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## Next-Gen Industrial AI
## Energy Sector

# Next-Gen AI in Energy: A Tool for Transition

Artificial intelligence (AI) is starting to play a powerful role in the energy sector. It is enabling organizations to harness data to innovate, become more efficient, and adapt to the energy transition.

But just how is the energy sector embracing AI, and what are energy leaders' attitudes toward the technology? What do those leaders expect from the next generation of AI? How are organizations responding to the changes AI is driving? And how is AI changing the workplace?

To answer these questions, we conducted a survey of 515 senior leaders who are responsible for, involved in, or knowledgeable about their organization's existing or planned use of AI. Here, we discuss what we learned from the 117 energy sector respondents; the findings for all industries are in our Next-Gen Industrial AI report.

Many energy firms in the research are already transforming their operations using AI. The top way they are using it is for more intelligent automation of machinery and equipment, which was selected by 30% of respondents. That is followed closely by asset maintenance forecasts (28%) and the optimization of processes, machines, software, or tools (28%).

Opportunities to benefit from AI applications extend throughout the energy value chain. EDF energy, for example, is considering use cases for AI across its network, including for predictive maintenance at power stations, identification of components to support digital replicas of equipment, and better understanding customer usage patterns.[1]

Operation centers for power grids can use AI to classify disturbances and help them to decide on the best response. Meanwhile, engineers in the field can use AI to help establish the location and nature of faults – valuable insights that make remediation quicker, safer, and more efficient.[2]

## AI in a post-covid world

When this research was commissioned, there was a lot of hype around the potential of consumer AI, and fewer insights available on industrial AI. While we at Siemens, with over 30 years' experience in industrial AI, are no strangers to this field, we wanted to learn more about the experience of other organizations. This research sought to uncover the benefits and barriers of industrial AI applications, and to highlight its potential, especially when combined with other technologies like IoT and digital twin. Suddenly the world is a different place. However, as organizations seek to recover, rebuild and adapt in a post-covid environment, the potential of industrial AI is more relevant than ever.

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*How/where does your organization currently use AI? (Energy respondents only)*

| Category | Percentage |
|---|---|
| Automation of machinery and equipment | 30% |
| Asset maintenance forecasts | 28% |
| Optimization of processes, machines, software or tools | 28% |
| Safety monitoring / incident prevention | 26% |
| Automation of non-mechanical processes | 24% |
| Quality control | 23% |
| Customer experience / personalization | 23% |
| Planning and decision-making | 22% |
| Cybersecurity | 21% |
| Sales and marketing (e.g. CRM, customer analytics) | 21% |
| Virtual assistants, expert systems, chatbots | 17% |
| Supply chain, logistics, inventory management | 16% |
| Designing new products | 11% |
| Simulations e.g. digital twins | 11% |

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[1] https://www.computerworld.com/article/3426809/how-edf-wants-ai-to-optimise-its-nuclear-power-stations-and-the-smart-home.html
[2] http://www.epcc-workshop.net/images/Presentations/Session5/EPCC15-5-2_Discussion_Siemens_Apel.pdf

## The future of forecasting

A key area of interest in the coming years will be how AI can help electricity grids to integrate renewable sources.

"Forecasting the supply and demand of energy has always been important, but it has become more complex with the introduction of numerous, distributed, renewable energy sources with fluctuating production," says Rolf Apel, Principal Key Expert at Siemens Smart Infrastructure. "In the past, it was just the load that depended on the time and the weather primarily. Now, the energy flow is influenced by many new variables, including home energy storage, roof-top solar, electric cars, offshore wind farms, and many others."

All of this makes accurate prediction much more complex – at least for human minds. AI systems, however, are well-suited to this kind of task, and are maturing at a similar pace to the growth of renewable energy.

Another challenge for today's power grids is the decrease of inertia, which requires better monitoring of transient processes, in order to detect emerging instabilities early and initiate appropriate countermeasures. AI can also provide good support in this area. The DynaGridCenter in Germany is an example of such a pioneering system. This transmission control center uses intelligent control systems and digitalized substations to manage the dynamics of a grid that has multiple inputs from renewable sources, as well as the increasing application of power electronics.[3]

"The DynaGrid system uses AI elements to semi-autonomously control transmission flows and optimize the network," says Michael Weinhold, CTO of Siemens Smart Infrastructure. "It is currently being tested, in parallel with a conventional control system, to successfully manage and optimize load flows across the transmission system in real time."
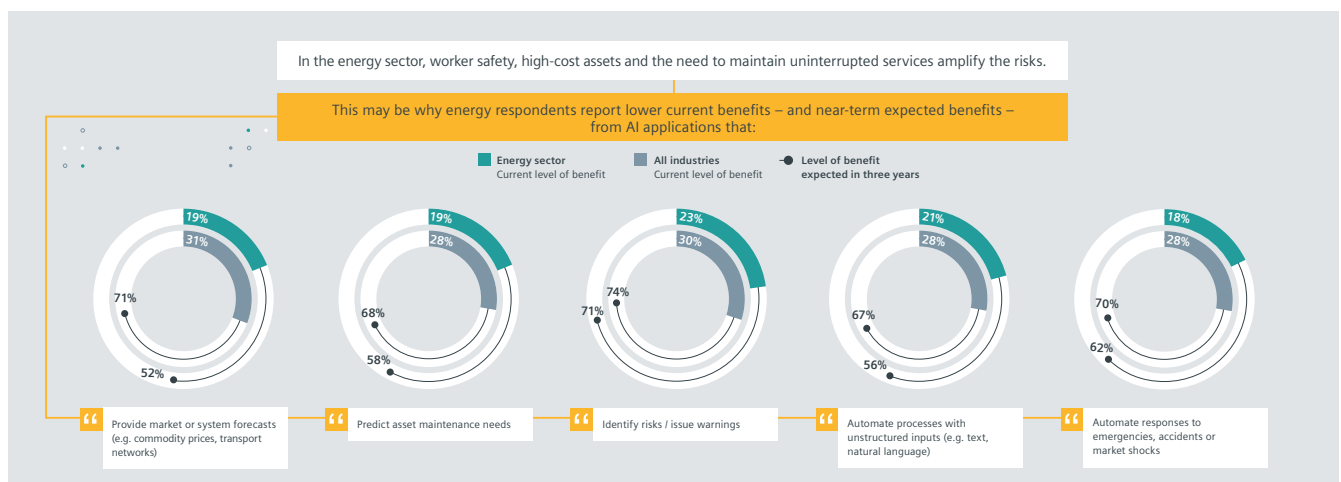
## What is AI?

In this report, and the research that supports it, 'artificial intelligence' and 'AI' refer to a broad spectrum of methods or technologies that perform tasks which would normally require functions of human intelligence such as learning, judging, and problem-solving. This is more in keeping with the contemporary business understanding of AI than any technical or academic conventions.

## AI adoption gains momentum

Energy firms are in the early stages of AI adoption. Only a minority of respondents in our survey (39%) say that their organization has easily moved from AI pilots to full-scale implementations. However, a higher percentage say they are seeing results, with half saying that AI has already had a significant positive impact on their organization. Even more (55%) say their organization is eager to use as much AI as possible.

But the energy sector is cautious about adopting new technology, and that is understandable given the importance and value of energy assets and the risks associated with them. In our survey, however, energy respondents' top barrier to further adoption of AI is resistance to change/conservatism (selected by 85%).

That inertia can be part of organizational culture, but when it comes to AI it can also be fueled by more specific issues with the technology. Since AI can help us to intelligently automate processes, some see it as a threat to their value in the organization. Others may have difficulty trusting AI with important assets and decisions.

In the energy sector, worker safety, high-cost assets and the need to maintain uninterrupted services amplify the risks.

This may be why energy respondents report lower current benefits – and near-term expected benefits – from AI applications that:

**Energy sector** Current level of benefit   **All industries** Current level of benefit   **Level of benefit expected in three years**

| 19% / 31% | 19% / 28% | 23% / 30% | 21% / 28% | 18% / 28% |
| 71% | 68% | 74% | 67% | 70% |
| 52% | 58% | 71% | 56% | 62% |
| Provide market or system forecasts (e.g. commodity prices, transport networks) | Predict asset maintenance needs | Identify risks / issue warnings | Automate processes with unstructured inputs (e.g. text, natural language) | Automate responses to emergencies, accidents or market shocks |

[3]  https://new.siemens.com/global/en/products/energy/topics/dyna-grid-center.html

## Energy leaders are divided: can they trust AI?

To explore these factors, we created a hypothetical scenario for our respondents to consider. This was designed to reveal inherent biases toward AI-related change, and is a valuable exercise for us all.

Imagine that your organization has installed a brand-new AI model, called Maintain-AI. It has been trained with 20 years of performance data from the manufacturer of your machinery. On assessing your machines, Maintain-AI recommends immediate high-cost refurbishment work on mission-critical equipment. The work will require extensive production downtime, which would be disruptive and costly.

But there's resistance. Your head of operations, who has 20 years of industry experience, is not happy with Maintain-AI's conclusions. In fact, they strongly disagree. They have personally inspected the machinery and see no issues, and stress that making the recommended repairs would waste money.

We put this scenario to the 117 senior energy industry professionals in our survey, and the results reveal a clear split. While a small majority (56%) say they would side with Maintain-AI, 44% would listen to their head of operations.

This points to a looming challenge for energy companies because in this scenario question we also told respondents that Maintain-AI had outperformed the organization's best people in a year-long pilot prior to the refurbishment recommendation. With that in mind, the fact that a sizeable group (44%) still opted to go with the head of operations is more concerning: it indicates a potential bias against AI that could stop some companies from progressing.

## A safer sector with AI?

This issue of bias comes to the fore when we look at situations of high value, importance, or risk. For the energy industry, these situations are both common and strong contenders for AI-driven automation.

Nearly half of the energy executives we surveyed (48%) say that within the next five years an AI system will autonomously control assets in their organization that could, as a result of error or accident, cause injury or death.

And AI is expected to make the energy industry safer over time. Respondents are much more likely to say that their workplace will become safer (56%) as AI drives more sophisticated automation, than more hazardous (23%). In addition, a sizable proportion (42%) say that AI *has already* prevented safety incidents at their organizations.

"More advanced data analytics and AI will enhance safety and security in energy systems," says Weinhold. "AI can help us to make data-driven decisions quickly for many contingencies. For example, to react to critical situations, like a strong in-feed from renewables or a system fault, AI trained by simulations and analysis of hundreds of eventualities can rapidly generate the right countermeasures to keep systems running safely."

## Cautious optimism for AI's potential

The energy industry is balancing several competing priorities as it transitions to a lower-carbon future. Decarbonization, decentralization, and digitalization are the most-cited challenges, and AI is part of that. But it is also a potential ally – a powerful tool that can help the energy industry adapt to decentralized, lower-carbon energy sources. Similarly, AI automation – perceived by some to be a hazard – will increasingly look more like an opportunity to make the industry safer.

Our research finds the energy industry divided on AI. For some, the technology has not yet proved its value and safety; but a small majority is already embracing the benefits of AI, and is exploring its potential with a balance of caution and optimism.

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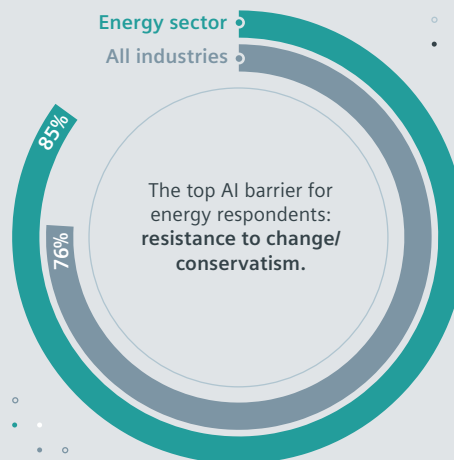
Even looking five years ahead, fewer than half of energy respondents think that their organizations are likely to give AI full control of any high-value assets within that timeframe.

" Within the next five years, an AI system autonomously control some of my organization's high-value assets "

100%

**46%**

Energy sector

100%

**54%**

All industries
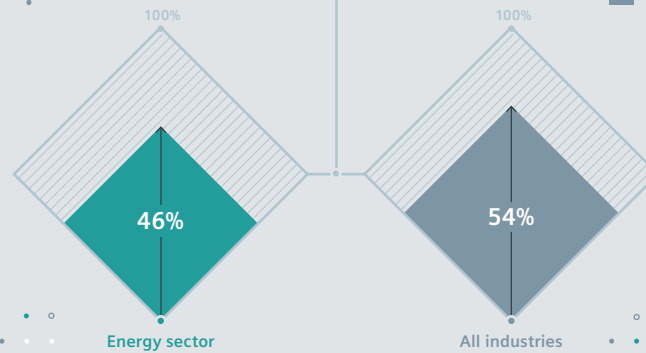
Taken together, the results of our research show energy leaders are rational about AI's potential, while being cautious about its implementation.

Much of this caution is well-placed, given the importance, value and risks associated with energy assets. However, respondents report that there is an even more significant barrier to further implementation of AI...

**Energy sector**
**All industries**

85%

76%

The top AI barrier for energy respondents: **resistance to change/ conservatism.**

While other barriers are also prominent (e.g. data integration, skills, safety, cybersecurity and funding), our research suggests that a cultural shift – towards embracing new ideas, models and processes – is needed in order to overcome these barriers and accelerate the benefits of AI applications in the energy sector.

**ABOUT THE RESEARCH**: Siemens and our research partner Longitude conducted primary research into the uses of, attitudes to, and outlooks for AI in industrial organizations. We surveyed 515 senior business leaders in the energy, industrial/manufacturing, urban infrastructure, and transportation sectors. Of the 117 energy industry respondents, 82.1% were from power generation organizations (e.g. operators of hydro, gas, wind, oil, coal, nuclear, biomass or solar power plants), and 17.9% were from electricity transmission and distribution organizations (e.g. power utilities, grid operators, distribution system operators). In order to qualify for the survey, respondents needed to be responsible for, involved in, or knowledgeable about their organization's existing or planned use of AI and related technologies, strategies, budgets, and applications.The research included respondents from North America, Latin America, Europe, the Middle East and Africa, and Asia-Pacific and was concluded in September 2019. All respondents were from organizations with an annual revenue of at least $100 million.