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Using Industry's Own Words to Evaluate ISO 50001 Energy Management Systems Adoption

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Energy Technologies Area

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Disclaimer

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Table of Contents

Executive Summary

A growing body of research is starting to qualitatively and quantitatively reveal the drivers, benefits, and challenges of implementing an ISO 50001 energy management system (EnMS). To date, a few surveys of ISO 50001-compliant firms, mostly in Europe, have been conducted. An as yet unused data source springs from the annual Energy Management Leadership Awards, held by the Clean Energy Ministerial. Launched in 2016, this international awards program requires ISO 50001 certified organizations to develop a case study describing their implementation experience, using a uniform template. This report analyzes these case studies from 2016 and 2017 using the method of content analysis, a well-established practice widely used in the social sciences to examine qualitative information.

Content analysis occurred via a close reading of each case study and transcription of relevant phrases from the following categories: motivations and goals; role of management and the organization; benefits achieved; keys to success; and challenges. Phrases were then assigned one of several carefully defined attribute "codes" within each category that capture their meaning. The relative frequency of each code suggests, or even demonstrates, the importance of the corresponding concept. In some instances, the results of this analysis are consistent with the previous survey-based work, and in some cases the analysis reveal new insights.

Some of these attributes were frequently mentioned across several categories. **Management support (CEO)** is seen to be critical in terms of challenges, keys to success, and role of management and the organization, while an **energy-aware culture (CUL)** is simultaneously a major benefit, challenge, and key to success. **Cost savings ($)** and **environmental sustainability (SUST)** concerns were each both a motivation and a benefit, with **existing values and goals (EX)** proving both a motivation and a key role in management and the organization. Amassing **accurate energy data (INFO)** was both a challenge and a key to success, while **prevailing over silos (SILO)** was both a key to success and a critical management and organizational practice. Going forward, policymakers and others looking to promote ISO 50001 uptake can use these results to highlight benefits and incentives that will resonate well when communicating with industrial facilities.

Applying the methodology of content analysis to Energy Management Leadership Awards case studies yields new insights into different perspectives on successfully operating an ISO 50001 EnMS. For example, cost savings are commonly believed to be the primary motivator for firms to invest in energy efficiency. Yet this analysis shows that other important drivers, such as existing energy goals and values, environmental sustainability concerns, and government incentives or regulations, are mentioned in more or nearly as many case studies. In another example, this paper reveals over several categories that management support is necessary for successful implementation, and highlights the importance and advantages of energy-aware company culture. Widening the lens, application of this content analysis method to a new area—in this case energy management system implementation—holds broader promise for the field of energy program design. Researchers can adapt this method to more systematically and consistently analyze other qualitative data to allow for better comparisons and reach new conclusions.

Highlights

By share of case studies mentioning these drivers, the biggest **motivations and goals** for ISO 50001 certification are:

Motivations and Goals	Code
Existing values and goals	EX
Cost savings	$
Environmental sustainability concerns	SUST
Government incentives or regulations	GOV
Improving image and marketing value; gaining competitive advantage via visibility	PR

The **role of management and the organization** is paramount to effective implementation; organizational practices common among certified companies include:

Role of Management and the Organization	Code
Engaging top management	CEO
Sponsoring crucial trainings	TRN
Building connections between silos	SILO
Actively raising employee awareness of energy	AWAR
Relying on existing energy management goals or frameworks	EX

The most common **benefits achieved** at participating companies are:

Benefits Achieved	Code
Cost savings	$
Increased productivity	PROD
Systematizing energy management	SYS
Fostering environmental sustainability	SUST
A stronger company culture	CUL

Mutual **challenges** faced include those surrounding:

Challenges	Code
Energy data	INFO
Gaps in expertise	EXP
Difficulty of integrating energy-aware behavior into company culture	CUL
Lack of ongoing management support	CEO
Challenges assessing project performance	EMV

Finally, this analysis yields chief **keys to success** with respect to adopting ISO 50001:

Keys to Success	Code
Obtaining management support	CEO
Relying on an existing culture of energy awareness or taking measures to recognize that energy conservation is everyone's responsibility	CUL
Collecting reliable and accurate energy data	INFO
Reducing silos between departments	SILO
Collaborating with external actors	COLL

Case Studies in Brief

Outreach

- In targeted outreach activities, the highest priority should be given to organizations that have already articulated an energy vision, taken steps to improve operational energy efficiency, or that include environmental sustainability among their core values.
- Securing the support of higher-level management has the most bearing on a successful ISO 50001 EnMS. Therefore, any communication material or future policy should directly target top management, encouraging them to establish well-defined energy policies and targets, allocate appropriate resources, and stay interested and involved in the ISO 50001 effort.
- A public database where insights from previous ISO 50001 implementations are shared and used by interested companies can significantly improve future implementations.

Drivers and Benefits

- Cost savings are not the most frequently mentioned driver for implementing ISO 50001, but they were the most commonly mentioned benefit achieved.
- Benefits of ISO 50001 EnMS go beyond energy and cost savings and can drive consistency and performance improvements at a single facility or at the enterprise level.
- Government regulations and/or incentives are an important motivating factor in an organization's decision to pursue ISO 50001 certification.
- Analysis of case studies confirms ISO 50001's underlying premise of continual improvement. Undergoing the ISO 50001 process benefits an organization by fostering a culture of continuous improvement and energy efficiency awareness, which in turn makes it easier for management and the organization to execute future improvements.

Operations

- Organizations can positively influence the implementation and certification process by providing necessary trainings and actively augmenting employee energy awareness.
- Among the top keys to success is collaboration with outside actors such as external consultants, peer organizations, or government or intergovernmental energy agencies and ministries. Outside actors can help render critical areas like technical expertise, energy audits, and training more effective than can be done relying on internal resources only.

Challenges

- Major challenges highlighted by case studies are lack of data availability and in-house expertise, as well difficulties with conducting measurement and verification (M&V). This suggests that a new approach to data collection and M&V (hardware and/or software) can overcome a major challenge for ISO 50001 implementation.
- Findings from this analysis, and most available studies on ISO 50001 implementation, is from organizations that successfully implemented ISO 50001. Thus, very few challenges and difficulties are revealed. To learn more about implementation challenges, organizations with unsuccessful attempts to adopt ISO 50001 should also be included in future analyses.

Introduction

ISO 50001 is an international framework for the structured practice of managing energy. First published in 2011 by the International Organization for Standardization (ISO), ISO 50001 is based on continually managing energy using the plan, do, check, and act cycle popularized by W. Edwards Deming (Deming 1986). The standard specifies requirements for energy management systems that enable organizations to deepen and sustain improvements in energy performance. As of 2017, ISO 50001 has been implemented at more than 20,000 facilities worldwide by companies seeking to improve performance and cut operating costs while furthering competitiveness and resilience (ISO 2017).

Interest in and adoption of ISO 50001 is likely to increase for multiple reasons: countries may require it as part of a climate policy, firms may introduce it to improve performance and competitive position, and organizations in general may adopt it to achieve sustainability or reputational objectives. Further, businesses may incorporate energy management into supplier requirements and corporate sustainability strategies.

New adoptions can be accelerated with better understanding of the factors adopters view as important. This analysis of Energy Management Leadership Awards case studies provides different insights into these factors than have existing survey-based studies. The questions motivating this study were:

- What were the **motivations and goals** for implementing ISO 50001?
- How important is the **role of management and the organization** in executing ISO 50001?
- What were the **keys to success** for companies that successfully implemented ISO 50001?
- What were some of the **benefits achieved** and **challenges** faced by organizations that pursued ISO 50001 certification?
- What can we learn from these early adopters, and how might policymakers use this knowledge to better target communication materials for other companies to increase uptake of ISO 50001?

Previous Results

A growing body of research is beginning to document and study the drivers and barriers to ISO 50001 uptake. These studies, methodology, and selected findings are summarized below in Table 1. The first two in the table present some rationale and details for ISO 50001, but perform no analysis. The subsequent three used survey methods on specific groups of adopters. Significantly, 274 of 308 collective survey respondents (89%) were located in Germany, France, or Spain, compared to the share of certified facilities in those same nations (51%). These are all advanced industrial economies in the European Union, and thus may face markedly different conditions for implementation relative to the rest of the world, especially with regard to regulatory and financial incentives. Moreover, from limited information presented, the sampling method of these surveys appears to be neither random nor stratified, precluding high external validity. Ideally, a future random sample of companies that have attempted (and not necessarily achieved) ISO 50001 certification, with greater geographical reach, is required for more robust results.

Table 1: Summary of previous studies of ISO 50001 energy management systems

Study	Methodology	Selected findings
Fiedler and Mircea (2012)	Unclear; presentation of ISO 50001 approach to energy management	Speculates that cost saving is "probably the major driver for the majority of organizations" putting an ISO 50001 energy management system (EnMS) into effect, achieved via lower energy costs and compliance with governmental financial incentives. Further suggests that certification "proves a sustainable company strategy … and strengthens its company image."
Clean Energy Ministerial (2016, (2017)	Summary of Energy Management Leadership Awards	For Energy Management Leadership Award candidates, presents a collection of quotes from employees along with energy and cost savings calculations, facility locations around the world, and applicable industry sectors.
AFNOR (2015)	Online survey of 66 certified companies	Common motivations: obtaining certification, achieving methodical energy management, cost savings through managing energy, corporate strategy, available subsidies and financial support, and rising energy and/or carbon costs. 65% of organizations saw both financial and non-financial benefits, such as better identifying energy consumption zones to ultimately increase profit margins, prioritizing strategic actions, increasing personnel skill level, and triggering innovation.
AFNOR (2017)	Online survey of 185 certified companies	ISO certification increasingly appeals to companies of all sizes, and many (78%) surveyed facilities are certified in at least one other ISO area, most often 9001 (quality) or 14001 (environment). In descending order of prevalence, common drivers were: financial savings through systematic energy management, meeting or anticipating regulatory requirements, availability of government subsidies and financial assistance, company strategy, and the need to restructure existing processes
Marimon and Casadesús (2017)	Online survey of 87 certified companies	Main drivers for implementation are ecological, gaining competitive advantage, and social requirements. Positive results from ISO 50001 include monetary savings, motivating other organizations to implement the standard, improved environmental performance, safety, and better overall productivity. Positive attitudes of company staff were critical to successful implementation. Main difficulties were the high cost of certification, data complexity, lack of available resources and leadership commitment, and uncertainty of benefits.

Results from Table 1 show the primacy of financial savings as rationale for adopting ISO 50001, among other non-financial objectives and benefits. Because the three online surveys were centered so heavily on Germany, France, and Spain, they provide value for further adoption in these countries, but their extensibility may be in question.

This report explores data in the form of case studies submitted for Energy Management Leadership Awards consideration as a qualitative dataset that can be quantified through content analysis, an established social science method applied to this new area. The dataset developed for this report draws from companies headquartered around the globe, representing a wide variety of industrial, commercial, and municipal sectors overcoming some of the limitations of earlier,

survey-based work. This yields a different view of the expected and perceived attributes that facilitate the adoption and operation of ISO 50001.

Data from the Energy Management Leadership Awards Applications

The Clean Energy Ministerial's Energy Management Working Group (EMWG) hosted the first awards ceremony in May 2016, with a second following in May 2017.[1] To qualify for consideration, ISO 50001 certified facilities or corporations were required to submit a written case study using a template with the following sections: Company/Facility Profile, Business Benefits Achieved, Business Case for Energy Management, Keys to Success, EnMS Development and Implementation, and Lessons Learned. Submitted case studies typically range from five to nine pages in length; 35 case studies were tendered in 2016, and 37 in 2017. All 2016 and 35 2017 case studies were used in this analysis; two 2017 case studies were excluded due to reporting inconsistencies. Table 2 displays their sectoral and geographical reach, as classified by the Clean Energy Ministerial (2016) and (2017). Regions are aligned with UN (2018); manufacturing subsectors and regions are ordered by facility count, then alphabetically. Specific countries represented are displayed within each region in descending order of facility count.

Table 2: Sectors and countries represented in 2016 and 2017 case studies

Sector	**# facilities**	**# case studies**
Manufacturing*	82	49
Insurance & property management	28	2
Oil & gas production	26	5
Technology & services	26	1
Sector	**# facilities**	**# case studies**
Energy & energy management products & services	21	2

Region	**Specific countries represented**	**# facilities**	**# case studies†**
Europe	Spain, Germany, Ireland, Italy, UK, France, Poland, Portugal, Hungary, Latvia	59	19
North America	USA, Canada	57	16
East Asia	Indonesia, Philip-pines, South Korea, Thailand, Singapore, Taiwan	30	20
Western Asia	UAE, Jordan	27	5
Region	**Specific countries represented**	**# facilities**	**# case studies†**
Latin America	Mexico, Brazil, Argentina, Chile	12	7

[1] All case study participants received an Insight Award, and three organizations received the Excellence award. Cummins Inc., LG Chem, Ltd., and New Gold, Inc. received the 2016 Excellence award, and Abu Dhabi National Oil Company, Arabian Cement Company, and Mutua Madrileña were the 2017 recipients.

Water & wastewater	8	2
Electric power generation	3	3
Telecommunications	3	1
Municipalities	2	2
Charity	1	1
Financial services	1	1
Freight transportation	1	1
Iron, steel & fabricated metals	1	1
Mining (gold & copper)	1	1
Totals	**204**	**72**

South Asia	India	10	10
Africa	Egypt, South Africa	6	6
Devel-oped Asia & Pacific	Japan, Australia	3	3
Totals		**204**	**86**

[*] *Specific manufacturing subsectors represented: general, cement, engines & related technology, automotive, chemicals, electrical equipment, food & beverage, pharmaceuticals, textiles, pulp & paper, acrylic film & battery, aluminium, automotive parts, commercial & defence nuclear, footwear, healthcare (diagnostics), non-metallic mineral product, plastics, and safety equipment*

[†] *Shows the number of case studies with a presence in each country, because some case studies pertain to multiple countries.*

Methodological Approach

The collection of case studies written for 2016 and 2017 Energy Management Leadership Awards eligibility encompass several hundred pages of text, loosely structured by the case study template. One approach to systematically extracting insights from heterogeneous textual data is content analysis, a well-established methodology widely used in the social sciences to make sense of qualitative data. Frequently cited recent work covering important methodological considerations are Elo *et al.* (2015) and Stemler (2015), while two recent applications in the field of energy and environmental management are Nath and Ramanathan (2016) and Herbes and Ramme (2014). The main objectives of content analysis are transparency and a systematic, replicable approach. Drawbacks inherent to this methodology are that analysis of content often has an interpretive aspect, and that it can be difficult to infer hidden or latent content (that is, content not conveyed in identifiable phrases). This particular dataset also contains only successfully certified companies motivated to publicly promote their successes in the context of an awards process. Thus, content from those who did not win, or participate, wasn't available for analysis. Accordingly, this analysis may understate a fuller accounting of challenges faced.

The application of content analysis to evaluate the content of these case studies occurs via close reading of each case study and manual transcription of relevant phrases from the following categories of interest: motivations and goals, role of management and the organization, benefits achieved, keys to success, and challenges. These categories were chosen based on their expected relevance to stakeholders wishing to expand the uptake of ISO 50001 energy management systems, and are mapped to corresponding case study headings in Table 3. For the awards process, case studies were scored by expert reviewers chosen by the Energy Management Working Group (not by authors), with each section allotted a number of possible points.

Table 3: Mapping between classes of interest and case study headings

Content analysis category of interest	Case study heading	# possible points
Motivations and goals	Business Case for Energy Management	5
Role of management and the organization	EnMS Development and Implementation	40
Benefits achieved	Business Benefits Achieved	15
Keys to success	Keys to Success	5
Challenges	Lessons Learned	5

The EnMS Development and Implementation section is by far the longest (and consequently eligible for the most points) of the case study template, with five relevant subsections with the following headers: Organizational; Energy review & planning; Development and use of professional expertise, training, and communications; Tools & resources; and Steps taken to maintain operational control and sustain energy performance improvement. While researchers focused on the case studies headings listed in Table 3, they transcribed relevant phrases from the appropriate category of interest throughout all portions of case studies as necessary.

As part of this research, authors created a coding manual, which defines a number of "codes", or pre-determined and well-defined categories, for each category of interest. Codes identify specified characteristics of each transcribed phrase, and analysis of these codes can quantify, for example, how often certain motivations or benefits were experienced by participating companies. Some codes were determined in advance via a conceptual framework and literature review of motivations, barriers, best practices, and behavior related to industrial and commercial energy efficiency. This review included seven significant works summarized in Table 4.

Table 4: Summary of literature review conducted to create first iteration of coding dictionary

Source	Summary
Brun, L.C. and Gereffi, G., 2011. The Multiple Pathways to Industrial Energy Efficiency: A Systems and Value Chain Approach. Center on Globalization, Governance, and Competitiveness, Duke University.	Posits that legal, financial, and social incentives are subject to the energy intensity of production and the company's position in the supply chain. Categorizes barriers, discusses ways to overcome them, and examines behavioral motivations to adopt energy-efficient practices in the industrial sector.
Environmental Defense Fund, Duke Center for Energy, Development, and the Global Environment, and Duke Center on Globalization, Governance, and Competitiveness, 2011. Capturing the Energy Efficiency Opportunity: Lessons from EDF Climate Corps.	Explores motivations behind commercial sector energy efficiency, as well as challenges and considerations across five stages of the energy-efficiency process: setting goals, identifying opportunities, financing, implementation, and measurement/benchmarking/reporting. Key challenges relate to communication, risk assessment, time horizon, financial instruments, and scaling.
Luboff, J., Legett, R., Jangra, V., and Firme, R., 2016. Commercial Strategic Energy Management Programs: Best Practices and Approaches. Behavior, Energy, and Climate Change Conference.	Discusses internal and market barriers to commercial strategic energy management programs, as well as activities to support successful implementation.
Straehle, O., Petrick, K., Stierli, F. and Bron, A., 2013. Hidden Treasure: Why	Presents a range of non-financial benefits and examples of corporate energy efficiency measures, as well as best practices to mobilize an

Energy Efficiency Deserves a Second Look. Bain & Company Bain Brief.	organization to institutionalize these initiatives. Suggests the top three reasons why programs fail are lack of ongoing support from management, misalignment of budgets and responsibilities, and deficiencies in target tracking and data transparency.
Sullivan, D., Armel, C., and Todd, A., 2012. When "Not Losing" is Better than "Winning": Using Behavioral Science to Drive Customer Investment in Energy Efficiency. ACEEE Summer Study on Energy Efficiency in Buildings.	Suggests that attitudes are poor determinants of behavior, so to increase investment in energy efficiency, focus on ameliorating investment-specific challenges instead of changing attitudes about energy efficiency. Use TITE model: Target behaviors, choose level of Intervention, determine Techniques appropriate to change behavior, put the program into operation, and then Evaluate results. Discusses techniques to overcome barriers such as endowment effect, loss aversion, percentage bias, reference dependence, excess choice, and first cost bias.
Therkelsen, P. and McKane, A., 2013. Implementation and Rejection of Industrial Steam System Energy Efficiency Measures. *Energy Policy* 57, 318–328.	Shows that near-term financial concerns and payback period, not energy savings, drive a facility's decision to adopt energy efficiency measures. Six categories of reasons measures were rejected: economic, facility/production, behavioral, organizational, attempted, and other. Economic concerns prove the greatest impediment to adoption, followed by facility/production and behavioral barriers.
U.S. Department of Energy, 2015. Barriers to Industrial Energy Efficiency – Report to Congress.	Examines economic/financial, regulatory, and informational barriers that obstruct the deployment of energy-efficient technologies and practices in the industrial sector with respect to end-use energy efficiency, demand response, and combined heat and power. Includes summary of barriers, opportunities, and successful examples.

Other codes emerged via analysis of the first 20% of the 2016 case studies to be transcribed. This approach, known as emergent coding, relies both on existing literature and on using data to guide theory and thus combines the theoretical and empirical in a manner tailored to the specific situation. Codes are meant to be mutually exclusive and exhaustive. Further, codes should fit the data, instead of forcing data to fit the codes. While assigning codes unavoidably entails interpretation, definitions should be clear enough to result in high inter-coder reliability, *i.e.* the degree to which independent coders agree on coding assignments[2].

[2] Although a scientifically acceptable method for such analysis requires a high degree of inter-coder reliability, two researchers working on this effort acted in conjunction to develop and assign the codes, thus precluding the requirement for an inter-coder reliability metric. In order to publish this work as a scientific journal paper, the coding process should be redone by multiple individuals—without coordination—to establish an appropriate metric.

Researchers then assigned each transcribed phrase the applicable three- to four-letter codes; each phrase can be assigned multiple codes if appropriate. Two researchers independently (blind) coded all case studies, starting with 2016. Initial percent agreement (number of overlapping codes divided by total number of codes assigned) was 70%. In-person discussion and revision of coding definitions then led to overall percent agreement for 2016 and 2017 case studies of 81%. In case of remaining disagreement, a random code among assignments was chosen. Finally, spreadsheets of code assignments were evaluated with custom-built analysis software; analyses are presented in the following section.

Example: Assigning Code to Text

Consider a phrase in the motivations and goals category: "Excellent overall opinion is one of the key performance indicators at [company]. It is a measure of brand health from our customers' perspective. External recognition for EnMS and SEP certification is a key pillar to support overall opinion improvement."

This would be coded PR = improving image and marketing value; brand protection; gain competitive advantage via visibility.

Findings

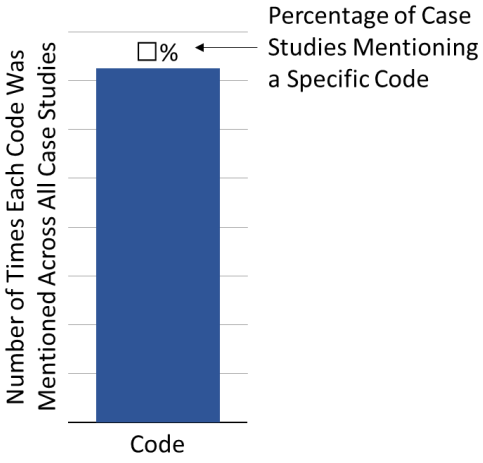

Figure 1: Graphical convention for interpreting content analysis results

Using content analysis produces both overall and detailed findings. Overall findings are presented first, followed by detailed discussion of the findings for each category of interest.

Each category of interest subsection presents the top five codes in terms of the most number of mentions within each category of interest, which are also the top five codes in terms of the percentage of case studies mentioning those codes. The text in each subsection attempts to accurately represent salient points from each figure, and quotations from individual case studies further bolster interpretations of these data, using organizations' own words. Case studies may have mentioned numerous dimensions of, for example, an energy-aware culture or the support of upper-level management to underscore the weight of these factors, and/or because the phrases encapsulated by these codes may have lent themselves to more detailed textual description. Because these two-different metrics allow for multiple interpretations, the following subsections include figures with both metrics to report findings by category.

A. Overall Findings

Figure 2 presents the most commonly mentioned codes across all categories. It highlights what types of considerations are mentioned most frequently in all categories. Shown are all the codes across all categories in aggregate, excepting the codes mentioned in less than 25% of the case

studies; the following Table 5 provides a general description of each code included in the figure, organized in descending order of number of mentions. Note that the same code could have different or opposite meanings depending on the section in which they appear (*e.g.*, an energy-aware company culture, CUL, could represent challenges if it appeared in that section, or a key to success if it appeared in that section).

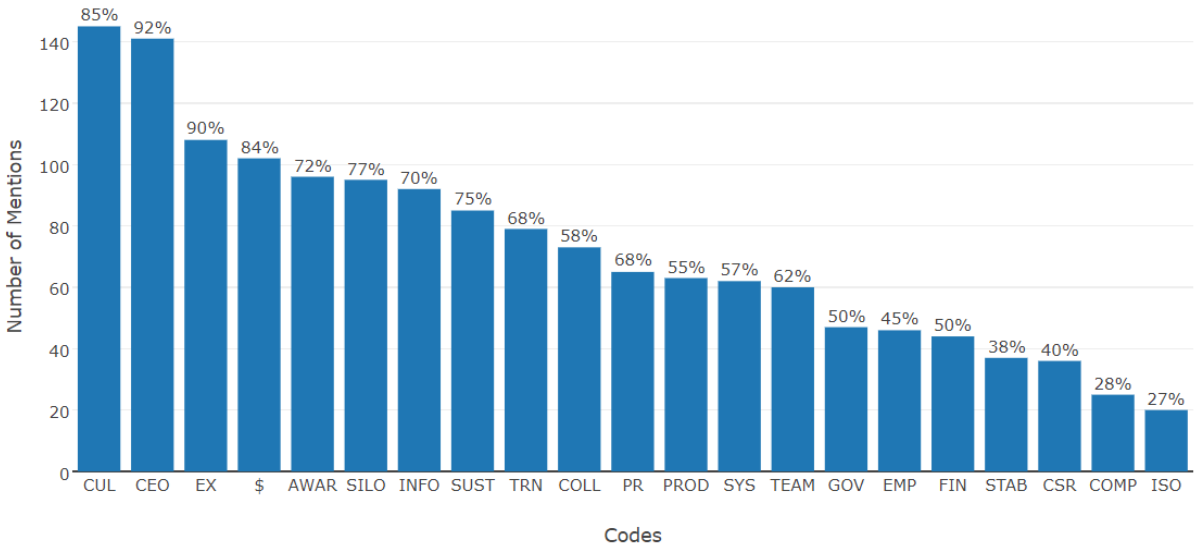

Figure 2: All codes across all categories mentioned at least once in ≥25% of case studies; data includes case study submissions from 2016 and 2017

Table 5: Description of codes represented in Figure 2

Code	General Description
CUL	An energy-aware company culture
CEO	Engagement and support of upper-level management
EX	Existing goals and values; previous energy efficiency achievements
$	Cost savings; return on investment
AWAR	Employee awareness through communication and transparency
SILO	Overcome organizational silos *(e.g.*, cross-departmental teams, share best practices)
INFO	Reliable and accurate energy metering; understand SEUs and identify facilities with largest impact
SUST	Environmental sustainability
TRN	Organize and sponsor relevant trainings
COLL	Collaborate with government, utility, or other outside entities for funding and knowledge
PR	Visibility, marketing value, and company image
PROD	Increase productivity (*e.g.*, via less plant downtime or lowering energy intensity)
SYS	ISO 50001 provides a structured framework and tools to achieve energy goals
TEAM	Dedicated energy teams and appointment of internal champions with clear accountability
GOV	Government incentives or regulations; partnership with organizations such as UNIDO
EMP	Employees feel empowered and rewarded to take action
FIN	Dedicated funds and resources outside individual groups' budgets; financial approach beyond simple PBP
STAB	Improved economic stability; reduced risk/exposure to energy costs
CSR	Corporate social responsibility; consumer, shareholder, or buyer pressure to be green
COMP	Increase competitiveness; business performance-related issues
ISO	Previous implementation of other ISO management systems (or similar)

Considering in aggregate all the codes in Figure 2, an energy-aware culture, engagement and support of upper-level management, existing goals and values, and cost savings were among the topics most discussed in all the case studies. The number of mentions for an energy-aware culture (CUL) and engagement and support of upper-level management (CEO) clearly outpaces those of existing goals and values (EX) and cost savings ($), yet the percentage of case studies that mentioned each code ranges narrowly from 84–92% for these most commonly mentioned codes.

Figure 2 demonstrates that the content analysis of hundreds of pages of written case studies yields quantifiable results from a rich but qualitative dataset. Further examination reveals that this chart contains 21 unique codes of 66 total unique codes, meaning that approximately one third of unique codes developed were mentioned by at least one quarter of the pool of 2016 and 2017 case studies. Also, the number of mentions (on the Y-axis) generally—but not always—tracks in step with the percentage of case studies that mentioned each code at least once (above each bar). Divergences are attributable to case study authors stressing certain salient points more than once, and to researchers who agreed on an informal framework to decide whether such emphasis should be transcribed as separate phrases.

B. Motivations and Goals

The results of this content analysis suggest that **existing energy goals and values**, **environmental sustainability**, **government regulations and/or incentives**, **cost savings**, and **improved company image** were among the most important motivations for implementing ISO 50001 energy management systems. Existing energy goals and values are the most common driver, both in terms of absolute number of mentions and percentage of case studies (72%). Environmental sustainability, government regulations and or/incentives, and cost savings cluster together when it comes to both number of mentions and percentage of case studies referencing these motivations (48–54%). Still among the top five of fourteen possible drivers, but exhibiting fewer mentions among fewer case studies (38%), is improving company image and marketing value.

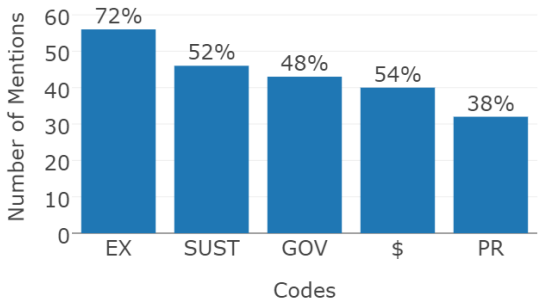

Figure 3: Motivations and goals for implementation of ISO 50001

Table 6: Description of codes represented in Figure 3

Code	Description
EX	Existing goals and values; previous energy efficiency achievements
SUST	Environmental sustainability
GOV	Government incentives or regulations; partnership with organizations such as UNIDO
$	Cost savings; return on investment
PR	Improving image and marketing value; brand protection; gain competitive advantage via visibility

Those companies that have already articulated an energy vision, taken steps to improve operational energy efficiency, or include environmental sustainability among their core values are prime candidates for ISO 50001. Companies with existing energy and sustainability goals and values can look to ISO 50001 as a way to move towards achieving those aims. Policymakers may want to target communication materials to these companies in order to accelerate uptake of ISO 50001, especially emphasizing these energy management systems as a proven and systematic path to realizing existing energy goals. Policymakers in a position to create incentives or mandates should note that about half of the companies who submitted 2016 or 2017 case studies mention government regulations and/or incentives as a motivating factor in their decision to pursue ISO 50001 certification. Some indicated that they acted in direct response to government regulations such as India's Perform Achieve Trade (PAT) Scheme, which set up a market for energy-efficiency certificates required in energy-intensive sectors, or Indonesia's Energy Management Regulation No. 14/2012, which directs energy consumers exceeding 600 tonnes of oil equivalent (toe) to put energy management into practice. Others, such as firms headquartered in Europe, adopted an ISO 50001 EnMS as one strategy to reduce greenhouse gas emissions to meet national or EU targets, while others chose to act in response to voluntary government incentives or in advance of anticipated government regulation.

Although cost savings were mentioned as a motivation less often than were existing energy goals and values, cost savings was the most commonly mentioned benefit of ISO 50001 energy management systems (see Benefits Achieved section on page 12). Stakeholders may thus wish to emphasize the primacy of cost savings as a proven benefit to motivate organizations deciding to pursue ISO 50001 certification. Finally, in the body of case studies, improving company image was often linked to improving competitiveness. For example, HARBEC, Inc.'s case study reads, "HARBEC nurtures its green image, which delivers growing value in domestic and international markets," while Mike Clemmer of Nissan North America, Inc. stated that "Nissan values third-party validation and the external recognition for being an environmentally manufacturer." These and similar experiences may serve to convince firms that publicizing ISO 50001 implementation goes beyond positive press to strategically position certified companies above their competitors.

C. Role of Management and the Organization

Because ISO 50001 is a framework that is integrated into the management practices of an organization or facility, the role of management and the organization is paramount in its successful implementation. After reviewing the first 20% of the 2016 case studies, it became apparent that management and the organization play an important role in successful

implementation of ISO 50001, and thus was given its own category. **Obtaining top management support or corporate-level commitment** for ISO 50001 is first in this category both in terms of number of mentions and percentage of case studies (72%). Next, the essential role of the organization in **arranging and delivering relevant trainings** comes second in terms of number of mentions, but is outpaced by the necessity of **overcoming organizational silos** when it comes to percentage of case studies (65% vs. 70%). The higher number of mentions for training may be attributable to the fact that many case studies described various types of trainings aimed at different actors within companies (*e.g.*, certified energy managers, energy team members, management, and process workers). Finally, **actively taking measures to increase employee awareness** is highlighted by the same share of case studies (51%) as is **having energy management as an existing goal, or having an existing framework** (*e.g.,* ISO 14001 [Environmental Management] or similar) that could readily be modified to accommodate an EnMS, though this latter theme saw fewer mentions than did employee awareness efforts.

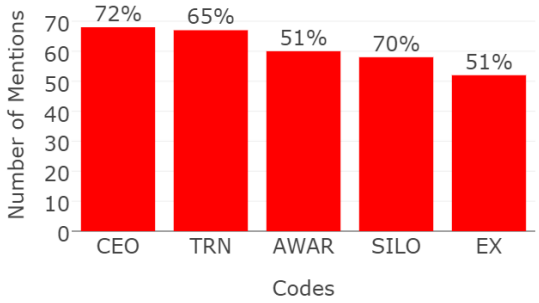

Figure 4: Role of management and the organization in successful ISO 50001 implementation

Table 7: Description of codes represented in Figure 4

Code	Description
CEO	Top management support or corporate-level commitment
TRN	Organize and sponsor relevant trainings
AWAR	Actively take measures to increase employee awareness through communication and transparency
SILO	Overcome organizational silos (*e.g.*, cross-departmental teams, share best practices among facilities)
EX	Energy management as an existing goal; existing ISO 14001 or similar framework(s)

This analysis suggests that securing the support of higher-level management has the most bearing on a successful ISO 50001 EnMS. Generally, management support was critical to ensure that planning and implementation processes were well-resourced, roles and responsibilities on the energy team were clarified, and that energy management became integrated into company culture; one way of encouraging the latter was by mandating a 5% weighting for energy management and conservation in all business units' balance score cards, as seen at ENOC Retail Operations & Marketing. A code mentioned by almost as many case studies pertains to rising above a silo mentality by sharing best practices among facilities or by constituting an energy team that bridges departments—instead of relying solely on engineers, for example—such that the team works together for the benefit of the larger organization. For example, at 3M, "the wide-ranging inclusion of key team members across department lines…provided great benefit to the

implementation process. This included increased EnMS awareness and leverage of EHS team members already engaged with ISO 9001 and 14001."

In addition, an organization as a whole can positively influence the implementation and certification process by providing the necessary training, actively taking steps to increase employee awareness about energy efficiency, and linking ISO 50001 adoption to existing goals and values that support sustainability and energy efficiency measures. Training topics ranged from user training on energy awareness, energy behavior, and details of ISO 50001 to full-blown energy manager certification to expert training of enterprise energy managers. Recipients of training were varied as well: top managers, energy team members, all employees, and employees whose daily practices most affect plant energy consumption. Such training was sometimes provided by third parties, either consulting firms or by government programs such as UNIDO or the U.S. Department of Energy's Superior Energy Performance program. Examples of specific steps taken to increase energy awareness are trainings, electronic campaigns conveying practices put into place via ISO 50001 and resultant energy savings (*e.g.,* e-mails, blog posts, newsletters, and periodic reports), visual communication materials (*e.g.,* posters that reinforce the benefits of energy management), annual energy awareness weeks or energy fairs, periodic energy pep talks, energy-themed hard hat stickers, and energy-saving tips on informational cards in badges.

Finally, management often positioned ISO 50001 as the preferred option to achieve existing energy-related values. Existing management systems, such as ISO 9001 and 14001—or others with a focus on continuous improvement—were regularly cited as critical in quickening and simplifying the process of ISO 50001. For example, FCA US LLC's Dundee Engine Plant set up their EnMS in one year, commenting "Regarding the fact that the EnMS was born integrated with the other normalized systems already existing in the company, namely ISO 9000, ISO 14000 and OHSAS 18001, the work of implementing operational control measures was facilitated. There was only a need to reinforce some existing practices…to strengthen [their] energy dimension." Ultimately, the insights that arise from examining in case studies the role of management and the organization in establishing a successful ISO 50001 EnMS can be used by interested companies to improve their own implementation processes, as well as by stakeholders who may wish to further develop toolkits or customize outreach materials.

D. Benefits Achieved

Although cost savings were not identified as the most important motivation for adopting ISO 50001 (only the fourth most important, according to Figure 3), Figure 5 demonstrates that 64% of organizations characterized **reduced cost** as the most important benefit resulting from adoption. The benefits next most frequently mentioned in the collection of case studies were **increased productivity**, **systematizing energy management**, **improved environmental sustainability**, and a **stronger company culture**—with 45–50% of case studies including these benefits. Here, increased productivity can arise from less plant downtime, greater plant capacity, better energy intensity, or time and/or resource savings gained from automating processes or data collection. Improved environmental sustainability was most commonly referenced in case studies with respect to reduced greenhouse gas emissions. Each of these benefits were similarly mentioned as

motivations to implement ISO 50001 by some companies, although only cost savings appears in the top five across both categories.

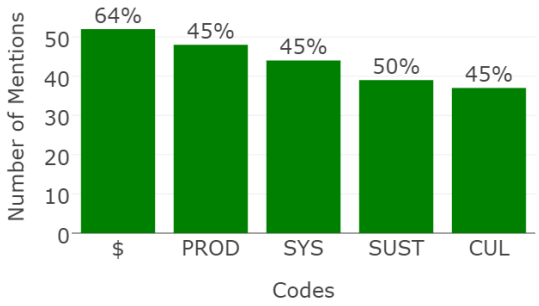

Figure 5: Benefits to organization post-implementation of ISO 50001

Table 8: Description of codes represented in Figure 5

Code	Description
$	Cost savings; return on investment
PROD	Increased productivity via less plant downtime, higher capacity, better energy intensity; time/resource savings via automation
SYS	Established process, tools, and consistency for managing energy and data; good methodology for energy review and planning
SUST	Improved environmental sustainability; increased use of renewable resources
CUL	Better employee motivation; strengthened company culture; built culture of continuous improvement

Cost, energy, and carbon savings for participating firms are quantified in Table 12 on page 20. Sergio Alcantria from Arabian Cement Company found that "Reducing energy use makes perfect business sense as it reduces costs, reduces greenhouse gas emission[s] and help[s] with security of energy supply by reducing dependency on imported energy sources." Going even further, 3M's case study summarizes multiple benefits (cost savings, increased productivity, and systematizing energy management) as follows: "The opportunities to streamline the implementation process through corporate leadership and with multiple plants working as cohorts through our enterprise-wide certification provided significant benefits in terms of time savings, cost savings, and sharing of best practices." Additional benefits of rendering energy management more structured and systematic through the framework of an ISO 50001 EnMS were partially captured by Steve Sacco at Schneider Electric: "The ISO 50001 and Superior Energy Performance frameworks not only build upon our energy management systems, but also help us drive consistency and performance improvements across our locations." Similarly, Mohammed Sadek from ENOC Lubricants and Grease Manufacturing Plant asserted, "Implementing ISO 50001 systems has been an eye opener to us at ELOMP, as it made the process of identifying savings opportunities systematic and streamlined.", while José Luis Vasquez at TNT Chile Limitada stated, "The ISO 50001 EnMS gave us the structure and tools but overall, the systematicity to focus our efforts and achieve results never seen before."

Better employee motivation, strengthening company culture, and creating a culture of continuous improvement, all encapsulated in the code CUL, is one of the top benefits, mentioned by nearly

half of the organizations that submitted case studies. It is important to point out that promoting a culture of energy efficiency awareness was identified in 47% of case studies as a key task for management and the organization for facilitating the adoption of ISO 50001. Therefore, by comparing Figure 5 (Benefits Achieved) and Figure 7 (Keys to Success, discussed in a later section), one can conclude that undergoing the ISO 50001 process benefits an organization by fostering a culture of continuous improvement and energy efficiency awareness, which in turn makes it easier for management and the organization to execute future improvements.

E. Challenges

Challenges were most commonly listed under the section labeled as "Lessons Learned". Authors were not awarded points for discussing challenges specifically relative to other items suggested in "Lessons Learned", such as insights, plans to replicate or expand ISO 50001 efforts at other sites, advice, or solutions to challenges and measures to succeed. Interpreting analytical results concerning challenges in this section necessitates caution. 80% of the case studies mentioned at least one challenge; however, no single code was mentioned in more than a quarter of case studies that discussed any challenges. This suggests that individual organizations cover a narrower range of challenges compared to other categories. In addition, given that all the analyzed case studies were from facilities that attained ISO 50001 certification, it is expected that each organization will focus more on its successes and less on the challenges of implementation.

About one quarter of the case studies indicated **insufficient disaggregated energy consumption data** as a major challenge. From EMWG awardees, this can take shape as a lack of availability, accuracy, and connectivity of power meters; difficulties setting up or maintaining an effective monitoring system; issues surrounding energy data transfer, security, and confidentiality; and the challenge inherent to identifying and prioritizing major energy consumers. Next most common were a **lack of experience and in-house expertise** with regards to ISO 50001 execution, as well as **energy efficiency not being an integral part of the company culture**, with the former outpacing the latter in terms of number of mentions. Among participating companies, gaps in expertise were identified with respect to technical knowledge to manage energy, familiarity with ISO 50001 requirements and details of energy management systems, and finding a qualified accreditation body (as the standard is so new). Concerns about culture typically revolved around the challenges in sufficiently engaging plant personnel to motivate them to care about energy, institutionalizing necessary behavioral changes, and maintaining synergy and commitment throughout. Lastly, a **lack of ongoing management support** and **challenges conducting energy measurement and verification** were mentioned by 17% of all case studies. The former challenge often involved overcoming management's initial disinterest or reluctance, driven by a focus on increasing production, revenue, and profitability, as well as a lack of awareness of energy efficiency benefits. Some strategies to meet such a challenge common to several organizations were starting with no- and low-cost projects, positioning ISO 50001 as a way to meet strategic challenges, and showcasing the success of smaller projects in order to obtain further required resources from management.

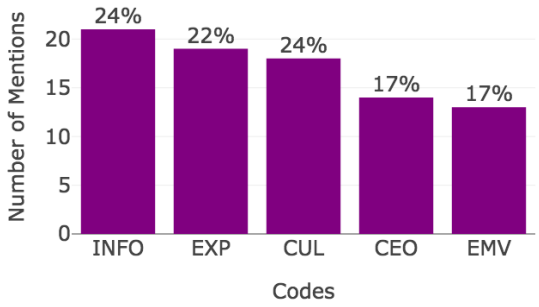

Figure 6: Challenges faced by organizations in implementing ISO 50001

Table 9: Description of codes represented in Figure 6

Code	Description
INFO	Imperfect information; lack of disaggregated and transparent energy consumption data
EXP	Lack of in-house expertise; limited access to best practices and outside contractors with necessary expertise
CUL	Energy management not integrated/rewarded within company culture, nor is part of daily employee behavior
CEO	Lack of ongoing top management support
EMV	Challenges conducting EM&V, the energy review process, or energy accounting

F. Keys to Success

The term and content for "keys to success" is taken from the section of the EMWG case study template of the same name. In the template, this section recommends a bulleted format for the top tips and insights to help others successfully execute ISO 50001. **Strong management support** was by far the most critical to successful uptake, as coded from almost three quarters of case studies. Developing an **energy performance-focused culture with engaged employees** received the second most mentions and was key for 42% of participating companies. Next, more than one third of case studies analyzed featured two additional keys to success: the **availability of high-quality energy data** and the **reduction of departmental silos**; the former was slightly more common by both number of mentions and percentage of case studies. Rounding out the top five, with nearly 30% of case studies and almost as many mentions as reducing silos, is **working in collaboration with service providers, government, and/or implementation coaches** in order to achieve a successful ISO 50001 EnMS.

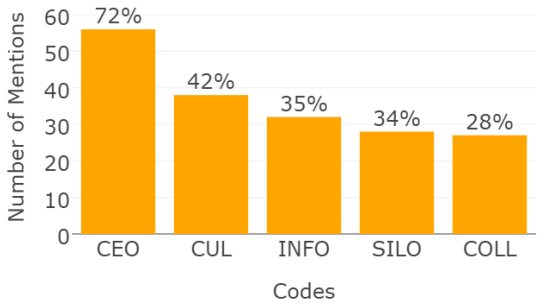

Figure 7: Keys to success in implementing ISO 50001

Table 10: Description of codes represented in Figure 7

Code	Description
CEO	Support from management; corporate-level program leadership
CUL	Existing culture of energy awareness; recognition that energy conservation is a responsibility and part of everybody's work
INFO	Reliable and accurate energy metering; understanding SEUs and identifying facilities with largest impact
SILO	Reduce departmental silos; create cross-functional energy teams; share required tools, frameworks, and information
COLL	Collaboration with service providers, government, or implementation coaches; access to guidance documents

In looking more closely at the case studies that emphasize strong support from management, it first becomes clear that because instituting a systematic EnMS requires time as well as financial and human resources, for best results senior management should establish well-defined energy policies and targets, allocate appropriate resources, and stay interested and involved in the ISO 50001 effort. Mutua Madrileña's 2017 case study notes, "Top management provided up-front support to the EnMS, giving it strong initial thrust. However, it is continuous improvement and sustained performance that maintain and enlarge support and recognition." Second, multiple firms mentioned the advisability of treating energy awareness as a mindset that is integrated tightly into employee behaviors, instead of viewing the EnMS solely as a system implementation or, worse, as a formality.

Next, case studies discussed energy data availability in various dimensions, including increasing knowledge of equipment and systems via real-time sub-metering, identifying significant energy uses to capture the best opportunities for energy efficiency investment, creating tools and databases that allow the evaluation of energy consumption in relation to certain variables, and having a direct link between operational control and monitoring phases, which allows informed decisions to be made based upon specific performance indicators. Measures taken to overcome organizational silos were also heterogeneous in nature, but often involved: ensuring that dedicated energy teams were cross-functional and drawn from various departments; intensive (and sometimes top-down) communication; energy teams developing strong partnerships with finance departments; and sharing best practices between plants or facilities. Finally, participating companies advised collaboration with outside actors such as external consultants, peer companies or municipalities, government energy agencies/ministries, or organizations like UNIDO in order

to render critical areas like technical expertise, energy audits, and training more effective than can be achieved solely relying on internal resources.

G. Comparing Challenges and Keys to Success

Results from the "Challenges" and "Keys to Success" sections may be more meaningful when compared side by side with one another. Figure 8 summarizes all the codes where those two categories overlap with each other, and organizes them in a tornado diagram style. These codes are important to highlight because they are not only barriers to implementation, but can also be turned around to be used as an organizational strength for effective adoption of an ISO 50001 EnMS. In other words, each theme represented in this chart is both vital to success—but also can be difficult to effectively harness. Note again that because the case study template placed little emphasis on challenges, the percentages for the bottom half of Figure 8 may understate impediments to successful EnMS adoption.

Nearly three quarters of all case studies emphasized how critical it is to obtain top-level management support, with 17% identifying the same as a challenge (again, since not much emphasis was put on the challenges given the case study template design, the percentages in the bottom half of the tornado diagram may be understating impediments to successful EnMS adoption). Relative to top management support, an energy-aware culture was next most prevalent as a key to success, but fostering such a culture was more commonly identified as a challenge than was securing management support.

Next, gathering sufficient and accurate energy data in order to understand significant energy uses was found at a similar rate among case studies as was reducing departmental silos through various measures—yet the difficulties in energy data and monitoring were encountered twice more often by participating organizations. Specifically taking measures to increase employee awareness of energy can be viewed as complementary to creating an energy-aware culture; smaller shares of case studies identified this theme as both a challenge and a key to success.

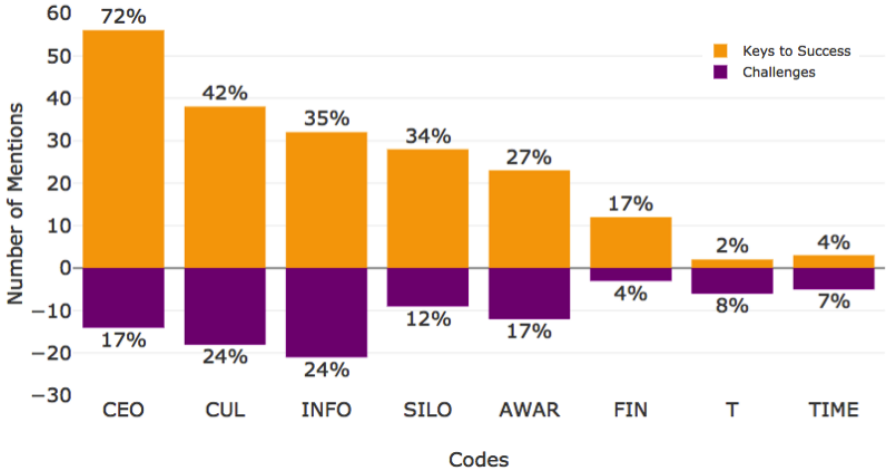

Figure 8: Analysis of overlap between "Keys to Success" and "Challenges"

Table 11: Description of codes represented in Figure 8

Code	Description - Keys to Success	Description - Challenges
CEO	Support from management; corporate-level program leadership	Lack of ongoing top management support
CUL	Existing culture of energy awareness; recognition that energy conservation is a responsibility and part of everybody's work	Energy management not integrated/rewarded within company culture, nor is part of daily employee behavior
INFO	Reliable and accurate energy metering; understanding SEUs and identifying facilities with largest impact	Imperfect information; lack of disaggregated and transparent energy consumption data
SILO	Reduce departmental silos; create cross-functional energy teams; share required tools, frameworks, and information	Departmental silos; misaligned responsibilities & budgets; knowledge gap between departments
AWAR	Specifically take measures to increase employee awareness and improve transparency and reporting	Lack of awareness or failure to recognize benefits of systematic EnMS or non-energy benefits
FIN	Commit sufficient resources; give program its own budget responsibility	Internal competition for capital
T	Minimize implementation time	Time commitment required for learning/implementation
TIME	Think on a longer time horizon, as energy management requires long-term planning	Managers stay in posts only a short time; short business time horizons

Often seen in the case studies were direct linkages between challenges experienced and advice for overcoming them. For example, some organizations were concerned about the magnitude of the economic investment anticipated or required. HARBEC, Inc. mentioned that companies often perceive the initial upfront costs as a barrier to adopting ISO 50001, but that "in [our] experience, however, the short- and long-term economic value of this project far outweighs the out-of-pocket expenses. The simple economic payback on this project was 2.4 years. There are however a number of high-value benefits…that have achieved additional value to the business, including achieving carbon neutrality, reinforcing its eco-conscious business culture, and putting a process- and performance-based discipline in place for continuously driving resource efficiency and process improvements." In addition, Mutua Madrileña's initial financial expectations were not borne out: "When [we] first started implementing ISO 50001, we were sure it would need deep economic investment. Nearly two years later, everyone has been happily proven wrong…We have realized that saving energy makes strong commercial sense and this drives the support from the top."

In many cases, a challenge assigned one code would be resolved by a key to success coded differently. For example, changing the company culture to integrate energy management was a challenge met by specific actions to improve communication, awareness, and competencies at New Gold, Inc.'s New Afton Mine. "Support of the management team and the employees must be done face-to-face, talking to people and listening to their concerns. Let them know what this will do for them…Communication, training and awareness is the crux of the system." New Gold, Inc.

suggested utilizing external expertise to save time and frustration. In addition, their concerns about the time commitment required were in part mitigated by relying on systems already in place for communication, safety, and incident reporting: "Avoid reinventing the wheel for every initiative: piggyback where possible, on existing systems." Nissan North America, Inc. also faced a major challenge in "shifting the culture and convincing plant officials to invest in energy efficiency" because "some believed the company had already seized all opportunities to reduce energy usage." Here, the solution was found via better information from the EnMS and the EnPI tool provided by the Department of Energy, which together "enabled discovery of correctable, previously undetected energy losses."

Conclusions

Because the ISO 50001 standard is so new, until recently there had been little evidence of a well-defined value proposition for instituting an ISO 50001 certified energy management system. The scarcity of data on motivations, barriers, and benefits to implementation—particularly outside of Europe—has meant that it has been difficult to clearly communicate the business value of ISO 50001. Part of the reason for this is that this standard can be implemented by heterogeneous organizations of all types, sizes, and sectors. Fiedler and Mircea (2012) assumed that cost savings was the chief driver for most companies. In contrast, this content analysis of case studies finds that existing goals and values around energy, environmental sustainability concerns, and government regulations and incentives were mentioned more often in case studies as motivations for implementing ISO 50001 than was cost savings. Indeed, in transcribing case studies we found that certified organizations contending for Energy Management Leadership Awards had a range of motivations and experienced myriad benefits. However, some commonalities have emerged. From this analysis, the biggest drivers for ISO 50001 certification are:

1. existing values and goals,
2. cost savings,
3. environmental sustainability concerns,
4. government incentives or regulations, and
5. gaining competitive advantage via visibility.

These are largely aligned with those from recent European surveys (AFNOR 2015/2017 and Marimon and Casedesús 2017).

Given these insights, policy makers may want to position ISO 50001 as a proven means to achieve existing energy and sustainability strategies while enhancing company image and competitiveness. Government incentives have also increased uptake, whether financial, regulatory, or through the provision of tools and expertise. Of these motivations, cost savings and improving environmental sustainability were commonly seen as benefits, and can be seen in Table 12 for the pool of companies that submitted case studies.

Table 12: Total annual savings from ISO 50001 energy management systems among Energy Management Leadership Awards contenders

Savings metric		**2016**	**2017**	**total**
Cost ($USD million)		$67*	$160	$227
Energy	(petajoules)	4.9	51	55.9
	(billion Btu)	4,644	48,340	52,984
CO_2 emissions reduction (million metric tons)		0.92**	5.8	6.72
Equivalent number of passenger vehicle removed from the road each year (million)		0.2	1.2	1.4

* *Several organizations did not report energy savings in their 2016 case studies*

** *Several organizations did not report CO_2 emission savings in their 2016 case studies*

Participating companies also increased productivity via less plant downtime, higher capacity, and/or better energy intensity, or by automating energy monitoring or management processes, which yielded time and resource savings that may not be encapsulated in annualized cost savings presented above. Finally, ISO 50001 was valuable in terms of establishing a systematic framework for organizations to integrate energy efficiency throughout their facilities and daily operations. We see that it also facilitated a culture of continuous improvement that strengthened employee motivation and company culture. All of these benefits provide business value, even those less quantifiable than energy or cost savings.

In comparing role of management and the organization and keys to success, we see that top management support is critical to an effective EnMS, so policy makers should focus on making the case for ISO 50001 to this stakeholder group. Commitment and ongoing interest from top management help ensure that the implementation process has the resources it needs. Moreover, management can optimally structure this effort to transcend company silos by establishing cross-functional teams and ensuring that lines of communication between departments and facilities are clear. Actively taking measures to increase employee awareness is vital in advancing a culture of energy conservation, while conducting trainings and gathering detailed and accurate energy data—both often in concert with outside implementation coaches, service providers, or government entities—equip an organization's workforce to effectively manage energy use and to strive for the continuous improvement that is the hallmark of ISO 50001.

Advancing this Work

Steps to further this work are forthcoming. External contributors will be brought in to code all case studies independently from the initial researchers involved. This will allow the determination of an appropriate metric of inter-coder reliability. When 2018 case studies have been submitted and scored, they will be incorporated into the pool of 2016 and 2017 case studies and analyzed using the same framework. The addition of the 2018 case studies may allow for industrial sub-sector disaggregation, shedding light on differences within the industrial sector.

An online database of results will be developed that will highlight non-energy benefits and compelling quotes from case studies. We intend the database to be structured such that users can search and display records pertaining to specific sectors, countries, and years. An increasing number of case studies in various sectors and countries will allow for more robust examination of

whether certain drivers, benefits, or challenges are correlated with these parameters. The principal goal of the online database with up-to-date results is to facilitate improved messaging to specific stakeholder groups and, ultimately, to quicken uptake of ISO 50001 energy management systems.

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Appendix I: Tables of All Defined Codes

This coding manual is split by category of interest, and then organized alphabetically by code. Codes are in the left column, with definitions on the right. Some categories of interest are further broken down into subcategories.

Motivations and Goals

$	Cost savings; return on investment
BUS	New product development, business models, or business opportunities
COMP	Increase competitiveness; business performance-related issues
CSR	Corporate social responsibility; consumer, shareholder, or buyer pressure to be green
CUL	Strengthen company culture; improve employee awareness of and motivation for energy savings
EX	Existing goals and values; previous energy efficiency achievements
GOV	Government incentives or regulations; partnership with organizations such as UNIDO
ISO	Positive results from previous implementation of other ISO management systems (or similar)
PR	Improving image and marketing value; brand protection; gain competitive advantage via visibility
PROD	Increase productivity (*e.g.,* via less plant downtime or lowering energy intensity)
QUAL	Better product quality
STAB	Economic stability by reducing exposure to volatility; risk reduction; improve business sustainability
SUST	Environmental sustainability
SYS	ISO 50001 provides a structured framework and tools to achieve energy goals

Role of Management and the Organization

AWAR	Actively take measures to increase employee awareness through communication and transparency
CEM	In-house presence of certified energy managers
CEO	Top management support or corporate-level commitment
COLL	Collaborate with government, utility, or other outside entities for funding and knowledge
CUL	Involve all employees in creating an energy-aware culture; energy management is everyone's responsibility
EED	Consider an energy-efficient design from the start of each project
EMP	Empower and reward employees for taking action
EWA	Enterprise approach to streamline efforts at various facilities
EX	Energy management as an existing goal; existing ISO 14001 or similar framework(s)
FIN	Dedicate funds and resources outside individual groups' budgets; use financial approach beyond simple PBP
INFO	Develop energy metering plan for reliable and accurate data; understand significant energy uses (SEU)
INT	Rely on internal resources and in-house capabilities
METR	Determine appropriate metrics (*e.g.,* energy performance indicators, baselines, and benchmarks)
NCAP	Focus on low or no-capital projects

SILO	Overcome organizational silos (*e.g.*, cross-departmental teams, share best practices among facilities)
SUPP	Engage with suppliers or others in supply chain around energy policy
TEAM	Dedicated energy teams and appointment of internal champions with clear accountability
TRN	Organize and sponsor relevant trainings

Benefits Achieved

$	Cost savings; return on investment
BUS	New product development, business models, or business opportunities
CEO	Solidified management support for energy management and energy efficiency
COLL	Better relationship with governments, utilities, peers, and other partners
COMP	Increased competitiveness
CSR	Achieved existing corporate sustainability or social responsibility goals
CUL	Better employee motivation; strengthened company culture; built culture of continuous improvement
EQP	Increased service life of machines and equipment
GOV	Achieved compliance with existing or impending regulations or external governmental commitments
INFO	Better information about energy, cost, plant processes, and SEUs; automated data collection
ISO	Helped comply with other ISO standards (given that overlap exists)
JOBS	Created new jobs
NCAP	Energy savings through low or no-capital projects
OTH	Improved other processes not related to SEU (*e.g.,* maintenance, procurement, occupant comfort)
PR	Enhanced visibility, marketing value, and company image
PROD	Increased productivity via less plant downtime, higher capacity, better energy intensity; time/resource savings via automation
QUAL	Better product quality
RES	Identified opportunities to save other resources used (*e.g.*, water, nitrogen)
SAFE	Achieved safety benefits
STAB	Improved economic stability; reduced risk/exposure to energy costs
SUST	Improved environmental sustainability; increased use of renewable resources
SYS	Established process, tools, and consistency for managing energy and data; good methodology for energy review and planning
WFD	Workforce skill development and knowledge enhancement

Challenges

Financial	
$	High upfront project costs; insufficient access to capital; lack of financial resources
CYC	Program planning cycles
NPV	Capital budgeting methods do not fully account for capital improvements because they do not use NPV

PBP	Insufficient payback; low cost of energy as share of operating costs; energy price trends favor inaction
TAX	Corporate tax structure
U$	Uncertainty of energy and cost savings realization, difficulty framing EnMS as financially beneficial
Informational	
AWAR	Lack of awareness or failure to recognize benefits of systematic EnMS or non-energy benefits
EMV	Challenges conducting EM&V, the energy review process, or energy accounting
EXP	Lack of in-house expertise; limited access to best practices and outside contractors with necessary expertise
INFO	Imperfect information; lack of disaggregated and transparent energy consumption data
Organizational	
CEO	Lack of ongoing top management support
CUL	Energy management not integrated/rewarded within company culture, nor is part of daily employee behavior
DIFF	Certification requirements difficult to achieve, onerous, and distracting
DIR	Lack of policies, goals, and direction that favor energy efficiency investments
DUP	Duplication of effort (*e.g.,* system to manage energy exists so firm is reluctant to implement another)
FIN	Internal competition for capital
GOV	Lack of government/industry programs
OWN	Lack of ownership for energy/carbon emissions within company
RISK	Perceived risk to quality or production
SILO	Departmental silos; misaligned responsibilities & budgets; knowledge gap between departments
SPL	Split incentives (*e.g.*, those using the energy are not the same as those who pay for it)
T	Time commitment required for learning/implementation
TIME	Managers stay in posts only a short time; short business time horizons

Keys to Success

General	
CEO	Support from management; corporate-level program leadership
CONS	Consistency of effort; concept of continuous improvement
INFO	Reliable and accurate energy metering; understanding SEUs and identifying facilities with largest impact
PORT	Portfolio approach, where projects are aggregated across global operations
SIMP	Keep planning and implementation as simple as possible
Goal Setting	
AWAR	Specifically take measures to increase employee awareness and improve transparency and reporting
CLR	Clearly stated strategic targets and corporate goals for energy efficiency
CUL	Existing culture of energy awareness; recognition that energy conservation is a responsibility and part of everybody's work
REL	Relative goals, which allow more flexibility
STAB	Anchor EE efforts in a broader evaluation of organizational risk and commercial feasibility
T	Minimize implementation time

TIME	Think on a longer time horizon, as energy management requires long-term planning
Identification of Opportunities	
COLL	Collaboration with service providers, government, or implementation coaches; access to guidance documents
NCAP	Focus on low or no-capital projects (*e.g.,* behavioral change)
Financing	
3PAR	Third-party financing
FIN	Commit sufficient resources; give program its own budget responsibility
PAY	Improve financial modeling (*e.g.,* adjust simple payback criterion; use appropriate discount rate for NPV)
Implementation	
BKM	Adopt best known methods and/or best-practice project management approaches
CAP	Existing employees' capability, competence, and expertise
CSR	Corporate social responsibility policy; pressure from consumers, shareholders, and buyers to be green
EED	Consider an energy-efficient design from the start of each project
EMP	Employees feel empowered and rewarded to take action
EXST	Modify existing infrastructure or systems instead of replacing; handle issues through existing change control process
ISO	Previous ISO experience
SCS	(Momentum from) past successful energy efficiency projects
SILO	Reduce departmental silos; create cross-functional energy teams; share required tools, frameworks, and information
SUPP	Engage with suppliers or others in supply chain around energy management policy
TEAM	Establish empowered energy teams and internal champions (for each facility, if applicable)
TRN	Organize and sponsor relevant trainings
Measurement/Benchmarking/Reporting	
CENT	Centralize energy data collection; centralized and single point person documentation
METR	Determine appropriate metrics (*e.g.,* energy performance indicators, baselines, and benchmarks)
PROC	Use established process, governance, or system to (re)assess progress
VER	Verify energy savings according to principles of ISO 50015 and IPMV; perform complete energy review
TECH	Availability of advanced tools, innovation, and use of new technology