

Digital transformation in the age of energy volatility

How data can help the utilities sector turn uncertainty into opportunity





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The utilities industry is seeing unprecedented drivers to change and must adopt new ways of working, due to catalyst factors such as climate change, the war and COVID-19. The combination of these factors has exacerbated the challenge we face. We need stronger open collaboration across the industry, wider digital technology adoption, and ubiquitous use of shared data to rise to this challenge and hit our 2050 goal.

James Houlton UK Head Strategy & Solutions — Energy & Utilities, AWS

There's no silver bullet, no miracle cure or single solution that will fix everything overnight. There are also plenty of reasons to be optimistic about the future of utilities. For although it might all look—and feel —overwhelming, it is possible to break the sector's challenges down into a number of smaller areas of focus. Just as there are short-term problems and longer-term ones, there are solutions and resolutions that can be deployed now and in the future.

Greg Davis Client Principal, Global, Thoughtworks



Executive summary

The utilities sector is dominated by themes such as energy security, equity of supply and the drive toward net zero.

Any business leader trying to manage these challenges in a balanced way would be forgiven for feeling overwhelmed; knowing where to start is a challenge in itself.

A good place to start might be to understand that utilities businesses need the best information and insights possible in order to make the right decisions at the right time. That change begins with data — collecting it, analyzing it and using it to move forward confidently.

A host of supply-side disruptions have been reflected in a level of pricing volatility that has defined the energy market in 2022 and 2023. It created a level of uncertainty in the sector that brought the question of how to plan for and manage energy into sharp focus.

It is also vital to accept that the future of the industry is an uncertain one. Placing smaller bets and taking small steps toward new ways of thinking and working are, we believe, one of the characteristics of tomorrow's utilities success stories. That will mean migrating IT systems to flexible, cloud-based platforms that will support more Agile operational behavior, like the capacity to deploy new services quickly without making large investments. And it will mean gathering data with a real sense of purpose.

Data that can be analyzed to provide valuable information about customer trends, business performance, or market dynamics and beyond.

This research paper from Thoughtworks, in association with Amazon Web Services, is based on interviews with energy and utilities experts, on the challenges facing businesses like theirs and the industry.



Direction of travel: viewpoints and perspectives

In April 2022, the UK government and the energy regulator, Ofgem, published their response to an industrywide consultation on the future of the sector. The Secretary of State for Business, Energy and Industrial Strategy at the time, Kwasi Kwarteng, summed up the key challenges that need to be addressed:

"We need fundamental change to ensure we match the scale of our net zero ambitions... but also to implement this change efficiently so that consumer bill payments are kept as low as possible."

"This requires a shift to a more 'whole system' approach, coordinating the ever-more integrated electricity and gas systems, both onshore and offshore, while looking ahead to the emerging markets of hydrogen and Carbon Capture and Storage. And it is necessary that the rules and governing institutions of the system adapt and evolve to support and enable this transition."¹

^{1 &}lt;u>Business, Energy and Industrial Strategy & Ofgem | Future System Operator</u> <u>consultation response</u>

The magnitude of change needed to avoid the worst effects of the climate crisis is not to be underestimated. Nor is the challenge of balancing the push for net zero with the need to ensure that energy is affordable and available. That tension was voiced by several of the respondents to our research.

Sarah Williams, Director of Regulation, Asset Strategy & HS&E at Wales & West Utilities, told us: "We need to seriously model the whole energy system to understand our future energy needs to deliver net zero — we can't look at any one vector in isolation. A lot of this is centered around data — understanding where demands are, modeling the peak demand (when we need the most energy) and mapping this to supply. Ensuring the gas network, or the future hydrogen network, supports the electricity network to deliver reliable and resilient energy sup plier at the least cost to consumers here in the UK."

Modernizing the sector will necessitate targeted investment in cloud-based technology that offers the combination of power and flexibility that will be needed. Across the sector there is a wide variation in how these new technologies are regarded. Take the example of a future where smart homes run on smart devices that automatically manage energy consumption. Some of our respondents felt that scenario is just a few years away. Others estimated it was a long way off, maybe as much as 20 years.

Such disparities in the use of — and approach toward — technology can create the impression that those businesses who are not currently leading the way have already fallen a long way behind.

In fact, energy and utilities businesses can make important, incremental gains by focusing their efforts on taking smaller steps toward their ultimate desired future state.

As we will discuss, it is useful to think of modernization as having three levels or lenses — each incrementally future-proofing an organization, while feeding into a longer-term vision:

Operational

Improving the efficiency of operations.

System wide

At the next level up there are ecosystem operators trying to make things work as a standard. For the sector to improve in a step-change way, it needs much greater collaboration by the players involved. And because of innovation, change and complexity, the whole area of data interoperability (for example connecting IoT devices) is going to be a major issue going forward.

Future

At the top level, there is the longer-term future-looking piece, designed to drive the far-reaching changes envisioned by our research respondents.



The short-term Operational efficiency: from cost to revenue

Using data as part of a decision-making process is a relatively inexpensive way to maximize value on the journey from short-term optimization through to longer-term advancement.

For example, the use of predictive analytics can give early warning of customers who are likely to struggle in the current cost of living crisis so that organizations can offer proactive help and support. Equally, real-time data can radically improve an operation's ability to respond to changes in market conditions and customer behaviors. As markets mature, data could help, for example, to unlock a currently dormant market for surplus energy by connecting it with buyers — potentially in real time.

In a similar vein, digital twins use data from smart sensors to create detailed simulations showing the impact that even the smallest change may bring. One leading example of the use of digital twins is bp's APEX system, which creates a virtual copy of the company's production systems throughout the world. It has been used to great effect in the North Sea to help determine how to adjust production levels safely and efficiently. Advanced data analytics in areas such as AI and machine learning (ML) sit at the heart of better decision making — these require the right tools and skills but have the potential to revolutionize customer experience.

APEX delivered 30,000 barrels of additional oil and gas production a day during 2017 across BP's global portfolio.²

Data, data everywhere

The same data can be used in several different ways — in real time to control; in the medium-term to change behavior, and in the longer-term to deliver a lasting impact. The industry is already looking at areas such as acting on real-time data to improve decisions and building more accurate forecasting models.

As with digital twins, sophistication in data analysis varies across organizations and within different parts of the sector with renewable energy suppliers sitting at the more advanced end, gas suppliers sitting more in the middle and water being more behind the curve.

Many utilities organizations have much to do in terms of improving their ability to forecast. Of course, some parts of the utilities sector are actively using AI and ML to forecast and predict customer behaviors based on billions of data points and drive improvements in areas such as CX and responsiveness.

² BP Twin win for oil and gas production

This brings its own challenges. As one respondent put it:

There is going to be so much data that the human engineer at the receiving end may struggle to assimilate all of the information and make the right decision.

The respondent pointed out that organizations can't take risks with this. There has to be a balance between how the system is controlled: how much control is with humans and how much is managed by machines.



The medium-term: the rise of the ecosystem

Collaboration in a system-wide context is arguably where some of the biggest advances will come in the medium - and long-term. There are plenty of questions yet to be answered, including who owns the responsibility within each system, and how to define the roles for individuals, companies and regulators in this new ecosystem. It may also be the case that the ecosystem, by virtue of its members, should look to set interoperable standards, rather than wait for the regulatory process to do so.

There are already moves afoot to make collaboration more feasible. Yorkshire Water, which serves over five million households across parts of northern and eastern England, has partnered with the Open Data Institute and the Data Mill North to improve data transparency. "We are challenging our industry to be more open about the data that we hold and publish, as part of our promise to be more transparent about our business operations and to also encourage greater innovation within the sector," the company says on its website.³

³ Yorkshire Water | Open Data

UK Power Networks (UKPN) owns and maintains electricity cables and lines across London, the South East and East of England.

UKPN is one of 12 energy and utility businesses working together with local authorities and regulators to modernize operations and communications between them. It provides an interesting perspective into the future of energy ecosystems.

Partnerships for change

Speaking at a conference run by the industry publication Utility Week, UKPN spokesperson Charlie Barnes said: "Imagine the power of having a local authority, a water company, a gas network, and distribution network operators all working together to identify people in need of support and providing that support holistically."

Being able to work together effectively means it becomes possible to offer tailored support across customer advice and help, energy and water efficiency, heating upgrades, and assistance in the transition to net zero. This is a classic example of how data and digitalization can improve customer experience and enable organizations to drive customer insights and responsiveness in the industry.

One of the tools being used to reimagine communication and collaboration is blockchain. Thoughtworks and AWS helped a consortium of leading energy companies and banks — VAKT — create a secure digital platform that has made collaboration between competitors possible.⁴

⁴ Thoughtworks Case study

The organizations that make up the consortium are: bp, Equinor, Shell, Gunvor, Koch, Mercuria, ABN Amro, ING, Société Générale, Chevron, Reliance, and Total.

Their aim was to modernize the global commodities trading industry, by replacing time-consuming, manual post-trade checking processes.

Blockchain means all parties can manage that task in the same place for the very first time, removing the need for paper records being checked separately by both parties.



The longer-term: realizing a future vision

At the more visionary level, there is the future-facing aspect of data intelligence, designed to drive the long-term changes highlighted by our research respondents.

Our respondents painted a picture of the way consumers will use energy and how this will change over time. One scenario described a vision where consumers will all have a black box somewhere in their home driven by a smart device such as an Alexa. This will take a signal based on factors such as carbon intensity, price or demand, and will in turn control devices (e.g. turning off the fridge freezer or vehicle charging for an hour). From the consumer's perspective, this will just happen in the background.

In another scenario, there may be control measures where a consumer can delay charging so that a device such as an Electric Vehicle would charge between 5:00 and 6:00, the neighbor can charge 6:00 to 7:00 after that, and so on. This is an area that is being looked at for digitization from a network's perspective.

These scenarios suggest that there will be a number of new mechanisms in place. Managing a dynamic supply in an industry where you can't control the outputs (such as is the case for renewables) usually requires dynamic pricing.

So, for example, could a smart washing machine respond in real time to renewable energy unit prices changing due to weather conditions? There are a lot of questions about how this kind of scenario will work.

In particular, systems need to be able to talk to each other and where there is dynamic supply there needs to be dynamic pricing, which doesn't exist currently.

In addition, the long-term move toward zero carbon 100% of the time means that load shifting is going to be crucially important. We will need to be consuming energy when it's being generated and not consuming it in an evening when maybe it's not being generated so much. i.e. heating the hot water tank and charging vehicles at times when there is less of a spike in demand.

This move toward true demand flexibility means that we must have the ability to shape demand. And for this to happen, there has to be agreement on protocols, communication methods and a whole series of inter-related factors which need to integrate together and work seamlessly. At the end of the day, you can't have any single point of failure because we're relying upon it for security of supply.

All of this is possible but requires long-term strategic thinking and a will to co-operate. Digital technologies, Al and cloud will again play key roles as enablers but much wider systemic issues need to be addressed before vision becomes reality. This was encapsulated in one of the comments made to our interviewers by Jonathan Giff, Electrical Networks Operations Manager at SP Renewables:

There's a drive to have a green economy. And to do that, we really have to be digitally smart. To enable low-carbon technologies, both domestically and industrially, we really need to have a network that is sustainable.

To make it sustainable, we'll have to have the right control, monitoring and functionality in place — and to do that with the volume of data to be processed, you have to have it digitally.



Summary and conclusion

Our report has highlighted several key considerations for the utilities sector:

- In an increasingly complex market, the focus has shifted more toward affordability and sustainability of supply
- Although change is happening on an unprecedented scale, there are numerous restraining factors which are acting as a powerful brake on progress
- Consequently, visions for the development of the sector can almost seem out of reach
- However, digital technologies offer utilities companies a chance to drive change at a faster pace. So, organizations can make huge gains in operations, insight and efficiency without affecting their physical infrastructure
- By facilitating improvements in the short term, digitalization opens up a staged approach for making the long-term visions within the sector far more attainable
- En route to realizing long-term goals, collaboration both within and across sub segments of the industry will play a key role

One of the conclusions we reached was that utilities organizations should be doing more to drive themselves and the industry forward. Of course, many operational obstacles still need to be addressed before all the potential advances highlighted in this paper come to fruition.

However, with the right guidance from experienced digital partners such as Thoughtworks and AWS, organizations can navigate and then exploit both short- and long-term possibilities — without throwing everything up in the air.

Another was that time really is of the essence. Utilities are under the spotlight like never before so it's unlikely that the sector will be able to set its own pace. So, now's the time to get ahead and take advantage of everything that digitalization has to offer.

To learn more about how an Agile Data Strategy approach can turn uncertainty into opportunity, **book a free one-hour consultation session with Thoughtworks** today (subject to Thoughtworks qualification).

Methodology

Thoughtworks is a leading global technology consultancy that integrates strategy, design and engineering to drive digital innovation.

Toward the end of 2022, we along with Amazon Web Services (AWS) embarked on a series of interviews with prominent experts from the energy and utilities sector.

We wanted to hear their thoughts on the challenges facing businesses like theirs, and the industry more generally. After all, this is a critical time for the sector, especially in Europe. Safeguarding operations and customers has probably never been more necessary than now.

The interviewees talked to us about a range of issues affecting the industry now and into the future, including:

- Maintaining sustainability efforts during economic turbulence
- Using technology to create more resilience and flexibility
- Balancing the need to manage costs with the desire to invest in innovation

Those views have helped inform the research at the heart of this report, which we hope will capture the essence of some of the biggest challenges facing this vitally important sector of the global economy.

The research for this report was conducted by our partners at The Marketing Practice, via telephone and video call during October and November 2022. Thoughtworks is a global technology consultancy that integrates strategy, design and engineering to drive digital innovation. We are 12,000+ people strong across 50 offices in 17 countries. Over the last 29+ years, we've delivered extraordinary impact together with our clients by helping them solve complex business problems with technology as the differentiator.

