Can energy retailers move faster than lightning?
Unprecedented pressure to keep pace with new technology and the appetite for data

From “fail-safe” to “safe-to-fail”
The World Energy Council’s new thinking on energy resilience

Duke raises the bar on security
With utility assets facing increasing cyber threats, Duke Energy’s Terrell Garren outlines new leading practices to safeguard critical infrastructure
Learning to learn from others will help utility leaders make better choices, says Benoit Laclau.

The rapid changes taking place in the global energy system – including changing customer behavior, renewable energy and disruptive digital technology – are creating an abundance of energy choices:

- **More choices for utilities**: Competition from new entrants to the industry, together with climate policies and the digital revolution, are pushing traditional utilities to find new ways to deliver good service and shareholder value. Smart innovation offers new routes to grow, improve operational performance and safeguard energy infrastructure from climate and cyber risks.

- **More choices for consumers**: In mature markets, new entrant suppliers and smart technologies are providing consumers with new ways to control energy use and generate their own energy. And in developing countries, solar photovoltaic (PV) generation and battery storage offer an alternative to waiting for the grid to arrive.

- **More choices for governments**: There is an increasing diversity of choice to develop and manage cleaner, smarter, more reliable systems that bring affordable energy to a range of communities, from fast-growing cities to isolated rural areas.

But in my work, I still meet people who tell me these choices seem illusory. Utility leaders can feel hemmed in by the pressure of delivering results for shareholders. Finding money to support much-needed innovation can be difficult, given the typically risk-averse nature of the sector, particularly in distribution and transmission businesses. Political leaders may be reluctant to throw their weight behind visionary schemes, constrained by the short-term realities of the electoral cycle and economic pressures. And many consumers are still suspicious of retail utilities’ motives, pricing and service, complaining that competition has done nothing substantial to improve their offer.

So what can utility leaders do to liberate themselves and make the best choices – both in their own strategy and as part of a better energy sector? Without wishing to oversimplify, one answer is to set aside the natural conservatism associated with traditional utility thinking and change the culture in the business to make the most of people and technology. This involves:

- Creating an open, receptive environment where innovation flourishes
- Collaboration regularly, both across business units and with external partners to learn how they have transformed businesses
- Making benchmarking into a much tougher discipline to understand what “good” really looks like

This issue of *Utilities Unbundled* presents interviews and ideas from utility leaders around the world who are doing exactly this and reaping huge rewards. Please feel free to contact our authors to discuss your ideas, or for more information please visit our website ey.com/powerandutilities.
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Power & Utilities Insights from EY

#UtilitiesUnbundled
Wisconsin Energy was already one of North America’s largest electric and natural gas delivery companies, but as far back as the early 2000s its aging infrastructure made executives feel vulnerable. To position the company for the future, they invested US$3b in new power plants with a total capacity of 2,800 megawatts, US$1.3b to upgrade existing power plants and US$2.7b to upgrade the distribution system. Their Power the Future campaign began in 2003 with the installation of two natural-gas-fueled combined-cycle units to replace the 80-plus-year-old coal plant at Port Washington, Wisconsin, and two new coal-fueled super-critical generating units at Oak Creek in Milwaukee County. All the new units had advanced emissions controls.

Just a decade later, and despite the acquisition of Integrys Energy Group, executives at the newly named WEC Energy Group (WEC) concluded that the generation portfolio that they had believed would keep the 4.4-million-customer utility commercially, economically and environmentally viable until 2020-2030 needed an upgrade. With concern about greenhouse gases rising, low gas prices undermining the economics of their coal units and demand for energy weaker than previously forecast, the only way to grow the company would be from within, by raising WEC’s operational game.

Heading toward the top
In the Top Quartile by 2020 (TQ-20) campaign, WEC executives set an ambitious goal to raise the company to the top quartile of US utilities in power plant operations, diagnostics, and planning and maintenance by 2020.

“To-20 is an effort for us to get a firm grip on the things we can do that can make us more attractive in the market, by controlling our operation and maintenance (O&M) expenses, and increasing overall availability of our generating units,” explains Patrick Stiff, VP of Coal Generation and Biomass for We Energies, the Milwaukee-headquartered utility and subsidiary of WEC.

Fulfilling TQ-20 required a deeper understanding of how the business operated, stronger benchmarking, experts to analyze the new data and – most importantly – a deep commitment to change, according to Stiff. The company planned to take advantage of the new power of machine-to-machine connectivity and remote sensors, to understand how every element of the operation’s generation fleet performs. They hoped to analyze this new trove of data to find opportunities to improve performance and uptime, reduce cost and raise overall business efficiency.

In particular, the TQ-20 plan entailed using better benchmarks and a wider range of expertise.
Better benchmarks

The TQ-20 team looked at a variety of sources, including the Electric Power Research Institute (EPRI, the Palo Alto-based US electric power industry research center) for ideas of how We Energies could improve.

“In many cases, we thought we were best practice. When we looked at what others were doing, we saw many opportunities to learn — in addition to what we were already doing well — that could cause us to be better positioned to control our costs,” Stiff says.

The new benchmarks gave the company a number of fresh insights that it continues to find helpful. “These days, we’re comparing ourselves to industry benchmarks such as planned outage factor, equivalent availability factor and equivalent forced outage factor. We previously didn’t pay much attention to comparing ourselves to peer benchmarks around these areas,” he says.

More experts

The team identified strong external and internal experts to analyze operations in light of this new data, to try to understand where systems and processes could be optimized.

We Energies specifically sought out experts to develop advanced work planning processes that helped the company to utilize its field crews more effectively. These experts also monitored We Energies’ coal fleet in Wisconsin, offering diagnostics whenever they saw an opportunity for improvement. Finally, they helped implement EPRI’s System and Equipment Reliability Prioritization (SERP), which We Energies executives believe will enable the company to achieve significant improvements in reliability and cost management.

The internal experts – a select group of junior, middle and senior managers – helped to analyze the fleet’s operations, and played a crucial role in educating staff about the advantages of the new operational methods.
In Stiff’s view, this outreach — especially from the executive level — made a tremendous difference to the employees’ acceptance of the new processes, procedures and tools being implemented. “I really believe that our being out in the power plants in front of large groups, talking about the initiative on a regular basis, has been critical to our success in terms of having people be informed,” he says.

But actions mattered too: one key aspect was a promise to let the staff reduction that is a part of the overall TQ-20 plan occur entirely by attrition. This has helped ensure that the employees’ incentives stay aligned with the company’s interests, according to Stiff.

A changed game
Two years later, TQ-20 is starting to take hold. Stiff says that, after visiting many top-quartile utilities, the company has made significant structural advances. “One of the things we learned in best practice visits, watching what top quartile companies were doing, was that they were paying extremely close attention to the condition of their equipment,” Stiff explains.

An equipment registrar
In particular, top quartile companies created a central location to track the condition of all equipment. Creating their own central tracking center will help We Energies make more strategic maintenance decisions and reduce outages. New metrics revealed a relatively large commitment to planned outages, and Stiff knew that driving outage days down through better management would be a significant opportunity for greater efficiency and effectiveness. Most leading companies have planned outage rates around 7%. “Historically, we had been in the high teens — or as high as 20% in a couple of years recently,” Stiff recalls.

Over the next three or four years, he hopes to “compress the amount of time that we have units out of service for planned work, get more work done, and get the right work done during those outages such that our availability goes up.”

A new attitude to maintenance
Overall, the TQ-20 team realized it needed to be more strategic about its attitude to maintenance. A new data-driven understanding of the life cycle of machinery, including real-time insights into wear and tear, has given them more insight into what was wearing out, so that maintenance can be scheduled more efficiently. These insights have also shown that repairing noncritical equipment can be inefficient and that it can be more cost effective to hold off on repairs and, instead, replace those components at the end of their useful life. Further, they found that best practice companies focus their time and effort on the most critical equipment — a practice that yields greater system reliability and cost savings — and they made a strategic decision to follow suit.

Letting expert partners monitor their real-time data also revealed many other opportunities.

“We’ve been working with [expert partners, monitoring our real-time data] for over a year now … They’ve provided us with many insights that we believe have saved us millions of dollars.”

Patrick Stiff, We Energies
opened up the bearing it had actually been partially wiped at the point of contact due to friction.”

Repairing that bearing early, before it had time to damage the whole turbine, saved the company money and assured unit reliability. “That’s one example of what they’ve been able to do for us – things that we otherwise wouldn’t have done for ourselves because we didn’t have the bandwidth to do it, we just didn’t have the folks to do it,” Stiff says.

**Workforce management**

Not all the changes were mechanical. To handle maintenance more strategically, they decided to give the task of planning and scheduling to managers. “We went full circle and came back to having a planning and scheduling workforce that is solely management employees,” he says. “We used to have a mix of represented employees and management employees doing that work, but we found that we had not given those employees the correct tools and the correct amount of time and room to do those jobs very effectively,” he says.

Now, they are going back to the strategy used in the 1970s and 1980s when managers performed the planning and scheduling. “We believe long term that’s going to help us perform better, by giving them better tools such that they can perform at an even higher level,” Stiff says. They also plan to track the scheduling data, which should yield ideas for even more scheduling opportunities.

**Determination to win**

This year, Stiff stepped back from day-to-day management of TQ-20 by assigning a manager to those duties, confident that his team is still on the right path. “We’re just starting to see people hit their stride in terms of making those jobs their own and making them work. So we’re really in this phase right now of starting to see a lot of things come together.”

He receives weekly team updates and is very pleased with the continued focus and progress. But he emphasizes that his short distance from the day-to-day campaign isn’t a sign that TQ-20 is any less important now.

“This is the single most important initiative going on in our business unit right now,” Stiff says. “We are committed to staying the course here and seeing all the things that we’ve envisioned to take place be implemented, making adjustments where we need to and keeping our promises to our senior leadership team and to our employees that we’re going to make the changes that we need to make.”

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**Patrick Stiff**

**VP Coal Generation and Biomass, We Energies**

Patrick Stiff is responsible for leadership, operations and support of all aspects of the We Energies and Wisconsin Public Service (WPS) coal and biomass-fueled generating facilities. Stiff joined We Energies in 1978 as an instrument technician at Oak Creek Power Plant. He was appointed vice president – coal generation for We Energies in January 2014.

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The road to grid innovation

A nationwide €600m program is set to revolutionize Germany’s grid in the next four years, with innovations that could have worldwide impact.

Report by Frank Burkert and Christian Jussen
Energy transition has made Germany a global test bed for unprecedented levels of innovation to hit federal targets of 60% renewable supply by 2035 and 80% by 2050 in the electricity sector.¹

In the course of sweeping energy reform, the country will be running five major energy transition pilot projects to develop the grid of the future, test new technology under real-life conditions and reform markets.² The focus will be on delivering innovative projects to market in a rapidly changing sector, through a collaborative process.

The full program, known as SINTEG,³ launched at the end of 2015 and will run for four years, from 2016 to 2020. Of the total investment of €600m, the German Federal Ministry for Economic Affairs and Energy (BMWi) is supplying €230m in cash grants, and a further €370m will come from private businesses.⁴

Each of the five pilots is a collaborative effort across power and utility businesses, manufacturers, research institutes, municipalities, local districts and German states. More than 200 organizations have already signed up to be involved, working in five consortia on dozens of individual work streams and hundreds of projects.

As the work begins in earnest, we take a look at the topics and territory each pilot will cover, key common challenges to overcome and the broader international significance of Germany’s initiative.

**SINTEG objectives and pilots in brief**

As the share of electricity generated from wind and solar photovoltaic (PV) installations rises, German electricity generation, grids, consumption and storage have to be combined in a smart way. That requires innovative technologies, procedures and digitization. Participants in the SINTEG program will be working together on projects that aim to:

- Promote secure, efficient grid operation with a high proportion of renewables
- Realize efficiency and flexibility in markets and grids, on the demand side
- Make more efficient use of the existing grid and reduce the need for distribution grid expansion

The five consortia will develop, test and demonstrate — in their respective region, see Figure 1 – how hundreds of thousands of renewable energy generators and flexible loads can act together to drive down cost and increase renewable energy (RE) share. The solutions they develop will become blueprints for use across the whole country. All five energy showcases focus on a specific issue:

- **C/sells:** focuses on solar energy in southern Germany’s “solar arch.” This project will implement a cellular solar energy system, which will function autonomously at the regional level and interact at the supra-regional level.
- **Designetz:** explores how decentralized renewable energy sources (both solar and wind) can be used to supply industrial centers of demand. More than 7,000 households and around 140,000 meters will be included in the demonstration project.
- **enera:** looks at regional ancillary services to stabilize the grid. The company has three priorities: the grid, the market and data. Energy system flexibility will be improved by upgrading the technology used by generators, consumers and storage units. The EPEX electricity exchange will account for information on grids in its order books for the intraday market.
- **NEW 4.0:** focuses on energy transition in northern Germany. The goal is to demonstrate that 70% of the entire region’s energy can be generated from renewable sources, securely and reliably, by 2025, 10 years earlier than anticipated for the whole of Germany. Flexibility options from private and industrial stakeholders and sector coupling will be used to boost the amount of renewable energy consumed within the region itself, and electricity exports to other regions will be stepped up.

- **WindNODE:** showcases smart energy from northeastern Germany. The goal is efficient integration of renewables into an energy system that works irrespective of energy source and combines the electricity, heat and mobility sectors. The project’s ICT platform connects generators and users of electricity, grids and markets and coordinates flexibility options (e.g., industrial load shifting, power-to-heat and cooling systems, electric mobility).

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1. Currently, 30% of Germany’s electricity is supplied by renewable sources.
3. The English title in full is Smart Energy Showcases – Digital Agenda for the Energy Transition.
4. Following a competitive process for the best ideas, BMWi granted SINTEG funding to the five best projects. EY helped to win three out of the five, totaling close to €150m in cash grants.
The five pilots tackle a range of energy transition challenges, including integrating distributed renewable energy sources (DRES) into the system, flexibility and stability, security of supply, energy efficiency, and smart energy systems and market structures.

<table>
<thead>
<tr>
<th>Pilot</th>
<th>Coordinator</th>
<th>Key project issue</th>
<th>Unique features</th>
<th>Project volume €m</th>
<th>Number of project partners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>enera</strong></td>
<td>EWE AG</td>
<td>Provision of regional ancillary services that serve to stabilize the grid at a regional level</td>
<td>Extensive preparation, smart curtailing of wind power generation</td>
<td>202</td>
<td>74</td>
</tr>
<tr>
<td><strong>NEW 4.0</strong></td>
<td>HAW Hochschule für Angewandte Wissenschaft Hamburg</td>
<td>Demonstration that 100% of the entire region’s energy demand can be generated from renewable sources in a way that is both secure and reliable, and that this can be achieved as early as 2035</td>
<td>Industry focus, export character and education</td>
<td>83</td>
<td>50</td>
</tr>
<tr>
<td><strong>WindNODE</strong></td>
<td>50Hertz Transmission GmbH</td>
<td>Efficient integration of large amounts of renewable energy into an energy system that works irrespective of the energy source and combines the electricity, heat and mobility sectors</td>
<td>Broad approach, cooperation with Poland</td>
<td>123*</td>
<td>70</td>
</tr>
<tr>
<td><strong>C/sells</strong></td>
<td>Smart Grids BW GmbH</td>
<td>Implementation of a cellular energy system that focuses on solar energy and the optimization of generation and consumption at regional level as part of supra-regional interaction</td>
<td>Smart grids, regional cells, PV</td>
<td>100</td>
<td>60</td>
</tr>
</tbody>
</table>

Source: EY; BMWi; plus project websites:
www.smartgrids-bw.net/csells/downloads/
www.energie-vernetzen.de/files/enera_Projektskizze.pdf
www.windnode.de/partner/
*www.klimafonds.gv.at/assets/Uploads/SINTEGVorzeigeregionen.pdf
Pushing the boundaries
A closer look at the NEW 4.0 pilot, which spans Schleswig-Holstein and Hamburg in the north, indicates the highly ambitious nature of what Germany is seeking to do. NEW 4.0's basic goal is to demonstrate that 70% of the entire region's energy can be generated from renewable sources by 2025. But the particular innovation of this project is to prove, by 2020, that a whole region can be supplied by 100% renewable energy for several hours or even days, while keeping grid operation stable. Key aspects that the participants are looking at include real-time grid transparency, renewable energy providing ancillary services to support grid stability, flexibility of the load in continuous industrial processes and sector coupling.

Another novel aspect of the project is that it brings together a huge range of existing technologies and stakeholders – including power to heat, power to gas, batteries, electrolysis, flexibility of industrial processes and many more – to act as one single system, which more or less follows the renewable energy supply. This is new and requires collaborative partners from all levels of the value chain to be integrated. It will allow grid operators to draw conclusions about the needs of the European electricity grid in the next 20 years, and present convincing business cases to regulators based on grid redesign.

So if NEW 4.0 succeeds, what are the potential impacts on the German grid and on German network operators? Already, hundreds of thousands of small DRES are feeding into the distribution grid. It's clear that the operator's role will continue to be increasingly complex and ICT-driven, redefined from simple operator to smart grid operator. Business cases will be challenged by new players on the power market. Operators' competencies and responsibilities will be turned upside down: the ongoing changes will redefine the role of system operators, and how transmission system operators and distribution system operators work together to address increasing decentralization.

Another obvious challenge for all the pilots is the issue of collaboration. The beauty of this initiative is that it brings R&D specialists, academics, big industrial players and new market entrants to the same table, to dream up ideas and make them into marketable products. But success will depend on aligning the mindset of all these different stakeholders to achieve a joint goal. It will depend on market competitors being prepared to collaborate on pre-market opportunities, share funding, invest their own money up front, share the results and share the risk of failure.

Regulation to get innovation to market
A second common challenge is bringing innovations successfully to market – proving they have a viable business case and then convincing regulators to make the necessary changes to make things work.

In principle, much of the new technology being piloted is market-ready, but it is hindered by regulation. The utility and heat sectors in Germany are not necessarily working to their full potential
because regulation is still oriented to a static environment with a small number of non-flexible power plants. The use of flexibility is still being penalized, rather than incentivized: batteries pay levies and taxes when they charge, and again when they discharge, paying twice for the same kWh stored. Implementing flexibility will require new regulation that takes the changing conditions into account.

Each year, hundreds of millions of euros are lost as wind turbines and solar panels are curtailed because the grid is “full.” Changing regulation could incentivize the local use of otherwise curtailed DRES, for example in power-to-heat or power-to-product processes, and maximize overall economic benefits. At present, conventional “must-run” capacities are needed to provide system services to the grid. If services could be supplied by renewables, Germany could switch off the must-run capacity, cutting electricity prices and emissions.

**Data ownership and use**

Agreeing on data ownership and economic use is one of the toughest challenges. Grids of the future, and the new “energy-plus” products and services being tested in these pilots, will all be driven by data quality and availability. Data will enable the unique selling propositions (USPs) of the future. Aside from any legal restrictions on its use, willingness to share data will be as important as financial support in the success of the projects.

**Significance outside Germany**

Restructuring the energy system in one of the world’s leading industrialized nations will clearly impact Germany’s neighbors in Europe and stimulate global energy transition elsewhere. SINTEG is an open learning process attracting worldwide scrutiny. If it can prove that the goal of meeting 80% – or even 100% – of the energy demand with DRES in a region is realistic, it could contribute significantly to a global model for sustainable growth.

In terms of international impact, all the consortia have globally operating utilities and stakeholders on board that are watching the project outcomes eagerly. In addition, they are linking up to, for example, Denmark in the case of NEW 4.0 and Poland in the case of WindNODE, to ensure that the project outcomes and solutions are disseminated. If the pilots prove that demand can be met 100% from DRES, the economic success of any solutions developed can be taken for granted. Ongoing cost degression of DRES is moving close to grid parity, and increasing environmental standards around the globe will further fuel this interest.

Grids of the future will be much more decentralized and will have to be transparent in real-time. Investment periods will be much shorter and much more ICT driven. New stakeholders will do business with the grid, both feeding in power and providing flexibility.

With 195 countries signing up to the COP21 climate change agreement at the end of 2015, emissions will need to reduce much further and faster, putting more strain on the power and utility sector worldwide. Renewable energy and sector coupling will play an important role in big-scale emissions reduction. In the same way that the German feed-in tariff model was adopted by many countries around the world, the solutions developed by SINTEG participants are likely to serve as a blueprint for large-scale renewables and grid redesign in Europe and beyond.

At a wider level, the lessons from German pilots are likely to influence countries that do not yet have a well-developed infrastructure, including many African and Asian states. They could skip the use of conventional sources and grids altogether and move directly to 100% renewables supply and smart grids.

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“Today’s energy customers want a sense of control, wrapped up in a friendly interface. I strongly believe we have to change how we share energy information.”

Mary Anne Brelinsky, EDF Energy Services
Can energy retailers move faster than lightning?

To survive and thrive, energy retailers have to master new technology, reinvent the customer interface and revolutionize the information they provide, says EDF Energy Services’ Mary Anne Brelinsky.

Report by Abdullah Khan

Two key challenges face the energy sector, according to Mary Anne Brelinsky: the lightning speed that technology is developing and the vast amount of data our society is consuming. Brelinsky is President of EDF Energy Services, one of the largest US energy retailers to commercial and industrial (C&I) customers. She sees traditional power utilities struggling to keep up with unprecedented pressure to innovate in response to these challenges, and move as quickly as technology is changing.

“In the past, utilities managed disparate applications. Now, they need a totally fresh set of IT skills to deal with an integrated world where system connectivity is the cornerstone of the business,” she comments.

“And in the past, utilities built in triple and quadruple redundancies to an already aging infrastructure, which is both expensive and hard to change quickly. Now, data centers are outstripping refineries and chemical plants as the heavy loads on our power grids. We have to completely transform our infrastructure and approach to technology to keep pace with that vast demand for electrons.”

So what is the role of energy retailers in getting ahead of this curve? “We have to ask: do we have the necessary entrepreneurial approach, IT talent and listening skills? And are we developing our technology fast enough to support customers effectively, as their information needs shift?” says Brelinsky. “That’s my driving passion – and I’m lucky to be surrounded by brilliant problem solvers, looking for the answers.”

Customers want integrated service to deal with complexity

Serving her clients – large commercial and industrial (C&I) operations across the US and Canada – is vastly more complex today than it was eight years ago, when her former company became part of the EDF family. From the beginning, Brelinsky has had a keen focus on technology innovation, and as a result, EDF’s Scheduling Online and Reporting (SOAR) portal is one of the fastest growing applications in US energy retailing.1

Brelinsky explains why it is vital to be able to offer an integrated service as a retailer, from production of electrons to end use consumption. “C&I customers are looking for creative, integrated solutions to manage complex needs – onsite generation, demand response, flexible loads, the ability to shift consumption either inside a state or across regions, and new energy storage options.”

Clean power choices are top of mind for non-traditional consumers, she says: “Technology companies in particular are very aggressive in how they procure their green megawatts. They want transparency. They want to buy more

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1. SOAR gives EDF Energy Services’ customers a comprehensive range of information about their energy consumption, supply sources and pricing alternatives.
than renewable energy credits or a paper certificate — they want to be able to show steel on the ground was built because of their commitment to greening up supply. They want to procure long-term green generation and hedge against market volatility, all bundled into one product offering.”

Budget management and transparency are increasingly important to customers. They want billing schemes to manage sophisticated commercial portfolios and allocate costs across multiple locations, which may include coordination across countries and across continents: “If our customer has manufacturing locations in Florence and Dallas, they expect us to be able to provide the same level of service and comparable energy products in both locations,” says Brelinsky.

“Some of our sophisticated C&I customers have taught themselves the energy business and deal with all these nuances themselves,” says Brelinksy. “But most still want a partner who can manage energy complexity for them. As long as we can do that cost effectively, we have a role and will retain their loyalty.”

For Brelinisky, the vital point is integration — reconnecting the energy value chain from production to consumption: “We’re even physically putting the pieces back together again to serve customers better. Our retail teams (working directly with consumers) sit next to our customer transaction desks, which provide wholesale market access, and next to the real-time desks and generation optimization experts.”

**Putting the right information in customers’ hands**

In addition to managing supply and demand, the crucial need is to give customers clear, accessible information to support their energy decisions.

“We generate terabytes of data every day – whether that’s real-time pricing optimization, retail billing systems, ancillary services or information on transmission constraints. We use this data to improve our own business decisions, including dispatching power plants, monitoring interruptible loads and trending market prices. But it’s just as vital to turn this information into a simple, straightforward format for customers,” says Brelinsky.

In responding to this challenge, she thinks we can learn from the peer-to-peer networking revolution in the taxi business: “Until 2009, the taxi model hadn’t fundamentally changed since the horse-drawn carriage days of the seventeenth century. Now, there is a new model in which real-time information that used to belong to taxi companies – where’s my car? How much will the trip cost? What is the traffic situation? – is in the hands of the user.

“Today’s energy customers want that same sense of control, wrapped up in a friendly interface. I strongly believe we have to change how we share energy information. It used to be a big faux pas to show customers forward price curves, but if we don’t tell our customers what the price is, how can they manage their exposure effectively? Big commercial ventures, universities and hospitals are all looking for budget certainty, and we can provide the tools to help them. If they can buy next year’s power cheaper than they could have in the last five, let’s show them. Give them the option to ‘layer in’ – buy 10% today, 10% next month, and if we reach a price that is compelling, buy the rest.

“The same should apply to every piece of the energy ‘pie,’ from ancillaries to capacity to renewables: let’s put the information in their hands.”

**Solar PV and energy storage offer new retail opportunities**

C&I customers who are installing rooftop solar, investing in distributed generation or buying a slice of a wind farm all need wholesale markets and retail markets working together painlessly. Brelinksky definitely sees this as an opportunity: “When one of my customers says: ‘We have the biggest rooftop in Texas and we want to fill it with solar panels,’ I’m excited. I want to be a part of their solution – to work with them on the forecasting and put all the pieces in place to ensure they optimize their energy spend.”

She cites what is happening in storage to illustrate how the retailer’s role is changing. “Several years ago, I was involved in dispatching the first battery in Texas, in the ERCOT market. At the time, registering a battery was not even an option, so we approached the CEO of ERCOT and worked out how to get it done. Since then, we have dispatched pumped hydro storage for customers in the Northeast and multiple battery projects
in Texas and California, with systems that can tie in the generation, the load and the optimization around individual assets.”

This can only become more important. Wind and solar, with production tax credits, are today’s competitive megawatts in the US, but the massive hike in solar and renewable capacity3 has created a looming storage problem. Retailers have an important part to play in working out an economic solution, says Brelinsky.

**Interface innovation**

Her company is in the extraordinary position of being a “start-up” inside the world’s largest utility, but that hasn’t eased the path to growth because EDF is not a household name in the US. Having mapped out the business strategy – optimizing resources in the real-time, day-ahead and term markets, across all energy sources, for C&I customers – Brelinsky has brought together specialists with retail, IT, energy trading and generation expertise into a single multi-disciplined team to tackle the transforming energy agenda.

“Since EDF bought our business in 2008, we’ve grown to the point where we now have customers in every deregulated area of the US. Probably our greatest asset is the SOAR platform, which allows us to tie wholesale and retail markets together and optimize the ‘seam’ between those two worlds,” explains Brelinsky.

Her team developed a smartphone app that presents energy information in a simple, visual way, so customers can make decisions quickly and easily. They also have visibility into what forward markets are doing and can transact when the market sends a buy signal – and do it all with one counterparty, EDF.

“For example, one of our data center customers who has bought a volume metric wind hedge can see their load and optimize it in real time by shifting between different data centers or signaling to turn on the backup generator – all from their iPhone,” she explains.

Customers are constantly looking to be more informed, in a simple manner. “SOAR can show them the health of their positions, the power they have bought, their consumption, real-time prices at their node, what percentage of their portfolio is forward hedged, changes in weather and whether they have optimized their supply against current market prices,” says Brelinsky.

“They can see when it is going to be hot in Texas or freezing cold in Pennsylvania and make sure that they are prepared. We have built billing interfaces that can directly upload data into a customer’s SAP system and tie together, in a single invoice, demand response, load consumption and optimization of generation resources.”

**Bring on the competition**

Energy retailers are facing a radical change in how technology allows customers to procure and optimize energy, and interface with them. This is pioneering territory for utilities, says Brelinsky, “And it’s up to us to put people who understand the energy market together with our customers to develop effective solutions. We’re helping customers figure out what makes sense for them, with solutions that are very specific to their needs: it’s unconventional problem solving.”

According to Brelinsky, not many competitors have the bundling capabilities of EDF: “For clients with multiple needs, only a handful of companies can provide this spectrum of services in a single product offering in the US.” However, she expects competition to grow and put pressure on her team to stay ahead: “We are up to the challenge – bring it on. This is an exciting time to be in energy.”

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2. Electric Reliability Council of Texas.

**Mary Anne Brelinsky**

President, EDF Energy Services

Mary Anne Brelinsky has been President of EDF ES since 2014 and currently serves as an Executive Committee Member for EDF Trading Limited. She joined EDF in 2008 and held positions in Trading and Origination prior to taking up her current role. Her career began at Exxon, where she held various engineering and operations positions. She later worked with Dynegy, where she managed power plants, developed bidding strategies and traded spark spread positions for the company’s generation assets.

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Case study

Enterprise and regulation

Duke raises the bar on security

The largest US electric utility has gone far beyond regulatory standards for cybersecurity to create a sustainable, holistic approach to protecting critical infrastructure.

Report by Joshua Axelrod, Matt Chambers and Mike Riggins
Growing sophistication in threats to infrastructure security.

The bulk electrical system is a critical part of US infrastructure. As such, utilities are facing a barrage of threats. “We face ever-increasing risks from nation-states, terrorist organizations and activist groups,” explains Terrell Garren, VP and Chief Security Officer at Duke Energy. Utilities – along with any business supporting critical infrastructure – have to continue to strengthen their defensive capabilities and advance a broader cybersecurity program, to address increasingly sophisticated threats.

December 2015 witnessed the first publicly-acknowledged cyberattack to result in power outages, which NERC confirmed affected “up to 225,000 Ukrainian customers in three different distribution-level service territories and lasted for several hours.”1 Following the incident, the US National Security Agency (NSA) and the Federal Bureau of Investigation (FBI) launched a national campaign aimed at raising awareness of cyber threats to infrastructure companies.2

In a speech on 2 March 2016, Admiral Mike Rogers, the Director of the US Cyber Command, warned: “It is only a matter of the ‘when,’ not the ‘if’ we’re going to see a nation-state, group or actor engage in destructive behavior against critical infrastructure in the United States.”3

Combining physical and cybersecurity organizations

Duke decided to invest in a long-term sustainable approach to security, which combines its physical security and cybersecurity organizations. “What the Ukrainian situation highlights is the need to coordinate the protection of both cyber and physical assets,” says Garren. “There was both a denial of service attack against a call center and malicious software that got into the grid control workstations. Hackers can do more substantial damage by attacking substations, plants and IT networks at the same time. Duke’s new approach means our people can share and evaluate threat information, collaborate on analysis and take coordinated action.”

New requirements from the North American Electric Reliability Corp. Critical Infrastructure Protection (NERC CIP) standards Version 5/Version 6 were also incorporated. “The standards are beneficial, and they set the foundation for our program, but they cannot keep up with...
the changing threat landscape. We will continue to look for ways to go above and beyond compliance,” says Garren.

**Investments focus as much on people as on technology**

Duke’s new approach enables it to respond more holistically and effectively to security threats: “At the point of a physical attack within a company, you want your physical security to detect it and communicate with your cyber team. It could be a joint attack or physical indicators caused by a cyber-event. It’s important that 24 x 7 monitoring and alerting by those groups are integrated, so information is shared,” says Garren.

Management now has greater visibility regarding risk, easy to use reporting tools and greater automation, which can be translated across both logical and physical security. The end result is better decision making, improved efficiencies and simplified workflows.

“Company leadership, starting with our CEO Lynn Good, very much understands the risks we face and is very willing to make the investments needed to protect our critical infrastructure,” says Garren.

These investments focus as much on people as on technology - something particularly important given the high demand for cybersecurity expertise. “The best cyber specialists not only understand the technical tools, techniques, procedures, but also how to analyze systems. They can think like cyber criminals: how can I break this? How can I circumvent this? Effective penetration testing is critical and utilities should maintain the capability in-house, contract with a third party or do both.”

Garren is quick to point out that all employees share responsibility for protecting the company. Many of the incidents reported by Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) involve phishing attacks on employee’s email accounts: this is how the BlackEnergy malware was introduced in the attack on the Ukrainian power plant.

“Better security requires a mindset change, and not only by avoiding suspicious emails. If we had a copper theft at a substation, we need to ask: was it just a theft, or was it an attempt to disguise something more sinister? For example, was someone trying to get inside the substation control house to access the operational technology?”

Collaboration is also a key theme of Duke’s new approach, says Garren. “Utilities need to share information with each other and with government agencies, to help maintain current situational awareness regarding threats and vulnerabilities – allowing high levels of systems availability and protection of critical infrastructures. We are all in this together.”

**What next?**

“Looking ahead, we’re going after network segmentation in a big way,” says Garren. Greater segmentation of networks enables companies to block or firewall off certain areas, such as internet presence and mission critical equipment. In this way, test infrastructure only communicates with test servers; QA servers only communicate with QA environments; production servers only talk to production equipment; web servers only talk to application servers. This makes it much more difficult for an intruder to maneuver east/west and north/south across a network.

Duke is also exploring the potential of host-based security and data analytics to strengthen security further. “Utility IT networks need to develop sophisticated detection based on intelligent monitoring, so the industry can guard against anomalies in behavior versus known signatures. Financial institutions can
Terrell Garren leads the group responsible for maintaining cybersecurity and physical security for Duke Energy. This includes enterprise protective services and IT security and compliance. Garren joined Duke Energy in 1983 and has extensive experience in the technology field. He is a certified information systems security professional and serves on the board of advisors for Security magazine. He is a retired Colonel from the North Carolina Army National Guard, where he served 28 years and earned a Bronze Star for meritorious active duty service in Iraq.

**Lessons**

**Garren emphasizes three key areas for best practice:**

1. **Invest in technology and people:** The best defense is a knowledgeable, educated cyber workforce. Yes, you also need current tools, whether that’s application-level firewalls or behavior-based monitoring to defend against current and emerging threats. But technology alone can’t save you. A skilled cyber workforce is also essential to keep up with an evolving threat.

2. **Establish a security mindset:** Security is everyone’s job - it’s important that all employees understand both physical and cybersecurity risks. Just as important as how they go about their work is the willingness to speak up when they notice something suspicious. This could be someone behaving unusually at a work location, substation or plant, a device connected to a network that shouldn’t be there; or an employee in a building they shouldn’t be in. Employees need to be willing to “see something, say something.”

3. **Share information externally:** Companies need to engage with external parties, whether it be peer companies, government agencies like Homeland Security and the FBI or sector-specific Information Sharing and Analysis Centers. By sharing information and best practices, we can all improve our understanding of evolving threats, new tools and techniques. External awareness and collaboration are critically important.
From “fail-safe” to “safe-to-fail”
Security has always been the “crunch question” for utilities, but they now face unprecedented challenges to their physical and digital resilience.

Utilities used to tackle resilience by building extremely sturdy power plants, transmission lines and substations. Today, analysts at the World Energy Council (the Council) argue, that approach needs to change. Exposed to unparalleled change and uncertainty, to fulfill their role and even to survive, power companies need to rethink how they handle risk, how they approach innovation and even how they define their own role in the energy ecosystem.

Forget “fail-safe.” Tomorrow’s utility will face so many kinds of uncertainty and emerging risks – including volatile weather patterns, water shortages, huge swings in power demand and cyber terror – that building a fail-safe system is no longer an option, Council analysts say. The new aim should be to design a system that’s safe to fail.

The triple transition

In several recent reports, Council analysts concluded that the utility’s traditional business model is under threat and needs to change because of global warming, uncertainty in demand and supply, and advances in technology. In the Council’s 2016 World Energy Issues Monitor, over 1,200 public and private energy leaders in nearly 90 countries weighed in on the issues, offering “a snapshot of what keeps CEOs, energy ministers, and experts awake at night in nearly 90 countries.”
Extreme weather threat increases

One concern high on the executive agenda is extreme weather events, which have become much more common over the past three-and-a-half decades. Since 1980, the annual number of extreme weather events has more than quadrupled, from 38 in 1980 to 174 in 2014 (see Figure 1). “Nothing should keep us from viewing this as a trend,” says Christoph Frei, World Energy Council Secretary General.

Many of these events led to catastrophic economic losses, particularly for utilities: Typhoon Haiyan, which hit the Philippines in November 2013, crippled the power infrastructure so badly that the cost of rebuilding is estimated at more than double the country’s GDP. In 2015, hydropower facilities in Brazil sustained economic losses of more than US$4.3b due to drought-related energy and water rationing measures. The Council suggests these examples highlight a lack of location-specific knowledge on water and climate issues and limited understanding of the risks posed in energy infrastructure investment decisions.

Globally, the 10 warmest years on record have all occurred over the past 17 years, and the overall global temperature was the highest on record for each month between January and June 2015 (see Figure 2). Such extreme heat and extreme cold spells are expected to continue to rise, raising overall energy demand and straining peak capacity. In India in July 2012, for instance, a heat wave triggered a nationwide blackout that affected 670 million people in all, or roughly 10% of the world’s population. Such extremes reduce the efficiency of thermal plants and put more stress on transmission and distribution systems to an extent that may not only affect production, but the integrity of the equipment itself.


2. Global anomalies are with respect to the 20th century average. Anomalies are a departure from a reference value or long-term average. A positive anomaly indicates that the observed temperature was warmer than the reference value, while a negative anomaly indicates that the observed temperature was cooler than the reference value.
Water shortage threat increases
Water is also predicted to become much scarcer over the next 30 years. Sixty percent of today’s hydroelectric plants and about 80% of thermal plants will face growing competition for their water source. This may be a disaster not just for hydroelectric systems, but also for most kinds of thermal power generation - particularly because society’s interest in preserving water will always outweigh concerns about energy.

“You always have to keep in mind that when we have a competing agenda between water and energy, water security will trump energy security,” Frei notes. The energy-water nexus is considered a critical uncertainty issue for countries in Latin America, the Middle East and Africa.

Cyber threats increasing
Finally, the Council believes that the possibility of cyber terrorism is making our electrical infrastructure more vulnerable.

“In highly integrated, interconnected systems ... cyber is getting very, very high on the list of concerns, and we are very, very early on the learning curve regarding how to deal with those threats,” Frei says. The Council notes that risks from cyber threats have become particularly prevalent in North America and Europe.

Smarter, not stronger
These days the system is too complex, and the threats are too diffuse, to plan for every risk. Adaption and mitigation are therefore critical for building resilience. Adapting means adjusting to a constantly changing environment, such as strengthening energy infrastructure. Mitigation measures are key in the move toward sustainable energy systems through reducing the causes of extreme weather events. Both of which require new ways of collaborating, innovation and financing.

Tomorrow’s power systems need to be smarter, not stronger, with a “soft-resilience” approach - meaning an approach that recognizes the risks, designs mechanisms that make it easier for the infrastructure to absorb a shock, and accepts the possibility of partial system failure as a way to limit damage to the whole (see Figure 3, page 27).
“A soft resilience approach can make energy supplies more secure, more reliable and can contribute to quicker restoration of services in case of disruptions,” according to the Council.

**Achieving “safe-to-fail” systems**

Making the system “safe-to-fail” won’t be easy. Although soft resilience will be cheaper to achieve than hard resilience, building this capability requires greater collaboration among all the stakeholders in the energy ecosystem than previously considered necessary, Council analysts say.

For example, the International Energy Agency recently predicted that US$48t to US$53t will be needed by 2035 to build the global energy infrastructure, and building more resilience into the system will push that bill even higher. “That’s too much money for governments to build alone,” Frei says, but the risks are also too uncertain to attract private investors.

At present, “limited data and a lack of best practice sharing is creating an information vacuum which is reducing the ability of both the energy and finance sector to properly price the investment risk presented by increased extreme weather,” Council analysts write.

The solution: more collaboration. To attract private investment into these new systems, the industry will need to get better at sharing data and at creating dynamic models that take into account the rising levels of volatility. “Increasing the resilience of energy infrastructure is not an option, but a must. Resilience can only be achieved by moving from individual to joint efforts to build systemic energy systems that support the growth of the global economy,” says Frei.

Frei and his team suggest four key steps for power utilities to achieve soft resilience:

► **Design the grid for local control.** Just as the internet can never go down because it’s not centralized, the new electric grids need to be operable at an increasingly local level to make power generation less vulnerable to extreme weather. Rural micro-grid providers will also have a role to play.

► **Lobby for more storage.** Intermittent power means batteries and other storage devices are going to be more important than ever. However, the current structure of many markets discourages investment in storage solutions. Regulators should be encouraged to find a way to remove these obstacles. Power storage encourages renewables and also helps build more local control, notes Frei.

► **Model your risks.** Take into account risks in this new era, such as the prospect of water shortages and extreme weather. The United Nations has projected that there could be a 40% shortfall of water availability globally by 2030.6

**Growing threat of water shortage**

The world’s population of 7.3b people is expected to grow to 9.7b by 2050.3

Some 580 billion cubic meters of freshwater are withdrawn for energy production every year – that’s 15% of the world’s total water withdrawal, second only to agriculture.4

98% of the power currently produced needs water.5

The world will need significant investments in water management to ensure that energy generates power and not water scarcity.

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6. Ibid.

**continued on p28**
Focus on resistance. “Fail-safe” – building single infrastructures to withstand sudden impact. Looks to strengthen individual infrastructures and single assets.

Focus on absorption. “Safe-fail” – building infrastructures that recover quickly from sudden impacts. Looks to reduce impact of disruption by taking a systemic view.

weather events. Better understanding of the risks could help institutional investors overcome regulatory constraints by enabling them to incorporate extreme weather risks into their models. Understanding costs also makes it easier to decide, for example, whether it's cost-effective to dig underground power lines, which cost 5 to 10 times more to install than overhead lines.

Encourage climate insurance plans – for government and for the energy industry.
Create a government insurance program to guarantee electrical purchases in the event of a major disruption. New infrastructure also needs more support than it can get on the market. At the moment, utilities can't insure for storm events more than a year ahead, but that's an untenable situation when a major investment, such as a hydroelectric dam, may have a 50-year working life. Rules should also be changed to enable insurers and pension funds to invest substantially in energy infrastructure.

Exciting times ahead
A triple transition in energy is underway, according to the Council: we are moving away from carbon-based fuels toward decentralized, zero-marginal cost energy markets and toward a more complex market structure.

For the power executive, these ongoing events mean business as usual is no longer an option. “The transition is not something we can decide on. It's something that's happening,” Frei says. The only question is how to give utilities the best chance to survive and thrive through the shift. Utilities will need to be open to innovation, which could mean reevaluating the role of their organization as the dominant provider of power in the market.

Running a utility used to be a fairly calm, some would say dull, business. No longer. While stakeholders are driven by diverse motives, everyone has a role to play. The energy system will only be able to play its crucial role as the backbone of the global economy if all stakeholders work together. “It's going to be an exciting time,” concludes Frei.
“Increasing the resilience of energy infrastructure is not an option, but a must. Resilience can only be achieved by moving from individual to joint efforts to build systemic energy systems that support the growth of the global economy.”

Christoph Frei, World Energy Council

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Christoph Frei
World Energy Council CEO and Secretary General

Christoph Frei took up his current role in April 2009. The World Energy Council publishes the World Energy Scenarios, World Energy Issues Monitor and World Energy Trilemma flagship studies and facilitates the World Energy Congress. Prior to joining the Council, Christoph was a member of the Executive Council of the World Economic Forum (WEF) and its Senior Director in charge of Energy. He is also a titular Professor at EPFL and a member of the International Peace Institute’s Task Force on Energy and Security.
Renewable Energy Country Attractiveness Index (RECAI)

The quarterly RECAI report ranks 40 countries on the attractiveness of their renewable energy investment and deployment opportunities, and provides commentary and analysis on key trends. The latest issue has a new look and a new index, following a reassessment of the factors driving market attractiveness in a world where renewable energy has gone beyond decarbonization and reliance on subsidies.

[Link](https://ey.com/recai)

Talent at the table: Women in Power and Utilities Index 2016

EY began the Women in Power and Utilities Index in 2014. The index analyzes and tracks the number of women in the boardroom and senior management teams in the top 200 utilities globally by revenue. In 2016, 16% of board members of the top 200 utilities globally were women. With a 1% increase over the past three years, this number is not rising quickly enough to reach gender parity in this generation, or the next.

[Link](https://t.co/rZKJaEiKvb)

Diversity and disruption in utilities

Are utilities doing enough to improve diversity by recruiting, retaining and promoting outstanding female talent? The latest EY research uncovers four key factors that are holding progress back, including a lack of realism, lack of data and an inadequate pipeline of female leaders.

[Link](https://t.co/H1XQa5YDC6)

EY Global Information Security Survey 2015: Creating trust in the digital world

Our 2015 Global Information Security Survey (GISS) provides insights from 1,755 participants and investigates the most important cyber security issues facing businesses today. Last year, we identified the ways organizations could get ahead of cybercrime by following a three-stage journey: Activate, Adapt and Anticipate. This concept still applies, but as cyber attackers are continuously changing tactics, increasing in their persistence and expanding their capabilities, the nature of the cyber threats has evolved.

Power Transactions and Trends: Q1 2016
The quarterly Power Transactions and Trends update analyses mergers and acquisitions (M&A) and key market trends in the global power and utilities (P&U) sector. This edition reports on the first quarter of what looks like another robust year for M&A, with a five-year high for Q1 deals.
ey.com/ptt

Global Capital Confidence Barometer: Power & Utilities – issue 14
The Global Capital Confidence Barometer is a unique biannual study of corporate and boardroom confidence, conducted for EY by the Economist Intelligence Unit (EIU). The latest report reveals that utilities across the globe are changing their approach to investment. Capital agendas are increasingly shaped by disruptive industry trends, including distributed generation, low-cost renewable power, market reforms, energy technologies, new market entrants and changing customer expectations.
ey.com/powerandutilities/ccb

Energy: a sector in transformation
Transformation in the energy sector varies greatly by geography and market, but EY has identified four common sources of change across the globe: regulation, infrastructure, digitization and operational change.

Five key priorities for utilities for 2016
Benoit Laclau, Global Sector Leader, Power & Utilities, shares his thoughts on priorities for the changing sector, identifying 2016 as a year of opportunity.
ey.com/Publication/vwlUAassets/ey-Five-key-prioritie-for-utilities-for-2016/$FILE/ey-Five-key-prioritie-for-utilities-for-2016.pdf
Will digital help us do less or be more?

#BetterQuestions ey.com/betterworkingworld

The better the question. The better the answer. The better the world works.