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A digital edge in the new energy world



Giuseppe Di Franco

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Over the last ten years, it has become absolutely clear that leadership in the new energy world can only be achieved by those companies with a digital edge. In significantly deregulated markets, characterized by the rapid growth of decentralized operation and renewables, digital vision is a prerequisite for sustainability and success.

The thought-leadership pieces in this publication explore the opportunities energy and utility companies have to grow by reinventing their ways of working and creating new value chains and innovative partnerships. Looking ahead, all successful utility operating models will be data-driven.

Major transformation is key to ensuring that companies retain customer loyalty and create strong foundations for delivering this industry's digitally-enabled future. This will enable energy and utility companies to become key players in connected ecosystems in which businesses and citizens can thrive.



Paul Da Cruz

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The world is being permanently reshaped by COVID-19, emphasizing more than ever, our reliance on the services provided by energy and utility companies. For millions of people, the home has become more than just a place to live. It's also the place where we work and learn and this, inevitably impacts both the volume and pattern of power usage.

Utilities, in turn, must create and deliver services which are increasingly agile and responsive to the demands of both residential and business clients. Against this background, we are also seeing an irreversible shift away from fossil fuels toward renewables. The "green industrial revolution" is taking center stage on multiple fronts where the demands for more sustainable, clean energy options are leading to credible plans for real change.

For over 40 years, Atos has worked in close partnership with many of the world's foremost energy and utility companies. Our own emphasis on digital transformation make us a natural partner for forward-thinking energy and utility players.

Megatrends in utilities: the rise of a decentralized energy world



50%

of utilities will integrate IT and OT security unifying data governance to mitigate physical and cyber breaches by 2026



20%

of digitally determined utilities' revenues will come from new products and services by 2022



55%

of utilities will use a core digital platform to automate, optimize and orchestrate all assets and processes by 2022



\$138bn

to be spent on smart homes on 2023



\$7.2tn

will be invested by utilities in residential energy storage by 2025



\$4.6bn

will be spent on smart grid data analytics by 2022



45%

of grid operators will have deployed AI to enable resilient and flexible management of the grid by 2023

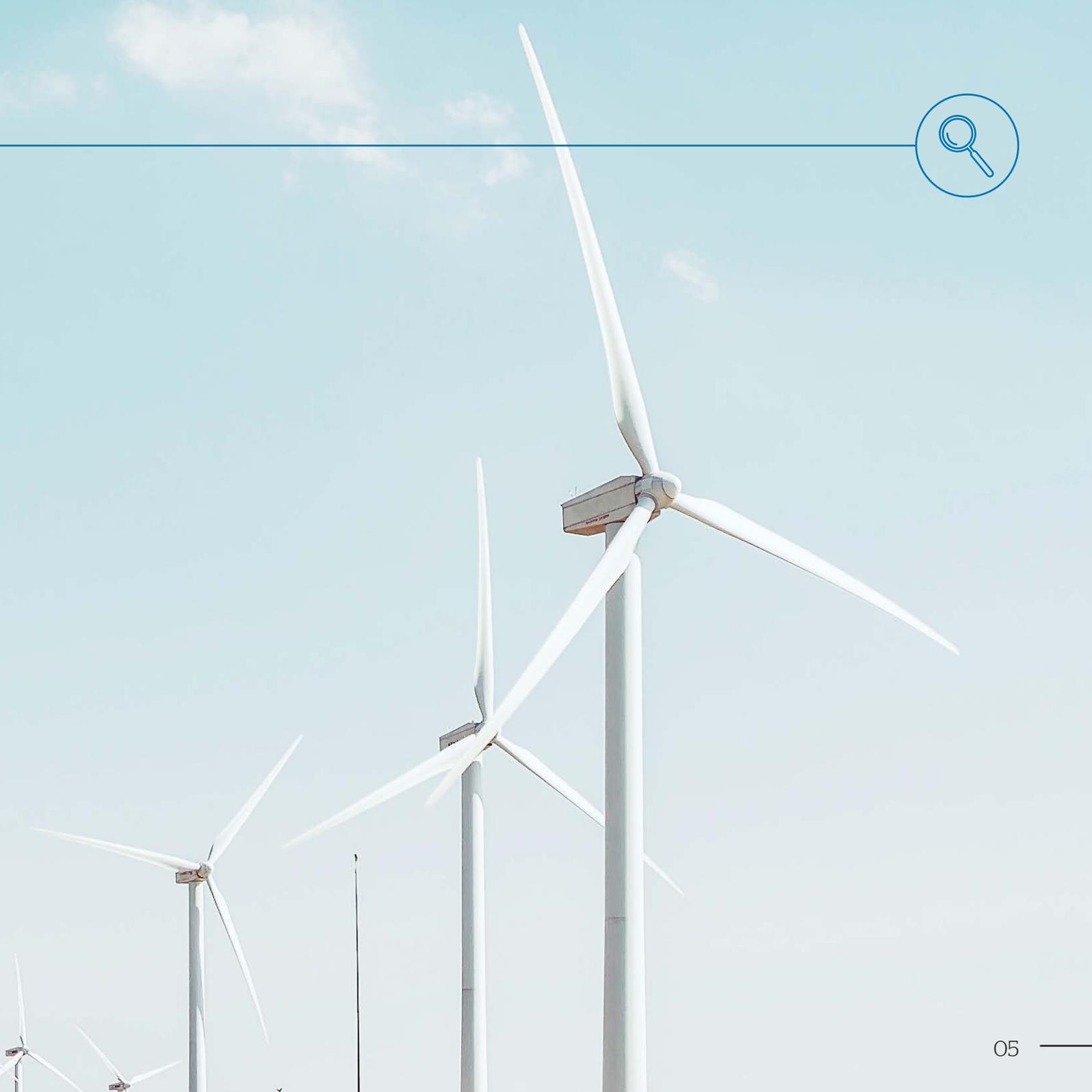


35%

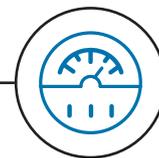
of energy utilities will drive at least 30% of their business via digital platforms based on cloud native technologies by 2025

Sources: IDC, Markets and Markets, Transparency Market Research, International Energy Agency









Classic utilities: leading digital value generation

Established utility companies are in pole position when it comes to taking full advantage of digital opportunities. Their chances are simply out of reach of the newer, smaller players. But some traditional players see the road to digital as a tough one.

The digital journey may not be as daunting as it first seems. Before exploring why incumbents are ahead of their more agile counterparts, let's start by taking a quick look at why digital is essential for established utilities.

Overwhelming drivers for change

Climate change; renewable development; tougher regulation; resource and market uncertainty - utility companies face formidable forces for change. And we shouldn't forget their customers. Whether B2B, B2G or B2C, customers are looking for new ways to interact with their energy providers in pursuit of energy efficiency and environmental responsibility.

Established utilities must develop new services that offer their customers more interaction. Classical service providers must adopt new business models, or newer players will become the intermediaries - or even replace them entirely.

Not every utility is succeeding in managing change. Many analysts see classical utilities being constrained by their infrastructure. However, digital is enabling change - helping utilities reinvent business models.

Digital offers utilities the opportunity to transform the value chain from generation to the end-consumer. New business value comes from smart cities, mobility and renewables: domestic solar not only changes the network, for example - it also gives distribution companies opportunities to develop new services.

Change isn't so hard

Change both pushes and pulls traditional utilities. Digital is a must for survival and is also simpler than many would anticipate.

Many utility companies are already advanced on the digital journey; they have connected digital systems interacting with their business - and it is not just smart meters that are game changers.

In generation, all assets are connected to digital systems. In transmission, to optimize and manage grid flexibility, TSOs are developing increasingly advanced functions on top of SCADA systems. For distribution, digitization is more recent, but adoption is accelerating. Retail has also made huge investments in digital, far beyond invoicing and CRM.

We do have a digital dilemma: legacy systems and the data they generate is both a threat and an opportunity. The weight of legacy may pose a barrier to change, but the volume of data gives utilities chances to develop new services and more value.

Data puts incumbents ahead on the grid

Established utilities' huge data volumes mean they can develop new business models more quickly and more efficiently than agile new entrants.

Years spent aggregating data can kick start both machine learning and AI. Transmission and distribution companies can exploit data to analyze their estates for predictive maintenance and indeed, long-term investment planning.

Incumbents can create even more value by connecting previously siloed systems. Digital twin, for instance, unleashes value by aggregating asset information from Enterprise Asset Management with information from operational and external IoT systems. Connecting and sharing data between these can bring immense value in generation and grid - both transmission and distribution.





Sustainability and the digital value chain

Climate change and population growth are two of the biggest threats to sustainability. The UN Paris Agreement aims to limit global warming to 1.5°C by cutting greenhouse gas emissions, primarily by reducing fossil fuel use. But an increasing population needs more energy, with fossil fuels being their primary source today.

How do we provide energy for a growing world population while reducing emissions? Improving sustainability demands a move from fossil fuels to renewables and electrification. A recent McKinsey report on 'The future of energy' explores how the move in this direction is accelerating. A third element is essential to addressing the sustainability challenge: digitalization.

Sustainability is about wellbeing too

Many areas of society are moving from fossil fuels to electrification to address sustainability. In transport, for example, internal combustion engine emissions decrease as we move from petrol and diesel to electric.

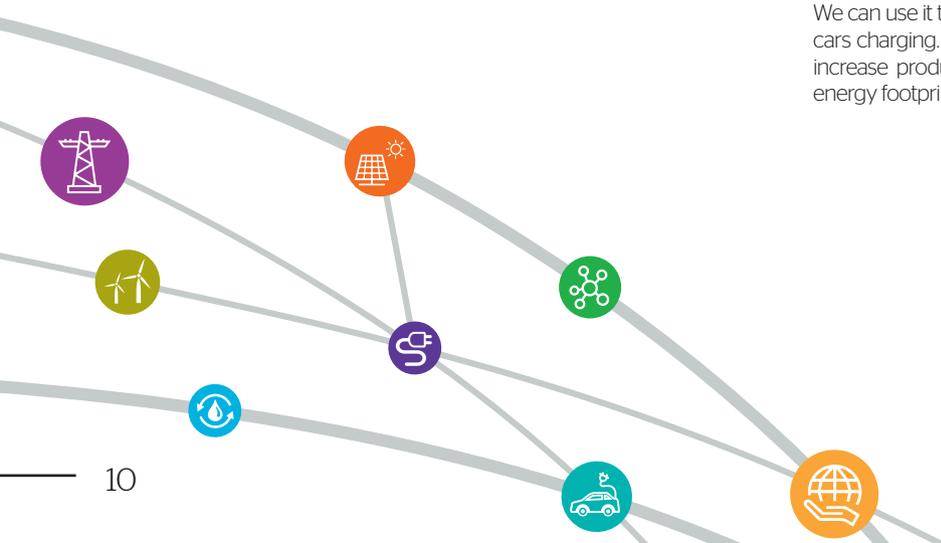
However, it is not only about reducing emissions. We need to take wellbeing and quality of life into account too: sustainability must be compatible with societal development. Renewables and electrification can help here too.

Cooking is one of the biggest sources of energy consumption. Many households in the developing world cook with firewood, charcoal or even dung. The smoke emitted is not just adding to greenhouse gases; it's also a substantial health risk. Home grids that combine solar with LED lighting and in-home electricity supply can give reliable energy for light and cooking. The electricity is clean, from both public health and environmental perspectives. It brings even more social benefits: allowing study at night and keeping mobiles and essential tools charged.

Electrification and digitization go hand in hand

Moving from fossil to electric has another great benefit: it makes consumption easier to manage in real-time. It allows us to implement tools to balance production and consumption in ways that are efficient, effective and sustainable. Flexibility will increase as distributed energy storage gains momentum.

We can also use digital to forecast what types of renewables are available. We can use it to forecast user demand, by estimating the number of electric cars charging. We can ask consumers to reduce their use or prosumers to increase production. By combining these elements, we can optimize the energy footprint at different scales, from single homes to entire continents.



The image features a serene sunset scene with two wind turbines and solar panels. The sky transitions from a deep blue at the top to a warm orange and pink near the horizon. In the foreground, several rows of solar panels are visible, their dark surfaces reflecting the ambient light. Two wind turbines stand prominently in the mid-ground, their three-bladed structures silhouetted against the sky. The overall composition conveys a sense of clean, renewable energy.

Europe already has 'zero emissions' microgrid islands based on solar and wind combined with storage. Digital intelligence automatically manages the balance between production and consumption through monitoring, alerts and more.

This is important. Increased use of renewables and growing electrification leads to a drop in fossil fuel consumption - but that's not enough to meet UN targets. Only through digitization can we take advantage of renewable energy and electrification to meet those targets while, producing the energy people need.

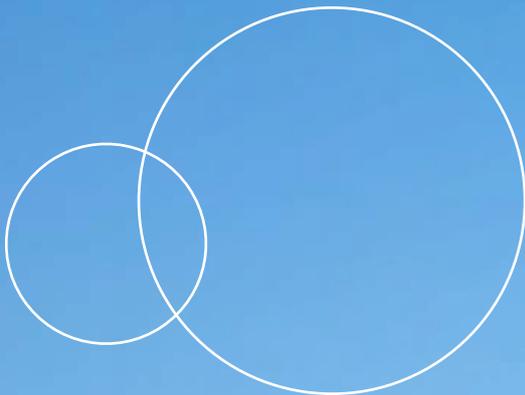
Digitizing the energy value chain

Digitization also brings the various players in the energy value chain closer together. Every player in that extended value chain needs to exchange information with other agents on the wider energy network so they can work together to manage energy efficiently.

Take electric vehicles, which could help balance production and consumption in real-time. They can recharge if there is a peak on renewable production or stop doing so if the demand on the network can't be fulfilled. Car batteries could also be used as storage. For this to happen, systems in the energy value chain must interact, and the way to do that is through digitalization.

Optimized and reliable infrastructure

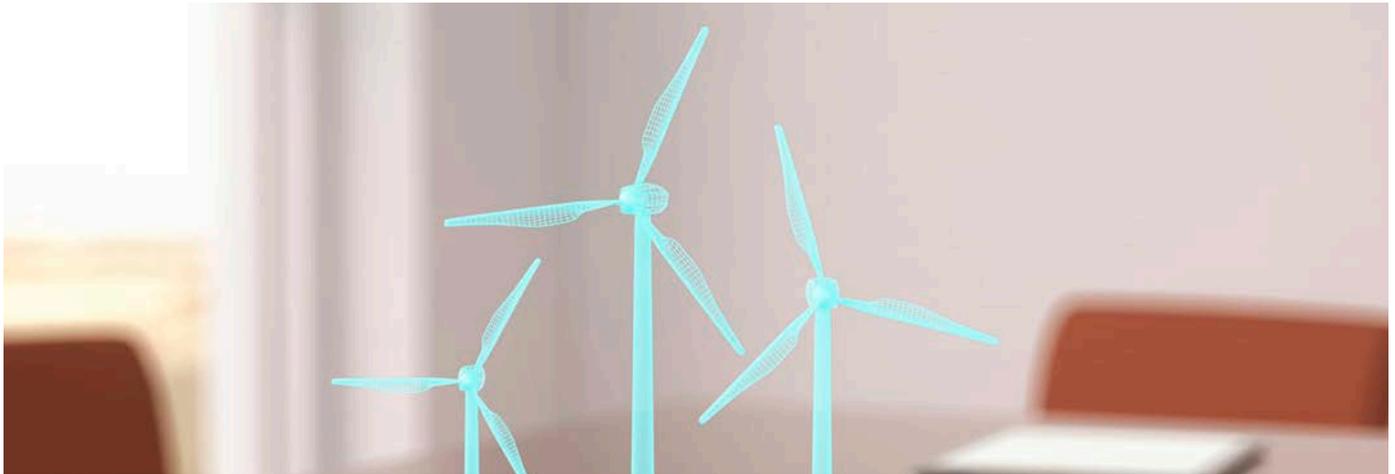
Safe, efficient and cost-effective plant operation and maintenance is critical for every utility company. How must digital technologies be applied to optimize operations and equip a new generation of personnel for maximum productivity?





Digital twins: enabling performance benefits

The digital twin will impact the entire energy and utility value chain - improving performance of power generation plants; high voltage distribution networks; low voltage transportation lines; sub-stations and more.



While the term dates back to 2002, digital twin is still work in progress. It's complex, but when it does arrive, along with huge performance benefits, digital twin also poses digital dilemmas.

Meet the digital twin

The term digital twin has changed over time. My preferred definition was presented by Siemens in its 'Next Generation Digital Twin' conference paper:

"A comprehensive physical and functional description of a component, product or system together with all available operational data. This includes more or less all information which could be useful in all - the current and subsequent - lifecycle phases."

In other words, a physical asset, process, system or service across its lifecycle in combination with its digital representation and the information created during its design, manufacture and operation.

Looking into the future, the paradigm of the next-generation digital twin, according to Siemens, is:

"The comprehensive networking of all information, shared between partners and connecting design, production and usage."

A digital twin example

Consider a wind turbine, with an engine inside, and bearings inside that. A fully-shaped digital twin includes all the sub-components of the turbine and integrates the data of all those components.

The information is both internal and external. Data crosses the design and production of each component and its lifecycle management, maintenance and day-to-day running. It might also include the financial and wear data that drives maintenance programs.

Designing a fully-shaped digital twin that includes all the turbine sub-components is complex.

We expect digital twin to mature in around five years - but the triggers are here today:

- Increasing deployment of IoT sensors to provide sufficient data
- Sufficient computing capacity available at a lower price, and
- New components and analytic algorithms support the design of complex scenarios.

Conflicts of interest

Having introduced the digital twin, a first digital dilemma relates to conflicts of interest between stakeholders across the value chain. These range from component manufacturers and sub-contractors through to the digital twin end-user company. Let's stay with the wind turbine example.

The first conflict of interest concerns trust and shared economic benefit. The turbine is manufactured and sold by one company but has internal components made others. Each company wants to sell added-value services based on the digital twin to the end-user - the energy generator.

But who owns which data? Who can deliver these ancillary services to the end-user?

The sub-component manufacturer may not be able to. All the benefits go to the primary manufacturer, the company selling the turbine. This is our first conflict of interest.

Creating mistrust

You can also have a conflict of interest between the manufacturer and the end-user. While transparency may build trust, it also puts pressure from the customer on the provider. Should manufacturers give end-users a complete view of the digital twin?

Can the manufacturer also include specific algorithms to enhance their own business - relating, for example, to maintenance and spare parts? This might create mistrust.

A possible workaround would be for the provider to adopt a pay-as-you-use business model. They could then recreate trust around that alternative service-based model.

The end-users, on the other hand, face a procurement dilemma. They don't want the risk of reliance on a single provider. For them, one workaround is to bring digital twin capabilities in-house as part of a 'web of systems'. Other, more trusting, end-users might slice different parts of their grid, so no manufacturer is in charge of the full stack.

Losing control

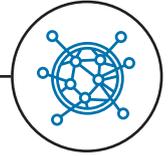
The second digital dilemma concerns losing control and 'human agency'. Complex systems with multiple sources of data mean you need to think about data governance and the ability to understand results.

Only if you have "fair access" to the data can you be confident in the output of the digital twin. Are you sure the ingested data mirrors reality, is up to date, and has not been modified?

As humans, we may no longer be able to manage or understand decisions suggested by algorithms. Can we accept what our system is saying - and how it is reacting? And what about the potential consequences of its actions? We may not understand these either.

So, how much can we accept from autonomous equipment when its decisions may be beyond human understanding?

Digital twins are just one example of the numerous new digital technologies utilities need to remain competitive. These new technologies bring new digital dilemmas.



IoT as an innovation catalyst

With different utilities companies at different stages of digital maturity, there is broad recognition across the industry of the critical role that data will play in its successful evolution. Yet with a vast array of technologies available, there can be confusion for some players about the next steps on their digital journey.

What is the optimum investment profile? How can they bring together data from the field and from the back office? And how do they orchestrate solutions that identify and then sustain real value?

Rapid connectivity

With the arrival of the Industrial Internet of Things and Industry 4.0 (cloud, automation and artificial intelligence), industry is now at a tipping point. Powerful technologies are converging in a way that enables companies – at scale – to connect real objects to the digital world, aggregate rich data, and turn that data into game-changing insight and value. Along with the automotive industry, the water and energy sectors are thought leaders in this domain.

At Siemens, we are working with utility companies to harness data to address significant business problems. By integrating streams of data from operational technology and information technology, real transformation becomes possible.

Transforming processes

One key domain in which data is now being exploited is diagnostics and preventative maintenance of plants and infrastructure. Real-time data from sensors, such as vibration analysis on water pumps, is analyzed to identify maintenance and repair issues even before a problem occurs, reducing downtime and improving the overall efficiency and effectiveness of the plant.

Another major area is operational efficiency: using data to analyze a process and identify where any delays are occurring. Extracting and integrating this data – sometimes from a number of different sensors to infer what is happening – produces a picture of the entire process.

Being able to integrate that data into business decision-making is a massive step forward for industry.

As far as business benefit goes, using data from sensors, for example, to predict a maintenance issue immediately increases efficiency.

Yet if companies can also use information about a vibration change or a temperature increase to uncover a problem either upstream or downstream in the process, the benefits multiply. This kind of real-time, holistic view is unprecedented – and is the reason why new collaborations between different parts of the organization and between specialist providers are now so crucial.

Rapid advances

Use of IoT and analytics is developing very fast and we are seeing new innovations every day. Smaller companies are driving a lot of the ingenuity and product innovation, such as new more easily installed battery-operated sensor technologies. Yet the step changes in value lie in the data that these sensors capture – and the ability to spot and act on opportunities along the supply chain, such as offering water quality as a service, rather than providing individual technology and engineering solutions.

Increasingly interventions will become automated and upstream to downstream operational machinery will be self-learning, sharing data back to control. In the meantime, a new realm of engineering is opening up, with an urgent need now to invest in training and competences to develop the engineers of the digital future. We also need to continue developing horizontal agility, with learning and collaboration between partners and colleagues to bring new solutions into the market.



Learning from other sectors is important here, to look at business problems in new ways to deliver truly transformational change. Although this space is very fast-moving, with industrialized, flexible and ready-to-use IoT and analytics solutions already available, now is the time for utility companies to start optimizing their data for competitive advantage.

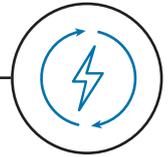
Connecting data, machines, people and processes - an agile approach

MindSphere is a secure, scalable, ready-to-use and cost-effective cloud platform with seamless connectivity to collect and utilize data. It offers a wide range of connectivity protocols, industry applications and advanced

analytics to give organizations immediate access to applications and services for collecting, aggregating and getting value from data. MindSphere's open Platform as a Service capabilities support a rich partner ecosystem for developing and delivering industry applications.

As a strategic digital partner for Siemens, Atos offers strategy consulting and a MindSphere incubator approach to kick-start agile MindSphere application development.

Atos also provides all integration, infrastructure and security services needed to build customer-specific applications on the MindSphere platform.



Machine learning for load balancing at the edge

Wind. Solar. Tidal. Waves. When it comes to energy production from renewable sources, we're often at the mercy of nature. Intermittent energy production is unpredictable.

In any energy network, balancing production and consumption is critical. But how do you do that with unpredictable energy sources? Is there a more efficient way to balance the load on the grid when the mix is diverse.

The end of the centralized energy grid

Traditionally, the TSO (Transmission System Operator) is responsible for balancing the high-voltage power, managing the energy produced by power stations. That all changes when energy production comes from intermittent renewable sources.

Over 90% of intermittent energy production is local and is managed by the DSO (Distribution System Operator). This energy is then fed into the TSO-managed grid. Regulation stipulates the TSO must balance this.

The latency that occurs when local energy is fed into the high-level grid makes load balancing difficult for the TSO. Studies have shown that when load is balanced centrally and more than 35% of the energy produced comes from intermittent energy sources, there is a significant risk of the grid becoming challenging to manage and even unstable.

Feeding energy produced at the edge of the grid into the central TSO grid can lead to significant technical losses. These are due to resistance in feeders, cables, overhead lines and transformers. The further the power has to travel, the greater those technical losses.

Local load balancing on a decentralized energy production

Latency and technical losses can be reduced by decreasing distances. This leads us to the idea of balancing production and consumption locally. With local load balancing, energy production and demand is managed locally by the DSO. This minimizes the distances from the point of production to the high-voltage network.

This demands excellent local forecasting of production and consumption. Machine learning will play a vital role, utilizing knowledge of the local weather, the topology of the local grid and end-users' consumption profiles to forecast production potential and consumption.

Local load balancing lets DSOs avoid the 35% limit for energy production from intermittent sources. This enables an increase in the use of intermittent energy sources without risking the grid becoming unmanageable or even unstable. By avoiding latency, DSOs can react to changes to demand in pseudo-real-time.

Machine learning for load balancing at the edge

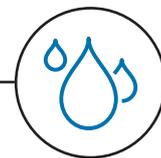
We have verified the concept of local load balancing in the SMAP smart grid demonstrator led by Enedis and Auvergne-Rhône-Alpes Energie Environnement. The SMAP project is built around France's first photovoltaic village, the rural municipality of Les Haies in the Rhône valley. The village has 810 inhabitants and around 500 m2 of photovoltaic panels.

With our partners, we demonstrated how new infrastructure and communication technologies can enable the dynamic management DSOs need. We used machine learning to forecast production in intermittent energy sources accurately. This made a local system based on intermittent sources predictive, communicative and controllable.

The pilot shows a future of energy production enabled by information technology. For the TSO, it confirmed the viability of a well-balanced decentralized national grid.

Local load balancing is a critical in enabling utilities to ensure the grid remains manageable when over 35% of energy is produced from local intermittent renewable sources.

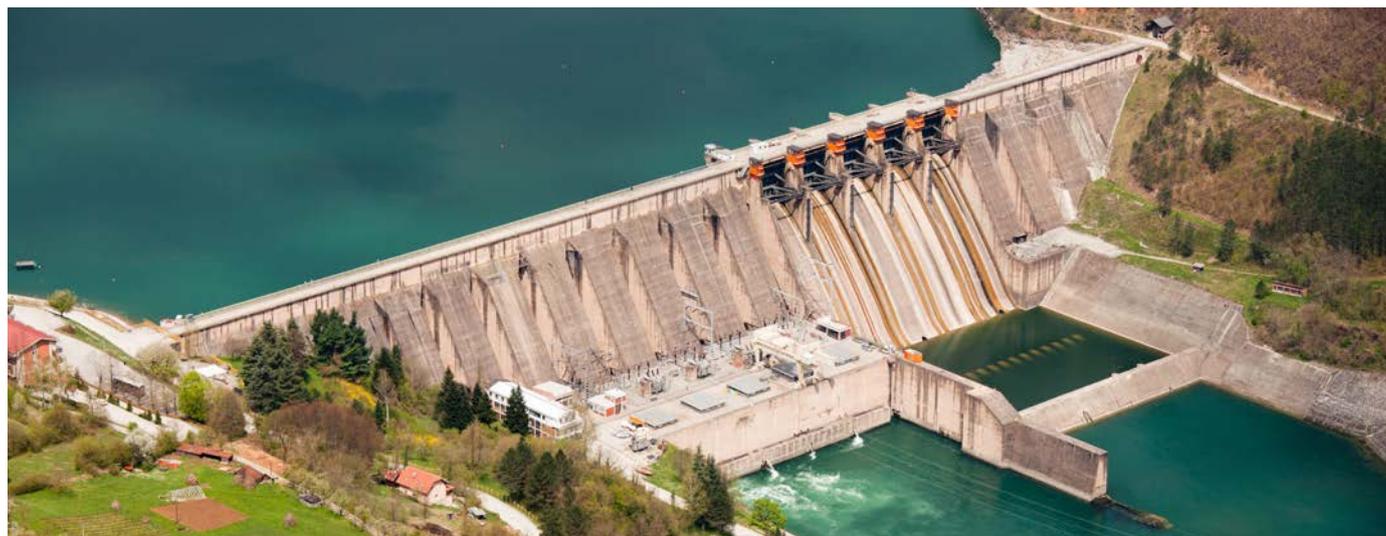




Hydropower analytics: ready for innovation

For many years, utilities have been leading exponents of scientific data analysis - applying it to forecasting for generation and consumption, and for optimized trading.

We are now seeing significant changes in both the operational models affecting hydropower, and in the ways in which analytics, cognitive computing and the Internet-of-Things can be turned to operational advantage. In this new landscape, open data becomes particularly important.

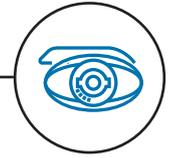


Hydropower and the changing renewable mix

In many parts of the world, we now see renewables delivering more power than fossil-fuel. The mix gets richer, with wind, wave and solar all combining with hydropower to create a socially and industrially viable alternative to fossil and nuclear. According to World Energy Council research, hydropower makes the largest contribution to the renewable mix.

Renewability is not just about generation. It's also about the scale and the business model. Renewables have become an option for local control. This is evident at domestic, metropolitan and commercial level.

In hydropower, we now see utilities operating multiple installations as part of a distributed grid in which smaller local players can also make a viable contribution.



Extending capabilities for the field workforce

Technology drives disruptive change. Robots, AI and process automation are radically changing the nature of work. To remain competitive, utilities must adapt quickly, adopting new business models, tools and processes. How will the utility workforce keep up?

Employee empowerment

Utilities must turn technology threats into opportunities. By taking a human-centric approach to reskilling and flexibility, they can empower their employees, reducing mundane tasks and improving work/life integration and balance.

Take bots and AI as an example. These technologies enable automation but, they also allow employees to leave behind repetitive tasks and focus their unique human skills to deliver value.

When adopting new technologies, involving employees is key both in ensuring the workforce thrives but also in avoiding unanticipated outcomes. Not including the workforce in the design and implementation of new technologies increases the risk that they won't work effectively.

In Japan, companies like Toyota and Honda are embracing the idea that workers give wisdom to the machines and not the other way around. They started to focus on the most difficult or most dangerous jobs and where workers would be happy to see technology improve their working lives. Their initial successes allowed them to progress to other areas.

Extending capabilities in the field

Let's explore some specific examples of how technology could improve work for utility field service engineers. Combining mobility, augmented reality, wearables and contextual information with social networking and gaming principles can help field service teams. These technologies are particularly interesting for engineers working in remote or hostile environments, or where local service teams are less skilled.

Take an engineer repairing high-voltage power lines high in the mountains or water pipes buried deep underground in a remote region. They may be working in the wind or rain and likely with gloves. Reading paper-based documentation is almost impossible.

Today there's no reason why they can't be shown a virtual exploded technical diagram or a virtual image of what may be hidden behind meters of earth or concrete. The same augmented reality technology can provide contextual documentation through a pair of smart goggles.

Technology can also help anticipate what expertise will be required for job allocation. Augmented reality visualization techniques can be used when the field engineer lacks specific knowledge. With augmented reality and communication techniques, engineers can now collaborate with a remote expert for step-by-step guidance.

Improving worker experience

In both examples, technology improves the efficiency of the engineering team while also reducing risk and cost. It empowers engineers to do more. They are no longer expected to know all the facts and data; they simply need to be able to ask the right questions.

The wider adoption of these technologies will free employees from mundane tasks and bring what robots and automation can't deliver: complex problem solving, creative design thinking, adaptability and social interactions.





Cognitive cybersecurity: protecting critical infrastructure

Edge devices, the Internet of Things, wearables and swarm computing: emerging systems are enabling new utility business models. But they can also expose critical energy networks to new security threats. In a hyperconnected world, utilities will need to adopt new approaches for protecting their Operational Technology (OT). A cognitive cybersecurity approach is vital for protecting critical infrastructure.



IT has opened the door for an attack on OT

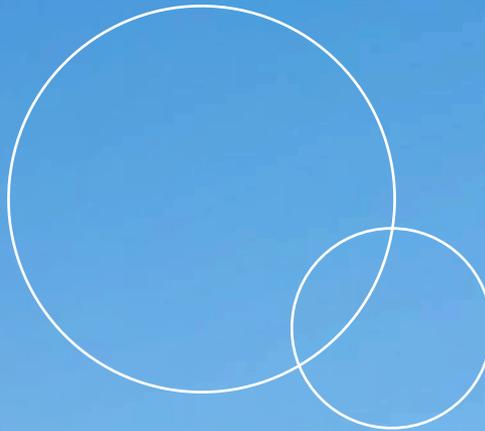
Until recently, utility companies used specific digital tools for specific tasks. The tools that controlled electricity and gas flow and the sensors on mechanical turbines in power plants, for instance, used specific software that ran on specific hardware and used specific protocols.

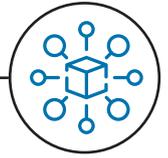
All that has changed. OT and information technology (IT) are now not as separate as people may think, with OT systems exposed to internet attacks far more easily than operators may realize. Servers using vulnerable operational systems, for instance, can now put OT at risk.

Both the risk and potential impact are growing. As the gap between OT and IT shrinks (or disappears outright), a malicious person could steal data - or even shut down a plant. The safety and security impact could be even more serious - sending regions into chaos and putting lives at risk.

Intelligent real-time grid management

Decentralized generation and the rise of renewables have changed the grid and grid management forever. The monolithic utility of the past which sold units to customers in a captive market has no place in the present or future industry landscape. How best can utilities weave AI, IoT, edge computing and other digital technologies into winning grid management strategies?





The shift to decentralized utilities

The monolithic and centralized utility models we are used to are now challenged by one critical imperative: the transition to clean energy. To make this change requires a new type of energy infrastructure and a new business model – and both have decentralization at their heart.

When we think about decentralization in energy, our natural focus is on massively distributed renewables. It's a major shift, but the change doesn't end there.

Control of the power network itself is becoming more and more decentralized. In part, this is made possible by the increased computational and communication power of network devices.

In parallel, the utility business model becomes decentralized too. In the old model, monolithic utilities sold energy by the kilowatt as a straight commodity. In the new model, utilities can only create differentiation by offering high-value energy-related services. These must appeal to a new breed of advanced prosumer - people who expect engagement over smart digital business platforms.

Decentralization is now central to innovation and transformation.

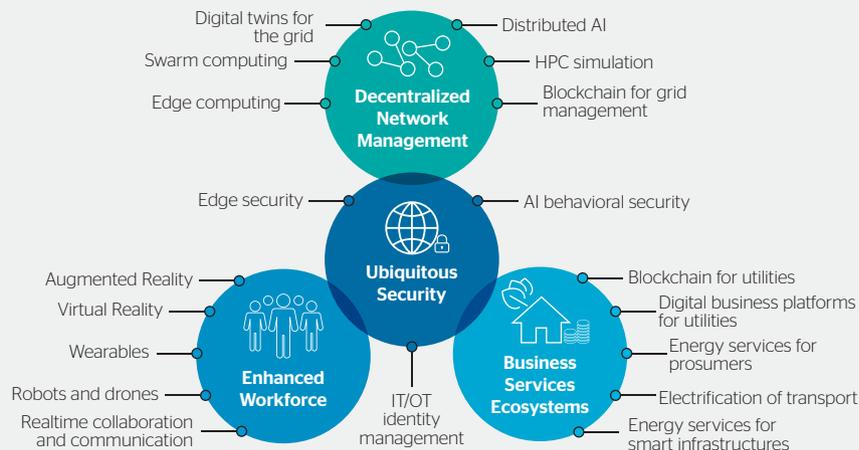
The technology building blocks

What are the core technology building blocks needed for these new decentralized operational and engagement models?

The figure below shows the four principal technology areas enabling the new model i.e. Decentralized Network Management, Business Services Ecosystems, Enhanced Workforce and Ubiquitous Security.

Beyond these four categories there are other technology developments set to have a major impact on newly decentralized utilities.

Foremost among these is Blockchain and its related hyper-ledger technologies. Microgrid management, peer-to-peer energy markets and electric vehicle roaming initiatives are just some examples of where Blockchain already shows promise for utilities.





1	Decentralized Network Management	Edge computing pushes processing right across the power network, allowing us to distribute and coordinate AI on an unprecedented scale. With swarm computing we can decentralize energy network control and intelligence. We establish the digital twins needed to ensure that physical and digital worlds are in lockstep.
2	Enhanced Workforce	Despite massive automation, many important tasks will still be carried out by skilled engineers. The way that utility professionals work will, however, be increasingly enhanced by timely and contextual access to digital data of all kinds.
3	Business Services Ecosystems	The decentralized utility is part of a business service ecosystem. For domestic customers, utilities must facilitate integration with smart home devices and renewables. The ecosystem spans relationships with transport and automotive; public sector engagement; and the manufacturing industries.
4	Ubiquitous Security	Power networks are now key targets for criminal and terrorist cyber-attack. The millions of customer relationships which utilities routinely manage must be protected with equal effectiveness. Centrally imposed and managed security policies must now become both more adaptive and more proactive.

New models need new attitudes

For management, the transition to decentralized utilities is not fast or easy. Utilities must balance central generation with massively distributed renewables.

With this co-existence between centralized and decentralized models, utility companies are also under pressure to integrate new services and modes of operation with legacy systems and practices.

Utilities must learn how multiple operational and commercial elements within their business can follow a common direction while remaining ready to flex as conditions change.

Only by embracing decentralization can utilities gain the adaptability needed for business innovation, while delivering the overall efficiency required to ensure long-term sustainability.



Edge and swarm in smart grids

With vast numbers of IoT devices producing incredible data volumes, generating companies are already seriously considering the edge computing model. Can edge and swarm models outperform 'cloud only' and centrally-based architectures?



Let's examine a concrete example, showing how edge and swarm offer a scalable option for managing the high penetration rate of distributed renewable energy resources into an electrical grid.

Why we need edge and swarm

Cloud computing models locate the resources needed to process IoT data centrally. The incredible volumes of IoT data must be transmitted across networks to be processed and analyzed. The ultra-low latency required is far from guaranteed.

Edge computing offers the answer. Putting compute capabilities very close to the asset reduces both bandwidth and latency. Connected edge devices - with their small physical footprints, low energy

consumption and intrinsic computing resources - mark a shift away from reliance on centralized data centers in the cloud.

Edge nodes interact in a dynamic ecosystem of connected devices, edge compute capability and cloud-hosted services. Orchestration of this collective capability results in dynamic computing swarms able to deliver context-driven services.

This swarm computing offers a new approach for deploying a continuum of collaborative IoT and cloud strategies able to handle the most complex scenarios dynamically.

Renewable energy sources join the grid

Consider a future electric grid where massive numbers of photovoltaic panels coexist with new storage capacities, including batteries and electric vehicle charging stations. This distributed production topology risks production peaks that compromise both the balance of the grid and the power quality.

Today's grids are managed centrally: with a top-down topology, power flows unidirectionally from large production to consumer. At peak production, local fallback mechanisms prompt distributed production nodes to automatically go off-grid to preserve balance. Corresponding energy production is lost as a direct consequence.

This management strategy is not viable in a grid with a relatively high ratio of distributed energy production. A smarter grid management strategy must be capable of:

- Forecasting local production peaks at every grid node
- Querying the grid for available energy storage capacity and
- Reconfiguring the grid before it becomes unbalanced.

Edge and swarm critical to the smart grid

We could stick with the present mode of operation. While technically feasible, grid nodes – both production and storage – would need close monitoring. Potential drawbacks include:

- Significant data and processing overhead for the central system
- Investment required to connect and instrument additional grid nodes
- Resiliency issues from OT/IT communication failures.

A mode of operation based on edge and swarm is a better option. Using 'smart node' software, a mesh of smart nodes is deployed on fit-to-cost ruggedized hardware at production and storage nodes. These nodes host an *ad-hoc* local production forecast algorithm for local production peaks.

Visibility of peaks means nodes can work autonomously to maintain resilience. If a node senses imminent disconnection, it proactively communicates with nearby edge nodes to seek storage capacity. After consolidating details of current storage capacity received from peers, the requesting node conveys the optimal grid reconfiguration option to absorb the anticipated production peak to the central system. Benefits include:

- No data or processing overhead for the central system
- Better resilience - communication takes place at the edge and only when necessary
- Ability to deploy *ad-hoc* local algorithms at the edge for better forecast accuracy.

Overcoming digital dilemmas

A solution based on edge and swarm is a safe and scalable option that operators can deploy as an extension to existing central systems.

In crafting a strategy for your adoption and deployment of edge and swarm, it is particularly important to examine all aspects of trust and security. Your newly extended environment will, by definition, be both highly heterogeneous and dynamic. This demands an approach which takes numerous new factors into consideration. These include:

- Distributed ledger technologies - these may underpin new trust mechanisms
- P2P mesh architecture - now emerging as an ideal model for defining communication requirements
- Data-driven security principles - the paradigm shifts when data can be stored almost anywhere, and
- Information-centric networks - which show real promise in overcoming network failure and overload.



Energy storage and the new energy mix

As we enter a new era in utilities, batteries have a critical role. With the new and increasingly distributed energy mix, battery storage is essential in achieving a flexible, cost-efficient and sustainable electricity supply.

New challenges and trends ahead

Renewables and local energy production are central in the new energy mix. Utilities must be able to integrate intermittent production from wind and solar into production and consumption forecasts. They'll also need to consider e-vehicles with their rapidly rising energy consumption and storage capacity.

With all this change, utilities have some major concerns: supply resilience; grid stability; and energy quality. In addition, they must comply with regulation for decarbonization.

Data is essential in addressing these concerns: collecting, aggregating and analyzing data - and then deciding how to act on the outcomes. With so many new producers and new devices connecting to the grid, data volumes are growing exponentially. Managing these centrally in the cloud is a challenge: it requires more computing power; there is more data to be stored; and more demand for network bandwidth. Managing data locally would be a better option.

Three trends and approaches are emerging:

1. **Collective consumption** - local collectives collaborate on generation, storage and consumption, increasing control and minimizing reliance on central production.
2. **Edge computing** - in which data and compute capabilities stay close to the asset, reducing bandwidth requirements and latency.
3. **Battery integration** - distributed energy storage will increase flexibility and sustainability.

The journey ahead

The journey to this new landscape can be seen in three stages:

1. **The emergence of the microgrid.** Edge computing, together with local production and consumption forecasts, will help utilities balance consumption and production locally. Battery capability is essential in balancing local intermittence and the grid load.

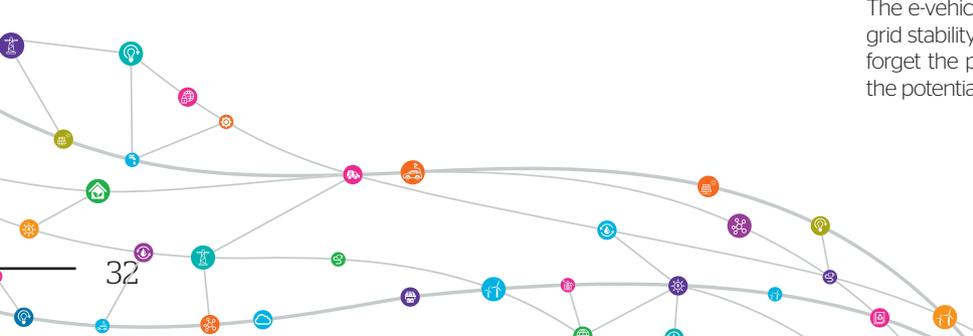
The stakeholders here are the TSOs and DSOs. Connecting batteries to the microgrid will optimize grid usage and reduce the impact of peak demand. Reduced grid congestion obviates the need to add new power lines to carry power flow coming from renewable production.

2. **Prosumer collectives grow.** Communities manage and consume local production from renewables within a local part of the grid. As the local power supply becomes more concentrated within these local areas, it opens the market for collective consumption.

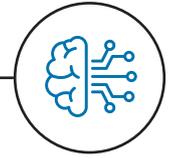
Small producers and consumers are the main stakeholders here. Prosumer collectives lower the purchase price of electricity while increasing the revenue for local producers, boosting RoI. Although not directly involved, DSOs benefit from prosumer collectives, thanks to their impact on the grid stability.

3. **E-vehicles connect to the grid** - they are no longer simply consumers, but now also act local electricity storage providers. Enlarging storage capacity improves grid load balancing, with digital twins supporting grid modelling and load forecasting.

The e-vehicle owner becomes the stakeholder here, contributing to grid stability also gaining some financial incentives. But we shouldn't forget the previous stakeholders. These batteries will only increase the potential of steps one and two.







AI now underpins utility success

Artificial Intelligence is nothing new. But things are very different now from when the term was first coined in the 1950s. So where can AI be best applied for today's utilities?

Firstly, AI can both help optimize aging production capabilities and minimize maintenance costs. Renewables aside, much of the equipment in the utilities industry is 30 years old – and more. AI can be used to predict how assets run, improving both safety and performance from technical and financial perspectives.

Secondly, AI can make customer contact centers more efficient and more engaging. Whenever a customer makes contact, the operator follows an internal process, often using different applications with multiple fields to fill. It's slow; it's minimally interactive – not great for customer service. Where utilities outsource to a third party billing by the minute, it gets costly too.

When combined with natural language processing, AI transforms work for the operator. Listening to customers, AI-enabled bots open the right applications and pre-fill the fields. Operators can focus on the customer, responding faster and more accurately to make the experience efficient, more effective, and less costly.

Supporting essential transformations

AI doesn't just help address pain points. It is key to essential transformation in the new energy era.

Investing effectively in renewables is complex. Capex drives renewables as utilities finance wind and solar. Finance is raised through investors, and the utility needs to demonstrate a convincing business case. AI has a role to play here, producing the forecasts needed to make the business case.

AI also has a role in retail, reducing churn and increasing sales by helping contact center operators better understand and respond to customer re-

quirement. Deregulation means customers are free to look for the best of offer and this increases churn. Utilities can use AI to help analyze the factors affecting loyalty and churn. Utilities can learn a lot from the telcos here: with AI, contact center operators spend less time fielding complaints and more time actively promoting personalized offers.

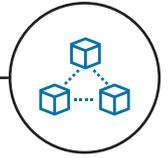
AI also has a role in modeling the grid. TSOs are looking to AI application to help manage investments over 20 and 30-year cycles. They need to analyze grid set-up, taking into account multiple factors. How best, for example, to set up for a factory or a wind farm from which the grid would ingest power.

It has a role to play in transmission planning too. Utilities are looking to AI modeling able to combine data from diverse sources, analyze it, and produce execution scenarios. Traditional planning analysis takes a limited number of external factors into account. With AI and deep learning, they can take a far wider view, producing thousands of scenarios for consideration which in turn can be validated and sorted.

AI essential in today's complex world

The utility sector becomes increasingly complex. Players can no longer use traditional technologies to handle the information they need. AI, together with natural language processing, deep learning and reinforcement learning, must now become a standard part of their business toolset.





Resolving blockchain dilemmas in utilities

Blockchain presents great opportunities for utilities. Numerous use cases are already acknowledged with various consortia and startups working towards realization.



Households and companies can, for instance, produce solar energy and sell it to the grid during the day and then consume from the grid overnight. Electric cars and advances in battery technology make distributed private storage feasible.

Blockchain will give an immutable record of what you produce, store, and consume without needing an independent regulator to guarantee accurate billing. It brings transparency and trust in smart meter data, putting prosumers in control.

But while blockchain has much to offer, it also presents utilities with new 'digital dilemmas'.

Blockchain immutability

Consider immutability. Once you have stored information in blockchain, it remains there unaltered and indelible forever. It's how blockchain increases trust.

Immutability improves agility and overcomes inertia by diminishing organizational risk. Involved parties can trust what the others are doing. Agreements and operations can be done at a more junior level and without involving costly third-party fees.

But blockchain's immutability could cause inertia in the future. What is acceptable today may not be acceptable tomorrow; seemingly trivial actions may have unseen repercussions: you can't alter or hide anything on blockchain.

Consider smart meter data, for instance. Algorithms are emerging that deduce with a reasonable level of certainty that a given spike corresponds to a specific appliance. It's not a huge leap use energy consumption patterns to detect models and makes, profile users, and even trace a family that has moved house. If you share smart meter data in an immutable format, what else could be done with it further down the line?

If you recognize the dilemma at the design stage, you can build around it. We could evaluate what we publish and revise those guidelines periodically. We could embrace transparency and acknowledge the need to own our mistakes down the line. Or we could inject nonsense data to deliberately destroy patterns that might appear in our data or metadata.

A single identity held in blockchain

The second dilemma concerns using blockchain to manage an individual's identity. Bringing together driving license, academic qualifications, fishing license, job history, tax returns, and more carries risk. With so much information in one place, what if someone hacks it?

While blockchain encryption and game theory make it extremely resilient under stable conditions, advances in technology or significant distortion in the user base or underlying economics can expose vulnerabilities. A hacker could find out more about you than you

intended. They could impersonate you or even control you. And identity theft can leave a black mark against your name forever.

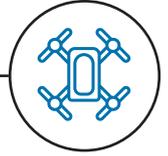
Utility companies are a potential gateway to blockchain digital identities that could allow individuals to execute financial transactions without revealing their identity. Utilities need to consider how to deal with impersonation, recognizing the dilemma at the design stage, and building around it.

Inequality brought by blockchain

My last dilemma is inequality. Examples of how blockchain could help overcome inequality are commonplace, helping bank the unbanked, for instance, or providing an alternative in areas of hyperinflation.

But blockchain could also deny some people access to services, specifically where services require a mature identity stored in blockchain for proof of who you are. Where does someone who has no identity on blockchain start? They could be denied access to bank accounts, government services, and more. You can imagine cycles where vulnerable people who are already in energy poverty can't get access to energy deals. And with no deals, they get even deeper into poverty.

This third dilemma can also be dealt with if we recognize it at the design stage. We can build in features to allow people with no identity in blockchain to use a different way to prove their identity and gain access to the same services.



Putting drones to work

Drones have so much to offer the utility industry: improving operational efficiency, reducing cost, minimizing service disruption, enhancing security, improving safety, and revolutionizing site surveys. Drones can access areas that would be costly, difficult or dangerous for humans to reach.

Combining drones with emerging technologies including edge computing and artificial intelligence creates additional possibilities. It is time to explore the opportunities and challenges of drones – especially in combination with edge and AI.

What is a drone?

Drones are flying robots with two basic functions: flight and navigation. They can be referred to as 'unmanned aerial vehicles' (UAVs) or 'unmanned aircraft systems' (UASes).

They have different levels of flight autonomy, from full automation using software and onboard sensors to remotely controlled aircraft that need operators. They can have one or multiple rotors or be fixed-wing, and can carry sensors including: cameras for collecting images, video or geographic data, or chemical sensors.

Initially for military use, adoption is now broader. Beyond surveillance, mapping, and delivery applications, drones are used in search and rescue, disaster response, asset protection, weather and wildlife monitoring, firefighting, healthcare, and agriculture. People also enjoy drones as recreational gadgets.

A broad range of use cases

In essence, drones use cases can be segmented into: entertaining and recording; protecting and inspecting; evaluating and managing; and delivering and transporting; photography, racing, and acrobatics.

In utilities, uses include:

- Checking power lines, hydroelectric dams, pipelines, solar panels or wind turbines;
- Inspecting vegetation along transmission and distribution lines;
- Pinpointing leaning, sagging wires or broken insulators during or after an emergency;
- Monitoring for criminal activity, vandalism or potential security threats;
- Mapping the orientation of solar panels to maximize energy output;
- Scoping sites for new transmission lines, pipelines, dams, solar farms, and wind farms;
- Carrying out wildlife inventories to reduce impacts on protected species; and
- Calculating volumes of stockpiled fuel at power plants.

Combining with edge and AI

Drones can create huge data volumes, from cameras and sensors. Before data can be processed and analyzed, it needs network transmission, and this can be a limitation.

Edge computing promises to change that by giving the drone compute capabilities. The drones then become connected edge devices able to process and analyze the data for themselves. This will reduce both bandwidth requirements and latency.

Combine the edge model with AI and machine learning, and we have a smart drone that can work in near-real-time. Imagine fully autonomous utility inspection drones able to detect and identify defects or malfunctions earlier, without human assistance.

Consider inspecting damage in a remote territory after a storm. With intelligence onboard, the drones can quickly determine what critical infrastructure is damaged, enabling utility managers to make quick decisions about priorities, crews and skillsets.

Drone dilemmas

While drones have much to offer utilities, there are challenges relating to privacy, security, and safety.

Drones can invade privacy and from a safety perspective, can increase the risk of collisions. Drones have also been used recently to attack oil plants and disrupt flights at airports.

Regulation becomes critical

While utilities have started using drones for short-range tasks, the greatest opportunities will come with autonomous drones working on longer-range tasks. Out-of-sight droning will be the next frontier for grid operators with their miles of pipes and pylons.

While flying drones "beyond-line-of-sight" is largely prohibited because of safety concerns, European watchdogs have granted special permits to allow utilities to test prototypes.



Data-driven customer services

Whether thinking about domestic, civic or business customers, few individuals or organizations exist “off-grid”. That is good news for the utilities: almost nobody can live without their services. So how can forward-looking utilities stay ahead of the pack in building and sustaining mutually beneficial relationships with their customers?





Putting the consumer at the heart of business

Utilities must provide bespoke experiences for their domestic, business and civic customers – putting the consumer at the heart of their business thinking and behavior.

Utility customers are no longer passive commodity users. With the rise of smart homes and smart buildings, people seek to actively optimize consumption. They have new usage patterns too, thanks to smart appliances and electric cars.

The growth of local wind and solar generation means fewer energy consumers and more energy producers or 'prosumers'. To an increasing extent, intelligent connected devices now handle the relationship with providers.

This evolution nurtures competition with new players too, with start-ups specializing in consumption optimization and with appliance manufacturers.

When facing better-informed, savvy and empowered consumers, incumbent providers must provide a better experience right along the consumer journey. They must also leverage data to offer the best prices along with value-added services.

Let's take a look at a day in the life Jo - of one of this new generation of smart utility customers ...]

Jo's smartphone alarm goes off at 6:00. At sunrise, rooftop solar panels start producing and recharging the energy storage in her garage. Jo glances at her smartphone to check energy usage at her elderly mother's house to make sure all is as it should be - alerts are set to let her know if that changes.

She loads the washing machine, which is programmed to run during peak solar production later in the afternoon. She showers and gets ready for work, knowing that the water she uses will be reclaimed at a community treatment plant.

On her way out, she receives an alert from the local utility letting her know that hot, humid weather today is driving high electricity demand and the utility will pay her a rebate for using less energy during peak demand.

With one click, she agrees to participate, automatically resetting her smart thermostat for the afternoon when the house is empty. Her

security system is activated as she leaves and she sees the insulated cellular shades on her front windows close automatically to keep the house cool.

Arriving at work, Jo is directed by an app on her phone to an open parking spot with a charging station for her electric vehicle. She plugs in her car, which is programmed to charge during the lowest cost period of the day. EV charging costs will appear on her consolidated utility bill.

Later that morning at home, the washing machine starts, powered by rooftop solar energy. Her smart thermostat sets itself back six degrees to take advantage of the utility's lead reduction rebate. She receives a message that her home battery is fully charged, and her washing machine is running off rooftop solar.

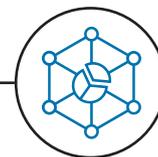
Her home, despite warm weather, is running on virtually zero net energy. At the end of the day, Jo packs up, leaves the office and gets into her fully charged car to drive home.

The smart meter at Jo's house retrieves her location information to calculate her estimated time of arrival so that her home automation platform transitions her systems and appliances to "at home" status.

When she gets home, Jo checks her energy dashboard to see energy production versus consumption; data disaggregation from the smart appliances; savings from participation in the demand response event; energy and water consumption compared to neighbors; and a calculation of her overall savings for the day and month.

That evening she receives an email from a smart appliance manufacturer warning her that the lead shape of one of her appliances and the amount of reactive power it's drawing indicate that a service call should be scheduled. At the same time, an RFID tag on a food item in her refrigerator alerts her that an expiry date is approaching. Because she already did her laundry, Jo also activated a transactive energy app on her smartphone to sell her excess solar generation to neighbors using a local power pool app running on a blockchain in her smart meter.





New business needs new models

Utilities worldwide face one of the biggest threats in their history: liberalization. Customers are now free to select their utility providers, including innovative new market entrants.

With the newcomers tempting customers away, traditional utilities ask how they can stand out. They cannot differentiate via the quality of the electricity or gas. So, what should they do?

Distinguishing offers key to survival

Traditional utility offers are simple: charge a fee for the consumption of electricity, gas or water. Meanwhile, inventive and agile new players distinguish themselves with value-added service offers, often for a flat fee.

Some add heating system maintenance services. Others sell commodities such as thermostats or light bulbs. Some establish partner agreements to resell household appliances. Others provide smart services for cities, stadiums or even cruises.

Utilities need to develop offers beyond their traditional business models. New offers may be based on a platform business model that incorporates a wider partner ecosystem. For many utilities, this will be the only way to survive in the era of liberalization.

Liberalization has not reached the same level around the globe: it's advanced in some countries, just emerging in others and not present at all elsewhere. In Italy, for example, liberalization started back in the nineties and will be completed by June 2020.

Nevertheless, there is a clear global trend toward liberalization. Utilities need to start now.

Business models based on digital platforms

Digitalization sits at the heart of the new platform business models. Increases in the volume of electronic data and breakthroughs in AI are reshaping customer engagement and redefining value chains. New market entrants are already taking advantage.

Traditional utilities can take some concrete steps to build new business models based on digital platforms, so they are ready to win customers as markets open up:

First, utilities must transform how they interact with their customers, who increasingly like to use apps and social networks. Utilities traditionally only spend perhaps five minutes a year engaging with their customers, and often only for complaints. This must change. Digital platforms help utilities reshape customer engagement by allowing them frequent customer contact across digital channels.

Secondly, utilities must leverage digital to develop new products and services. A digital platform becomes essential, both for minimizing time-to-market for new offers and for bringing flexibility to the systems these offers depend on. It also allows utilities to tailor offers precisely to customer needs, turning a handful of offers into multiple personalized alternatives.

Thirdly, utilities must focus on building B2B partner ecosystems that stimulate innovative and disruptive business models. These new business models use ecosystems that extend beyond traditional boundaries: transport, cities, factories and even competitors. Digital platforms allow partners to share information and services efficiently and safely.

Take Italian utility Enel as an example of a well-established utility that has done just that. Enel founded a new company, Enel X, based around a partner ecosystem. Enel X has opened physical stores that sell electricity and gas contracts, alongside e-bikes, ovens, fridges and other physical products.

Adapting for the prosumer era

We've seen how digital platforms are vital for B2C interactions, accelerating time-to-market and enabling new partner ecosystems, business models and offers. These platforms also have a critical role to play in energy generation.

More and more consumers are joining the energy generation community, becoming prosumers. To balance local consumption and production, all parties need to share information about consumption, the weather, production forecasts and more. Digital platforms help the generation ecosystem share information securely and efficiently.

When liberalization arrives, success for utilities will depend on platform business models.





Envisioning platform-based ecosystems

Platform-based ecosystems will account for 30% of all utility revenues by 2025. For the energy industry, platform-based ecosystems are critical to digitalization and the basis for a new change of paradigm. What does this mean for energy and utility players?

Breaking siloes to build services

Companies in all markets have traditionally worked in siloes. Insular perspectives conflict with today's transformational business models. With ecosystems, diverse stakeholders work together to provision novel services.

At the heart of the ecosystem lies the digital platform, providing the requisite interoperability. For utilities, these may include Distribution System Operators for both renewables and traditional sources, electromobility providers, power providers, energy service companies and customers. These span water, electricity, gas and waste.

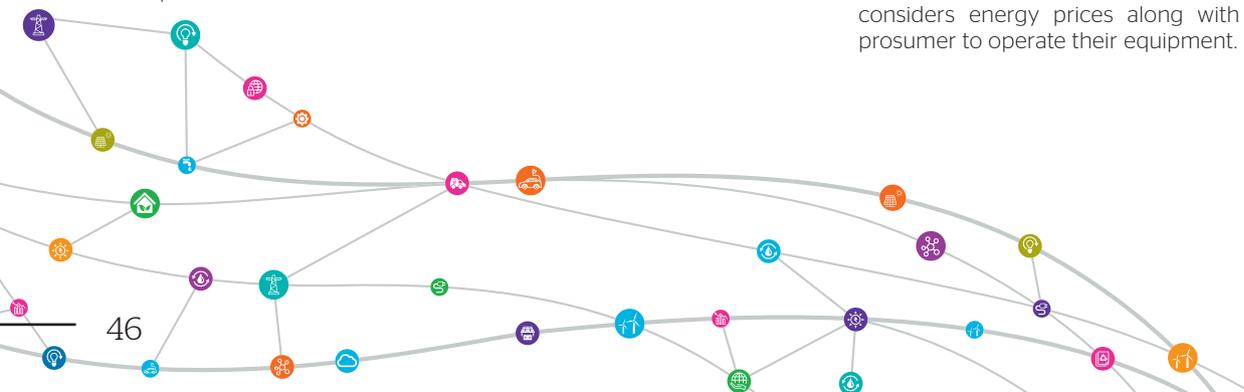
In time, even more actors will participate, including businesses outside the utilities. Energy data then increases in value, with third parties exploiting it to create new services.

These third-party services will rely on open environments and common standards. Where physical meets digital, well-known standards will be needed by both equipment manufacturers and those working in the digital domain.

A multitude of new services

Competition is building among utilities collaborating in platform-based ecosystems. Some are already utilizing ecosystems to gain the ideas and contacts needed to extend their services. Here are some concrete examples:

- An energy island project we are working on in Austria. A community of 400,000 people chose to disconnect from the national electricity network and instead adopt self-sustainable energy solutions. The ecosystem allows the community to leverage the expertise of traditional utilities through services including energy solution optimization strategies and tools.
- We're also participating in several platform ecosystem projects funded by the European Commission:
 - **inteGRIDy** facilitates optimal and dynamic operation of the distribution grid by coordinating distributed energy resources, virtual power plants and innovative collaborative storage schemes within an energy system with an increasing share of renewable energy.
 - **SHAR-Q** optimizes storage capacities for the small energy sites by encouraging collaboration between peer-to-peer interoperability networks that connect renewables and storage ecosystems.
 - **MERLON** enables novel business models. It allows local energy communities to introduce local flexibility markets and paving the way for Microgrid-as-a-Service models.
- A service that helps prosumers decide when to consume, store or sell the energy they produce. For this, the service provider considers energy prices along with best practices for the prosumer to operate their equipment.



Dilemmas facing platform-based ecosystems

While these new platform-based ecosystems bring new opportunities, they also bring concerns. To succeed, these must be addressed. Let's consider the dilemmas.

Firstly, platform-based ecosystems must offer utilities trust in an environment out of their control. With OT/IT connecting everything, platforms could gain access to assets that were not accessible before. Utilities must address cybersecurity threats and risks.

Consider information privacy. Some of the data the ecosystem collects is sensitive and affected by privacy regulations. The data platform must deal with this kind of data. Additionally, people need an incentive to share data.

The final dilemma is about building enough trust to expand the ecosystem. Building sufficient trust is critical to utilities being able to offer more services and, in doing so, increase the value of their data.

The future lies in platform-based ecosystems

I've explored how collaboration among different energy utilities will be critical to their future success. While there are currently utility silos, collaboration is key for making utilities sustainable and ensuring proper energy delivery. The digital platform lies at the very heart of the solution as a connection point for development.





Omnichannel experiences: evolving customer contact

Contact centers continue to play a central role in utilities' customer engagement strategies. The effective management of these centers remains business-critical. Customer satisfaction equates to vital competitive edge.

Given that utility regulators assign ratings to how each company runs its contact centers - including an evaluation of customer experience - a successful customer contact operation is relatively straightforward to measure. Low scores are fined, which in turn impacts companies' funding. It's therefore a core business objective to maintain and increase these ratings by enhancing customer service.

Flexibility and efficiency

Lean and efficient operations are essential; utility companies typically want to flex their contact center operations in line with customer demand. This can be a challenge - especially as some companies have grown relatively quickly and may have diverse technology estates. This is why many are innovating by moving to cloud-based IT infrastructures, with the agility and flexible 'pay as you go' services cloud brings.

Taking advantage of the technology available in the contact center space, it makes sense to take a hybrid approach that can blend private and public and on-premise, in-the-cloud technologies and applications.

In some cases, companies outsource their contact center operations as a managed service to specialist providers who can evolve more streamlined, efficient delivery - flexing the number of agents up and down.

Digital transformation

It's not just about technology infrastructure. Skilled customer services agents are valuable resources for utilities.

Working with them to create a joined-up customer experience, and backing this up by streamlined workflows and scripting, integrated media, and automated call-routing to different departments are all critical.

Delivering more immersive customer experiences requires organizational and cultural change. As far as customers are concerned, success will depend on making sure the experience is easy and available over their preferred channels. Older customers may prefer phone-calls and printable web pages. Digital natives are more likely to initiate communication digitally.

Given the range of contact center operations, being able to integrate third-party solutions and using open source software and standards is key. This open approach means that operations can evolve in line with business need and underpin a roadmap of digital transformation. An omnichannel approach to customer engagement is needed. It will incorporate multi-media interactions in an agile, unified way that meets all data governance and compliance requirements.

Looking to the future

To service and support the connected homes of the future, contact center operations will continue to transform, incorporating new kinds of omnichannel experiences and delivering smarter and more proactive customer communications. The future customer experience will encompass online messaging, multi-media files, video, call-backs, online documents and real-time data. This includes IoT sensor data, for example, integrated with servicing databases that log gas or water leaks to arrange call-outs. Digital transformation of contact center processes will also enable enhanced staff support, such as care for solo workers through mobile apps and real-time data sharing.

As utilities evolve, prompt access to skilled customer services agents will always be important to retaining market share. Success will depend on transforming operations to drive consistently excellent customer experiences and produce deep, real-time understanding of exactly what customers need, and how they interact.





Helping smart cities drive greener futures

Everybody knows we have to manage energy better. But turning knowledge into action is never easy. To initiate change, smart cities must engage and motivate their inhabitants.



Take smart meters, for instance. We've heard much about how they will help reduce energy consumption. But this will only happen if people are willing to share data and act on the insights derived. Utilities must help smart cities encourage inhabitants to play an active role in smart metering initiatives.

The smart meter digital dilemma explained

Smart grids are critical to a sustainable energy future. They allow DSOs to manage energy distribution more effectively and efficiently at a time when the energy mix is evolving rapidly. Smart meters are critical in smart grids. They provide real-time insight on energy demands, helping retailers identify new markets.

Smart meters benefit cities too, contributing to cleaner environments and making more pleasant places to live. How do smart meters improve lives? These real-time data collectors certainly do impact inhabitants' lives, particularly, they often feel, their privacy. This is driving a 'digital dilemma' for smart metering deployment.

Since implementing GDPR in May 2018, the European regulation relating to data privacy, confidentiality becomes critical for utilities. The challenge they face is twofold. They must:

- Comply with personal data legislation
- Encourage people who are suspicious of smart meters to become active supporters

Our experience in working with ALEC (Agence Locale de l'Énergie et du Climat - the local energy and climate agency) in the French metropolis of Grenoble has shown that engagement is key to resolving this digital dilemma.

Reducing energy consumption in Grenoble

Created in 1998 to 'contribute locally to the energy transition,' ALEC is part of a network of around 250 European agencies acting locally for the global preservation of our environment. It provides energy consumption information to inform the city's building refurbishment and construction programs. To accelerate change across the city, ALEC also needed to motivate inhabitants to reduce their energy consumption. While everybody knows we have to manage our energy better, individuals tend not to act, often through lack of guidance.

The VivaCity collaborative energy data management program offers a potential answer. An experimental VivaCity platform, which is run by GEG in collaboration with Atos and utility operators in Grenoble, demonstrates the positive role such a solution can play in introducing energy changes. In 2019, 'Grenoble Metropole' confirmed that it would extend the program in 2020 to cover all Grenoble metropolis, renaming it as 'Metro Energies'.

VivaCity recognizes that inhabitants are more likely to take part in smart metering initiatives if they have confidence in the project. It clearly explains the aims of the initiative, along with why these are important and how it hopes to achieve them. It also addresses privacy concerns by demonstrating GDPR compliance, explaining how it manages

personal data and allowing inhabitants to manage their data. VivaCity's web portal has an 'About Me' area where any inhabitant who sets up an account on the portal can quickly and easily see all the personal data the system holds on them.

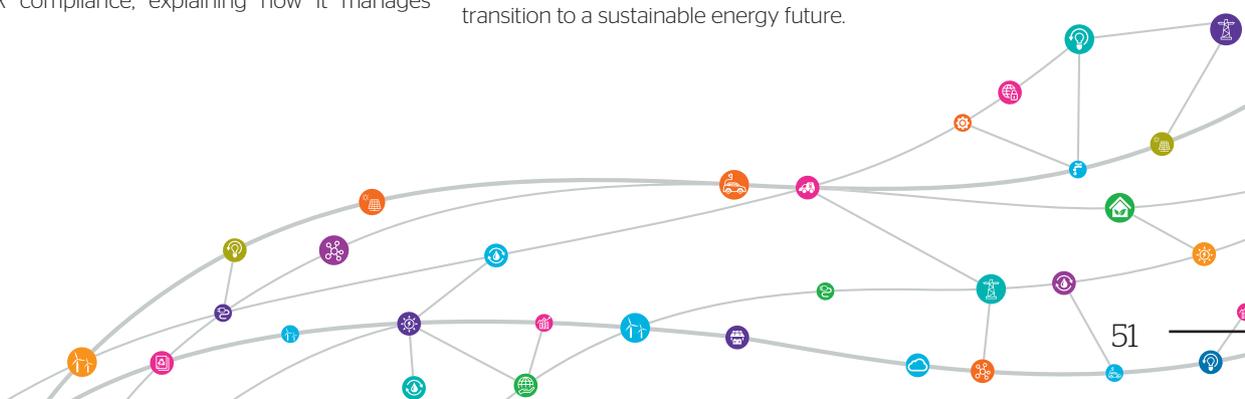
Confident they can access and control their data, people are sharing data for the benefit of the metropolis. By engaging in the smart metering initiative, inhabitants benefit from accurate information about their consumption of gas, electricity and water.

Engaging inhabitants, so they act

But the overall aim of the VivaCity portal wasn't to allow inhabitants to manage their data; it was to engage inhabitants in thinking about the future and encourage them to act for greater sustainability.

While today inhabitants may consume a lot of energy, in 20 or so years, their consumption will be lower. To speed up this transition, the portal pushed advice to help inhabitants engage with this vision of the future. Anyone using the portal could quickly and easily access a series of leaflets produced by ALEC addressing real energy and water concerns: saving energy and water and improving comfort in their homes.

The VivaCity platform allows utilities to help smart cities resolve digital dilemmas that are a barrier to a greener future. Utilities, cities and their agencies can use it on top of smart metering initiatives to make inhabitants aware of their energy consumption, then push information to them to encourage them to take action to reduce it. After all, encouraging inhabitants to participate is critical to enacting the transition to a sustainable energy future.





E-vehicle revolution and the ecosystem opportunities

E-vehicles are the future of transport. Although adoption is slow, the future is bright. E-vehicles bring opportunities to numerous stakeholders - from vehicle manufactures and smart home companies, from start-up prosumers through gas companies to electricity providers, and more.

Some companies are struggling to find the right business model. So what is slowing progress and what model options are there?

Manufacturers speeding forward

Car manufacturers' progress with e-vehicles is immense. The e-vehicle beats fossil fuel in many ways: pollution-free, better economy, better performance and faster acceleration in particular. For many OEMs, 50% of e-vehicle portfolios are now purely electric - moving away from the hybrids of a few years ago.

For drivers, car manufacturers bridge the gap to the charging point operator. By allowing drivers to charge their vehicles easily, they become intermediaries between drivers and charging point operators.

So what's holding up adoption?

Barriers to adoption: Infrastructure and batteries

Firstly, charging infrastructure: drivers hesitate with e-vehicles if they charging is a problem. Domestic charging is a priority. Charging points for detached dwellings is easy - for denser city apartment living, it is more challenging.

Charging beyond the home is also key and needs local authority champions. Charging needs political determination and investment with returns based on better and cleaner infrastructure.

Battery technology is my second challenge. Despite advances, battery technology still has far to go - particularly with regard to battery degradation when discharging to the grid.

This flow is particularly important for utility companies: e-vehicles extract power from the grid to run and, to balance increasing loads, the grid also needs to use electricity stored in batteries.

Partnerships the key to new business models

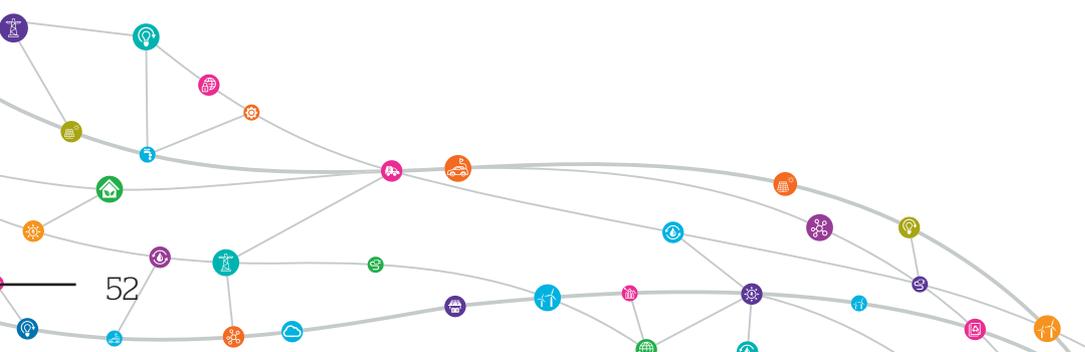
So where are the e-vehicle opportunities for utility companies? Many will involve partnerships with stakeholders in different industries with alliances between utilities and charging point operators a clear example. Charging point operators offer utilities an essential service which can be sold on to domestic, industrial and civic customers. Exploit partnerships with charging providers to create a complete 'household charging service' offer.

The e-vehicle impact on utilities' retail business is small for now - it will gather pace as adoption increases.

Visibility essential for TSOs

There is a symbiotic relationship between e-vehicles and the grid. We are already seeing transmission system operators put the technology in place for this - IT is critical to forecasting and load management.

Utilities must drive their e-vehicle business models forward: these will be critical in claiming a place in this fast evolving market.







In summary

Many thanks to all contributors and thought leaders who have shared their ideas and experience here.

We hope you have found this opinion paper informative and stimulating - and remember, if you are seeking to discuss any aspect of the digital transformation of your own enterprise, the chances are that we have experts with the requisite knowledge and experience of the energy and utility sectors.

Atos team is keen to learn more about your own challenges and ambitions and to share its real-world experience of digital innovation across the entire utility value chain - to deliver the digital edge.

Book a session in one of our Business Technology Innovation Centers (BTICs).



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