; Thompson 2005). At the very least, the host should dedicate a staff person to manage the vendor relationship.

HUMAN RESOURCE RISKS

Outsourcing may pose professional risks to facility staff. At issue is the potential for incumbent job loss, or at least some loss of influence or managerial status as outside vendors take on existing duties. The consequences depend on the contractual provisions of the outsource agreement. In some cases, incumbent staff may be offered employment by the outsource vendor. This can be beneficial in so far as the vendor obtains staff familiar with the facility. The vendor may also offer these staff more opportunities for advancement if they are amenable to possible relocation. On the other hand, the vendor may likely reduce base wages while shifting compensation to a pay-for-performance basis. This is a challenging arrangement for people who are accustomed to a paid-not-to-fail relationship. The potential for fostering the ill will of incumbent staff is sufficient to prevent many facilities from considering an energy service outsourcing solution (Risko 2013).

VENDORS' BUSINESS RISKS AND LIABILITIES

Unfortunately, unless a failed asset urgently needs replacing, vendors can expect to wait while facilities take months or even years to ponder proposed energy-saving solutions (Russell 2013). Thus vendors can expect a long sales cycle in pursuit of customers (Ambach 2013). Even then, prospective clients can pull the plug on proposals at the last minute, especially if management changes occur during the negotiation process (Hager 2013; Perry 2013). Added to this waiting game is the fact that some facility managers court salespeople only to obtain free engineering assistance (Russell 2013).

Outsourcing agreements often require vendors to provide long-term, fixed resource commitments to serve operations that are subject to frequent and often unpredictable changes. Due to poor market conditions, a host facility may scale back its production, yet its obligations to the outsource vendor may not be scaled back accordingly (Perry 2013). Consequences appear in the text of outsource agreements: hosts want the vendor to assume liability for failure to meet the agreement's prescribed terms (Gustashaw 2013; Henry 2013; Schoeneborn 2013). Host managers will typically reserve the right to terminate an outsourcing agreement for convenience, cause, failure to create savings, significant breach of service, asset degradation, or other exceptional events. If so, the supplier will want equivalent protection to recoup the value of any outstanding investment it has made for the host's benefit. Related to this are the provisions for succession, either reverting back to in-house control or transition to another vendor (Owens 2001; Peterson 2001; Thompson 2005).

There are many reasons why a vendor might be suddenly unable to recover its investment. What if the host facility is forced to radically change its output, relocate, or even go out of business? The exit clauses in the service contract are effective only to a point (Perry 2013). Bankruptcy proceedings may put assets in limbo for months or even years, with claims being paid for pennies on the dollar. Insurance for this eventuality is possible, but assurances beget contingency expenses that only inflate the outsource provider's fees. This relationship is especially problematic for the equipment manufacturer that ventures into outsourcing services for its equipment customers. If an outsourcing agreement goes sour, does the vendor want to risk suing a good customer (Risko 2013)?

What if an energy service outsourcing vendor, serving two competing facilities at the same time, unconsciously transfers proprietary knowledge from one facility to the other? What is the liability of the energy efficiency program administrator who has facilitated the implementation of outsourcing (Risko)?

Suppose a host site features an integrated energy system designed to serve one entity. One day, the host corporation decides to sell off a portion of its process to another company that will operate on the same site. The unitary energy system remains, but an accounting allocation tracks energy flows between companies. What is the fate of an outsourcing vendor hired to tend the total system (Ambach 2013; Spates 2013)?

Performance guarantees may cause business risk to shift from the host to the vendor. Some potential service providers question if the additional burden of performance guarantees is worth the extra revenue that outsourcing may offer (Loucks 2013; Martin 2013). To meet customers' stringent reliability requirements, vendors must react instantly in case of operational failure. In some cases, a vendor may obtain insurance to cover the damages to the host that result from system failure. The host's process requirements can be so demanding that redundant installations of backup systems are required. Performance guarantees may be feasible only if real-time monitoring systems are installed (Fisher 2013; Jarrell 2013; Kaminski 2013; Perry 2013). These commitments inflate vendors' responsibilities and necessitate an expansion of their staff and service infrastructure. The vendor is obligated to make large upfront investments when ramping up the capacity to meet stringent performance guarantees (Ambach 2013). When the purpose of outsourcing is to achieve energy savings, vendors will prefer large projects with large energy savings potential to justify fees that are swollen by performance guarantees.

Value is to some extent derived from the vendor's cumulative knowledge acquired over time at the customer site. Vendor staff turnover is a potential threat to the outsourcing relationship, especially when value is derived from total system optimization as opposed to a components approach (Gustashaw 2013; Henry 2013). A similar threat is posed by the host procurement director who, in search of lower fees, is willing to pull the plug on an incumbent vendor. This tactic ignores the value embodied in the vendor's familiarity with the site, a value that is lost when accommodating a new vendor's learning curve (Stowe 2013).

Keys to Success

Aside from their physical characteristics, industrial facilities are highly varied—even across facilities of the same company—by their management styles, business cultures, and economic priorities. Given this variety, energy outsourcing will not be adopted en masse by all eligible facilities. Customer interest may be episodic, with uptake by any one facility depending on a unique coincidence of variables that are sometimes beyond the control or influence of energy policy and program administrators. Patience is the first requirement in implementing energy service outsourcing as an energy resource acquisition program initiative.

FACILITIES

For any single facility, a preponderance of factors must be aligned for the facility to accept the outsourcing concept. Positive answers are required to many of the following questions:

- Do the facility's key decision makers perceive a need for the benefits derived from outsourced energy services?
- Are the concept, scope, and conduct of outsourcing consistent with the host facility's operating and accounting philosophies?
- Are the facility's physical design and layout—and particularly its asset configuration—conducive to accommodating the activity of a third-party vendor?
- Will the balance of facility staff support or resist the concept of outsourcing? And if resistance is likely, what are the prospects for winning staff acquiescence?
- Is there an urgent need to replace assets, coupled with difficulty in obtaining the necessary investment capital?
- Are the terms of the outsourcing agreement crafted to the mutual benefit of the vendor and the host, with adequate provision for adjusting to changing circumstances or for termination?
- Does the vendor demonstrate adequate capacity to serve at least one host facility?
- Is the vendor's cost of service—fully loaded with contingencies—economically competitive with the host's current internal cost of providing energy utilities?
- Is the energy outsourcing scope specifically designed to achieve continuous energy efficiency improvement, or is the goal something else?
- Is the host confident that the vendor will always act in the host's best interests?

Now consider the outsourcing business' approach to energy efficiency, if any. It helps if the outsource service focuses on an energy commodity that is practical to meter (Henry 2013; T. Willis 2013). Submetering capacity should be provided if not in place already. Additionally, the contract scope, fee structure, and vendor compensation mechanism should be conducive to reducing energy waste. As mentioned above, an outsourcing agreement predicated on reliability can easily run afoul of efficiency goals.[15]

VENDORS

A ready supply of vendors is crucial. The successful outsourcing provider must have technical know-how, access to cost-competitive labor and materials, and access to capital finance, all of these required in significant quantities even to serve one host facility. Added to these prerequisites is the intangible but crucial element of host-vendor compatibility that can make or break the relationship. Similarly, a vendor needs to have good working relationships with the utilities that administer local industrial energy programs. This includes staying current with regional energy resource acquisition programs and the staff who run them (Ambach 2013). To serve multiple customers, the vendor must be able to expand its human and financial capacities accordingly, without compromising quality and effectiveness. It must have either adequate scale or alternative lines of business to stay solvent if its outsourcing segment suffers losses due to customers' changing needs, relocation, or even shutdown.

THE ROLE OF CAPITAL ACCESS

Vendors will typically secure investment capital from third parties. The finance community presents an array of lenders, stratified by their investment terms. Commercial finance tends to impose the most restrictive qualifications. Angel investors, acting either singly or in groups, may offer less restrictive terms, but usually cannot provide as much capital as commercial counterparts. Private-equity investors may be an alternative, but as a group, they lack the patience to support longer-term deals. They are also reluctant to finance new or exotic technologies. Similarly, public finance is easier to secure when it supports technologies with a proven track record. The vendor who seeks large-scale participation in the outsourcing market, retaining title to assets at multiple host facilities at once, will need access to an enormous volume of capital. To achieve this, the vendor will likely devote significant time to assembling investor syndicates (Casten 2013).

FEES

Outsourcing deals strike a balance between value and cost. The fee for service will certainly include energy, labor, and maintenance costs, and optionally, capital recovery costs. Performance guarantees can be provided, but at a cost that increases with the prescribed degree of certainty. Naturally, vendors want to make the customer happy. When the vendor's scope includes replacement of a failed asset, the cost of an energy-efficient option may add more to the service fee than what is recouped through energy savings. To keep

[15] A detailed checklist based on these questions and considerations is found in Appendix A.

overall fees down, both parties may settle for a deal that provides only adequate technology that fails to meet full energy saving potential (Casten 2013).

CRUCIAL CONTRACT PROVISIONS

Of specific concern are contractual terms, assurances, and contingencies for outsourced services. Outsourcing agreements invoke contractual terms and conditions over and above energy management per se. Each individual agreement will be crafted based on motivations, capacities, and concerns that are unique to each pairing of signatories. Financial concerns may include terms for asset cost recovery and related financial accounting of liabilities. Legal issues address causes and remedies for failure to provide (or consume) a prescribed level of service.

Delineation of Responsibilities

Successful outsourcing proposals clearly delineate the operations and maintenance responsibilities of the vendor and host. This set of provisions will go some way to assuaging host staff's fears—either real or imagined—that their control, performance accountabilities, and professional relevance are at risk. An outsourcing relationship is very much a marriage of two organizations. As with any relationship, compatibility, trust, communications, and adaptability are crucial to ongoing success (Fisher 2013; Perry 2013).

Cost Recovery

In cases where vendor-owner assets are provided, capital cost recovery methods must satisfy the host's financial and legal scrutiny. Cost recovery terms (i.e., years) must be compatible with the host's business planning time horizon (Bessette 2013; Brockway 2013).

Risk and Recourse

Another key area is the assignment of risk and definition of recourse in the event of performance failure. Does the contract anticipate eventualities that may compromise performance? What are the remedies, and at what cost? Both the vendor and the host need to perform due diligence on each other, seeking mutual assurance that each party has the financial and functional strength to meet commitments (Bessette 2013; Casten 2013; Perry 2013; Willis, T. 2013).

BUSINESS SCENARIOS WHERE ENERGY OUTSOURCING CREATES VALUE

Outsourcing can create value in radically different business scenarios, described as follows.

Segmented outsourcing. As the scope of outsourcing for an energy system increases, so does the potential for deal-breaking disagreement between the vendor and host. Similarly, larger scopes pose resource acquisition challenges for the vendor. Segmented outsourcing may fractionalize the scope of the system to be serviced, the range of services applied to a system, or both. Doing so can make optimal use of the vendor's available resources. Segmented outsourcing may also be a way to allow a host facility to gain confidence in the outsourcing relationship while minimizing risk exposure (Risko 2013).

Very small-scale vendor. In this scenario, one vendor uses an existing customer relationship to serve one discrete energy system for one facility, and through an agreement that does not impose onerous performance guarantees. The vendor limits its overhead costs by virtually eliminating marketing and by confining its technical capacity to a narrow range of equipment types. The vendor's best knowledge and resources are concentrated on that customer rather than being spread thinly over many (Fisher 2013).

High-value/critical product manufacturer. Consider the manufacturer for whom the consequences of failure are high, due to the value of works in process, potential product liability claims, or both. Failure is not an option; process facilities need redundancies that ensure continuity of operations. Such manufacturers are more likely to tolerate the fees involved in an outsourced service. A pharmaceutical manufacturer, for example, might seek a vendor to provide standby utilities. The potential for advancing energy efficiency is mixed: while standby operations add to the site's total energy demand, energy-efficient practices would help the vendor optimize its profit margins (Roberts 2013).

Pilot installations. A host facility may want to test a new technology before adopting it across the board. A properly structured outsourcing deal may facilitate this approach (Feustel 2013; Gustashaw 2013; Jarrell 2013).

Replicable installations. Economies of scale in service provision may be attained if a customer presents multiple facilities with identical demand loads and operating parameters.

New construction. Outsourcing may be attractive in new construction scenarios. The issue of facility staff resistance is largely removed. A deal that provides vendor-owned assets helps the owner's construction budget stay on target. Vendor-owned assets may also obviate the host's temptation to install low-cost, inefficient equipment to avoid construction cost overruns. Note, however, that any inflation of the vendor's service fee attributable to asset cost recovery effectively reduces operating margins for the host facility.

Market Development Issues and Needs

This section describes the considerations involved in developing a market for outsourced energy services. These issues are relevant to all stakeholders: potential vendors, industrial energy users, and energy efficiency program administrators. Even if not directly providing these services, program administrators should be aware of the financial, contractual, and legal dynamics that shape the market's receptiveness. Future program initiatives to promote market segmentation will need to educate stakeholders about these issues and perhaps provide assistance. In turn, education will determine the pace and magnitude of implementation.

SERVICE PROVIDERS, FORMATS AND START-UP COSTS

The aspirants best suited to provide energy outsourcing services are those with established technical knowledge, equipment supply, and account relationships with potential customers (Elliott 2002; Stowe 2013). Three types of business entities come close to meeting these criteria: equipment manufacturers, engineering consultants, and utility distribution companies. Table 3 presents the relative strengths and weaknesses of these aspiring outsourcing vendors. The viability of individual engagements is likely to be determined on a case-by-case basis. See Appendix A.

Table 3. Strengths and weaknesses of aspiring energy service outsourcing vendors

Entity	Strengths	Weaknesses
Energy-related equipment manufacturers	Deep technical knowledge of their own hardware offerings Existing relationships with industrial facilities Sales and marketing capacity Access to a variety of third-party capital sources.	May lack technical knowledge unrelated to their equipment offerings Bias for energy solutions that lead to product sales Prefer to sell and service own brands May lack local office/community presence that industrials tend to favor for service vendors
Engineering consultants	Broad technical knowledge Lack of commercial bias in equipment recommendations Appeal to industrials' preference for local relationships	May have limited capital access May find it difficult to serve more than a handful of customers May have difficulty with the long sales cycle needed to find customers
Electric and/or gas utility distribution companies	Existing account relationships with eligible customers Access to low-cost capital Potential to align outsourcing vendors to achieve industry best practice Optimal role may be to facilitate the market for outsourcing as provided by equipment suppliers and other trade allies	Market entry and conduct may be barred or restricted by regulatory direction Business model not optimized to provide services to a handful of select customers Nature of the outsourcing business may not mesh well with utility's business mix and culture May have high overhead costs

To provide an energy outsourcing service, aspiring vendors should have access to expertise, parts, equipment, finance, and legal support from the onset. Equipment manufacturers and engineering consultants may have a head start in achieving these prerequisites by virtue of their existing business. But to some extent, aspiring outsource providers will need to amass some capacity before obtaining their first customer. Upfront costs for gaining capacity will be amortized in the service fee. The vendor's need to recoup these investments may or may not be conducive to energy saving, as illustrated in the scenarios that follow.

Scenario 1. Vendor compensation is a fee per unit of energy service delivered. To recoup its fixed costs, the vendor prefers to sell more units of energy, not less. The value in this arrangement may be predicated on reliability as opposed to energy efficiency.

Scenario 2. Vendor compensation is derived from energy savings produced. The vendor will prioritize customers' large energy-inefficient systems that have great savings potential (Ambach 2013).

Scenario 3. Vendor compensation is derived from energy units input per unit of production achieved. The vendor's earnings are tied to host production performance and can be discounted by evidence of degraded reliability or integrity of equipment, or similarly, by failure to achieve prescribed thresholds of equipment readiness as determined by performance audit (Risko 2013).

Vendors may anticipate that operating cost reduction targets can be more reliably met and maintained by using newer, more efficient technology. Conflicts of interest may arise in some situations. Some respondents indicate that energy service vendors would rather provide equipment upgrades in their scope of work. This desire is consistent with the objectives of equipment manufacturers who perceive outsourcing as a channel for selling their hardware (Casten 2013; Spates 2013). Manufacturers of energy solution equipment have their own cost-recovery goals, as they have invested their own capital in the tools and facilities that make equipment for their customers. Equipment manufacturers are motivated to ensure that their products are part of the outsourcing scope of work (Casten 2013). This may or may not be consistent with the customer's best interests. Similarly, manufacturers' service strategy may focus on hardware installation alone as opposed to operational or total system optimization. This focus can potentially compromise energy saving results.

CAPACITY TO SERVE

Scale is a factor for the aspiring energy service outsourcing vendor. An existing equipment supplier or engineering consultant could enter a regional market simply by serving one host facility. Assuming the vendor has access to capital and that the performance guarantees are not very demanding, the vendor could probably fulfill this duty with existing staff and resources. The real challenge lies in ramping up to serve multiple facilities and provide multiple technologies. The vendor will need to obtain more capital and resources, and have the logistical capacity to administer a mix of technologies across multiple sites for different customers.

Since industrial host facilities operate many technologies under one roof, outsourcing vendors might consider handling multiple systems. However this approach would be a barrier to entry for the single-technology equipment supplier. Mechanical engineering consultants may be agnostic with respect to the technologies and brands that they provide, but a multi-technology outsourced service requires vendors to amass the requisite technical expertise while gaining access to various equipment sources. Their start-up efforts and costs are inflated accordingly. This suggests that cost-competitive vendors will be highly specialized, offering a small range of technologies (Ambach 2013).

What if the vendor serves multiple facilities, each requiring ongoing maintenance and operations? In all likelihood, the vendor has dedicated his/her best people to the first customer. As the vendor taps the regional labor pool for additional staff, the quality of their skill set diminishes.

As an outsourcing vendor ramps up to serve multiple customers, there may be cost economies in standardized offerings. For example, compressed air or boiler services may be limited to a handful of predetermined asset configurations, modularized for quick installation and removal. Standardization is expedient for maintenance, training, parts, and inventories, all helping to minimize the service fee. This approach also provides a fairly clear division of responsibility between the host and the vendor. The modular configuration is clearly the vendor's domain, facilitating supply-side energy performance optimization while keeping the vendor away from the core process activities. However this approach effectively limits energy efficiency potential on the demand (end-use) side. A modular installation may be at the expense of site-specific customized solutions that drive energy efficiency in a total integrated system (Casten 2013; Perry 2013).

EDUCATION AND TRAINING

A great deal of education will be needed to inform potential consumers and providers of energy outsourcing services (Fisher 2013). Continuous energy improvement cannot be achieved without knowledgeable facility staff. The financial aspects of asset provision may be beyond the average facility manager's reckoning. Many industrial managers will confuse outsourcing with energy performance contracts offered by ESCOs. As discussed above, managers' recollection of bad experiences with similar approaches may constitute a barrier (Owens 2001).

A regional industrial energy efficiency program effort to promote outsourcing may rely on the vendor community to serve a sizeable number of industrial facilities. Can sufficient professional expertise be found within the region? Past experience provides benchmarks for success: outsourcing vendors will be expected to perform at least as effectively as the existing traditional alternative. To meet these expectations, vendors will be challenged to amass the requisite capacity and skill set. This may be a hurdle for vendors whose business has historically been based on equipment sales. Again, industry's uptake of outsourcing will be driven by creative marketing, a skill not always evident among otherwise technically competent engineering vendors (Elliott 2002).

To amass the capacity and skills to become effective outsourcing providers, vendors may need to partner with allied organizations. Assistance from energy efficiency program administrators may help in this regard. Energy efficiency programs may need to facilitate training, especially in monitoring and control technologies, energy management protocols, and leadership development. Training could be pursued in cooperation with industry trade groups and community colleges. Obviously this will add lead time to the implementation of energy outsourcing initiatives.

MARKET STUDY

Market entry requires preliminary investigation. A useful market study will describe the number and types of customers, the revenue potential, and the competitive potential of substitute products and services. Market aspirants will also need technology studies to gain the expertise required to provide superior value to their customers. The vendor commits these sunk costs before the first dollar of revenue is obtained.

Conclusions

Energy service outsourcing can be used to advance energy efficiency goals in particular instances. By their nature, outsourced energy functions require practitioners to perform particular duties that are usually conducive to energy efficiency. Outsourced services can lead to especially significant energy savings if, from the outset, they encompass a total system approach from supply through end use. The greater the physical scope, the greater the potential savings.

Energy efficiency program administrators may anticipate two overall results from an industrial energy service outsourcing initiative.

First result: improved energy program engagement with industrial facilities. Individual outsourcing agreements between a vendor and a host facility provide a scope of work with goals and metrics for energy performance. This structure establishes a degree of energy management rigor and discipline that may be unprecedented for many industrial facilities. This change may also benefit energy efficiency program administrators. Instead of dealing with industrial facility managers who lack the time, interest, or resources to optimize their energy use, energy program administrators can expect more consistent collaboration with managers (or their outsource vendors) who are motivated by an outsourcing agreement to remain proactive on energy issues.

Second result: improved capacity to monitor, measure, document, and verify energy performance. Following from the first result, energy outsourcing agreements can provide the infrastructure and protocols to generate essential data on the effectiveness of energy resource acquisition programs. Energy efficiency program administrators may facilitate or incentivize the collection and synthesis of the energy data usually required to develop outsourcing deals. Doing that would relieve energy outsourcing vendors of a startup expense they have to incur even if customers refuse the ensuing service proposals. At least the data generated in this way could inform other energy efficiency program outreach initiatives.

As a corollary, energy administrators who wish to implement energy service outsourcing should be wary of promoting business models (e.g., take-or-pay provisions) that can be antithetical to energy efficiency goals. It is essential that program administrators support only those service models explicitly designed to boost efficiency. An emergency asset replacement solution, for example, can sometimes be at the expense of efficiency. Asset upgrades are certainly consistent with energy efficiency goals, but vendor ownership of these assets will in some situations create accounting headaches.

Energy service outsourcing presents business issues peculiar to their signatories that remain outside the interests of energy program administrators. While administrators can stimulate the market by educating providers and consumers, the market's uptake will vary with decision makers' ability to craft agreeable contract terms. These terms can be easily conceived in theory, but it is virtually impossible to fully anticipate the myriad of potential performance failures and subsequent remedies (Risko 2013). Such issues can make or break industrial managers' receptivity to outsourcing. Energy program administrators should remain cognizant of these issues since they will shape the magnitude and pace of the industrial sector's developing receptiveness to outsourcing.

Utility distribution companies and related energy efficiency program administrators are uniquely positioned to increase awareness of energy service outsourcing. Direct entry into the market by utilities themselves is another matter. Utilities are accustomed to investing large amounts of capital for universal ratepayer benefit. The deployment of outsourcing services is anything but universal; the fit is achieved only occasionally and usually with customization. Instead of utilities, vendors may be better suited for such deployment, perhaps acting in coordination with energy program administrators. Theoretically, utilities could be the provider of capital finance to those vendors who own the assets placed in service on customer premises. However this business model may stray somewhat from regulators' expectations.

Future energy efficiency programs to promote outsourcing may be best promulgated on a regional basis, with input from energy policy and industry experts to reflect the character of local markets and regulatory oversight. Program development beyond even a small pilot effort will require the interest and long-term commitment of industrial facility managers and vendors alike. We hope the findings in this report will inform those efforts.

Regional energy program outreach can raise awareness of energy waste as well as the viability of energy service outsourcing as an industrial business solution. However, as discussed above, customer receptiveness to outsourcing may be instigated by circumstances unique to each facility. Equipment failure, management change, and shifts in product and capital markets are some of the instigators. Since motivating factors will be different for each facility, outsourcing will not be adopted all at once by facilities within a region. Implementation across a regional industry base will require patience. Are energy efficiency program administrators— and regulators—willing to wait?

In the end, the viability of energy outsourcing rests with the receptivity of industry decision makers. Increased energy savings depend as much on the coordination of people as on equipment choices. Organizational politics—the willingness to learn, adapt, and rebalance time and effort—will ultimately determine the effectiveness of outsourcing agreements.

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Appendix A: Checklist for Success: Gauging the Potential for Successful Energy Service Outsourcing

Conducive to outsourcing?	Conducive to energy saving?	Feature	Does this condition exist?
		RECOGNITION OF NEED	
Y		Energy distracts host from core business	
Y		Host seeks higher reliability than what is currently achieved	
	Y	Host seeks operating cost savings	
	Y	Host wants to improve energy monitoring and verification capacity	
	Y	Host wants to improve ability to comply with ISO 50001, SEP, Energy Star, other certifications	
	Y	Host seeks to improve energy-related regulatory compliance (Boiler MACT, etc.)	
	Y	Host seeks to retain energy-related expertise	
	Y	Host wishes to improve transparency of energy cost performance	
	Y	Outsource scope fills a current void in host's energy management capacity	
Y		Host wishes to improve return on invested capital and related balance sheet performance	
Y		Host seeks tax benefits of asset transfer	
Y		Host seeks to reduce head count	
?		Host wants to ameliorate risk of absorbing new technologies	
?		Host seeks ability to react quickly to changing opportunities	
		AMENABLE BUSINESS PHILOSPHY	
?		Host has solid understanding of current energy performance and costs	
	Y	Host believes that energy saving value is sufficient to pursue outsourcing agreement	
	Y	Host does not feel that energy efficiency compromises reliability	
Y		Host management has previous positive experience with outsourcing agreements	
		AMENABLE FACILITY AND ASSET CONFIGURATION	
	Y	Host's process configuration presents untapped opportunities for energy transfer or recapture	
Y		Host's asset in question operates at high load factor	
	Y	Upfront analysis of host facility proves that potential value creation exceeds cost of service	
Y		Host's production goals are stable, so energy demand is stable	
Y		Outsourcing opportunity coincides with host constructing or rehab'ing a facility	
		HOST FACILITY'S CULTURE AND MANAGEMENT STYLE	
Y		Host makes functional distinction between core assets and support assets	
Y		Host has empowered energy manager who is amenable to outsourcing concepts	
	Y	Host's energy manager has support and influence throughout facility chain of command	
Y		Outsource scope minimizes vendor intrusion on core process or host responsibilities	
Y		Outsource concept is acceptable and nonthreatening to host's incumbent staff	
Y		No objection in host facility to outsourcing fee due to conflicts with someone's cost accountabilities	
		CAPITAL EXPENDITURE ISSUES	
	Y	Host requires replacement of failed asset	
	Y	Equipment upgrade is included in outsourcing scope	
Y		Host lacks sufficient capital for asset replacement	
Y		Host's existing asset has been thoroughly depreciated	
Y		Outsourcing deal's capital recovery rate compares favorably to host's cost of capital	

Conducive to outsourcing?	Conducive to energy saving?	Feature	Does this condition exist?
		CONTRACT COORDINATION OF VENDOR AND HOST INTERESTS	
	Y	Terms of outsource agreement establish mutual stake in performance results	
Y		Outsource fee structure can reconcile host's flexible demand with vendor's fixed cost of service	
Y		Outsource terms coordinate host and vendor interests in the event of asset repair or replacement	
		VENDOR CAPACITY TO SERVE	
Y		Market evaluations are available to size demand for outsourcing concepts	
Y		Vendors can grow/retract their service capacity as demand varies over time	
Y		Vendor can demonstrate financial and technical strength, access to resources	
		FEES, TERMS, ASSURANCES	
	Y	Outsource fee structure does not dissuade vendor from reducing energy consumption	
	Y	Outsource agreement's cost to avoid energy is less than current cost to consume energy	
Y		Fully loaded fee for outsourcing (includes insurance and contingencies) is acceptable to host	
Y		Outsourcing deal's assignment of asset ownership is amenable to host's finance team	
Y		Term (years) for any capital asset amortization aligns with asset's planned economic life	
Y		Outsource fee structure includes price adjustment factor for energy, labor, and other inputs	
Y		Outsource agreement includes protections in case vendor fails	
		IMPLICATIONS FOR ENERGY EFFICIENCY	
	Y	Outsourcing scope identifies energy cost saving as performance objective	
	Y	Outsource scope covers entire energy supply-demand continuum for subject equipment	
	Y	Outsource scope provides energy monitoring and verification capacity and protocol	

Appendix B: Incidental Experience In Industrial Energy Outsourcing

In addition to the cases cited in the Ses in the body of this report, the following companies have had some experience with industrial energy outsourcing.

ALCOA, aluminum processing. Currently piloting a single-site arrangement for third-part asset ownership (unspecified technology). No asset is added to the balance sheet. ALCOA is relieved of operating a major plant utility and instead pays the vendor for units of energy service deemed to be 80-90% of a baseline consumption measure. The deal is not yet finalized (Brockway 2013).

BASF, diversified chemical products. Has not found outsourcing to be economical (Theising 2013).

Farmland Industries make nitrogen- and phosphate-based fertilizers. Seeking to reduce energy waste, but facing a shortage of capital and staff expertise, the company turned to Reliant Energy Solutions to finance and construct equipment upgrades. Per Farmland's director of engineering, this relationship yielded results "on time and within costs… as expected or better." Reliant is compensated by claiming a percentage of energy savings. Details about the volume of energy saved and contract terms are not available (Rosenthal 2013).

Jacobs Corporation, maker of precision tools. Would be interested in compressed air outsourcing, but this is not available locally (Freidmann 2013).

Kohler Company manufacturer of kitchen and bath fixtures. Considered, but never came close to corporate approval due to contractual terms for performance guarantees (T. Willis, 2013)

Toyota, automobile manufacturer. Outsourcing is traditionally not done, with rare exceptions including water treatment at one facility. Outsourcing is being considered for combined heat and power (Reed 2013).

Appendix C: Potential Applications for Industrial Energy Efficiency Outsourcing

Table A1. Examples cited by interview respondents

Application	Frequency	Examples of vendors
Distributed generation		
Combined heat and power	2	Recycled Energy Development, NRG Energy
District energy applications, including steam, hot water, chilled water	2	Hot Zero, Recycled Energy Development
Powerhouse prime movers and support		
Boilers (fossil fuel)	6	Johnson Controls, Springfield Mechanical
Boilers (renewable or onsite "opportunity" fuel)	3	
Standby generation	3	
Boilers as CHP backup	1	
Cooling towers	1	Nalco, Johnson Controls
Steam distribution system optimization	1	TLV
Space conditioning and comfort		
Lighting asset installation and maintenance	5	
Heating/ventilation/air conditioning	3	Johnson Controls, Honeywell, Jones Lang Salle
Chillers	1	
Data center cooling	1	Johnson Controls
Control room HVAC	1	
Materials refrigeration and heating space conditioning		
Geocoupled thermal networking; integrating process heating/cooling loads	1	Geoscart
Water treatment		
Water and wastewater	5	
Descaling (steel mills)	1	
Process air & airborne particulates handling		
Fans and fan systems	1	
Ventilation	1	
Electric power quality and maintenance		
Power infrastructure	2	
Motor drives		
Compressed air	5	Kaeser, Air Masters, Atlas Copco
Any motor-based technology	1	
Solar		
Photovoltaics	3	
Industrial gasses		
Onsite provision of gas feedstocks	1	
Unspecified		
Any non-core technology	1	
Any technology with low regulatory/permit risk	1	

Appendix D: Toward Measuring the Market for Industrial Energy Service Outsourcing

A proper measure of the market for outsourced industrial energy services would encompass total revenue potential, the numbers and segments of customers to be served, and the nature and capacity of service providers. This information was not available at the time of this study. A provisional measure of the market might start by evaluating the value of lost energy. Assuming that the cost of remedy should never exceed the value of loss, then the value of industrial energy loss suggests a preliminary measure of revenue potential for industrial energy service outsourcing. The most recent data describing the volume of all energy delivered to (and lost by) U.S. manufacturing facilities in aggregate can be interpreted as follows.

Table B1. Primary energy consumed for manufacturing heat and power applications by U.S. industry, 2006

Stage of manufacturing energy use	Volume of energy (trillion Btu)	Percent
Primary energy supply for industrial consumption[1]	21,972	100%
LOSS incurred by offsite generation and transmission of electricity and steam	*-6,479*	*-29%*
Total energy delivered to industrial facilities for heat and power applications	15,493	71%
LOSS from onsite conversion of fuels to heat and power	*-1,582*	*-7%*
Total energy available for onsite distribution	13,911	63%
LOSS from onsite distribution	*-937*	*-4%*
Total energy available for all applications	12,974	59%
NET energy diverted and applied to onsite non-process activity	-1,000	-5%
LOSS of energy diverted (but not applied) to onsite non-process activity	*-647*	*-3%*
Total energy available for revenue purposes	11,327	52%
LOSS from manufacturing applications	*-4,807*	*-22%*
Total energy applied to revenue purposes	6,520	30%
Energy exported offsite	-67	<1%
NET TOTAL energy applied to onsite manufacturing purposes	6,453	29%

Numbers do not add exactly due to rounding. [1] Omits feedstocks and energy produced onsite. *Source:* U.S. DOE 2012.

In 2006, 21,972 trillion Btu (TBtu) of energy were devoted to meeting the primary energy requirements of U.S. manufacturers. Energy purchased as feedstocks (i.e., direct content of products) is not counted in the total. Note that this is a gross total which includes energy consumed for the offsite generation and transmission of electricity and steam before delivery to industrial facilities. Losses incurred offsite amounted to 29% of the primary total supply. Thus only 15,493 TBtu (71%) were delivered to manufacturing sites, procured at a weighted average price of $10.05 per MMBtu.[16] This volume equates to $155.7 billion.

[16] Energy price per DOE 2013.

Care should be taken when interpreting so-called industrial energy loss. Raw energy inputs received by a manufacturing facility are refined through stages: fuel becomes heat, power, and pressure, while electricity becomes heat, motive power, compressed air, refrigeration, or other forms per the unique needs of the process. The stages of energy conversion impose some unavoidable losses attributable to the laws of thermodynamics and chemistry. While some loss is unavoidable, the balance of energy loss can be prevented at some cost; the law of diminishing returns suggests that the volume of *economically* recoverable energy waste is a smaller fraction of that which is *technically* recoverable. It is beyond the scope of this study to put a definitive number or percentage on the volume of economically recoverable industrial energy loss.

Of the total primary consumption of 21,972 TBtu described here, only 30% was actually used for revenue-making purposes, as it was either applied to process work or purposely exported offsite. A small amount (5%) was applied onsite for non-process-activities space conditioning and comfort purposes. Conversely, 65% was lost, 29% being lost offsite prior to delivery, with the balance (36%) lost while being processed, distributed, and applied onsite.

Given the 2006 DOE data for industrial energy price and consumption, we can suggest the following:

- The dollar value of U.S. industrial energy losses approximated $80 billion. This reflects 7,973 trillion Btu lost onsite for process and non-process purposes combined, priced at the weighted average price of $10.05 per million Btu. By applying this price to energy losses, it is assumed that the various forms of energy are lost in proportions equal to those at which they are acquired.
- Barring a definitive measure of economically recoverable energy loss, a parametric measure is in order. For example, 10% of industrial energy loss would be worth $8 billion.

The figure of $80 billion (in 2006 dollars) suggests a theoretical maximum value of revenue potential for industrial energy service outsourcing. However, this total should be immediately revised for at least these reasons:

- Manufacturing facilities obviously reserve the right to obtain energy savings in-house, with their own resources. Efforts that are not undertaken internally are delegated to outside entities. Outsourcing agreements are only one business model for enlisting outside vendors. Alternative contracting formats include time and materials billing, cost plus fixed fee, retainers, and other formats. Currently, there is no way to enumerate the share of energy savings to be accomplished by each of these business models.
- The cost to save each Btu varies. Certain savings are achieved at an increasing marginal cost. Other costs vary inversely with asset utilization rates. Seasonal, regional, market, and other price variances will influence costs. All of these forces ensure that the cost of attaining the "next 10%" of energy savings will differ from the cost of saving the previous 10%.

- Some of the energy waste described above accrues in manufacturing facilities that are certain to be shut down or demolished. Remediation of this waste is likely to be impractical.

The ideal study of industrial energy performance outsourcing would describe the practice across all technologies and industries. Data of that scope are not yet available. However, because it is utilized by 70% of U.S. manufacturing facilities, compressed air market studies are offered here as a proxy measure of industry's appetite for energy efficiency (see table B2).

Table B2. Compressed air market by the numbers

Percent of U.S. DOE survey respondents who in 2000 indicated the following about their compressed air operations and maintenance objectives:	
9%	Cost control is their primary objective
17%	Mentioned efficiency anywhere on their list of objectives
35%	Mentioned suffering at least one supply outage over the previous 12 months. Of these, two-thirds described the outage as a serious problem.
71%	Cite reliable supply as their primary objective
75%	Operators with no training in compressed air system optimization
34%	Respondents who have been offered an efficiency-oriented service contract for compressed air
30%	Respondents who have secured a general maintenance support contract for compressed air
3%	Respondents who have accepted an efficiency-oriented service contract for compressed air

Source: DOE 2001

Although dated, this survey information indicates that reliability, rather than energy efficiency, is a first priority for industry. But industry also admits to having low skills for energy optimization. At the time of the survey, there was little interest in outsourced energy services, especially with a scope focused on energy efficiency. Still, industry observers note that most compressed air vendors have provided or are attempting to provide outsourcing services (Elliott 2002).

Among those respondents who accepted an efficiency-oriented contract service, their top motivations were cost savings, improved production control, and production reliability. The top reasons for not obtaining the service were the perception that the service was too costly or that the same function could be done in house. Note, however, that the latter assertion may be contradicted by the 2001 survey finding that 75% of staff responsible for compressed air operation had no training in system optimization.