Artificial Intelligence for Energy:

HOW SMART ALGORITHMS CAN IMPROVE PLANNING

MINER & KASCH | UTILITY DIVE

Custom content for Miner & Kasch by **Utility Dive's Brand Studio**

Through digital transformation, electric utilities can gain new efficiencies, capabilities and opportunities that will enable them to thrive in the 21st century. However, to date, many utilities have been relatively hesitant to move their computing workloads to the cloud and to embrace artificial intelligence (AI) and machine learning tools to glean maximum value from data.

Fortunately, recent advancement and proliferation of these technologies mean that it's now easier than ever for utilities to get started with and make fast progress in their digital transformation. AI can help utilities realize efficiencies and insights that might not otherwise be possible. Here are a few examples:

- **Computer vision** can provide a nuanced interpretation of vast amounts of satellite, aerial and drone imagery. This insight, combined with more structured data (weather history and forecasts, among others), can help utilities optimize programs for vegetation management, wildfire safety, maintenance and other field activities.
- **Anomaly and outlier detection,** a fairly basic application of AI, can help utilities proactively detect emerging issues, such as malfunctioning or underperforming assets, billing system errors or security concerns. This can lead to opportunities for streamlining operations and business processes, as well as prevent and fix problems.
- **Natural Language Processing.** NLP gleans insights from unstructured text sources: customer interactions, social media posts, survey responses and more. This supports sentiment analysis: indications of how people feel about the utility, its service and its offerings. This can support granular market segmentation, enhance customer service, and identify emerging market needs and opportunities. Also, with document understanding, utilities can analyze contracts to optimize supply chain and other business-to-business relationships.
- **Deep learning techniques** for time series analytics can improve customer service and operations through better interpretation of smart meter and IoT data. This supports adaptive learning, personalization, and more accurate projections based on this data.

The goal of AI is to augment human capabilities, not to replace people. AI cannot deliver best results without human input. Utility staff must define problem areas to address, select the data that AI algorithms will use and provide judgment about which algorithmically-generated results are most useful. Over time, utility personnel will collaborate with AI to improve how they manage systems and processes, serve customers and plan for the future.

A common factor that's been hindering AI adoption at many utilities has been legacy systems and siloed operations and data. Utilities can start the process by shifting more computing workloads to the cloud, rather than overhauling legacy systems. This can allow utilities to leapfrog past these constraints and enable them to start experimenting with AI capabilities in safer, more affordable ways.

It's also helpful for utilities to understand some AI basics, to spot opportunities and develop a strategy for pursuing them.

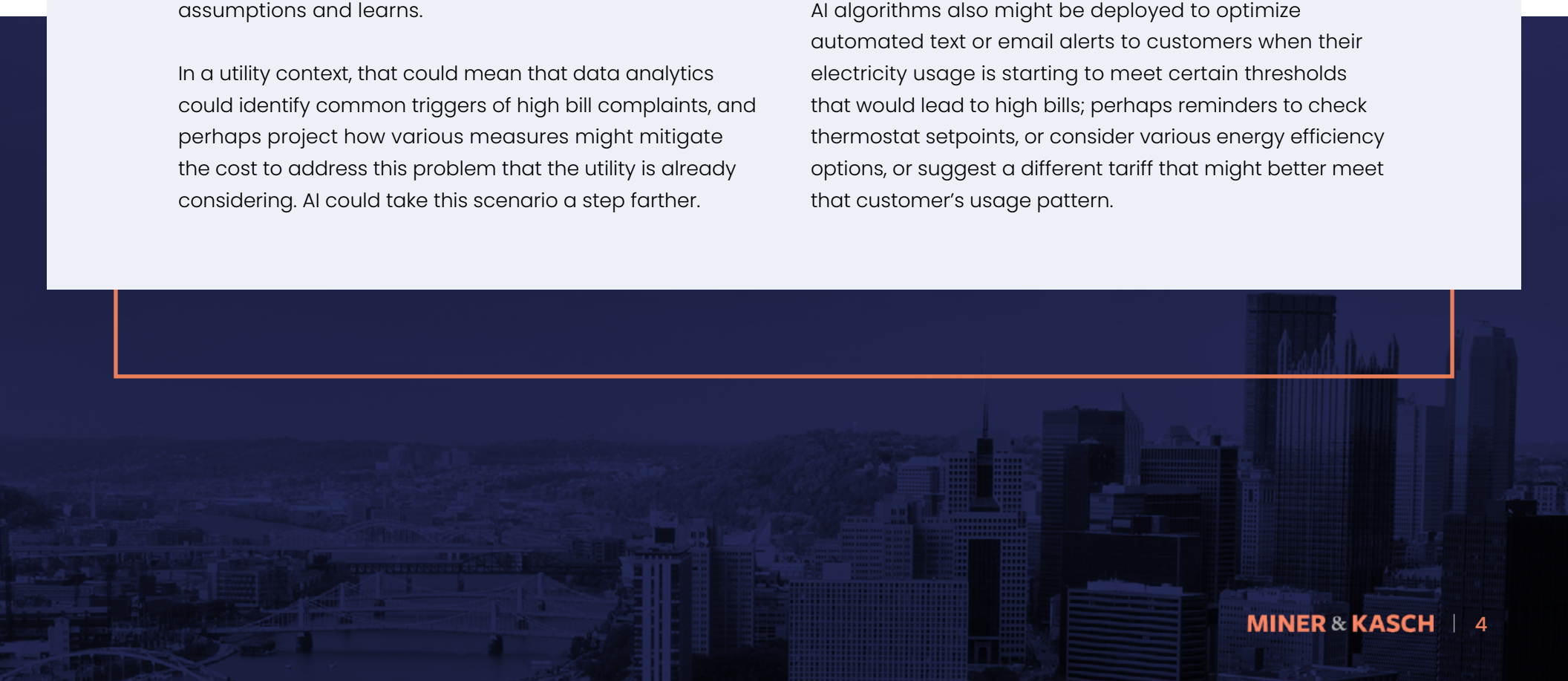
Over time, utility personnel will collaborate with AI to improve how they manage systems and processes, serve customers and plan for the future.

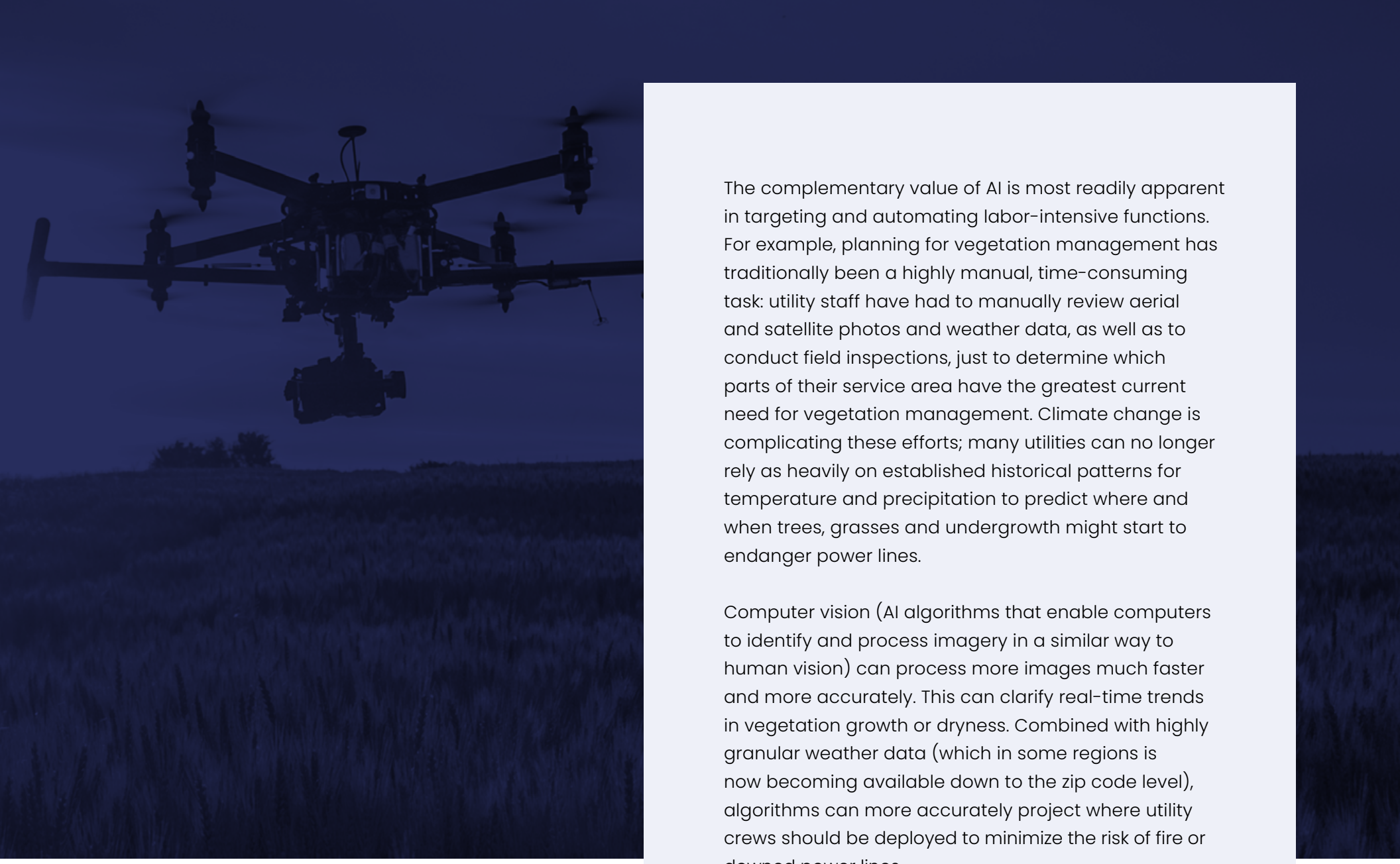
UTILITY USE CASES FOR AI

Most utilities are already using data analytics extensively — both for historical context and to predict future trends. AI extends this opportunity by adding a key capability that autonomously makes assumptions, tests those assumptions and learns.

In a utility context, that could mean that data analytics could identify common triggers of high bill complaints, and perhaps project how various measures might mitigate the cost to address this problem that the utility is already considering. AI could take this scenario a step farther.

An AI algorithm might analyze data from the customer contact center about high bill complaints, integrate that with energy usage data from those customers and suggest novel options for preventing high-bill complaints. AI algorithms also might be deployed to optimize automated text or email alerts to customers when their electricity usage is starting to meet certain thresholds that would lead to high bills; perhaps reminders to check thermostat setpoints, or consider various energy efficiency options, or suggest a different tariff that might better meet that customer's usage pattern.





The complementary value of AI is most readily apparent in targeting and automating labor-intensive functions. For example, planning for vegetation management has traditionally been a highly manual, time-consuming task: utility staff have had to manually review aerial and satellite photos and weather data, as well as to conduct field inspections, just to determine which parts of their service area have the greatest current need for vegetation management. Climate change is complicating these efforts; many utilities can no longer rely as heavily on established historical patterns for temperature and precipitation to predict where and when trees, grasses and undergrowth might start to endanger power lines.

Computer vision (AI algorithms that enable computers to identify and process imagery in a similar way to human vision) can process more images much faster and more accurately. This can clarify real-time trends in vegetation growth or dryness. Combined with highly granular weather data (which in some regions is now becoming available down to the zip code level), algorithms can more accurately project where utility crews should be deployed to minimize the risk of fire or downed power lines.

"Utilities have access to an enormous array of data streams, especially from the satellites that are imaging our planet every day," said Niels Kasch, founding partner of Miner & Kasch, a company that provides AI solutions for a wide range of industries and critical infrastructure. "AI allows them to finally access and interpret that data in an organized way to support more accurate predictions. Computer vision, in particular, helps to extract structured information such as trees encroaching on a power line from images, which in turn can be used for allocating and prioritizing staff and resources for preventative maintenance."

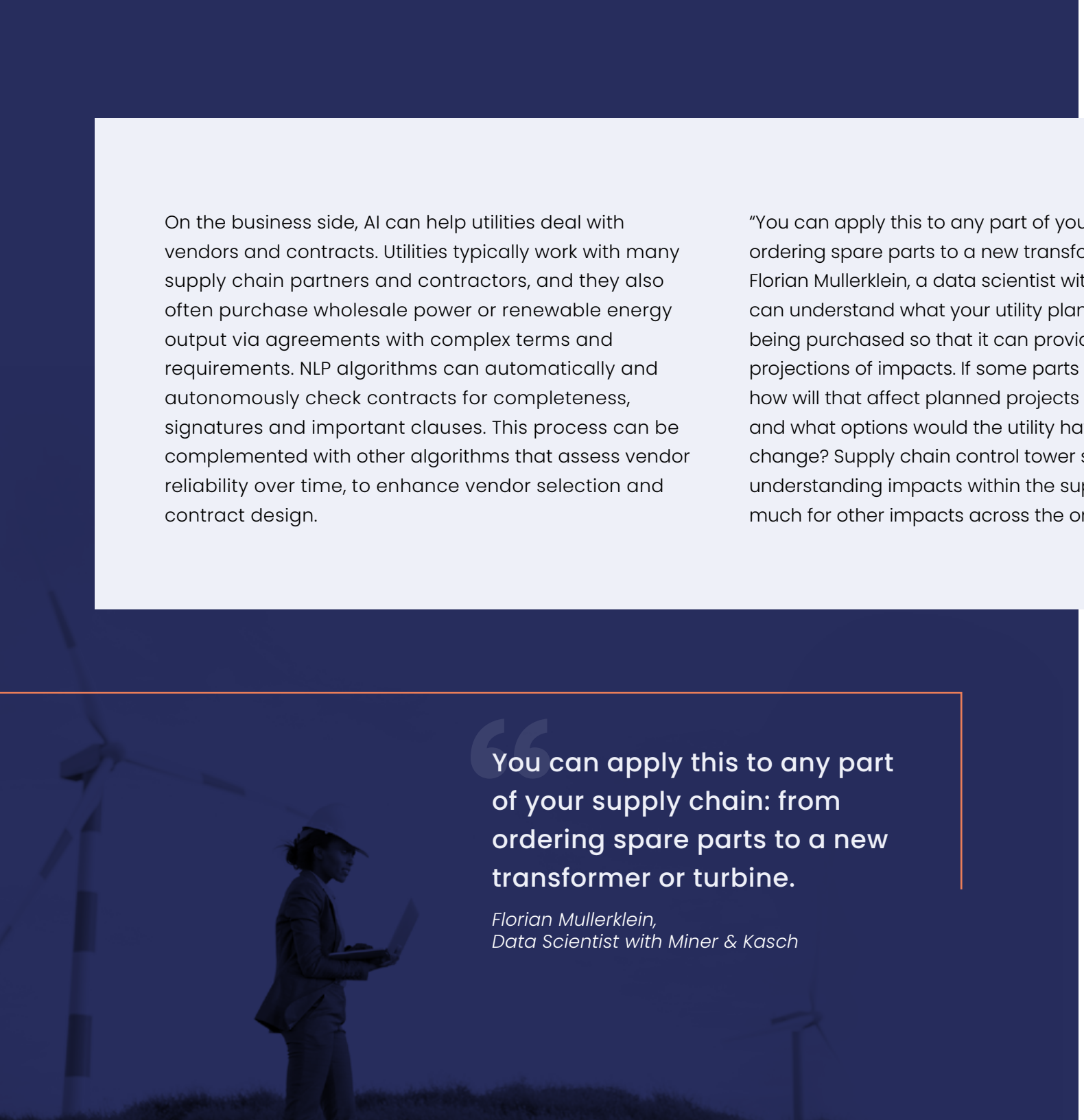
AI can also help utilities introduce new services for customers, either value-added or perhaps revenue-generating. For instance, Miner & Kasch has partnered with Whisker Labs to develop home safety technology that can monitor appliances for correct operation, alert homeowners to electrical fire hazards and warn of power surges. Utilities could similarly apply AI to examine customer data from smart meters and smart appliances, and proactively notify customers of tips for more efficient operation or warnings of possible malfunctions.

> **Utilities have access to an enormous array of data streams, especially from the satellites that are imaging our planet every day. AI allows them to finally access and interpret that data in an organized way to support more accurate predictions.**

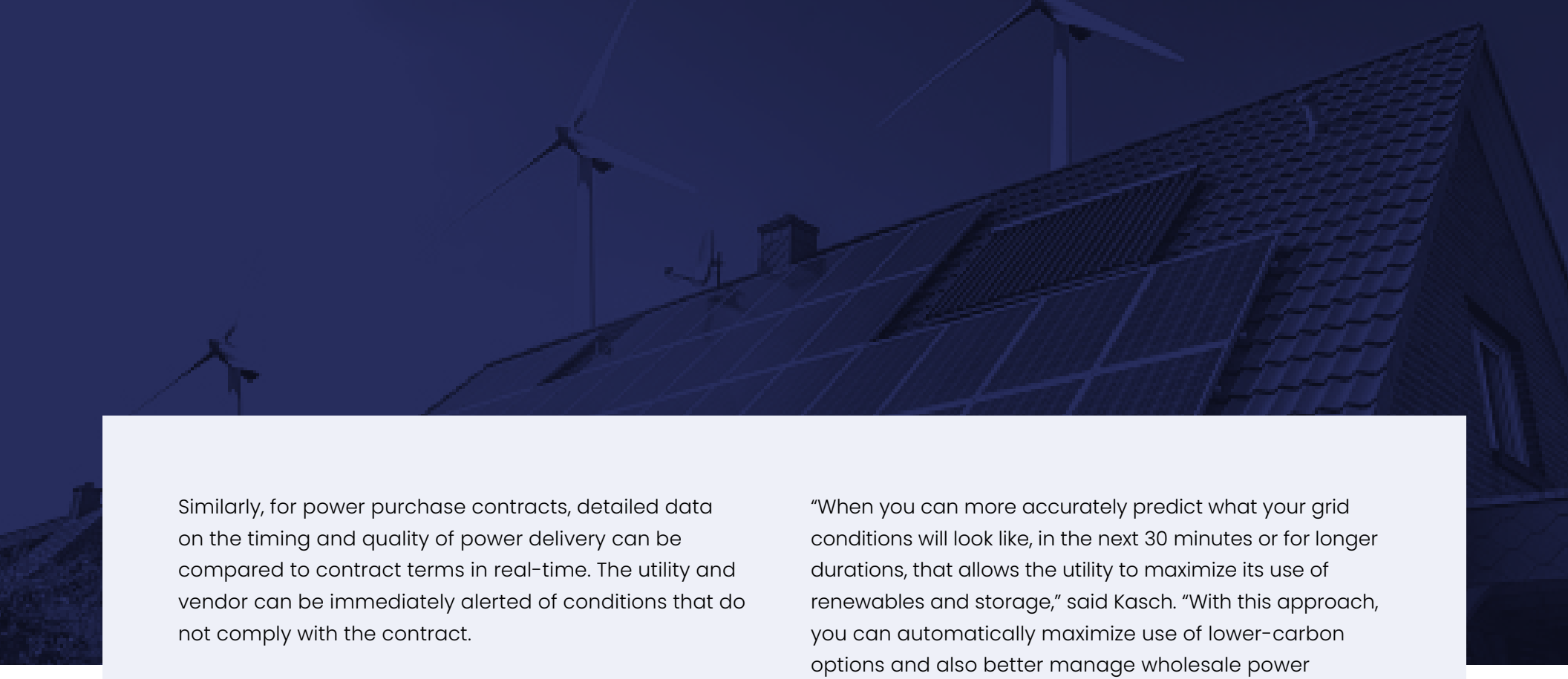
Niels Kasch,
Founding Partner of Miner & Kasch

On the business side, AI can help utilities deal with vendors and contracts. Utilities typically work with many supply chain partners and contractors, and they also often purchase wholesale power or renewable energy output via agreements with complex terms and requirements. NLP algorithms can automatically and autonomously check contracts for completeness, signatures and important clauses. This process can be complemented with other algorithms that assess vendor reliability over time, to enhance vendor selection and contract design.

"You can apply this to any part of your supply chain: from ordering spare parts to a new transformer or turbine," said Florian Mullerklein, a data scientist with Miner & Kasch. "AI can understand what your utility plans to do with the items being purchased so that it can provide detailed, precise projections of impacts. If some parts don't arrive on time, how will that affect planned projects and processes, and what options would the utility have to adapt to this change? Supply chain control tower software is good for understanding impacts within the supply chain, but not so much for other impacts across the organization."



> **You can apply this to any part of your supply chain: from ordering spare parts to a new transformer or turbine.**
>
> *Florian Mullerklein,*
> *Data Scientist with Miner & Kasch*



Similarly, for power purchase contracts, detailed data on the timing and quality of power delivery can be compared to contract terms in real-time. The utility and vendor can be immediately alerted of conditions that do not comply with the contract.

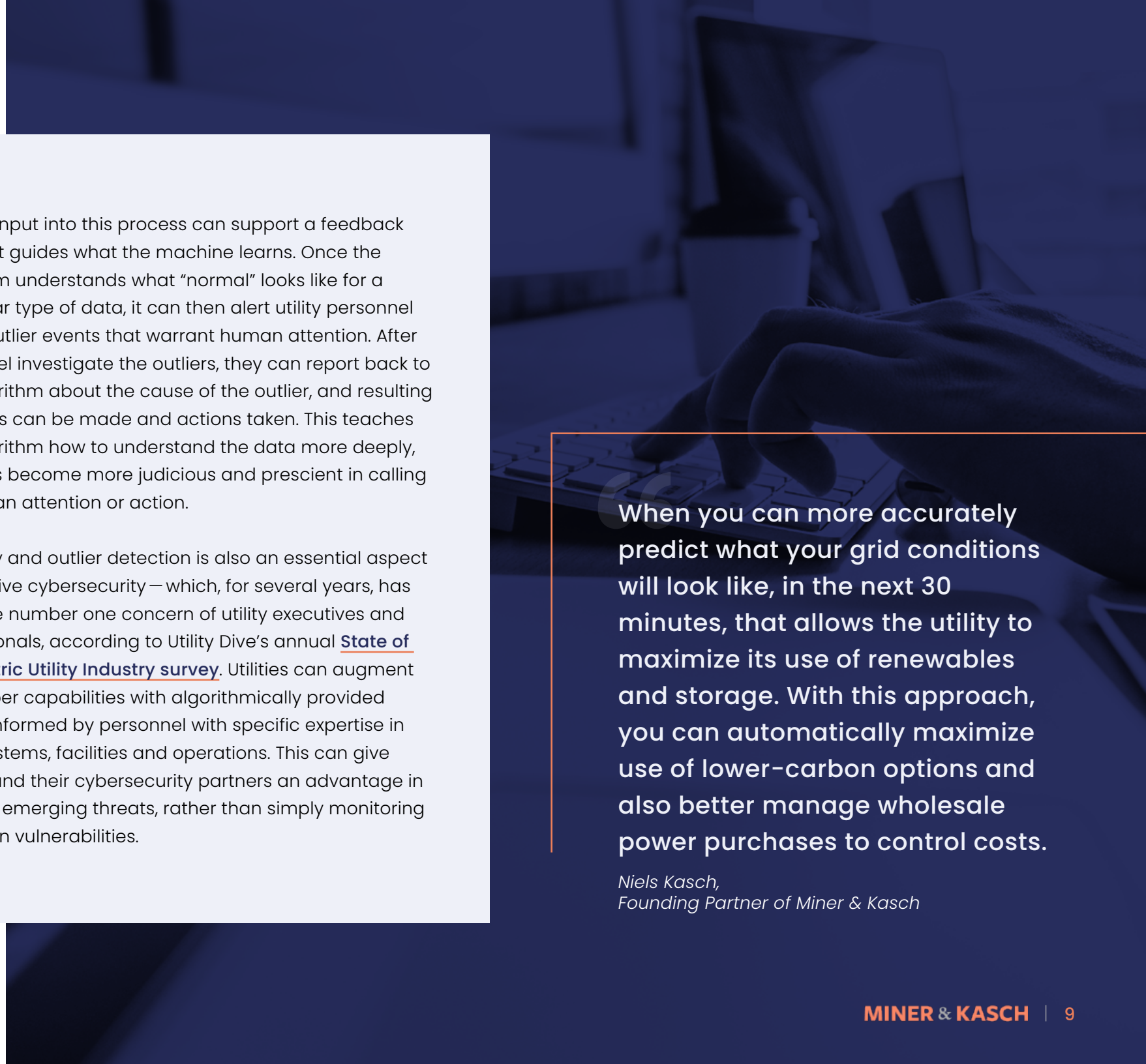
The intermittency of renewable energy resources (such as rooftop solar or wind farms) presents another utility challenge that AI can help solve. Power output from these resources can vary considerably, from one minute to the next, making it difficult for utilities to manage power flows on distribution grids in real-time. AI algorithms can analyze real-time, highly granular weather data and compare it to current grid conditions and localized demand projections, and make recommendations to grid dispatchers about when and how to ramp other dispatchable resources up or down.

"When you can more accurately predict what your grid conditions will look like, in the next 30 minutes or for longer durations, that allows the utility to maximize its use of renewables and storage," said Kasch. "With this approach, you can automatically maximize use of lower-carbon options and also better manage wholesale power purchases to control costs."

Utilities can gain even more value from their data via "deep learning," where multilayered neural networks can be used to progressively extract increasingly sophisticated insights from raw data. For instance, deep learning can be applied to time series and IoT data to monitor and alert when outlier and anomalous conditions occur. Analysis of these networks make it possible to provide better insight about the possible causes of these conditions.

Human input into this process can support a feedback loop that guides what the machine learns. Once the algorithm understands what "normal" looks like for a particular type of data, it can then alert utility personnel about outlier events that warrant human attention. After personnel investigate the outliers, they can report back to the algorithm about the cause of the outlier, and resulting decisions can be made and actions taken. This teaches the algorithm how to understand the data more deeply, and thus become more judicious and prescient in calling for human attention or action.

Anomaly and outlier detection is also an essential aspect of effective cybersecurity—which, for several years, has been the number one concern of utility executives and professionals, according to Utility Dive's annual **State of the Electric Utility Industry survey**. Utilities can augment their cyber capabilities with algorithmically provided insight informed by personnel with specific expertise in utility systems, facilities and operations. This can give utilities and their cybersecurity partners an advantage in spotting emerging threats, rather than simply monitoring for known vulnerabilities.



> **When you can more accurately predict what your grid conditions will look like, in the next 30 minutes, that allows the utility to maximize its use of renewables and storage. With this approach, you can automatically maximize use of lower-carbon options and also better manage wholesale power purchases to control costs.**
>
> *Niels Kasch,*
> *Founding Partner of Miner & Kasch*

NATIONAL GRID'S INVESTMENT IN AI FOR UTILITIES

AI is a growing priority for National Grid Partners (NGP), the venture investment and innovation arm of National Grid, one of the largest investor-owned energy companies, with electric and gas providers in the U.S. and Europe.

NGP has been investing in technologies to help utilities address decentralization, decarbonization and digitalization. This includes several applications of AI. Participating actively in technology investment and development is part of a National Grid's strategy to future-proof their utility business, while also fostering an entrepreneurial culture among utilities and expanding the industry's ability to innovate.

"Moving forward, National Grid is an energy and technology company, not just an energy provider," said Iliana Portugués, Head of Innovation for NGP.

The sheer pace of change and disruption has been especially challenging for the historically risk-averse and highly regulated utility industry. Also, so far, the digital technology sector has generally not strongly pursued utilities as a market for their more advanced solutions. "Utilities are not a high-profit, large volume industry that tech companies have cared much about so far," said Portugués. "We've had to work very hard to attract their interest."

To bridge this gap, NGP makes and manages strategic investments to help utilities and technology companies collaborate on ways that utilities can capitalize on disruption, not just respond to it. This method involves both technology development and strategies for shifting organizational culture at utilities.

"We're teaching tech companies to understand the special considerations of utilities, so they can see what an attractive and potentially lucrative market we are for their solutions," said Portugués.

National Grid works with NGP to co-develop and test some of the technologies that NGP is funding. In the approximately two years that NGP has been actively investing in AI, National Grid has been testing drones and other robotics equipped with computer vision capabilities for inspections of tunnels, powerlines and other assets.

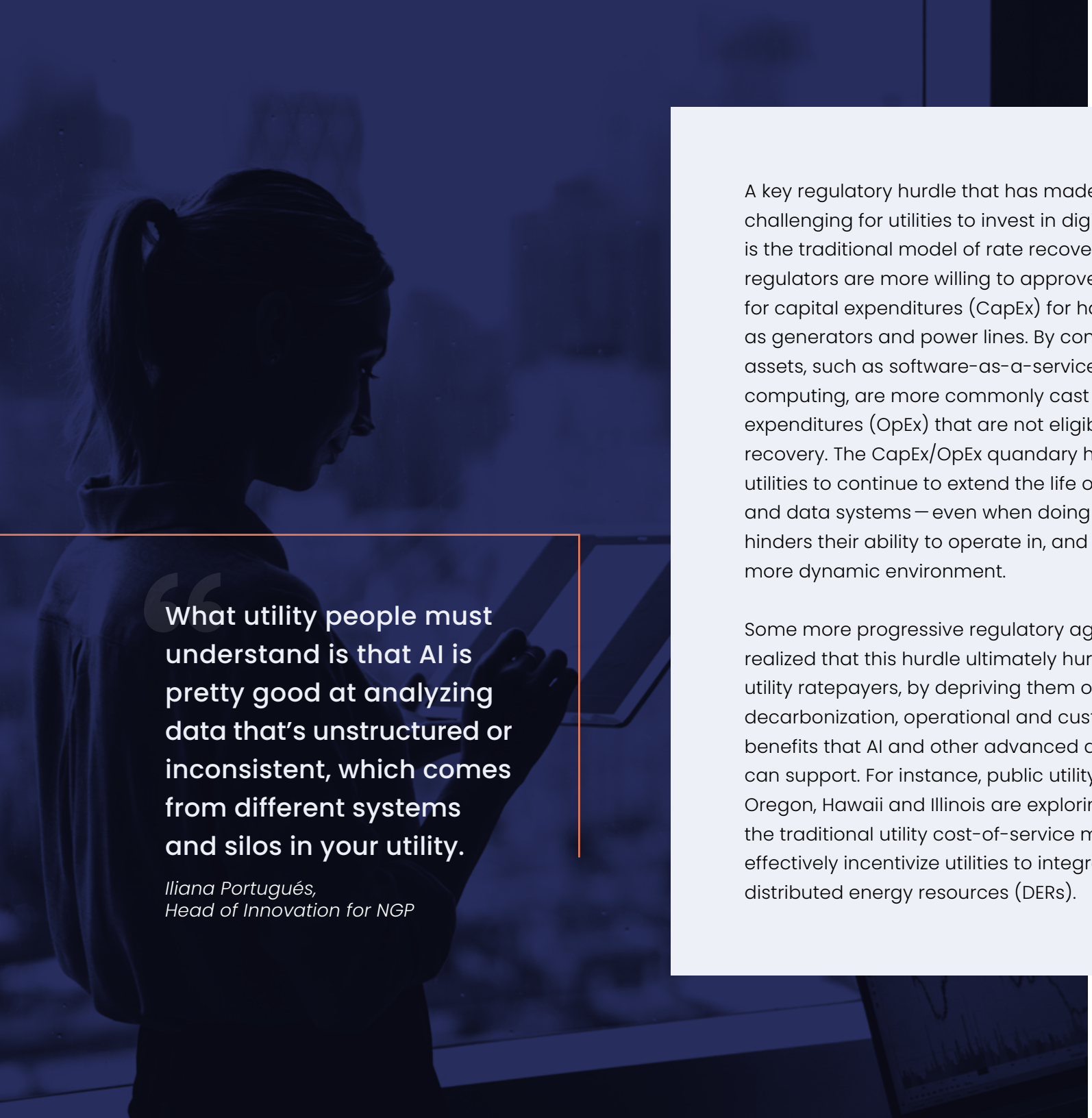
OVERCOMING BARRIERS TO UTILITY AI ADOPTION

As utilities prepare themselves to adopt AI capabilities, some common hurdles must be addressed. A key challenge is the way that utilities have customarily approached data and systems.

"Utilities employ lots of engineers, and we engineers love our standards," said Portugués. "It can be unsettling for us to hand over to an algorithm important data that's inconsistently formatted. But what utility people must understand is that AI is pretty good at analyzing data that's unstructured or inconsistent, which comes from different systems and silos in your utility. So don't let a love of standardization hold you back from using this powerful tool."

Also, internal processes often must be updated for utilities to reliably supply AI with timely, complete data. Regulated utilities often must follow business and operational processes—especially for the collection, storage and transfer of data—that were set up decades ago. Identifying how to update these processes, and ensuring that new processes still meet regulatory and legal requirements can be challenging.

"The most important part is to establish a database and framework to collect and store data, to make it accessible to algorithms," said Portugués. "Then, you can add data to that infrastructure, as your processes are adapted to support its integration."



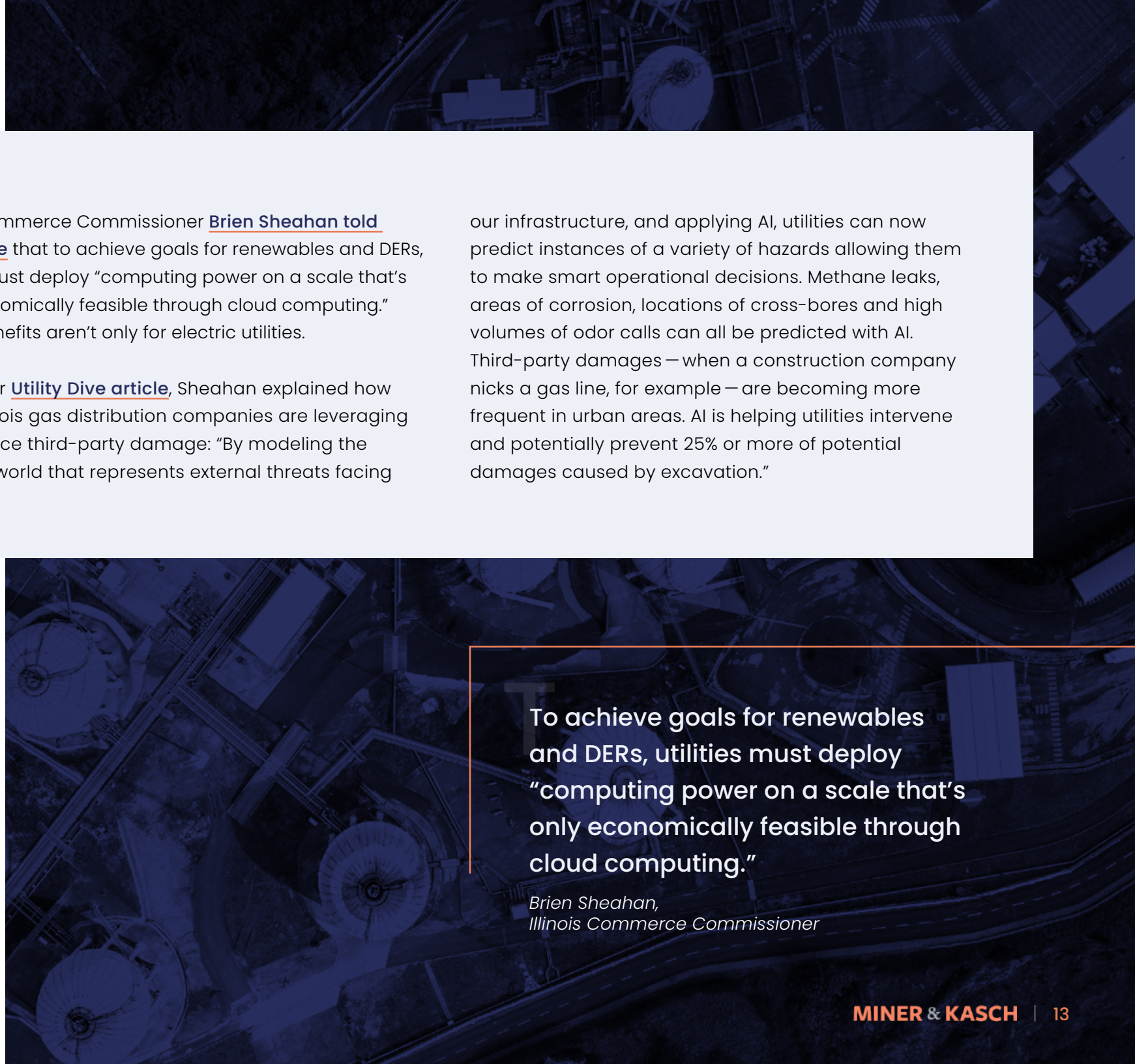
> What utility people must understand is that AI is pretty good at analyzing data that's unstructured or inconsistent, which comes from different systems and silos in your utility.
>
> *Iliana Portugués,*
> *Head of Innovation for NGP*

A key regulatory hurdle that has made it relatively challenging for utilities to invest in digital transformation is the traditional model of rate recovery. Typically, regulators are more willing to approve rate recovery for capital expenditures (CapEx) for hard assets, such as generators and power lines. By contrast, digital assets, such as software-as-a-service (SaaS) or cloud computing, are more commonly cast as operating expenditures (OpEx) that are not eligible for rate recovery. The CapEx/OpEx quandary has led many utilities to continue to extend the life of legacy computer and data systems — even when doing so demonstrably hinders their ability to operate in, and adapt to, a far more dynamic environment.

Some more progressive regulatory agencies have realized that this hurdle ultimately hurts the interests of utility ratepayers, by depriving them of the efficiency, decarbonization, operational and customer service benefits that AI and other advanced digital technologies can support. For instance, public utility commissions in Oregon, Hawaii and Illinois are exploring ways to disrupt the traditional utility cost-of-service model to more effectively incentivize utilities to integrate and deploy distributed energy resources (DERs).

Illinois Commerce Commissioner Brien Sheahan told Utility Dive that to achieve goals for renewables and DERs, utilities must deploy "computing power on a scale that's only economically feasible through cloud computing." These benefits aren't only for electric utilities.

In another Utility Dive article, Sheahan explained how some Illinois gas distribution companies are leveraging AI to reduce third-party damage: "By modeling the physical world that represents external threats facing our infrastructure, and applying AI, utilities can now predict instances of a variety of hazards allowing them to make smart operational decisions. Methane leaks, areas of corrosion, locations of cross-bores and high volumes of odor calls can all be predicted with AI. Third-party damages — when a construction company nicks a gas line, for example — are becoming more frequent in urban areas. AI is helping utilities intervene and potentially prevent 25% or more of potential damages caused by excavation."



> **To achieve goals for renewables and DERs, utilities must deploy "computing power on a scale that's only economically feasible through cloud computing."**
>
> *Brien Sheahan,*
> *Illinois Commerce Commissioner*

INITIAL STEPS TOWARD AN AI-ENABLED UTILITY FUTURE

For utilities that are in the early stages of investigating AI opportunities and how to pursue them, Miner & Kasch recommend beginning with a strategic advisory on their strategies for data, analytics and platforms. During this guided process, utilities can clarify their key overall challenges and opportunities, so they can design organizational goals and determine how AI can help achieve those goals.

The strategic advisory can also help utilities assess infrastructure options for managing large amounts of data. This can help a utility refine its plans to adopt or expand cloud computing in ways that will be economical and effective while also supporting experimentation, fast iteration and innovation.

"Computer vision and NLP, in particular, are very process-intense," said Kasch. "On-premise data centers are far too slow and unwieldy for AI. Without the cloud, it'd take a utility a year to set up their first application. But in the cloud, you can ramp resources up and down quickly, to develop and test new applications. This provides faster proof-of-concept to demonstrate ROI potential—and all with stronger cybersecurity than on-premise data centers can offer. This makes it both feasible and safer for utilities to experiment."

When selecting initial use cases for AI, NGP recommends that utilities consider starting with improvements to their planning and development processes.

> **Compared to other industries, utilities have a relatively limited number of asset types and configurations. That makes it relatively simple for utilities to use NLP, computer vision, AI and augmented reality to improve and accelerate how they plan and develop their power systems."**
>
> *Iliana Portugués,*
> *Head of Innovation for NGP*

"Compared to other industries, utilities have a relatively limited number of asset types and configurations. That makes it relatively simple for utilities to use NLP, computer vision, AI and augmented reality to improve and accelerate how they plan and develop their power systems," said Portugués. "That's much safer than starting with anything related to operations."

For example, a utility might initially apply AI to plan how to bundle jobs to consolidate planned outages for plant or grid maintenance and upgrades. "Human engineers might look at one job at a time, but AI can look years ahead to see maintenance and upgrade needs across the system."

Portugués also observed that many utility business processes are not unique to the utility industry. "There, you can start with existing algorithms developed for other industries. You don't have to develop all your algorithms from scratch," she said.

In NGP's outreach to tech companies on behalf of the utility sector, one advantage has been that utilities can make a compelling case for how tech companies can address key challenges to the planet and all of humanity. This can appeal strongly to the values of the founders and employees of tech companies, especially smaller and newer companies.

Often, technologists are not only seeking an edge in an emerging market for the technology sector; they also often seek a sense of purpose and value that goes beyond business — as well as exciting opportunities to demonstrate the practical value that their technologies can offer to people, not just to organizations. This tendency might help make utilities a more appealing market for AI developers, since AI is essential to realize two aspects of global sustainability: decarbonizing the power system and adapting to the impacts of climate change.

"I have no idea how you would decarbonize energy networks and deliver a net-zero society without digital technologies, especially AI and machine learning," said Portugués. "The challenge for utilities is not understanding what kinds of AI they need, but rather understanding what change is required to use them. Radical changes need to happen in how the utility industry works, to allow AI to work for utilities."

MINER & KASCH

Miner & Kasch is an artificial intelligence and data science consulting firm that helps companies build intelligent end-to-end, data-driven solutions. Our data scientists, cloud architects, and platform architects deliver industry-leading machine learning and data analytics systems that are functional, high-performing, and scalable.

We offer a range of services capable of providing solutions that meet your specific business goals. Whether it's a fully-managed team, staff augmentation, consultation, or professional training, we are here to help you make the most out of your vision.

Our data scientists, platform architects, and engineers form a team that is unrivaled in the industry. We bring to bear well-rounded expertise, strong academic backgrounds, and extensive real-world experience in cutting-edge big data platforms and AI methodologies.

LEARN MORE

Custom Content. Targeted Results.

Industry Dive's Brand Studio collaborates with clients to create impactful and insightful custom content. Our clients benefit from aligning with the highly-regarded editorial voice of our industry expert writers coupled with the credibility our editorial brands deliver. When we connect your brand to our sophisticated and engaged audience while associating them with the leading trends and respected editorial experts, **we get results.**

LEARN MORE