
REPORT

Sustainable operations through energy efficiency

Exploring current trends and key challenges for industries in developing energy efficient businesses towards a more sustainable world

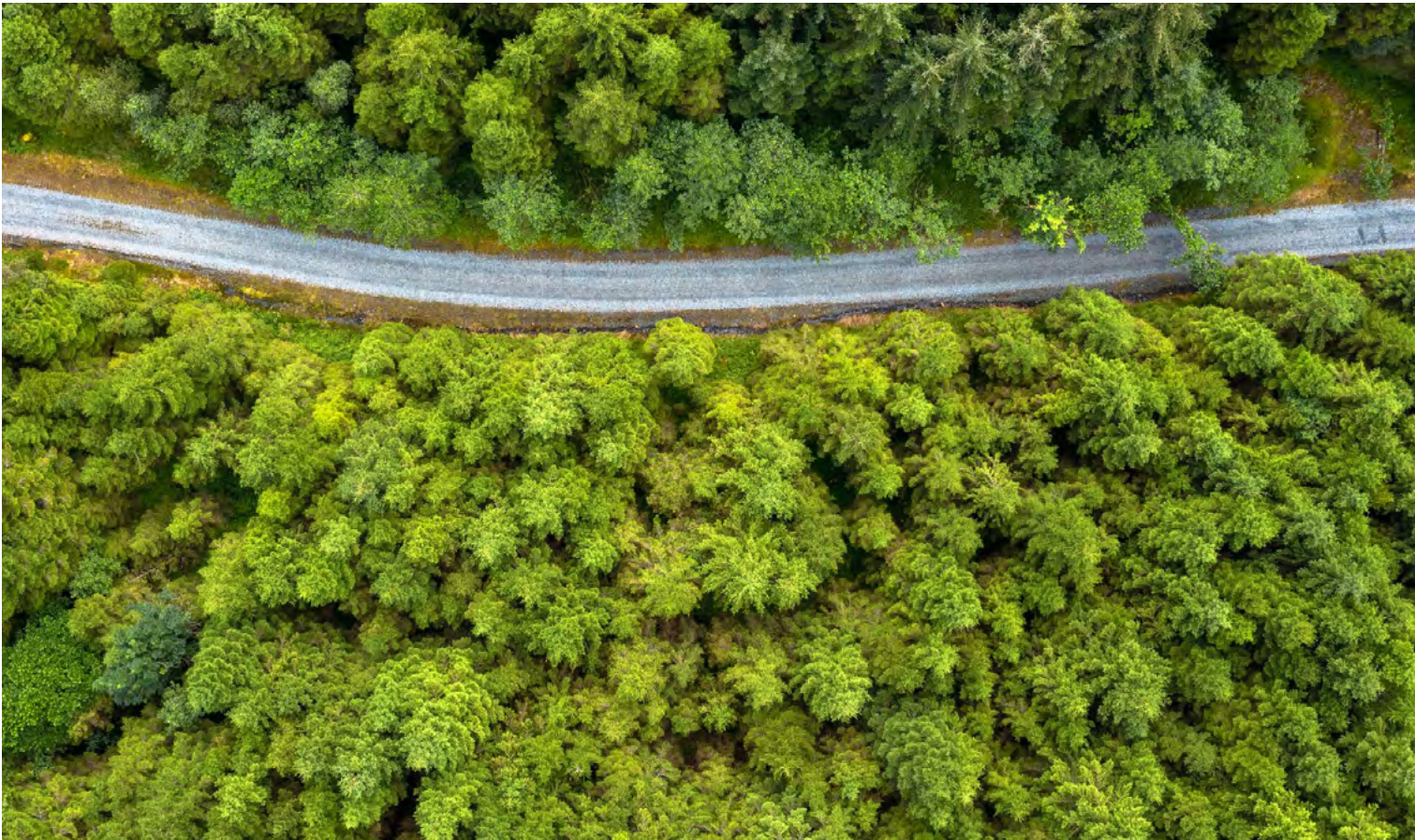


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Forewords

Increasing energy efficiency in the industrial sector

Dear Ladies and Gentlemen,

The issue of climate change has undeniably shaped the political and economic landscape of these past years. A global trend has risen to take even more actions to mitigate global warming as we are now, according to the UN Emissions Gap Report released in October 2021, heading towards a global temperature rise of 2.7 °C by the end of this century. The inevitable problems linked with climate change have brought the topic of energy efficiency to people's attention.

Many companies, not only market leaders, not limited to corporates from the Western hemisphere, and from various industries, have been taking steps to move towards a more sustainable future and have tried to implement energy-efficient solutions and practices using state-of-the-art technologies. Not solely to meet regulatory requirements and secure competitiveness, but

also to make their contribution to reduce carbon dioxide emissions.

Willing to move towards a future with increased energy efficiency, however, many industrial companies today lack answers to many pressing questions.

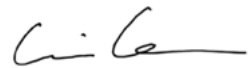
How to start with the topic? How will their industry be affected? What obstacles need to be overcome? Which technologies are relevant and how do promising use-cases look like? How can new business models drive the transformation?

Combining our forces, we at ABB and the Institute of Technology Management at the University of St.Gallen have been working together to find answers to these questions. We are glad to present you our findings in this report.

We wish you a pleasant reading.



Thomas Friedli
Prof. Dr.
University of St.Gallen



Mari Emilia Haapala
Digital Lead
ABB Motion

Motivation

Exploring the status quo and contributing to ongoing discussions

The growing issue of climate change has started to severely impact various industrial sectors. From the decision-makers to employees, everyone understood that something needs to be done to cope with climate change. At the same time, energy efficiency has become a business-critical topic. First, because energy costs are rising, and the stability of the energy supply has become more questionable. Second, the requests from investors, employees, and customers to act more sustainably are becoming louder and louder.

While the necessity to act is recognized, many are concerned with finding the right balance between

customer needs, regulatory needs and social pressure, while reducing carbon emissions but preserving competitiveness, and preserving the business while seeking new opportunity fields. Certainly, it remains a great challenge to shift towards more sustainable practices, as many industries have just started to deal with the question of what to do and how to do it.

Aiming to support decision-makers and shaping, aligning, and accelerating energy efficiency-related activities in industries, this study targets four objectives:



—
Reveal the driving factors
of energy efficiency-
related activities



—
Identify the roadblocks
on the path towards
increased energy efficiency



—
Uncover **use-cases**
to target energy efficiency



—
Explore how **new business models**
can help to boost
energy efficiency

Did you know?

Industrial manufacturing accounts for more than **37%** of total energy demand and greenhouse gas emission⁽¹⁾.

(1) IEA (2020), Tracking Industry 2020, IEA, Paris
<https://www.iea.org/reports/tracking-industry-2020>

Methodology

A human-centered research approach combining qualitative and quantitative data collected globally from 180+ participants

To address the objectives targeted in this study, interview and survey data was collected over a period of 10 months from May 2021 – March 2022.

1

Interviews

Interviews of 60 minutes were conducted with stakeholders from various continents and industries. Most interviewee roles are related to energy efficiency topic directly, bringing in thousands of years of experience while accepting some positive bias for the importance of this subject matter.

40 interviews

2

A quantitative survey

A quantitative survey was distributed among the interviewees and further stakeholders.

182 online surveys

40% primary decision-makers

3

Expert interviews

To further enrich our findings and reflect on our implications, four experts from academia were interviewed.

19 countries

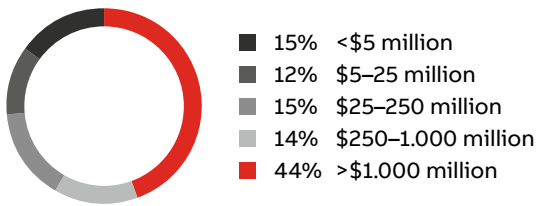
15 industries

1,100 trees planted

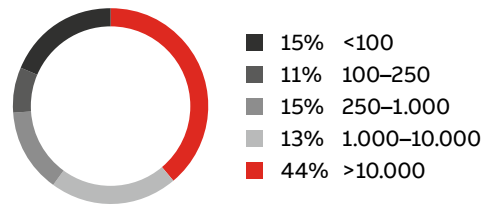
Company sector

11%	Automatives	11%	Cement	15%	Minerals & Mining	20%	Chemicals	19%	Food & Beverage
17%	HVAC	11%	Rubber & Plastic	14%	Transportation	14%	Water & Wastewater	20%	Electronics & Semionductors
23%	Power & Renewables	11%	Pulp & Paper	11%	Oil & Gas	11%	Metals	19%	Marine

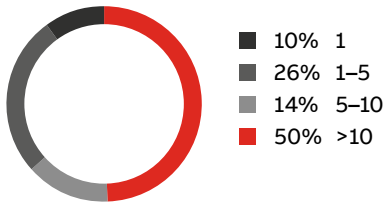
Revenue in 2020



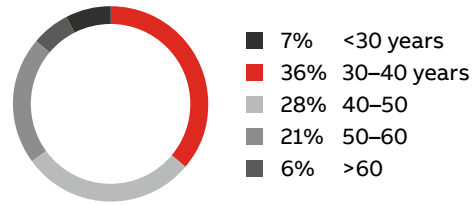
Number of employees



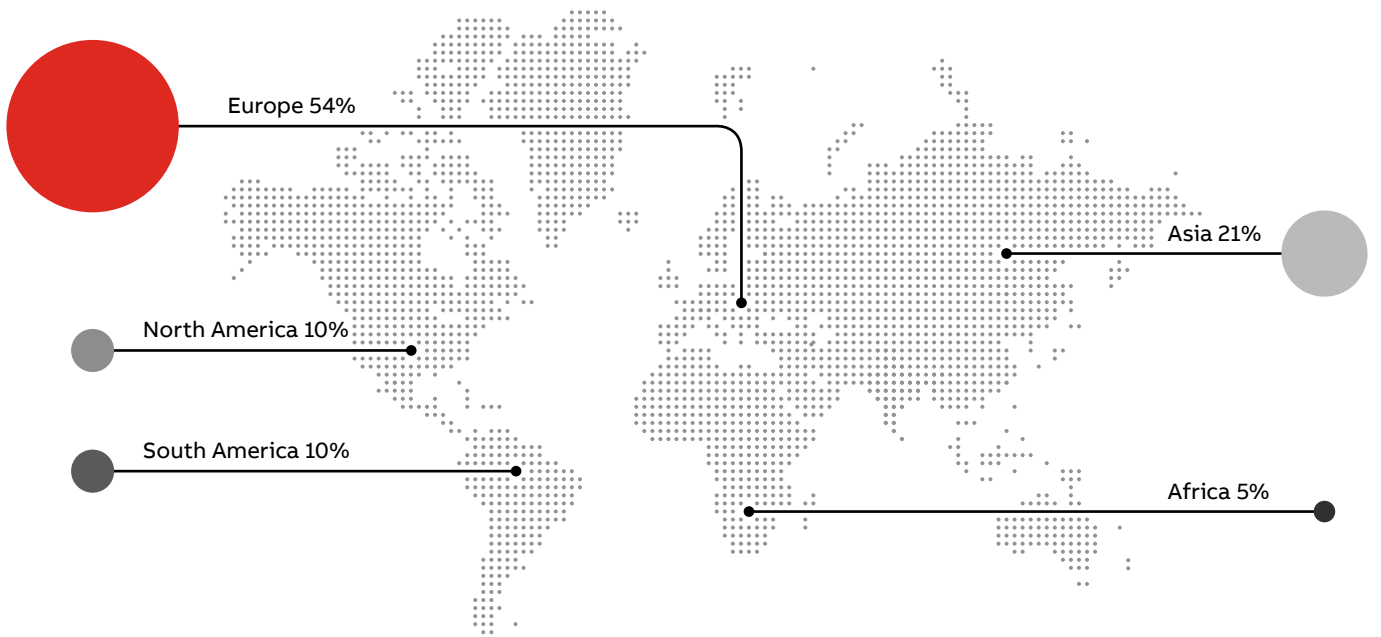
Number of sites



Age of respondents



Regional distribution of the respondents



Increasing energy efficiency in various industrial sectors

“Our business president has made the carbon-neutral plan and the energy reduction plan a key priority for the next 10 years. Since it is a part of our business core values, it is important for my role to be a driver for sustainability initiatives, but also just for everyone, just because it is part of the company's values.”

– HSE Manager, Electronics and Semiconductors, North America

“All CAPEX invests are checked for sustainability and OPEX impact with energy efficiency being a key decision criterion.”

– Head of Operations EMEA, Cement, Western Europe

“The mindset is a driver right now, which earlier possibly was one of the impediments to drive, because earlier people were thinking only of the main product, possibly they were not bothered about the energy. It is important that you look at energy very critically, more than just know about when you want to build a successful business. So that sensitizes them happen.”

– Chief Sustainability Officer, Metals, South Asia

“We have global goals for environmental issues, but specifically speaking of climate, we aim for 2030 to reduce both our emissions and our energy consumption by 30%. So, these are very challenging goals. It is the vision of the group for 2040, the goal is for all our plants to be carbon neutral. So, we have these goals that are climate-focused goals in overall energy consumption.”

– Energy Management Specialist, Electronics and Semiconductors, Latin America

“Both sustainability and energy efficiency are one of the five strategic pillars of our corporate strategy for next 5 years. We will allocate a lot of resources on the topic I think.”

– Chief Executive Officer, Metals, Western Europe

Nowadays, the topic of energy efficiency cannot be avoided. Dealing with it proactively has become a necessity with the rising energy prices, societal pressure, rising customer expectations, and tightening regulatory requirements and industry-specific guidelines and standards. This study's results show that more than 9 out of 10 participants agree that energy efficiency is an important topic for their companies which has increased in its importance within the last two years.

9/10 agree that energy efficiency is a key business topic today that has increased in its relevance within the last two years

As customer industries continuously drive for more sustainable solutions, almost four of five respondents stated that their companies are willing to pay slightly more and source-specific energy-efficient solutions.

78% could imagine that their companies would pay slightly more for sustainable and energy-efficient products and services.

Given the importance of the topic, many industrial companies represented in this study, therefore, take a multitude of actions. Three third of the participants report that their companies are fostering a culture that promotes energy efficiency, i.e., through workshops and training or by setting incentives to promote engagement and success with the topic. Similarly, three third of the participants state that their companies are investing financially in energy efficiency, either through direct investments into technology upgrades and specific use cases or indirect investment, by creating new positions and assigning employees to work on the topic.

76% agree that their companies are proactively working on cultivating a culture and a mindset that encourages energy efficiency

76% state that their company is investing financially in increasing the energy efficiency of their operations.



What drives transformation?

While the general willingness of industrial companies to engage in the topic can be observed, many questions about the specific drivers to do so remain in the dark. What exactly is behind this willingness to engage? What factors are driving this transformation in detail?

This study has identified six main transformation drivers towards increased energy efficiency in the industrial sector.

6 key factors that drive energy efficiency

- Actual and perceived regulatory pressure
- Cost savings
- Personal drive
- Image, reputation, and societal responsibility
- Customer pull
- New business opportunities



72% mention that their organization's effort goes beyond regulations

Actual and perceived regulatory pressure

Worldwide, regulations are implemented to accelerate the transition towards a climate-neutral, resource-efficient economy. More specifically, the targets are set to cut down greenhouse gas emissions and to reduce energy consumption affecting all industries.

- The European Union has no less than 40 laws, 11 policies, and 31 climate targets.
- The United States have no less than 14 laws, 8 policies, and 35 climate targets.

As specific requirements must be met, regulations now force industries to focus on energy efficiency.^(2,3)

63% agree that current regulatory pressure is a driving force to deal with the energy efficiency topic

Interestingly, many of the study participants have stated that perceived regulations exert a higher pressure on their companies than actual regulations. Participants expect future regulations to apply a higher level of pressure on companies to reach their sustainability goals.

75% state that regulations that are expected to be introduced in the future, drive their organization towards energy efficiency

A major issue arises from the fact that regulation is often not consistent across regions, which complicates efforts and causes additional costs. Interviewees reported that there is a gap between emerging markets and developed markets.

Regulatory pressure on energy efficiency topics differs between countries and regions

Insights shared by interviewees and experts indicate that Western and Central Europe, Scandinavia, and to some extent, the US and Canada are markets which seem progressive in terms of government-induced regulations to promote energy efficiency, while Asian and emerging-countries show very little political attention towards the topic.

“When there is a law, there is a regulation and then you need to meet that regulation.”

– **Chief Sustainability Officer**, Electronics and Semiconductors, Northern Europe

“We really lack governmental incentives in this area. [...] We could have a much better opportunity to invest in sustainable measures. A lot of investments today are made by the companies themselves or by private investors in this area. The government does not care about how this is regulated, how we tax energy consumption.”

– **Maintenance Manager**, Power and Renewables, South America

“In our manufacturing network there are new and old, small and large, high-tech and standard technology plants. It took us some time to prioritise where we should do something regarding energy efficiency. We must balance costs and benefits with regulatory requirements and public awareness of the issue in each of the countries where we operate.”

– **Senior Vice President Operations**, Automotive, Western Europe

“Yes, we must fulfil the governmental regulation. But government itself is not much behind checking it and there are companies that do not comply with the regulations.”

– **Electrical Engineer**, Electronics and Semiconductors, East Asia

(2) European Parliament. (2021, October). Fact Sheets on the European Union. Retrieved from European Parliament: <https://www.europarl.europa.eu/factsheets/en/sheet/72/combating-climate-change>

(3) CAP. (2020, April 30). States Are Laying a Road Map for Climate Leadership. Retrieved from CAP: <https://www.americanprogress.org/article/states-laying-road-map-climate-leadership/>

“There is a kind of barrier to balance compliance because the water industry is a compliance-driven industry [...]. Barriers tend to stop innovation, there is only little progress because you are incredibly risk averse, which means you do not want to try new things because of the risk of breaking the rules.”

– **Chief of Sustainability**, Electronics and Semiconductors, Northern Europe

“The stability of our manufacturing processes and compliance with regulation is a key activity for us. Sometimes this means that we are rather slow in adopting innovative solutions.”

– **Operations Manager**, Chemicals, Western Europe

“It is extremely complicated and burdensome for globally active organizations if different framework conditions must match in different markets. This drives up costs in the already existing cost-sensitive industry. The bottom line is that we need a sense of proportion and the greatest possible harmonization.”

– **Chief Sustainability Officer**, Automotive, North America

“The energy prices are cut to a level below market prices for us here. This is good for our business, but why should we invest now into modernization?”

– **Head of Operations EMEA**, Cement, Western Europe

“Politicians naturally lack deep technical insights into the markets. They should therefore—if at all—promote and regulate in a way that is open to technology.”

– **Chief Executive Officer**, Pulp and Paper, Western Europe

“Regulation differs quite a lot from country to country. In Europe there is a very strong emphasis on driving change by driving costs. And unfortunately, quite a few companies really responded well to that. If you add taxes, costs, and levies, most companies seem to view that as a cost that you cannot affect, but it's just there.”

– **Senior Project Manager**, Metals, Northern Europe

“The driving factor may or may not be a government regulation subsidy, because it is not always easy to obtain, and it comes with a lot of caveats.”

– **Global Environmental Specialist**, Electronics and Semiconductors, North America

“Sustainability is more than a requirement to fulfil, it is a necessity to survive.”

– **Site manager**, Pulp and Paper, Western Europe

“Industry standards and norms play an important role. Our customers are strict as they worry a lot about their public image.”

– **Plant Director**, Automotive, Central Europe

“It is a booster for companies to think in that direction. But we always set our benchmark way ahead of the local laws and regulations.”

– **Manufacturing Engineer**, Power and Renewables, Central Europe

Intensity of government pressure on energy efficiency topics differ between industries

The insights from this study show that energy-intensive industries and industries with closer consumer interaction tend to be strongly involved with energy-efficiency.

Respondents criticized misaligned incentives and inadequacies in enacted regulations due to legislators' lack of market and technology knowledge. For example, due to rising energy prices, some governments offer subsidies on the energy prices. This, however, sends mixed signals to both individuals and industries regarding the seriousness of energy-efficiency regulations.

Misaligned incentives and regulations often cause challenges

The methods to enforce regulations also differ. Certain countries put their emphasis on driving change by driving costs. Meaning that higher levels of carbon emissions lead to higher costs. Regulations penalize those who have high levels of energy consumption and CO₂ emissions. Other countries, instead, introduce regulations that aim at rewarding those who reduce energy consumption or produce energy through renewables.

Interviewees emphasized the need for governmental incentives for the successful implementation of energy efficiency-related activities.

Experts indicated the governments' struggle with defining targeted and effective subsidies without forcing companies into bureaucratic application processes. Exactly such resource-intensive application processes where positive outcomes are not guaranteed led small- and medium-sized companies in this study's sample to perceive subsidies as rather reserved.

But looking at governmental subsidies and regulations alone does not provide a full picture of the topic. Study participants also emphasized the relevance of industry regulations. Often, such regulations are ambitious and go beyond governmental regulations, which is why some segments or companies are further ahead than required by law.

80% state that their companies' efforts for energy efficiency go beyond applying governmental regulations

Cost savings

90% state that their companies drive energy efficiency for cost reduction

Most of the interviewees reported that the pressure of cost on companies is impaired by rising energy prices. In many industrialized countries these rising energy prices are intensified by the promotion of renewable energies and the introduction of energy taxes.

Increasing energy efficiency is, therefore, regarded as a necessity with a direct impact on their companies' bottom-line.



—
Interview with
Prof. Dr. Thomas Friedli

SCAN OR CLICK

“Increasing energy efficiency greatly reduces our costs and makes our business more competitive with the ever-changing landscape of the market.”

– Senior Electrical Engineer, HVACR, Southeast Asia

“The single most reason why we drive energy efficiency: Senior management has realized that energy efficiency is good for business as we can save costs.”

– Chief Sustainability Officer, Metals, India

“We already saved millions of dollar per year and hope to realize even more potential in the near future.”

– Plant Director, Automotive, North America

“The cheapest energy is the one you do not consume, and even the cheapest carbon is the one you do not emit.”

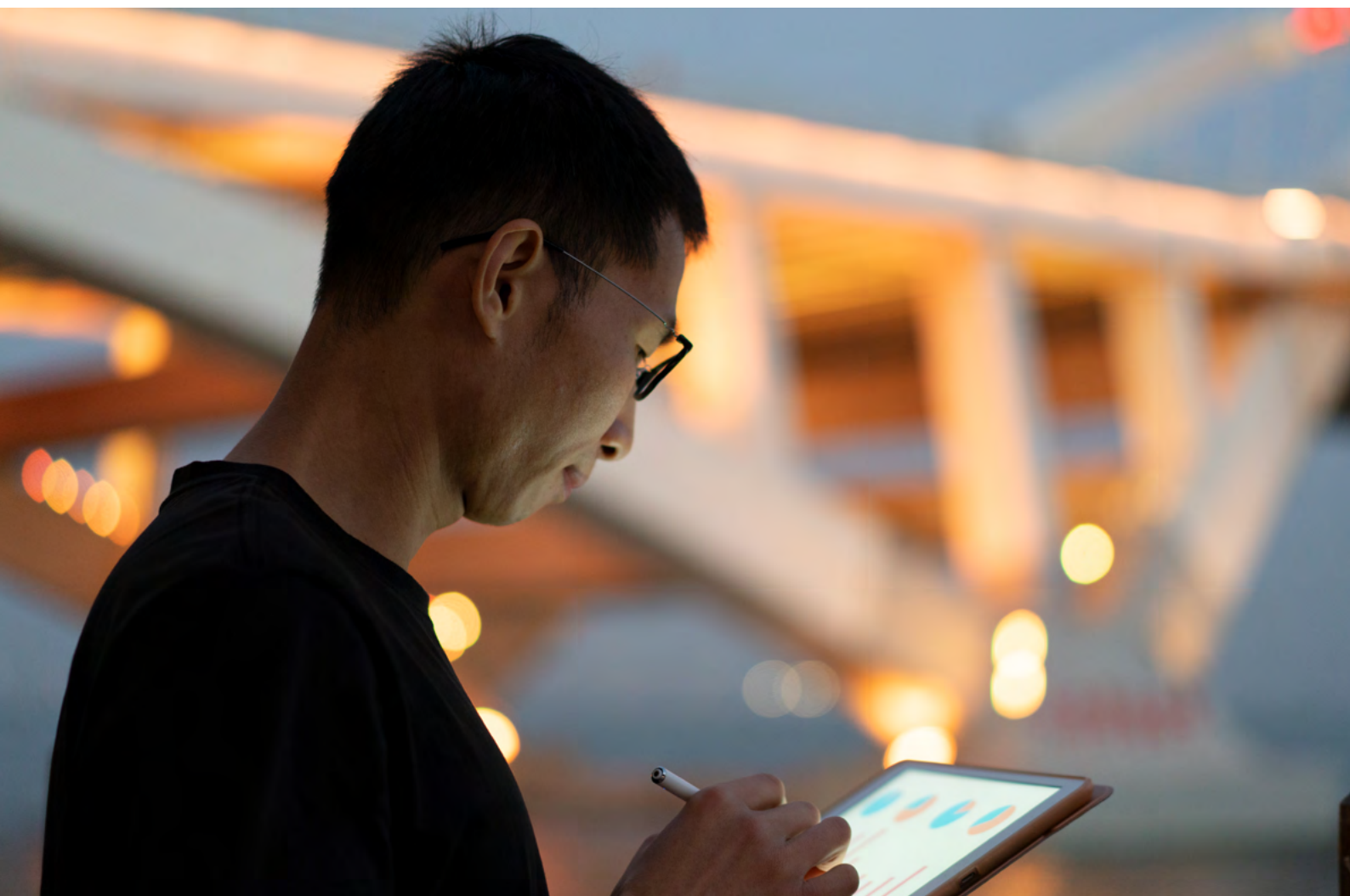
– Energy manager, Minerals & Mining, South America

“Reducing CO₂ emission affects reputationally and in terms of cost. So, if we reduce the amount of energy we use, we can lower the costs and therefore we can deliver cheaper to customers.”

– Energy and Carbon Manager, Water and Wastewater, Northern Europe

“The more efficient you are, the cheaper your product and your business running costs.”

– Energy engineer, Minerals & Mining, Africa



“I tell people all the time, you must pollute, there is no way for us not to pollute, it is part of the world we live in. But we must pollute concisely. We need to know that the resources we are getting out of this are balanced with what we are destroying.”

– **Global Environmental Specialist**, Minerals and Mining, North America

“Sometimes there is no alternative available. Sometimes, a more energy-efficient solution might come with significant performance losses.”

– **Plant Director**, Automotive, Western Europe

“Sustainability is implementing energy efficiency projects not just for the short-haul, but on the whole lifecycle, not just of the technology, but the whole process of the facility and the system.”

– **Senior Electrical Engineer**, Cement, South Africa

“I can see internally in our company that the understanding, for example of climate change of energy conservation and so on, is quite different from country to country. Even though we have a corporate set of values, we have got policies and stuff like that, but they are interpreted slightly different throughout the group.”

– **Senior Project Manager**, Metals, Northern Europe

“There is willingness to drive energy efficiency by our employees, but it is not a strong willingness. It is not their main drive. So, we are still working through it. Sometimes it is regional specific and goes on to the regionality of the culture.”

– **Global Environmental Specialist**, Power and Renewables, North America

“Individuals of all ages have raised their voices to fight for a more sustainable, greener future. Why should not I do that just because I work for a commodity company?”

– **Plant Manager**, Minerals and Mining, Northern America

“In terms of climate change if you have thought that it is all finite, that also has an influence on your personal life, and you also take that to work.”

– **Operations Manager Digitalization**, Minerals and Mining, Western Europe

Personal drive

89% state that sustainability is personally driving them and shaping their decisions in private life and business.

Energy efficiency can make a significant contribution to making industry more environmentally responsible and

91% agree that the importance of energy efficiency related topics has increased within the last two years.

Two third of the interviewees believe they have an impact on energy efficiency and sustainability projects to so they themselves can make a difference. It should be mentioned that the role of the study participants are to a great extent related to energy efficiency which implies a positive bias.

75% state that their company is proactively working on cultivating a culture that is emphasizing a sustainable mindset e.g., internal workshops, trainings, etc.

Participants of this study reported that they are empowered to shape their organizations while only

55% state that they are motivated to identify potential energy savings and engage in energy efficiency initiatives.

Which shows that companies foster the power of their employees, while there is still room for improvement.

The interviews also showed that personal drive is often influenced by socialization, region, and age.

- In developed countries, the topic of sustainability and energy efficiency is often prevailing in the social and cultural environment in the context of climate change.
- In other countries, energy efficiency is foremost seen as a cost driver.

In both cases, our data indicates that younger generations seem to be more sensitized to the urgency of the topic.

Image, reputation, and societal responsibility

While improving energy efficiency is driven by personal conviction, regulation, and cost-saving opportunities, on an organizational level, the public image and societal responsibility are additional important factors that drive energy efficiency.

88% agree that public image drives their companies to be more sustainable and energy-efficient

while

56% agree that societal pressure drives their companies to be more sustainable and energy-efficient.

Furthermore,

84% agree that societal pressure to be more sustainable and energy-efficient will increase in the nearer future.

But to what extent is this driven by the concerns of negative impact if the companies would not act?

Three of five study participants are concerned about the image and reputation of their companies, if they would not act.

In this sense, a fear of negative impact, if their companies do not act, is relatively high among the participating companies.

Still, many of them seem to act even without fearing the backlash on their reputation and image if they would not act. This underlines that multiple factors need to be taken to account to explain the driving forces behind companies' energy efficiency-related activities.

61% worry about the reputation and image of their company if it does not become more sustainable

Unsustainable operations, including inefficient production can lead to negative public image, because it is becoming a social responsibility to act sustainable. It could lead to loss of revenues if customers decide to source alternatively. What seems to also matter, particularly for stock-listed companies, is the fact that stock market value and financing are affected more and more by the degree to which a company is positioned regarding sustainability and thus, energy efficiency.

“But it's also an issue of staying on the market. I think that businesses that do not try to do this transformation will not be on the market 10 years from now.”

– Senior Project Manager, Minerals and Mining, Northern Europe

“Sustainability is becoming more and more important, so as a company and as a big company, you also want to be involved in searching solutions for the sustainability problem. We are also looking how can we contribute to a better environment due to our products.”

– Lead Energy Engineer, Chemicals, Northern Europe

“The capital market is increasingly scrutinizing whether investments are sustainable and therefore fit for the future. Genuine efforts to ensure sustainable and energy-efficient processes are thus becoming a success criterion for financing. But our customers, who work exclusively with equity, are also giving sustainability top priority, pointing to the changed awareness of the younger generation, who are keeping themselves precisely informed on social media.”

– Chief Executive Officer, Pulp and Paper, Western Europe

“It is imperative to be able to show some initiatives in the sustainability field at investor meetings. Energy efficiency topics are good because they also signal, we work on our costs, too. Nowadays, this is market value relevant.”

– Chief Financial Officer, Electronics and Semiconductors, Western Europe

“You see for example the young people today the first question that they have in their minds is which company is sustainable, how much the company respects the environment. [...] I think that it is the future [...] There is definitely a pull from the clients and from our direct clients in this area of sustainability.”

– **Maintenance and Energy Manager**, Food and Beverage, Brazil

“Our consumers are becoming even more aware of these issues. For the market we have pushed for 100% reusable, recyclable bottles. It is a reality that consumers are looking for that. [...] The “one way” is no longer well perceived by many of our consumers.”

– **Improvement and Productivity Manager**, Food and Beverage, North America

“They are beginning to ask the questions: Do you have energy management systems? What is your climate footprint?”

– **Senior Project Manager**, Metals, Northern Europe

“Basically, if we had a more climate-friendly product and we asked our customers, what would they say? The answer would be: “Well, that’s excellent, how much cheaper is it?” Because the basic idea is that if we have a new product, then surely it must be cheaper.”

– **Senior Project Manager**, Metals, Scandinavia

“As far as I know, they’re not there yet in the automotive industry. But if you compare it to the construction industry, when they want to buy equipment or building blocks, they look at different companies and evaluate who has the most sustainable building block for that big project. It’s a hot topic there. But in the industry, we are mainly in, it is not there yet. But I’m sure it will come. Customers will ask us and our competitors who has the most sustainable product.”

– **Lead Energy Engineer**, Automotive, Northern Europe

Customer pull

Four out of five respondents state that sustainability and energy efficiency is important for their customers.

This represents a big shift compared to several years ago. Customers are increasingly demanding sustainable products and services throughout the whole supply chain, which includes improving the energy efficiency of the manufacturing process. That makes it even more than a public-image topic and a societal responsibility – it consequently affects the revenues. Being unable to meet these demands is, therefore, no longer an option.

While the general necessity to meet such customer demands cannot be denied, large differences in responding to these demands exist across industries and regions. Our data indicate that developed countries and industries with high environmental impact and rather closer consumer interaction are more challenged, due to the strength of the pull of customers to “save the planet”. In all regions, cost savings due to energy efficiency is seen as an interesting value proposition by companies.

Customers pull for energy-efficient solutions is generally high across regions but with differences between industries and customer profiles.

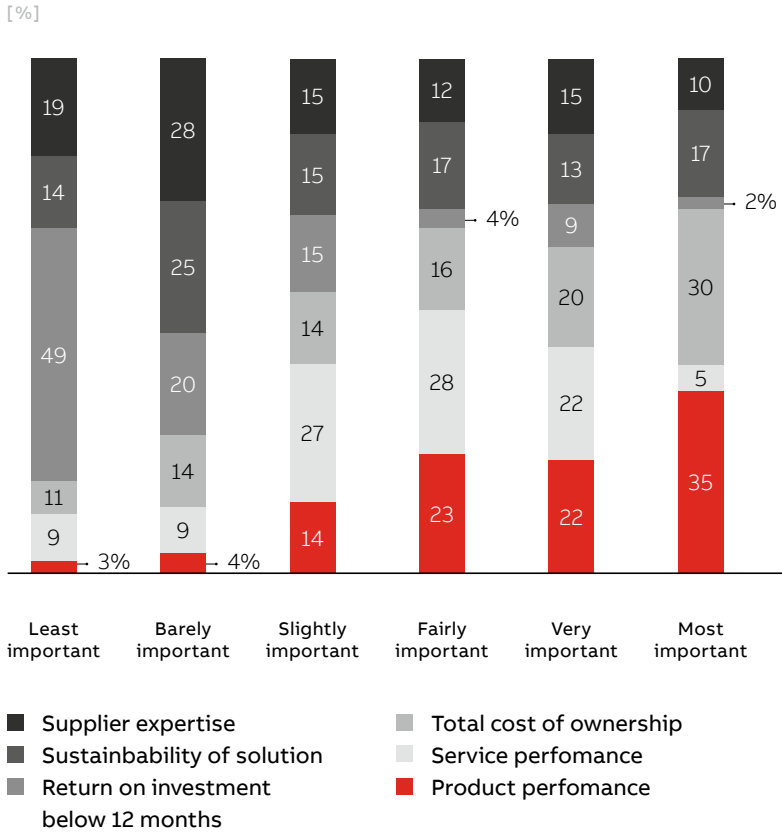
Customers are not only interested in energy-efficient solutions. **Almost four of five** respondents stated that their companies are willing to pay slightly more for sustainable and energy-efficient products and services.



82% state that
sustainability and energy
efficiency is important
for their customers

But what importance is attached to the sustainability of a solution compared to other purchasing criteria? The study's results show that sustainability is a decisive factor in the decision process and regarded as third most important purchasing criterion. However, as shown below, product performance is still the most important and total cost of ownership second most important decision factor.

Importance of different purchasing criterios in comparison



New business opportunities

Companies characteristically face pressure in their markets and look for opportunities to maintain and increase market share and margins. While cost savings are affecting the bottom line of companies, some companies use energy efficiency as a game-changer and accelerator to transform their business and improve the top line to:

- improve brand positioning,
- increase prices,
- develop new business fields
- enable new business models based on new products, services, or digital solutions.

Hence energy-efficiency plays a major role on the path towards environmentally sustainable operations.

More than **two-thirds** of those surveyed therefore even go so far as to state that sustainability will become the most important business driver in the future.

“It is true that we look on the efficiency and environmental impact of the things we buy much more than five years ago.”

– Senior Project Manager, Metals, Northern Europe

“I think decision-making will increasingly lead to procurers asking their supply chain: what are you doing to be carbon-free? Share your policy with us. What are you doing? Do your products still contain heavy metals and plastic that can't be recycled, and so forth.”

– Energy and Carbon Manager, Water and Wastewater, Northern Europe

“We need this transparency for ourselves to know what we are doing to fully understand our production process. So, if you have this data, you can also use it to show it to your customers or your suppliers. Look what we are doing and how efficient we are doing that.”

– Energy Engineer, Rubber and Plastics, Western Europe

“We have increased our investments into digital topics because with sustainability as a major driver of our industry, we want to offer our customers more digital solutions.”

– Business Development Manager, Pulp and Paper, North America

“The desire to be first to market is now very strong, so we are setting the standards for more climate-friendly products.”

– Senior Project Manager, Metals, Northern Europe

“If we are able to make the product more efficient from our development point of view, that will reduce customers' power consumption, this would be one of the main arguments why we would sell the engine.”

– Manufacturing Engineer, Power and Renewables, Western Europe

“40% of costs in the cement industry are due to energy consumption. [...] When we consume more energy, products become more expensive. Therefore, being energy-efficient means saving costs and generating more cash flow for the company and shareholders.”

– Project Manager, Cement, South Asia

What are the prevailing challenges?

The previous chapter has highlighted factors that drive industries towards energy efficiency. It was shown that most companies have recognized the relevance of it, right up to the management board and set ambitious goals to act. However, the reality is that the achieved results sometimes remain behind expectations as various obstacles in initiating and implementing energy efficiency targeting projects prevail.

This study has identified four closely inter-related challenges that industrial companies face in the transformation towards increased energy efficiency.

4 key challenges that impede the energy efficiency transformation

- Unclear about what to do
- Missing capabilities and resources
- Misaligned incentives and lacking prioritization
- Resistance to change



Uncertainty about what to do

A major obstacle that slows down and limits the effectiveness of energy efficiency initiatives in the industrial sector is to identify and prioritize clear use cases to foster energy efficiency. This applies to organizations at the beginning of the transformation but also those dealing with more advanced, technologically sophisticated, and resource-intensive use cases.

It is challenging to understand where to start and how to increase energy efficiency

Two main reasons that can explain this observation:

- First, it was observed that expertise about what is technologically possible was a limiting factor. Thus, many industrial companies end up taking decisions on energy efficiency measures by instinct
- Second, companies struggle to assess the opportunities and risks of different use-cases and therefore, often fail to take this into account in their decisions. Some interviewees reported that the “more visible” prestige projects with limited risks are often preferred over the “less visible”, riskier but potentially also more effective measures. But sometimes this is also caused by a misalignment between internal stakeholders.

Also, this is caused by lack of available data, particularly from technological processes. Indeed, **two-thirds** of study participants highlight a lack of transparency regarding energy efficiency potentials within their organizations which impedes progress with the topic as high-potential topics are not always identified.

It was observed that the data aggregation and interpretation, which creates transparency about opportunities, is insufficient and challenging due to:

- Mix of old, and new, state of the art hardware
- Maturity of IT systems
- Devices not connected to intelligent control systems
- Data quality
- Number of sensors installed to collect data
- Competencies to store, handle and interpret data

A high digital maturity of industrial companies enables smoother progress with advanced data-based energy efficiency use cases

“I think a lot of the obstacles on the part of the applicants was the fact that they had no experience with it. They want to show a net zero value for a property, but they do not know how to do that and what that means.”

– Senior Energy Manager, Metals, Western Europe

“Sometimes, there is a lot of confusion about what to do in our organization. [...] Maybe sometimes we do the wrong things to become faster.”

– Site Manager, Minerals and Mining, Eastern Europe

“It does not mean that management necessarily knows exactly what to do and that is the challenge. But they do commit.”

– Head of Sustainability, Cement, Western Europe

“We have done a lot in the past, but it is hard at some point. It costs a lot, and the benefits are getting lower at some stage, or it just produces so much additional effort.”

– Senior Project Manager, Marine, Scandinavia

“We often have set up a project on energy efficiency here and there, but I think we should rather pay attention to energy efficiency in everything we do.”

– Chief Executive Officer, Electronics and Semiconductors, Northern America

“We do not share everything public that we do. Especially not the details. We optimize something every month.”

– Energy Engineer, Minerals and Mining, Africa

“Nobody asked me what we should do. Management just decided. Could we spend the money better? I think so, yes.”

– Operations Manager, Automotive, Western Europe

“We do not even know our CO₂ emissions and energy costs for all processes.”

– Site Head, Chemicals, Northern America

“There is a lot of automated processes and equipment installed in our facilities. There are many data silos. Energy efficiency-related data is not what we used to work with and collect. We think about operational KPIs and data points. It took us time to understand how everything is connected.”

– Operations Manager Digitalization, Metals, Western Europe

“Yes, they have the willingness to drive towards sustainable practices, but the ecosystem and technologies are not fully mature yet.”

– Chief Technical Officer and Head of R&D, Cement, South Asia

“Look how complex our factory is with the combination of old and new devices and installations. We have of course an idea of what we could do, but any change then causes new problems. Do we have time to investigate that? Not really, so we stay with the status quo.”

– Operations Manager, Chemicals, Western Europe

“We do measure a lot today, but we do not have a good system to analyse.”

– General Site Manager, Minerals and Mining, Sweden

“We are very rich in data, but poor in information. So, I always say to stop putting any more meters on because we are not doing anything with those meters. It is a wasted investment until we have something like a data platform that we can do some proper machine learning and some data analysis with because, without dots, there is no point. We also do not have enough people to look at the screens. And so, nobody looks at this meter. We spend hundreds of thousands of pounds on meters that are not being used, and they all will be ripped out because we replace those things. And then I am asked whether I want to spend another hundred thousand pounds on them. I would say no since it is not doing anything.”

– **Head of Energy**, Water and Wastewater, Northern Europe

“We could do a hundred projects more that would pay off, but we just lack good people, because nowadays it is hard to find good people!”

– **Chief Technical Officer and Head of R&D**, Cement, South Asia

“Energy efficiency: Sounds good. But honestly, we lack competency and resources to really do it.”

– **Plant Director**, Automotive, Western Europe

“Our internal experts are busy with a lot of topics. It is sometimes hard to get them out of the daily business to work on strategic topics.”

– **Chief Executive Officer**, Metals, Western Europe

“The reality is that you cannot get condition monitoring for free. You must install sensors and electronic evaluators. You must assign someone to support it and keep an eye on it to make sure it is maintained. Software updates have to be carried out and all these things play a role.”

– **Operations Manager Digitalization**, Metals, Western Europe

“We all want to contribute to making our company more sustainable. But I prefer not to do this in addition to my existing responsibilities. This is essentially the problem.”

– **Digital Transformation Manager**, Chemicals, Western Europe

“We do have people working on corporate sustainability. But not sure if they are capable of steering projects within manufacturing.”

– **Chief Technical Officer and Head of R&D**, Electronics and Semiconductors, Southeast Asia

“The biggest problem is resource allocation [...] and the issues that come with balancing these in daily operations.”

– **Global Environmental Specialist**, Power and Renewables, North America

“We are more and more open to outsourcing things. Not only for costs but also because our business is getting more complex and it is hard to find good people anyway, also in maintenance jobs.”

– **Maintenance Manager**, Automotive, Western Europe

“Maintenance is our core competency. We do not want to rely on a supplier, because nobody pays the costs of downtime?”

– **Plant Director**, Metals, Southern America

Missing capabilities and resources

The previous section highlighted the importance of companies' capabilities to identify use-cases that can promote energy efficiency. This section describes the challenges in implementing energy efficiency.

Companies need to build up and further develop organizational and technological capabilities to steer energy efficiency projects, implement technology and processual adoptions. However, as our insights indicate, this represents a major challenge as it requires skilled workforce and financial resources dedicated to energy efficiency.

Missing organizational and technological capabilities and resources hinder companies progress with energy efficiency topics

Three measures could resolve this problem.

- **First**, companies can reallocate existing resources. This strategy allows people familiar with the companies' core processes and technologies to be reassigned and work immediately on the topic. However, many companies are hesitant to do so as they fear that this would impede other important topics and day-to-day operations in the company. Indeed, **almost half** of the respondents agree that their company cannot focus on energy efficiency projects as they must pay full attention to their core business.

46% agree that even if some projects are important, their company cannot focus on energy efficiency projects since they need to focus on running their core business

Insights also show that such a strategy has its limitations as companies are seeing energy efficiency as an additional topic for employees to work on. Doing energy efficiency in addition to the existing task is, often not a successful approach as it requires sufficient time and priority to make use-cases work successfully.

- **Second**, companies can hire additional resources to work on energy-efficiency topics. Many companies create specific sustainability-related roles. Typically, these roles are not well-suited

to implement projects but rather to steer and coordinate. Also, companies reported that it is not effective to solely rely on external support, but to some extent build up internally, technological expertise and capabilities, particularly for digital topics. Finding new employees in technology-related roles is, however, more difficult. And even if additional resources can be hired, many companies used them also for their day-to-day operations hindering progress with energy efficiency topics.

- Third, companies could also hire external support or make use of suppliers' expertise to boost energy efficiency topics. Some companies state that external support is needed as they started to be less concerned about the potential opportunities. But most companies remain reluctant to make use of external support. Only **two of five** respondents stated that their companies consider external support as a win. This is because external support is seen as costly and not trustworthy. Moreover, many companies show only little confidence that such external stakeholders could help them to progress with increasing their energy efficiency or improving operational results. Also, many respondents reported that their companies are unable to leverage partners effectively. Reasons include a lack of resources to manage these partnerships, conflicting goals and values, and insufficient alignment of processes. Also, some companies prefer working with external partners in a traditional buyer-supplier relationship instead of fostering a more intensive, co-creation-like partnership.

42% see a win in getting support from equipment manufacturers for maintaining or operating their equipment

“Our culture is like we can do everything better by ourselves.”

– Global Project Manager, Automotive, North America

“Time is one of the constraints, but one should always remember to allocate some time for partnerships and for that kind of work that drives the agenda together with others.”

– Head of Sustainability, Chemicals, Western Europe

“We do so much with partners but sometimes I feel it does not pay back.”

– Head of Strategy, HVACR, Western Europe

“We have little time to concentrate on managing external suppliers or to go into detail about specific projects with them. We want to get the job done quickly with low costs. We are not used to working together with them on certain things.”

– Energy Maintenance Manager, Minerals and Mining, Eastern Europe

“We sometimes do not bother to see the opportunities. But most of the potential partners want to make money. It is unclear to us if they are capable to make a difference and to achieve something tangible.”

– Site Manager, Pulp and Paper, Western Europe

“I see that operational blindness is also a big influence. When you are new to the industry, you see a lot of gaps. But after you are in the business a few years for two to four years, you lose that scepticism and see less gaps with potential for improvement.”

– Senior Project Engineer, Cement, Africa



“Management success is measured in terms of revenue and profit, not for energy efficiency and sustainability efforts. It is rather a soft KPI. I am convinced that this is an issue.”

– **Business Development Manager**, Cement, Northern Europe

“A sustainable agenda is not driven by any area of operation but by the management board.”

– **Improvement and Productivity Manager**, Automotive, North America

“The importance of energy efficiency is high at top-management level and low at middle- and lower management, and very low on the shop floor.”

– **R&D Manager**, Automotive, Central Europe

“You must remain profitable despite sustainability, but there is the problem that people think the issue is important but still only buy the cheapest product in the store. So, without a very strong incentive, it is hard to argue why it is necessary to invest in sustainability or increase production costs without benefiting the market.”

– **Senior Operations Manager**, Power and Renewables, Northern Europe

“Every investment even if it is a sustainable investment, maybe does not have a business case that you get cash-back immediately, but it will pay back over years. And that is a barrier these days in our business. As your return of investment is maybe two or three years, you are not getting the investment done, because currently, management is looking for a return of investment of 6 months, 3 months.”

– **VP Global Advanced Manufacturing Engineering**, Automotive, Western Europe

“Top management wants to have immediate savings, but it is not the sustainable one in the long run.”

– **Electrical Engineer**, Electronics and Semiconductors, Southeast Asia

“Various obstacles come at my expense, which then naturally depress the return, which in turn is difficult to justify to management and to obtain the necessary funding.”

– **Chief Technical Officer and Head of R&D**, Cement, South Asia

“However, they always tell us that we have a limited budget. We cannot just spend the little money left on energy efficiency topics. It must be a corporate budget, or our budget needs to be increased.”

– **Project Manager**, Metals, Northern Europe

Misaligned incentives and lacking prioritization

Many companies indicated the need for external support to progress with increasing their energy efficiency. Even if companies are willing to make use of external support, such a step would require a budget. However, while many companies invest, some are rather reluctant to make use of financial resources. Energy efficiency might lack prioritization and misaligned incentives. Indeed, even though energy efficiency is seen as a business-relevant topic, many companies do not pay attention to related projects or invest sufficient resources. Since **almost two out of five** study participants highlight this is partly because their company’s key performance metrics do not support the implementation of energy efficiency solutions.

38% support the statement that the key performance indicators of their company do not yet promote the implementation of energy-efficient solutions, while **30%** have a neutral view

Interviewees highlighted the importance to create incentives for all employees to engage in energy efficiency to truly move the topic forward.

Another reason is that seeing the impact of energy efficiency projects: implementation can take a long time and can lead to higher risks with many companies not even starting. Traditional business case templates based on risk-adjusted return on investment typically do not consider the reputation- and environment-related benefits of pursuing such projects. As most respondents highlight, companies act considering the multidimensional target systems and must consider other factors than “just energy efficiency. As a consequence, almost **half of the respondents** state that “quick wins” are often prioritized over long-term benefits **with only a third disagreeing**.

57% state that they cannot solely take investment decisions based on energy efficiency improvements

43% agree that their company prioritizes projects with short-term quick wins over sustainable and energy-efficient projects, while **30%** respond neutrally on this statement

It is, therefore, not surprising that many companies struggle to invest. But besides the decision itself and the need to rethink internal processes, companies need to also define whether budgets should be used or separated from core budgets and how energy-specific budgets should be allocated. Interviewees highlighted the danger of creating two separate worlds with different rules, energy efficiency projects, and other projects. But they also emphasized that such dedicated, often corporate-level budgets, can help to facilitate energy-efficiency projects faster. Still, such an approach bears the risk that projects are not well-aligned with operational needs or that projects outside of the company's core processes are started which then could have a lower impact.

Resistance to change

The previous chapters have highlighted many organization-level barriers to energy efficiency projects and the necessity to question and change sometimes the status quo. But making the change a success also requires individual stakeholders to engage pro-actively, with a positive mindset and willingness to change. Though energy efficiency is an important topic, not all stakeholders identify with it to a similar degree. Often, such concerns are due to stakeholders' fears that any changes of the status quo could be risky or cause too much effort not worth the benefits.

Changing the established way of doing business for increasing energy efficiency causes conflicts and resistance

Consequently, many organizations are communicating the importance of energy efficiency by providing internal trainings. Often, management tries to set an example and raise awareness and **four of five** respondents stated that trainings could help their companies move forward with energy efficiency.

Internal communication, visible management commitment, and trainings can help to create a common vision and willingness to engage and change ultimately supporting energy efficiency initiatives within the company.

82% agree that they could imagine making use of energy efficiency improvement related trainings & consulting services to help their companies realize their full potential.

“You can try to operate them and put them in front of the machine, but they still follow what they have built up in their head. So sometimes, you must force something until they understand it completely. We try to train them specifically with an engineer who can explain in detail why we need to do this and the impact it has on the overall system.”

– Maintenance Manager, Pulp and Paper, Africa

“I think the biggest challenge is how we can educate the entire organization to use these resources wisely.”

– Senior Maintenance Manager, Food and Beverage, South America

“Never change a running system.”

– Head of Operations, Automotive, Central Europe

“Any modification in our production can cause a lot of effort. We are operating in a heavily regulated industry. It is not that you can just change something easily.”

– Product Manager, Food and Beverage, Western Europe

“The biggest difficulty we have in general is the question of commitment and understanding that employees have for this issue. The challenge is also how we can convince production team that these kind of projects are interesting and do not cause problems.”

– Energy specialist, Minerals and Mining, South America

“We need to improve by making sure everyone understands the need for data and the impact of data. How can you measure efficiency that goes beyond the traditional measurement?”

– Head of Sustainability, Chemicals, Western Europe

“One of the things my supervisor pushed was Gemba Walks, meaning the action of seeing the actual process, understand the work, ask questions, and learn [...]. Not only do you use this opportunity to look for production problems when you talk to employees, as they see this every day, but you also achieve energy savings and sustainability [...].”

– Global Environmental Specialist, Power and Renewables, North America

Which use cases are implemented?



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For more use cases, see
the Energy Efficiency
Movement website

The previous sections show that there are good reasons to foster energy efficiency. Still, companies struggle to define, prioritize, and implement tangible initiatives. Technology and organizational adoptions can help to realize positive outcomes. But how?

This study has identified four categories of use cases, in various industry sectors, that can improve energy efficiency.

4 categories of use cases that can improve energy efficiency

- Replacement, retrofit, and upgrade of equipment
- Process optimization
- Digital solutions
- In-house energy production



Replacement, retrofit, and upgrade of equipment

A viable option to increase energy efficiency is to upgrade, retrofit or replace hardware. Upgrading means adding enhancements to existing hardware that significantly change the efficiency or functionality of the equipment or system. Today, many companies work with hardware that is in some cases very old and not state of the art.

> **60%** of the industrial motors used in the United States are older than **10** years.⁽⁴⁾

Companies can also retrofit hardware or certain components, by adding equipment not originally planned for or not yet available at the time of manufacturing which can result in enhanced functionality and potentially increased energy efficiency. Indeed, interviewees in this study confirmed that large parts of their outdated hardware are limited in terms of energy efficiency enhancements.

76% see replacing old equipment with a more efficient one to save energy as a viable option

The decision on whether to upgrade, retrofit or replace hardware depends often on three aspects:

- Trade-off between financial and organizational effort
- Cost of replacing or upgrading equipment
- Associated future cost and energy savings

40% of the companies interviewed only upgrade when old equipment fails

In this context, many interviewees highlighted the technological difficulties of stopping production processes and modifying processes. Upgrades, retrofits, or replacements installed rather far from core processes are, therefore, often prioritized.

"We have a lot of old equipment here that needs to be upgraded. They become highly inefficient and we see the huge potential there in terms of costs"

– Senior project engineer, Minerals and mining, Africa

"We have very old plants and new plants that are partly a recombination of old plants. It is difficult to pick the right technology to upgrade since one size may not fit all. In my role, I can contribute to the customization for every plant in terms of re-engineering during the evaluation phase before technical changes are implemented."

– Chief Technical Officer and Head of R&D, Cement, South Asia

"Hardware replacement is the single most important thing we need to do. We need to continue replacing equipment that was built in the 1960s and 70s and install equipment designed by standards from the 2020s. The introduction of systematic energy management system is also quite important in terms of creating a structure for continuous improvement and making the right choices when we make changes and for having procedure for the design of new equipment."

– Senior Project Manager, Marine, Scandinavia

"We usually do not touch the old equipment: better not to risk something"

– Senior Manager Manufacturing, Automotive, Western Europe

"Ship-owners prefer eco-ships over ships with lower energy efficiency. The price increases on the energy market and it sooner or later leads to rising demand for retrofit solutions and upgrades."

– Project Engineer, Marine, Western Europe

"As soon as a sufficient budget is available, significant efficiency gains can be achieved within a manageable timeframe. This requires a clear management objective and money."

– Plant Director, Automotive, Northern America

(4) Lawrence Berkeley National Laboratory (2021). U.S. industrial and commercial motor system market assessment report, Volume 1: characteristics of the installed base, Page 67. <https://escholarship.org/uc/item/42f631k3>

INDUSTRY EXAMPLES



German industry has total electricity consumption of 4,071 Petajoule (2016)⁽⁵⁾. The share for lighting is 4.5% of total consumption, which is an immense amount in absolute terms, but not the main driver of high energy consumption. As a result, only some companies surveyed in this study have made improvements to their lighting. Lamps, luminaires, and ballasts. Light control (regulating and controlling lighting systems) was introduced to improve utilization through retrofitted light systems using newly installed sensors and enhanced data analysis⁽⁶⁾.

(5) Destatis (2017). Press release nb. 398: https://www.destatis.de/DE/Presse/Pressemitteilungen/2017/11/PD17_398_435.html

(6) Kühl, A. (2017). Bedeutung der Beleuchtung beim Stromverbrauch in Unternehmen: <https://www.energynet.de/2017/05/09/beleuchtung-unternehmen/#:~:text=F%C3%BCr%20das%20Jahr%202015%20ermittelte,%2Fa%2C%20also%2010.000%20Gigawattstunden>



Process Optimization

Realizing energy efficiency potentials is not limited to hardware only. Instead, organizational, and technological adoptions can also be made on the process level to achieve a positive impact on energy efficiency.

INDUSTRY EXAMPLES



A large energy company in Northern Europe developed a method to reuse surplus heat from cooling systems. Usually, cooling systems and heat pumps are separated from each other. As a result, the cooling systems often release their excess heat into the air, which leads to a waste of low-quality heat. In addition, the customer does not want two different systems, but one complete solution. This led to the development of a combined heating and cooling system. Such a system is a sustainable and quick way to expand the district cooling system without a large investment in infrastructure. These solutions have already been used in fire stations, a supermarket, office buildings, a university, a hospital, and other buildings.



A Central European-based company in the metal industry has developed rollers for metalworking on a lathe machine (drilling, reaming, etc.) which can be operated at higher speeds.

In this way, machining can be performed more quickly, and the machine does not have to run as long and therefore uses less electricity. This results in significant energy savings. This use case shows that minor changes in processes can lead to energy savings and increased productivity at the same time.



Digital Solutions

Digital technology-based solutions can help to detect and realize energy efficiency potentials. Big data and artificial intelligence enable new potentials in automation and self-optimization. Recognizing these potentials, the great majority of study participants could imagine making use of digital solutions.

85% could imagine making use of solutions that allow to monitor, track, and optimize energy efficiency.



"We are working on correct monitoring solutions. With this monitored data we can take the right decisions and avoid any decisions based on gut feeling but choosing based on data."

—Energy Maintenance Manager, Marine, Western Europe

"We need this transparency for ourselves, to know what we are doing and to fully understand our production process. So, if we have this data, we can use it to show our customers or suppliers what we are doing and how efficiently we are doing that. [...] Our customers are requesting more and more data from us so that we must show, for example, the CO₂ that we emitted to produce one square meter of protective film."

—Energy Engineer, Chemicals, Western Europe



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Interview with
Prof. Dr. Felix Wortmann

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“How do we measure that our product is more energy-efficient than another one? How do we measure our handprints? That is difficult, however digital solutions can help here.”

– Head of the Sustainability Department, HVACR, Western Europe

“How do we measure that our product is more energy-efficient than another one? How do we measure our handprints? That is difficult, however digital solutions can help here.”

– Head of the Sustainability Department, HVACR, Western Europe

“Internally, the finance manager, data manager, they all should work together and analyse what our systems tell us and measure; Where do we have the higher costs? Where do we use the most energy? We should have the bigger picture, to decide on the right investment”

– Energy Maintenance Manager, Western Europe

INDUSTRY EXAMPLES



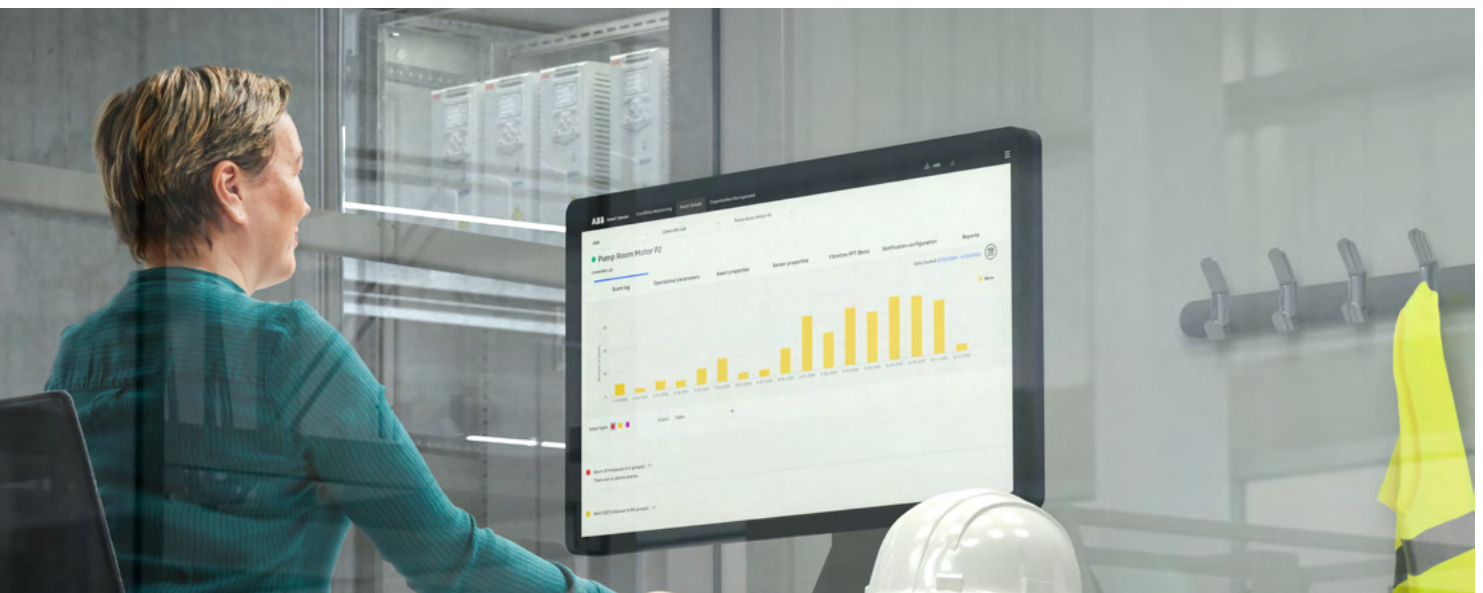
A South American water supply company introduced sensors and a remote controlling system to provide drinking water to more than 5.7 million people. This includes an intelligent multi-pump control system that can control multiple pumps simultaneously and align flow and pressure requirements with daily demand. The hardware replacement in combination with the digital solution led to a reduction in energy consumption of 25%.



An Eastern European-based cement company works with a condition monitoring system to improve the performance of its operations. This solution provides the company with the ability to easily view, analyse and act upon critical process data. Key benefits include increased plant availability and production. It monitors and improves emissions at many locations, significantly reduces the cost of electrical energy used in cement grinding and increases cement mill utilization. In addition, the tool helps to coach and support the process personnel and operators remotely.



A South American mining company has recently introduced a predictive maintenance solution to maintain, assess and analyse its mill drive system. The solution, based on condition monitoring, provides easy access to mill drive system parameters and visualization looking into the past, considering real-time data in the present, and assessing the future. In addition to being amongst the most expensive assets on site, mill drive systems are huge. The biggest of these mega machines has a diameter of 12 meters and is wrapped around the mill, delivering 28 MW of power. It aims to extend the lifetime of grinding assets through better use of resources and supports non-stop operation and avoids unforeseen downtime. At the same time, it allows improvement of the operating profile, and thus, energy savings can be realized. Moreover, predicting the time left for key condition parameters to reach critical values that could eventually lead to production stoppage and notifying customers of this in advance is crucial. Uptime of mill drive systems has a significant and direct impact on the ability of a plant to be reliable, productive, and perform at the maximized commercial potential.



In-House Energy Production

Beyond efforts to reduce energy on the consumption side, some companies also become producers of energy in the form of heat or electricity, with a few companies even improving their top line by selling surplus energy. This strategy is sometimes also helping to become more independent, particularly in countries with rather unstable or unreliable energy supplies. However, only roughly half of the participants work in organizations that see this as a viable option.

53% think that it is an opportunity for their company to benefit from reduced energy sourcing costs by becoming producers of energy and additional revenue from selling their energy surplus.

Indeed, almost 4 out of 10 industrial companies represented in this study are already doing that while others reported that they do not consider this as their core competence, that it is not financially viable or that they have not thought about it yet.

39% of the interviewed companies produce energy themselves

Two main reasons for producing energy in-house were identified. First, procurement costs are very high, especially for peak purchases. Second, regulatory incentives including support on purchasing equipment for production or taxes make self-production attractive.

The companies surveyed have implemented or are considering various technologies for in-house energy production.

“We are consuming quite a lot of power. It is cost-saving for us to produce parts of our consumption by ourselves.”

– Plant Director, Automotive, Western Europe

“The business case is excellent, and funding is well available. Solar energy was one of the first things we did! Already some years ago.”

– Site Head, Cement, Northern America

“For new buildings, like greenfield plants, we have done many things nowadays anyway due to regulation. At least in Western Europe.”

– Global Production Network Manager, Metals, Western Europe



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Interview with
Prof. Dr. Merla Kubli

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6 technologies that are used for producing energy by industrial companies

- Solar thermal systems
- Solar photovoltaic systems
- Heat pumps
- Geothermal plants
- Biomass plants
- Wind turbines

INDUSTRY EXAMPLES



A German logistics company has installed a photovoltaic system on the roof of its warehouse building, which has been in operation since 2019. The system has a capacity of 6.4 MWp and helps to avoid 3,193 tonnes of CO₂ emissions annually. The energy consumption time goes hand in hand with the energy production time, both of which are usually during the day. This enables a high level of self-consumption. To be able to supply the logistics building itself with renewable energy, two independent systems were built. A 750 kWp system supplies the company's own building and processes, while a second system feeds the energy into the local power grid. The company decided to install its photovoltaic system on the roof to make use of this free space. Free-standing systems are often given preference when it comes to subsidies, since ground-mounted systems have considerable disadvantages due to their design, as they have additional requirements – for example in terms of fire and lightning protection or statics.



A car manufacturer in Western Europe has been operating three of its 190-meter-high wind turbines since 2013 to generate wind power for production. In 2019, a total of 26.4 GWh of electricity were generated purely from the wind. This corresponds to about one-fifth of the plant's total electricity consumption. That would have been enough to supply more than 5,000 three-person households with electricity for a year. When no electricity is needed in production, the wind turbines supply other areas of the factory and provide the baseload.

How can new business models support energy efficiency?



SCAN OR CLICK

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Interview with
Prof. Dr. Maximilian Palmié

The previous chapters have highlighted that new technology and use cases to optimize energy efficiency exist but that it requires competence for use-case selection and implementation. Given the uncertainty about outcomes, progress in this area also does not always meet expectations. To overcome this hurdle, suppliers and other stakeholders have started to explore new business models. Indeed, a new type of collaboration and value creation between stakeholders can fundamentally help increase energy efficiency. In such new business models, suppliers, customers, and other typically work closely together and share risks and gains to a greater extent while

customers gain additional flexibility and increasingly pay for outcomes.

This study has identified two business model archetypes that can support the transformation towards increased energy efficiency in the industrial sector.

— **Two business model archetypes that can boost energy efficiency**

- Subscription models
- Outcome-based contracts



“Energy efficiency is a chance for us. We have changed our business model to make our offer more attractive to customers and simple on-off selling transformed to a more consultative partnership with the customer.”

– Chief Technical Officer and Head of R&D, Cement, South Asia

“We have realized that without partners it is not going forward.”

– Operations Manager, Marine, Western Europe

“We think much more about our customers now. We call it co-creation. I think sustainability will be one of the main drivers in differentiating between companies and their products. For large companies to achieve this, they will have to work with others to identify inefficiencies and waste that can sometimes be difficult to see when looking from the inside.”

– Engineering Director, Chemicals, Western Europe

“We are already busy with that. We have got multiple examples in different plants and not just on things as simple as, I would say, office supplies, but also physical pieces of equipment like compressors and larger pieces of control equipment.”

– Maintenance Manager, Minerals and Mining, Africa

“Subscriptions are standard for software purchases, but sometimes we still prefer to buy them when its critical or when we do not see the need for ongoing improvement and support.”

– Operations manager, Cement, Western Europe

Subscription models

Originated in the software industry, also the industrial sector is nowadays discussing subscription models for products, services, and digital solutions. In contrast to traditional purchasing one-time payment models, in subscription models, customers pay for the right to use the product, service, or digital solution on a recurring basis. Subscription models, thus, represent the change from capital to operational expenditures, from transactional to deepened provider-customer relationships. Subscription models are particularly used and somehow established for digital solutions and services, i.e., remote assistance, or software, as roughly half of the respondents stated that their companies already make use of them.

54% use subscription-based contracts as an alternative to upfront purchases for industry software

49% use subscription-based contracts as an alternative to upfront purchases for services

In contrast, buying hardware in subscription-based contracts is less established. Only a third of respondents reported that their companies buy hardware in subscription-based contracts. However, with more and more companies offering their hardware products as a service, often in a bundle with supporting repair and maintenance services, almost half of the study participants stated that subscription-based contracts could become a viable option soon. From a contractual point of view, hardware subscription contracts are in most cases operationalized via operating lease agreements. Thus, customers pay a fee, either fixed or outcome-based (see the next chapter) for being able to use the hardware product.

36% already purchased hardware in a subscription model

46% see subscription models as a viable option for hardware

The rising interest in subscription models relates to the prevailing advantages of the model compared to traditional alternatives.

Selected benefits of subscription models:

- avoids capital expenditures upfront
- provides flexibility for trial and opt-out of the model
- ensures customer retention and value over time, via new features and improvements
- allows the subscription customer to give up certain responsibilities to suppliers of such contracts because service is typically an integral part of the subscription model

Subscription models can boost energy efficiency for two main reasons.

- First, subscription models lower the entry barriers for upgrading, retrofitting, or replacing hardware and sourcing services and digital solutions that directly promote energy efficiency and or indirectly, through boosting productivity. Particularly for hardware, benefits of subscription models might motivate companies to replace machines with poor energy efficiency
- Second, subscription models offer customers more flexibility to try out products, services, or digital solutions and leave them more easily if they do not have the positive effect expected. This increases the pressure on suppliers to develop and improve products and services with proven customer benefits. Ultimately, this will further drive energy efficiency through increased competitive pressure.

Subscription models can help to overcome investment hurdles and push energy efficiency promoting use-cases

However, not all customers decide in favor of subscription models for multiple reasons. One reason is related to the preference of customers to stick with one-time, upfront payments. While less than **one of five** respondents state that their companies prefer upfront payment models, **almost a third** of study participants note that their purchasing regulations or processes hinder their companies sourcing subscription models. This is for example because companies work with defined budgets for capital and operational expenditures where investments must be made at a single point in time. It must be noted, however, that stakeholders across organizational functions perceive subscription models differently. Also, companies try to avoid additional efforts for paying on a continuous base and managing their contractual relationships.

“Many companies want to keep their machines in operation as long as possible to get maximum profit from them and then replace them with the latest technology at the end of their life cycle. Subscription models offer a different way of financing more efficient hardware compared to one-time upfront payments. Due to that, higher efficiency can be achieved if companies face cash shortages. This enables upgrades, refurbishment, or replacements before the end-of-life cycle of the hardware.”

– Business Development Manager Financial Services, Pulp and Paper, Western Europe

“I do not like to replace systems in the company that still work, even if I get something else that uses 3 to 4 percent less energy and could save me money in the long run. But if the system might work for another 5 years, I would rather use those 5 years before I dispose it, because I cannot sell it and if I do, I will only get the scrap value.”

– Head of Production and Maintenance, HVACR, Western Europe

“How long are we in business? What comes in 5 years? We often try to avoid any large Capex investments. Alternative models with the flexibility to get rid of them are interesting for us.”

– Operations Manager, Automotive, Northern America

“We need predictable costs and have targets to reduce invoices. Subscription is interesting but it also causes a lot of effort. We rather buy things we really need and avoid things for which we do not see the concrete need. I guess it is also a cultural thing.”

– Plant Director, Automotive, Western Europe

“We need to influence the manager or someone who makes the decision. Sometimes we can touch the maintenance manager, but they cannot make the decision, so it becomes complicated to find the decision-maker. Often, we need solution promoters, but there is no one always.”

– Digital Product Manager, East Asia



“Our large customers in Asia need on-premises solutions (not cloud-based digital solutions) and they buy licenses with additional support agreements. Subscription is a word we do not use there. They either want to pay for everything at once or annually.”

– **Head of Business Development Service**, Pulp and Paper, Western Europe

“They [providers] structure a lot of things in a way that you will always need them [to do an activity with their provided tool]. I am from the old school. [...] If I can do something myself, I will do it. I can train my people. [...] For the last 20 years, we have kept our plant going by doing things ourselves. If I want to customize, I will always have to go back to the provider to do the software for us which is not acceptable for me. That is why I do not like it.”

– **Electrical Engineer**, Minerals and Mining, Africa

“We are open to traditional and subscription contracts. It depends on the financial analysis.”

– **Maintenance and Energy Manager**, Food and Beverage, South America

“No, this is not a popular model in China. [...] They do not want to buy the products that way [subscription]. They just want one-time transactions and their factory’s own data [...] because their data is not allowed to leave their factories, so they do not use the Internet for their factory, for their operation.”

– **Digital Product Manager**, Electronics and Semiconductors, Southeast Asia

“Cybersecurity is a major dealbreaker of condition monitoring solutions. Customers only grant us access if they have trouble. We do not have the data and that is why we also struggle to provide meaningful, database recommendations.”

– **Digital Product Manager**, Food and Beverage, Western Europe

16% prefer one-time upfront payment models

34% state that purchasing regulations or processes hinder their companies in deciding on subscription-based contracts

Other concerns relate to the fact that many digital solutions are offered in cloud-based subscription models. Still, many customers prefer on-premise solutions. Similarly, study participants highlighted the fear of getting dependent on the provider or that providers might not exist long enough to support the sourced products and services in the long term. In this context, being the owner of the digital solution or hardware becomes an important rationale to avoid subscription models as ownership comes with the privilege to modify solutions and hardware as needed. Indeed, **one-third of respondent’s** state that their companies prefer to become owners of their assets which typically contradicts the underlying idea of subscription models as non-ownership business models.

36% want to become owners of their used hardware and software

Similarly, a quarter of study participants are afraid of paying too much with subscription models compared to the traditional one-off payment option. Indeed, from a cost perspective, subscription models can be more expensive in the long term. However, most participants appreciate the benefits of subscription models, i.e., productivity and energy efficiency improvements or increased flexibility, which are worth additional payments compared to the traditional model.

26% see subscription-based contracts as too expensive compared to one-time upfront purchases

Finally, a major issue in the context of subscription models and digital technology-enabled use cases is data protection. Data access and remote connection is a pre-condition for many services and digital solutions offered in subscription models, i.e., condition monitoring solutions. The study shows that many companies are reluctant to share machine data for various reasons. While some customers do not want to see any remote connection established and data to leave the company’s boundaries at all, many customers are open to such a move but expect suppliers to prove their cybersecurity and data privacy protection capabilities.

47% do not like giving external stakeholders access to their data

32% are comfortable with giving suppliers access to their data so suppliers can support them to increase energy efficiency in operational processes

Outcome-based contracts

Outcome-based contracts go beyond subscription models. Instead of billing only on a fixed recurring basis, outcome-based contracts link the payments to be made by the customer much more closely to the achieved result. Customers, therefore, pay for hardware, services, or digital solutions based on input-, usage-, output, or result-based metrics. Typical price metrics include but are not limited to pay-per-availability, pay-per-use, pay-per-energy saving, or pay-per-CO₂ reduction. Particularly in the context of energy efficiency-related projects with uncertain outcomes but significant investments, outcome-based contracts provide the opportunity to share benefits and risks between suppliers, customers, and other involved stakeholders. **In this sense**, suppliers as service or product providers no longer simply carry out services or deliver products, but actively help the customer to achieve their goals through optimizations and improvements, typically on a continuous basis over a longer time.

Selected benefits of outcome-based contracts for customers:

- reducing risks as suppliers are made financially accountable to deliver the promised value
- aligning outcomes with expenses
- streamlining interests of suppliers (create revenue and profits) with interests of customers (realize tangible results)

Outcome-based contracts can help to reduce uncertainty in energy efficiency projects and offer significant business potentials for suppliers that are able to realize positive outcomes for their customers

Given the prevailing benefits, more and more companies are thinking about adopting outcome-based contracts. While already one-third of study respondents make use of outcome-based contracts, every second study participant perceives outcome-based contracts as a viable option for their companies.

32% have purchased outcome-based contracts

50% perceive outcome-based contracts as a viable sourcing option

However, outcome-based contracts are difficult to implement and raise pivotal questions for recipients and providers of such a business model. For providers, outcome-based contracts make most sense if four conditions are met.

- First, the providing company must have the capabilities and resources to realize a positive outcome for their customers.
- Second, as specific outcomes can in most cases only be estimated upfront, companies must also be willing to accept a certain risk.
- Third, the profit of the outcome-based contracts must be higher than in the traditional alternative.
- Fourth, the contract duration must be long enough to benefit from the improvements.

Consequently, outcome-based contracts, therefore, can be challenging to scale for providers.

“It is a clever variant, because the customer does not take a big risk in the first place, but the one who offers the service first makes an advance payment. As a customer, I do not take any risks because I am oriented to the result. This means that if there is no result or no high-quality result, which of course must be classified contractually in advance, then I as a customer do not have to take the risk and pay for everything already.”

– Operations Manager Digitalization, Metals, Western Europe

“I think it would be an interesting model if a long downtime would end up in a situation where the provider pays us for the downtime. Because if you want to be in on the profit, you need to be in on the risk and so far, very few are willing to take part in the risk. But if the provider is willing to do that, I am more than willing to discuss the business model.”

– Senior Project Manager, Metals, Northern Europe

“I agree if you can guarantee a reduction in energy uses that comes with savings for us. And if you are willing to guarantee it, I am willing to pay for it. Of course, there is penalty in case you do not provide the service that you did guarantee. If there is an additional gain, there must be an additional pain.”

– Senior Project Manager, Metals, Northern Europe

“I was the first person to implement a lot of these outcome-based projects in the last five years. The first one was challenging because you needed to convince many people. People want to see the buyback and understand how it benefits them. But I think in the last two years we have settled most of those arguments.”

– Senior Engineering Manager, Minerals and Mining, Africa

“There must be a clear potential at the customer that can be leveraged. Otherwise, the additional effort will not pay off.”

– Business Development Director, Metals, Western Europe

“It is not so trivial to agree on the right outcome KPIs and get a greater share from our customers’ revenues. We work with a mix of fixed payments and performance-based terms to reduce our risks, especially for performance risks that are not caused by us.”

– Head of Solution Sales Program, Electronics and Semiconductors, Western Europe

“Outcome-based models are an option we are discussing for the last months. We will soon test different approaches with different customers to gain valuable insights to develop a solution that fits customer needs and our needs”

– Product Manager, HVACR, Central Europe

“Our company is yet not convinced of outcome-based models. The finance department perceives the model as risky due to the pre-financing of equipment and possible sales shortfall if a promised outcome cannot be achieved. They wish to see more successful use cases in our industry.”

– Energy Engineer, Cement, South America

“Customers want numbers about what our solution can do, but we can only give an estimation if we can assess the situation. And that is quite a lot of effort and cannot be done without compensation.”

– Product Manager Digital Services, Pulp and Paper, Western Europe

“Of course, we do not want to sign something we do not need, but it is not that we are against service contracts. But often, promises are not fulfilled and that is why we are rather staying flexible when working with new suppliers or sourcing new services.”

– **Purchasing Director**, Electronics and Semiconductors, Western Europe

“Yes, so in any case, you have to describe in detail what the expectations are or what the goal is. And the goal must also be provable. So, I must be able to prove and measure it if in doubt somewhere. In any case, it cannot be a feeling, it must be based on hard facts, it has to be measured, then it can be evaluated by both sides. The danger that I see is that the service provider – who offers such a service – must of course also have setbacks and that means he must lead other projects to success and these projects must yield so much that other projects that have not led to success are covered.”

– **Operations Manager Digitalization**, Metals, Western Europe

“Customers are very reluctant to show us their profit calculations and cost structures. That complicates meaningful discussions.”

– **Sales Director**, Metals, Southern Europe

“Co-creation is difficult. It is a new concept. Many customers think: we pay you to get it done, however that is not how it should work.”

– **CDO**, Marine, Western Europe

“We offer outcome-based projects only after we have assessed the customer. He must work professionally with us to ensure that we meet the targets that we want to achieve. Outcome-based does not mean that the supplier is doing all the jobs.”

– **Service Sales Manager**, Electronics and Semiconductors, Southeast Asia

A particularly challenging task for providers and customers of outcome-based contracts is to agree on key performance indicators. These KPIs further serve as a contractual baseline and represent a logic of how created outcomes are financially shared among the contractual partners. Negotiations about contract terms can be time-consuming and very complex, as possibilities of contract violations must be included so that the risk for the supplier can be mitigated to a reasonable extent. In addition, contracts must also be adapted to country specific legislation.

For customers, a major problem with outcome-based contracts is that they typically require to be long-term, which makes some customers in the industry skeptical. This is because they fear getting overcharged for many years. Still, if a clear outcome in such a relationship can be achieved, **almost three-quarters** of study participants show openness to engage in such contracts.

74% of the study participants do not hesitate to sign long-term, multi-year contracts as a customer if a clear value of such a relationship can be presented

Moreover, most customers wish to understand the implications of outcome-based contracts in terms of payment in different scenarios. To define a reasonable price model for the outcome-based contract, customers providers must trust each other and share information. Typically, however, there is a certain restraint to do so. This causes a paradoxical situation where providers cannot assess and promise potential outcomes because customers are not willing to share the necessary information.

84% need to see the value first, before making a project

Due to that, outcome-based contracts require a more deepened and dedicated co-creation between customers and providers. As introduced earlier in this study, not all companies have the resources or willingness, to engage with suppliers and other external stakeholders, which makes implementation challenging.

Conclusions

The insights generated through interviews and a quantitative survey across industrial sectors revealed important lessons for the transformation challenges and opportunities ahead.

- Energy efficiency is not a new topic on the agendas of industrial companies, but its importance has reached a level never seen before. While all study participants acknowledge the relevance of the issue for the entire industry, there are regional, industry and company size-specific differences in the degree of progress made in increasing energy efficiency.
- Efforts to increase energy efficiency are not driven by a single factor but by a combination of many. It was recognized that inaction leads to adverse changes in cost structures and already jeopardizes the reputation and brand image in the short term. In the medium and long term, companies are looking to leverage energy efficiency as a business driver to create new revenue streams.
- While many industrial companies have started to transform and implement use cases that facilitate energy efficiency, prevailing challenges prevent progress on the topic. Companies face challenges such as,
 - resistance to change the status quo,
 - unclarity about what to do,
 - prioritization of energy efficiency topics over other business topics,
 - new demands in capabilities and resources to implement, and
 - aligning incentives to support progress with energy efficiency.
- Digital technologies play a key role in enabling advanced energy efficiency-boosting use cases, creating transparency, as well as automating and optimizing processes. Renewable energy can help to realize energy cost savings but can only partly relieve pressure to foster energy efficiency on the consumption side.
- Intensified collaboration is likely needed to bridge capability gaps and accelerate progress. However, industrial companies are still often reserved to make use of external support for a variety of reasons.
- New business models, i.e., subscription models and outcome-based contracts, that reduce outcome risks, lower upfront investments, and fairly share outcomes, can accelerate energy efficiency increase in the industrial sector in upcoming years and might help to overcome some of the discovered issues that prevent companies in progressing further with their energy efficiency ambitions.

Acknowledgments

We express our sincere gratitude to all those who have shared their time, knowledge, commitment, and passion to make this research possible. Your contribution is much valued and helped us to bring out a global perspective on energy efficiency.



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Also, a special thanks to One Tree Planted for supporting our mission to make the world greener.

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