"As a public utility we can't justify making aggressive investments in untested technology to handle the challenge of big data ... we're validating our business model with smaller pilots instead."

Hoi-Chang Lee, KEPCO
Avoiding a power crunch

Capacity markets are viewed by many as a solution to Europe’s unique solar and wind grid challenges.

Energy supply security has long been a delicate balancing act for Europe. The region’s power utilities are now strongly supporting a changeover to market arrangements that compensate them for keeping backup generation capacity on tap. The deal is that they will earn predictable revenue from capacity payments. In return, they must deliver energy as agreed or face penalties. Introducing capacity markets in Europe should ensure that sufficient generating capacity is available at all times to meet demand, given that renewable supplies will fluctuate.

The UK is furthest advanced, with National Grid having run its first capacity auction in December 2014 for delivery in 2018. France isn’t far behind – it plans to start calling for tenders in 2015 for delivery in 2016–17. Plans are also under consideration in Germany and Poland.

One strong proponent of market reform is EURELECTRIC’s Juan Jose Alba Rios (page 4). He firmly believes that Europe needs capacity markets to decarbonize generation and deliver affordable, secure power. Embracing market change will also enhance competition, attract new entrants to new territories, provide clarity for investment decisions and may, he concludes, bring consumer prices down.

Not everyone enthusiastically welcomes the concept. Capacity markets have been fiercely criticized by a number of industry bodies and environmental groups, which argue that these markets could push up bills and open the door to long-term subsidies for fossil fuel-based generation assets, counter to the decarbonization agenda. The “anti” camp argues that capacity markets damage competition, force demand response services to withdraw, and don’t represent value for money for consumers.

Whichever side of the argument you are on, the capacity discussion confirms that the renewables revolution has entered a strong second phase. We’re no longer wrestling with the issue of how to boost their use, but how to integrate them into our energy systems.

In Germany, fast uptake of wind and solar power has created a major challenge to integrate the flood of renewables. The country aims to have renewable energy contributing 80% of its energy mix by 2050. We discuss the latest consequences for Germany’s networks on page 10, and look at how one big German network utility, EWE NETZ, is piloting new technology to deal with renewables in a way that avoids massive additional spending (page 14).

While the sustainability agenda is driving the expansion of renewable energy infrastructure, the same agenda highlights the need to manage the world’s restricted water supplies. In our continuing series on the energy-water nexus, we focus on groundbreaking work by Veolia – turning wastewater into a valuable asset that has saved tens millions of dollars for one US client of the water utility (page 26).

As always, we welcome your views on all the topics covered here; contact details for our authors are listed throughout.

1. Read earlier articles in the series in Utilities Unbundled, Issue 16 (June 2014) and Issue 17 (October 2014).
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#UtilitiesUnbundled
“Capacity markets come in many forms and ... what is happening in Europe might look confusing and messy. But fundamentally, they are all trying to solve similar problems and there is a lot of common ground.”

Juan Jose Alba Rios, EURELECTRIC
Capacity markets are on the rise in Europe amid continued fierce criticism from some lobbyists and environmental activists. Beyond the complexity and controversy, capacity markets offer multiple benefits, according to EURELECTRIC’s Juan Jose Alba Rios.

Soaring levels of renewable energy and the imminent closure of many traditional generation assets are creating the case for capacity markets across Europe. European power utilities are strongly supporting new market designs that would compensate them for keeping backup generation capacity on tap.

Let’s be frank: Europe clearly needs reform to sort out the distortions of the energy-only market. Although energy-only markets are the best economic signal we have for short-term operational decisions, they are failing to drive sufficient long-term investment in generation or even to ensure that needed backup capacity is kept online. We can’t go on with this situation.

This is a key concern for EURELECTRIC’s members – I’d go as far as to say the people I talk to are desperate for capacity markets to happen. Electric utilities are looking for the sort of stable, long-term signals that capacity markets will provide, to enable the necessary existing plants to stay online, develop demand response and support their investment decisions. Who can blame them for backing a market that reduces system costs by lowering the risk of investment in generation?

However, even utility leaders who are in favor of these changes tell me they are concerned about the prospect of a multiplicity of national capacity schemes that might be incompatible with each other. They’re concerned that this might unnecessarily increase costs to consumers.

I am backing capacity markets. I believe they will make a positive contribution to the European landscape that will enhance competition, attract demand response and new entrants to new territories, provide clarity for investment decisions and even bring consumer prices down – if we get the basics right and don’t get sidetracked by complexities.

Markets must be technology-neutral and open cross-border

Capacity markets come in a multitude of forms (see Figure 1, page 6), and on the surface what is happening in Europe today might look confusing and messy. But fundamentally, the various countries are all trying to solve similar problems and there is a lot of common ground.

Whatever the model, a capacity market always starts with a central entity that decides how much capacity is needed (or decides the criteria to define how much capacity is needed). Then somebody buys that capacity – either through a central auction or in a decentralized market. To succeed, the market should be:

- Technology-neutral – any capacity provider should be permitted to participate, regardless of technology – and this includes generation, demand response and storage.
- Open across borders – to ensure maximum efficiency, providers
Several European countries are pursuing plans to create capacity markets as a solution to the region’s unique solar and wind grid challenges. The UK is furthest advanced, having secured EC approval for its proposed scheme under new EU guidelines on energy and environment state aid, which came into force on 1 July 2014. Starting in December 2014, National Grid (the UK’s TSO) will be running annual auctions to ensure the country has adequate generation, with the first supply delivered in 2018. France plans to start calling for tenders in 2015, for delivery in 2016-2017. Germany and Poland are also on the list with capacity market plans under consideration.

Source: EY research
from one country must be able to participate in other markets (obviously, avoiding double remuneration). We want generators, storage providers and demand-response operators (aggregators) all competing internationally. That way, there is the best possible chance that arbitrage between different national markets will cause them to converge – which is, ultimately, the result Europe needs.

**Impact on the Internal Energy Market**

Given the variety of approaches to capacity markets across the European Union (EU), one big question is how they can be reconciled with a coherent Internal Energy Market (IEM).

The European Commission (EC) is in the middle of a highly complex process to make all its national energy-only markets converge toward a single IEM for the fully competitive single market for power. The worry, for some, is that capacity markets will disrupt this process.

It’s true that capacity markets are more complicated from a technical point of view than energy-only markets. It follows that achieving convergence between a variety of national capacity markets will be technically harder and more complex.

But it can be done. We have a good starting point in the Guidelines on State aid for environmental protection and energy 2014-2020, approved by DG Competition. These guidelines establish basic criteria for capacity market design, and through the approval process, DG Competition will check that different countries’ mechanisms comply with the guidelines. Again, this is a good tool to push the different markets to converge. As the EC continues its work on a more detailed set of recommendations, EURELECTRIC will provide input alongside other stakeholders, and we should have working principles by the middle of 2015 at the latest.

Don't get me wrong – I know this will be hard from a technical point of view. It also goes against a very basic concept for many governments, which is that security of supply is a national responsibility. But it wouldn’t be acceptable for other products and services in our European markets (even though it is, surprisingly, accepted for RES support schemes). I strongly believe that we need to look at security of supply from a European perspective – it’s ultimately cheaper and more efficient for everybody. That means capacity markets simply have to be open to cross-border competition.

**Impacts for generators: better investment signals and wider competition**

In general, I believe capacity markets will provide a common and better long-term signal for investment. Right now, investing in new generation in Europe, where it might be needed, is tough and uncertain. The conditions of wholesale markets are not attractive for investors. Long-term price signals are lacking and current carbon wholesale prices are not adequate as an investment signal. This is impacting generators all over Europe.

Capacity markets provide the long-term signals we need: they make generation an attractive investment and should reduce the cost of finance. This should cut the cost of producing our energy supply, which will surely have a positive impact on generators, other capacity providers and customers alike.

Clearly, we are talking about a different type of market, which is by definition more open to competition. In the energy-only market, there is competition among the generators that are already there. Capacity markets should prompt new competitors to enter these markets and compete with incumbents – and I include demand-side response operators and storage operators in this scenario.

In contrast to the critics’ view of the situation, I believe that far from pushing demand-response operators out, capacity markets will make balancing power increasingly bigger business. European companies that can offer up their energy loads to serve capacity needs – and the aggregators that can bundle this backup power at grid scale – will be positioned to profit. The development of demand-side response will be far more efficient if it is built on the level playing field of a capacity market open to all potential capacity providers than if it relies on subsidies or regulatory loopholes.

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Further key impacts for networks and customers

Network operators need to plan transmission, but in today’s unbundled structure they don’t know for sure which generation investments will happen. In an energy-only market, where short-term signals are most important, this makes planning very difficult. By contrast, capacity markets give us long-term economic signals for investment in generation – and with a more reliable view of the generation investment coming down the line, coordinating investment in transmission will be much easier.

Capacity markets should also promise benefits for customers. In today’s risky energy-only market, financing investment is always going to be expensive. By providing long-term economic signals, capacity markets reduce risk in the generation market and therefore cut the cost of financing. So, everything being equal, the cost of supply should be lower: far from pushing up bills, I believe this should translate into lower retail prices.

Keep your eyes on the horizon

We already have a big task on our hands in the EU: from the customer point of view, we urgently need to implement the IEM and remove existing barriers and distortions – in particular, the regulated tariffs that have been distorting investment and economic flow and the lack of harmonization of RES support schemes. This is something the EC – and EURELECTRIC – will continue to focus on intently.

Implementing capacity markets on top of that process will be extremely complex: the implications of introducing a long-term element into our market design need to be carefully thought through. But this development is momentously important – not just for generation owners, but for network operators, decarbonization and innovation around demand-side response. The devil will be in the detail, but we shouldn’t get mired in minutiae when the future of EU energy and climate policy is at stake.
Germany’s quest for smart networks

Fast uptake of wind and solar PV in Germany has created major new challenges to integrate the flood of renewables into the network.

Report by Helmut Edelmann.
Germany has been impacted far more, and far faster, by renewable energy and distributed generation than expected. National support schemes and low connection costs for renewable energy sources (RES) have created an explosion. Grids that were developed 30 to 55 years ago—and designed for large-scale power plants, typically built close to high consumption areas—now face the challenge of integrating a flood of decentralized power generation from RES into the system.

Technologies under consideration include intelligent local transformer stations, smart technology built into the grid and smart metering options for consumers. Ultimately, of course, customers will be the ones who pay; meanwhile, utilities and insurance companies to fund immediate change. Networks are looking to save every possible euro: building in intelligent technologies could drastically cut the investment bill. The more they can save in network spending, the less they will have to claw back in retail prices.

Moving energy where it’s needed

In all of this, the basic challenge is to move energy from where it is being created to where it is needed. Given the various regional and technological concentrations of renewable energy uptake, the expansion needs of individual German distribution networks vary widely. Rural distribution networks will need the greatest level of expansion while urban areas with high levels of consumption will hardly be affected.

Germany has 900 network operators, and the challenges they face on this front vary widely, from the heavily populated urban areas to the rural backwaters. Some operators have a lot of overcapacity, which gives them the flexibility to connect up large numbers of new fluctuating plants without creating too much of a problem. Others are working at the limit of their capacity, and each new renewable power plant means another expensive call on their funds to expand the grid.

Massive investment challenge

Recent reports by energy bodies, including the German Federal Ministry for Economic Affairs and Energy, make the magnitude and expense of change crystal clear: we need massive investment:

- Transmission grid investment is estimated at €22b to €26b (US$24.9b to US$29.4b) by 2024.¹
- Distribution grid investment is estimated at €23b to €49b (US$26b to US$55.5b) by 2032,² and 70% of distribution network expansion identified so far is required in the next 10 years.

Estimated total investment in German distribution grids by 2032: €23b–€49b

Renewable energy sources currently account for 28.5% of Germany’s electricity consumption.

Germany’s political target is to increase renewables to 80% by 2050.
In northern and eastern Germany, where wind power plants are proliferating (see page 14 for perspectives on the issue from North German utility EWE NETZ), the expansion of the high-voltage grid is a key topic. In the south, the strong growth of solar PV is driving development of the low-voltage grid.

Meanwhile, network expansion requirements for the medium-voltage grid are spread equally across all regions.

**Germany is the testing ground**

Germany is on a quest for the optimum solution that will deliver renewables integration without breaking the bank. It’s a huge and unprecedented challenge: essentially, Germany is leading the way into the unknown. Other countries are keenly watching developments for clues to their own future.

Conventional planning methods would call for significant network expansion. But there is a way to avoid this — by using innovative planning concepts and intelligent technologies. The distribution network study by Germany’s Federal Ministry for Economic Affairs and Energy is looking at the impact of curtailing renewable energy generation by 3%. It’s estimated that this could reduce network expansion by 40%. Intelligent network technology could reduce expenditure on network expansion by a further 20%.

**What might the transformed network look like?**

With innovation required on such a scale, Germany’s network development is very much a work in progress. A series of studies and pilots is being run by the Government to clarify the way forward. One aspect under discussion is whether we can “cluster” different medium- and low-voltage networks around current load and installed capacity of renewable energy plants and their expected development.

Germany’s political target is to increase renewables to 80% by 2050. To deal with such a massively ambitious target, networks will need a complete change of mindset, away from investing in more and more copper wires and toward investing in intelligent technology. The proposal that seems to make the most sense is that we create an intelligent network that works like a motorway, with a smart system that regulates the ‘traffic’ and helps operators to spot and avoid ‘traffic jams.’

**Keep learning lessons**

So what can we learn from Germany’s experience so far, in terms of integrating renewables to create a thriving energy sector? It’s tempting to be flippant and say: “Don’t do it like Germany.” But the serious lesson is to be super-sensitive about subsidies. Subsidies are a great way to boost the share of renewables in the market. But you have to know when to stop. We were too late in Germany, with the result that we’re now facing this extraordinary network and financing challenge, alongside difficulties with rising consumer prices and rising CO2 emissions.

In Germany, subsidies and regulation have created an environment with no price risk and no risk around selling renewable energy. Even if it isn’t needed by the market, German operators have to absorb all the renewable energy we generate. This has meant shipping overcapacity to our neighbors, including Poland and the Netherlands, who are not necessarily ecstatic at the prospect. Renewables are always at the front rank in the merit order, which has pushed conventional plants to the breaking point. None of this is helpful.

Looking at Germany from the outside, you can see how important it is to start integrating renewable energy into a real – i.e., unsubsidized – market early on.

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Out with copper, in with intelligence

North German utility EWE NETZ GmbH is piloting smart technology that could help the company to avoid expensive network investment. We asked Managing Director and Chairman Torsten Maus to comment on Germany’s network challenges, the lessons he’s learned to date and how he sees the role of regional utilities transforming.

As one of Germany’s largest electricity and gas network operators, EWE NETZ is responsible for network infrastructure for electricity, natural gas, telecommunications and drinking water in a large North German service territory. Approximately 70% of the electricity flowing through the EWE network comes from renewable sources.

The utility is now working at the limits of its network capacity. “In the last seven years, our installed renewables capacity has almost doubled, from 2.8GW in 2007 to 5.5GW in 2013. In 2013 alone, we connected 4,000 new plants to the network,” says Maus.

“By 2032, it’s estimated our territory will have a total installed decentralized generation capacity of about 9.3GW. This additional physical load can’t be integrated into our existing distribution networks. Our grid planning and cost projections show a clear need for smarter approaches than traditional copper and iron.”

The company has embarked on a pilot project that could help avoid continued heavy investment in network expansion. “We estimate that selectively curtailing wind generation by 5% (depending on power flow) and controlling demand with smart meters could double our grid connection capacity,” says Maus.

EWE’s smart pilot is one of several currently running in Germany, the results of which will heavily influence the Government’s approach to integrating renewables in the future.

In a field trial that began in October 2014 and is planned to last at least a year, EWE is exploring the relationship between curtailing power generation and expanding grid connection capacity. “Our electricity grid infrastructure could be far better utilized,” says Maus. “An essential feature of our trial is the use of smart meters that will allow flexible control of power from each generation unit in response to local loads.”

Piloting smart technology

“We are using tried and tested technology – BTCGRID Agent – which is already commonly used for controlling reactive power in wind farms and solar parks,” explains Maus. “For the field test, our experts developed additional functionality to give us active power control.”

The pilot technology constantly monitors the load and voltage stability in the distribution grid (see Figure 1, page 15). As soon as system limits are exceeded, power from a single generator or group of generators connected to one line is reduced until the system measures comply with the limits again.

By 2032, EWE will have to cope with 9.3GW of decentralized generation in its network. That’s the equivalent of the yearly consumption of 3.2 million household customers.

In 2013 alone, EWE connected 4,000 new plants to the network – including wind farms, solar PV and biomass.

Cutting wind generation by 5% could double EWE’s grid connection capacity.
The technology is based on:

- Monitoring of critical points in the network (e.g., electric currents and voltages)
- Remote connection to power generators, allowing fine control of the load
- Central automated system control; calculation of optimized target values for all power generation units; control of all consumers/storage capacity, providing shiftable loads

**Working toward a truly intelligent network**

EWE is partnering with various other organizations as the pilot continues. “This includes commissioning the Institute of Power Systems and Power Economics (IAEW) at the RWTH Aachen University and the FGH Aachen to do a system study on the nationwide use of our 5% approach,” says Maus. “Initial results are promising and, in principle, support the value of our approach.”

As part of its overall development strategy, EWE is researching other technologies in numerous projects and field tests. These include new concepts for voltage-reactive power control in distribution networks; application of storage batteries for grid operation; and controllable local transformers.

“Our main target is to develop a distribution grid that is ‘smart grid-ready’ and to design a truly intelligent electricity network that can efficiently absorb high amounts of renewable energy,” he says. “This means we can cut the level of investment needed to integrate RES into our distribution grid.”

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**Figure 1. EWE’s smart technology**

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**Source:** EWE NETZ

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3. FGH is a nonprofit research association of electricity supply industry and electricity industry bodies that aims to develop and provide competence and practice-oriented technical knowledge.
Although the ultimate impact on EWE’s network tariffs is hard to predict, Maus anticipates a clear damping effect as a result of efficiency increases and targeted grid enhancement. “We’re hoping this will give us an advantage when it comes to our efficiency benchmarking under Germany’s incentive regulation,” says Maus.

**Learning early lessons**

While the results of the tests remain to be seen, EWE has already learned valuable lessons about renewables integration. Maus highlights key points for utilities in Germany and elsewhere to bear in mind:

1. **Get your estimates right.** The big challenge in all of this is planning for the impact and having the money to pay for transformation. EWE has had to cope with unprecedented rapid change, with total installations of distributed energy resources (DER) in its territory up by 500% (to a total exceeding 55,500) in just seven years. In one historic month, December 2013, power generation from DER reached more than 94% of overall electricity consumption in EWE’s distribution network. The company’s annual average in 2013 was 70%, which means it has already exceeded the national German targets for 2035. The moral is: don’t get taken by surprise – think big.

2. **Get smart about data.** EWE’s ultimate operational challenge remains keeping distribution network quality and efficiency as high as possible. But it also needs to ensure efficient data handling, reliable and secure
communication, provision of energy
data and grid-related energy services,
minute by minute. “It is a challenge
to operate a network at its physical
limits. Information and communication
technologies are key enablers for us
to enter the next phase of electricity
infrastructure operation,” says Maus.

3. Secure the right skills. EWE’s people
had to learn on the job. “There wasn’t
an industrialized nation, a project or a
lab anywhere in the world that could
provide best practices we could follow
or answers to our questions. In 2008,
we had just 40 people working on
DER integration; now we have 270 – a
drastic increase of human resources.
We have to be able to offer fast grid
connection, state-of-the-art system
operation, excellent field service and
24-hour support. The talent pool is
not limitless, so utilities really need to
think about exactly who is going to do
it.”

4. Be a part of the change. Utilities
around the world are watching
Germany. “Sharing what EWE
has learned with the wider utility
community is important to us, and
Germany’s federal government
will be showcasing our field test as
a beacon project. We want to be a
part of developing the smart grid-
ready networks of the future and will
continue to share the results we are
achieving. This isn’t just a matter of
technology; it is a regulatory and legal
discussion on how to create our energy
future.”

“Our main target is to develop a distribution grid
that is ‘smart grid-ready’ and to design a truly
intelligent electricity network that can efficiently
absorb high amounts of renewable energy. This
means we can cut the level of investment needed
to integrate RES into our distribution grid.”

Torsten Maus, EWE NETZ

Changing role for utilities

So how does Maus see the role of utilities
changing as the network continues to
transform? “The advent of decentralized
RES has created a new industrial
revolution. This is driving system
innovation in the utility sector, and we are
managing continuous change.

“We can increase system efficiency by
investments in IT and telecommunications
instead of copper and iron. But innovation
at this level will only get us part of the
way to smart distribution networks and
smart local markets. We have to build up
truly intelligent distribution networks,
with active distribution system operators
(DSOs) supporting system operation and
market facilitation.

“The role of the DSO and the network will
continue to transform toward providing
decentralized data services and data
aggregation. By offering new services
based on data, the DSO will open new
paths of innovation for the German
energy sector. I hope political decision-
makers and regulators will support this
idea and help us to make the transition.”

Torsten Maus

Managing Director and Chairman of the Board
of Management, EWE NETZ GmbH

Torsten Maus has over 20 years’
experience in the energy industry. He
joined EWE in Oldenburg in 1991 and
held various management positions
before being appointed head of the
company’s networks division in 2005.
He became MD of the newly founded
EWE NETZ in 2006 and was appointed
Chairman of the Board of Management
in 2009.
“Coal trading provides a very good market-entry point for establishing a brand and serving demand in China and other markets.”

Chris Hagedorn, Peabody Energy
Coal is “absolutely essential” to meet the world’s future energy needs, says Peabody Energy’s Chris Hagedorn, who explains how coal and coal trading are important parts of Peabody’s strategy to meet the growing demand for energy in the Asia-Pacific region.

Report by Brad Hartnett and Amber Nelson

Despite environmental policy challenges and growth in renewable energy sources, the long-term global outlook for coal-fueled generation remains strong, according to Chris Hagedorn, Group Executive and Chief Development Officer for US-based Peabody Energy, the world’s largest private sector coal company.

Not only does coal fuel more than 40% of the world’s electricity – far more than any other source – but Hagedorn believes that the role of coal in bringing power to the world’s 3.5 billion people with inadequate access to electricity cannot be overlooked.

“Our business is to provide clean, affordable energy to the world,” he says. “Coal is an absolutely essential part of this. It is the only low-cost fuel of scale that can satisfy the kind of energy demand growth that we will see over the next half-century.”

Much of this demand growth will come from the Asia-Pacific region, particularly new energy powerhouses such as China and India. Indeed, in its latest World Energy Outlook, the International Energy Agency projects global coal-fueled electricity generation to grow at a compounded average annual rate (CAAGR) of 2.4% between 2012 and 2040 under its Current Policies Scenario. In comparison, growth in the non-OECD Asia region is projected to be significantly higher at a CAAGR of 3.4% per annum over the same period.

Hagedorn says Peabody foresees “a tremendous amount of growth in coal generation with opportunities in China and India leading the way,” and is pursuing a two-pronged strategy to capitalize on this potential.

Leveraging an Australian production foothold

Peabody is no newcomer to the Asia-Pacific region, having mined coal in Australia for more than 20 years. The first part of Peabody’s Asia-Pacific strategy sees it leveraging the geographic proximity of its Australian operations to the Asia-Pacific growth markets.

“We knew that Australia was well-positioned to produce and supply coal into growing Asia-Pacific markets,” says Hagedorn. “So about a decade ago, we began a process of growing our investment, mining operations and capabilities in Australia through a series of acquisitions.”

He says the expansion has transformed Peabody’s business model and its market presence in the region.

“We’ve gone from a few million tons per year to nearly 40 million tons a year of coal production in Asia-Pacific. Our portfolio of production between Australia and the US is now very balanced from a revenue-basis standpoint.”

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2. Ibid.
Trading into emerging markets

Trading is the second part of Peabody’s strategy to meet growing demand for coal.

“Coal trading provides a very good market-entry point for establishing a brand and serving demand in China and other markets in the region,” explains Hagedorn.

“China was a net exporter of coal up to 2008 and then swung to become to be a net coal importer – and that’s about the time that we began our China trading activities of providing coal and importing it into China. Last year, for example, we supplied nearly 20 million tons of imported coal, drawn from our Australian platform and our portfolio of third-party sources, into the Chinese market.”

As part of its trading strategy, Peabody has opened several offices across Australasia, including in Indonesia, China and India.

“For example, we’ve grown from having no presence in Indonesia five years ago to now sourcing third-party coal of roughly 4 million to 5 million tons per annum out of the Indonesian market. We use that coal to supply growing demand in the Asia-Pacific markets, with India as a key destination.”

Trading also offers Peabody other opportunities in these new growth markets: “Over the long term, it gives us the potential – not an obligation – to undertake other activities, from investment in clean coal technologies, up to and eventually including local mining operations.”

Opportunities to innovate

Hagedorn says that the coal trading market is more complex than most think, and that the complexities offer opportunities for companies such as Peabody to make the most of their ability to offer a premium product.

“Most people think of coal as a commodity, but when you look at the spectrum of coal qualities and types, no geologic reserve is exactly the same anywhere in the world. They all have different footprints, whether it’s sulfur quality, whether it’s metallurgical or thermal coal, et cetera. And yet – as with most commodities, such as aluminum, copper, platinum and gold – coal markets have been priced with a standard specification that is almost universal across the globe.”

The evolution of the coal market and the diversity of coal products offer opportunities for innovation in trading, says Hagedorn.

“An increasingly fluid trading model has emerged that allows for a lot of trading in and out of the product and a lot of derivative positions to occur along the forward curve in those products.

“Continued emergence and growth of the number of traded coal products, both thermal and metallurgical, can be good for the industry. Market liquidity will improve and, with these instruments, buyers and sellers will be better able to manage physical and financial commodity risks.”

“Mining is in our DNA”

Although strategically important, trading still only makes up about 10% of Peabody’s overall coal sales of approximately 250 million tons a year.

“While trading has been a key aspect of our strategy, it isn’t the historic core of our business, as it is with some other companies,” says Hagedorn. “Mining is in our DNA. Our overall aim is to remain a long-term, low-cost, highly efficient mining operations.”

© Peabody Energy
company that is extremely focused on safety and the environment. We recognize the importance of having sales and trading capabilities that put us in a very strong strategic position, especially in the Asia-Pacific region.”

Advancing clean coal
Can technology really make coal a sustainable answer to meeting the world’s energy needs?

Peabody believes the answer is yes. The company is among the industry’s leading advocates working to advance today’s clean coal technologies that minimize power plant emissions.

“We believe that 21st century coal generation that uses today’s advanced technologies will irrefutably remain an important part of the base load for power and power growth over the next half-century and beyond,” says Hagedorn.

Longer term, investment in research and development continues to advance next-generation technologies toward what Hagedorn describes as “the ultimate goal of coal-fueled power that is virtually free of emissions.”

“This would include commercializing carbon capture, use and storage technologies. How quickly we can achieve this will depend, in large part, on integration of the technologies, a clear regulatory structure and a solid understanding of geologic conditions. We are focused on accelerating our position as industry leaders in advocating for the most efficient and cleanest use of coal everywhere in the world.”

This past December, Peabody was named Energy Company of the Year, and CEO Gregory H. Boyce was named CEO of the Year, at the annual Global Energy Awards, in recognition of the company’s achievements in reducing energy poverty, increasing access to electricity and reducing overall emissions. An example of these efforts includes Peabody’s equity partnership, with eight other local companies, in China’s GreenGen power plant and carbon research center.

GreenGen uses integrated gasification combined cycle (IGCC) technology and ultimately will capture carbon for enhanced oil recovery.

Hagedorn says China’s recent efforts to cut emissions and improve air quality highlight what can be achieved when the political will is present.

“China is in the process of what is a truly monumental build-out, enhancing its coal-fueled generating fleet and investing in the best emissions control technologies for sulphur oxides (SOx), nitrogen oxides (NOx) and particulates. China is currently working to achieve in a few years what it took the US decades to do, as far as reducing emissions.”

Hagedorn is adamant that over the longer term, even as renewable generation grows, coal will remain a force. “Eventually the growth percentages will continue to show solar, wind and other renewables growing at very fast clips, but in absolute growth terms, coal will be — by far — the dominant growth mechanism. This is especially true for countries like India and China.

“Low-cost electricity is first and foremost on the agenda for these countries. Secondly, developing nations want to achieve their energy goals sustainably, with use of emission control technologies.”

Hagedorn emphasizes the importance of projects like GreenGen in demonstrating Peabody’s industry stewardship and leadership in driving deployment of innovative technologies.

“It is absolutely essential that public and private partnerships continue to invest in and support deployment of advanced coal technologies around the globe — and especially in Asia-Pacific countries such as China and India. This will ensure that as the world continues to turn to coal to power economic growth, we can achieve our global energy goals and make major environmental progress.”

Chris Hagedorn, Peabody Energy

Chris Hagedorn is responsible for Peabody Energy’s Global Development and Strategy Group. He recently served as President — Asia and Trading, leading the company’s global trading, brokerage and Asia growth activities. Hagedorn previously held positions at Peabody of Senior Vice President, Global Sales and Trading Support; Senior Vice President, Chief Procurement Officer; and Vice President — Business Performance.

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Personal view
Trading
The goal here is to turn data into insight for the business through better forecasting and management of various risks such as outages and blackouts, as well as customer dissatisfaction levels.

Hoi-Chang Lee, KEPCO
Most enterprises have a hard time keeping up with the pace of change, but public utilities have a special challenge. Where private companies can take calculated risks — and are often even expected to do so — a regulated utility has little room to maneuver.

The integration of big data and analytics into the operating model of the modern energy company is a case in point. Deriving actionable intelligence from the huge volumes of data generated by smart meters and smart networks promises to deliver real value to utility companies. Some analysts estimate that at the typical utility, big data could reduce peak loads by 5%, raise annual revenue by 2%-4%, and raise first-call outage resolution by 50%.1 Understanding load usage patterns and events through real-time intelligence may also take the guesswork out of many business decisions and enhance customer relationships.

Utilities currently invest US$1.5b annually in data analytics, and this amount is expected to rise to almost US$4b by 2020.2 However, commercial deployment of such solutions is still a work in progress, with an ROI that is still uncertain enough that many public utilities have had to take a wait-and-see approach.

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It doesn’t have to be this way. KEPCO, South Korea’s state-owned power company, is taking cautious steps toward the future, through two pilot projects that explore the possibilities of big data analytics without taking the kind of risks that might violate its mandate as a public utility. The company hopes, however, that even this low-risk approach will doff customers with better home energy management solutions and a smarter, more responsive grid.

**Big data, big risks**

Although South Korea is one of the world’s most advanced digital markets, and KEPCO believes in the value of networked information, CIO Hoi-Chang Lee explains that the company couldn’t quite justify making a large, aggressive investment in an untested technology. However, doing nothing about big data seemed risky too: “Expecting consumers who live in the 21st century to make do with mid-20th century technology for another decade could create an opportunity for an aggressive unregulated player to disintermediate us,” says Lee.

To keep its risks low, KEPCO decided that rather than roll out a vast new network, it would focus on two projects that leveraged the data made available through its Advanced Metering Infrastructure, explains Lee: “We thought that it would be a safer bet to validate our business model by doing a number of pilot projects instead of taking the risk of investing on a larger scale in one project.”

The pilots, which were started in June 2014 and will run through early 2015, tackle:

- **Customer engagement.** “Nearly 5 million KEPCO customers already have smart meters, and by 2020 the number will rise to 20 million,” says Lee. “We plan to use analytics to give consumers a chance to better manage their own power consumption, as well as to provide a fact-based foundation for the design of a future smart grid.”

- **Grid operations.** Analysts will use data culled from social media to improve responses to events, such as winter storms, that affect power use and delivery. “The goal here is to turn data into insight for the business through better forecasting and management of various risks such as outages and...”
Don’t just stand there

Public utilities weren’t designed for change; they were designed for stability. To serve their customers well, they sometimes need to find ways to take advantage of larger trends. KEPCO’s gambit offers a low-risk response that is within both the letter and the spirit of its mandate.

Looking ahead, the growth in commercially deployed big data and analytics solutions may make it easier for utilities to make the case to regulators for more IT investment. For now, KEPCO’s pilots represent a prudent path forward for new technology deployment by a major public utility.

As for Lee, he is confident that KEPCO’s pilots will give the company a good entrée into big data, and possibly even build the foundation for a stand-alone energy analytics business. “As we say in South Korea, a good start is half the task,” Lee says.

blackouts,” explains Lee. “We will also analyze social media data to monitor ordinary service levels, and better understand sources of customer dissatisfaction.”

So far, KEPCO executives have been encouraged by the results, particularly the positive customer response. “Customers like having greater insight into, and control of, their home power use,” Lee says. “At the same time, these pilots are giving KEPCO’S operations and marketing teams valuable insight into using big data to serve customers better.”

Challenges remain. For example, Lee says, it may not be easy to enforce the use of the same kind of meter in every home. “But the great thing about starting these projects as pilots is that we have the opportunity to work out solutions in a truly cost-effective way,” he adds.
Veolia connects the drops
At Veolia, we talk about the water-energy-natural resources nexus because our planet’s resources are dwindling. We need to think more about connecting all three sectors. We support a circular economy where natural resources are reused and re-manufactured as standard, products are designed to last longer and sustainability is an integral part of our lives.

It is well known that energy is a large part of a water company’s cost base: an estimated 25%-40% of costs for wastewater, and as much as 80% of costs to produce drinking water. So when we operate water assets, we have historically focused on optimizing energy consumption. As a responsible operator, we would also look at improving performance through better engineering, for example, by reducing leakage and improving pumping systems.

This was the starting point for our work with Milwaukee Metropolitan Sewerage District (MMSD), which wanted a partner to manage its wastewater treatment plants and related assets.

But we took this program to the next level. We thought about water resources, wastewater and energy — and how we could connect them. We thought about the dynamics of MMSD and how we could help the agency meet its goal of improving sustainability and lowering its carbon and water footprints.

Our solution not only improves the management of current wastewater assets, but also utilizes biogas that was previously flared into the atmosphere. This will ultimately help make MMSD’s wastewater plants 100% energy independent.

In our continuing series on the energy-water nexus, Laurent Auguste, Director of Innovation and Markets at Veolia, highlights the groundbreaking solution that turned waste into an asset — saving Milwaukee Metropolitan Sewerage District tens of millions of dollars.

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**High energy costs to produce water**

Only 2.5% of water on the planet is fit for human consumption without treatment.

Globally, energy represents 25%-40% of the costs to process wastewater ...

... and as much as 80% of the costs to produce drinking water.

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Veolia helped the city of Milwaukee to use landfill gas to power the Jones Island Water Reclamation Facility.

©Bryan Spear, Veolia

**Setting the standard in sustainability**

MMSD wanted a partner to operate, maintain and manage its aboveground and underground assets, as well as production of the fertilizer Milorganite®, over a 10-year period. The sizeable assets include two large wastewater treatment plants that serve 28 municipalities with a population of 1.1 million, 19 pump stations, a collection system, storm water system and deep tunnel system.

We challenged our team to think beyond current best practices and the traditional approach of energy optimization in order to support MMSD’s leadership position in renewables and its aspiration to set the standard in sustainability.

**Beyond energy efficiency into energy balance**

Our solution was built on best-practice asset management but went one step further. At the foundation was the traditional engineering-led approach to wastewater asset management. For example, we:

- Applied best practices and best technology from around the world.
- Reduced costs through energy efficiency, e.g., optimizing the aeration of wastewater treatment to significantly reduce energy usage.

However, we went beyond energy efficiency to achieve energy balance. And we did that by thinking outside departmental silos. Veolia mobilized people in waste, water and energy, and when we did that, we realized there was an unused asset just 20 miles away that could transform our solution: a large solid waste landfill, relatively close to the wastewater treatment plants. Why not pipe over the “waste” landfill gas (LFG) and use it to power the plant? We evaluated the feasibility and cost and carried out preliminary design work for the LFG pipeline and conversion of the Milorganite® dryer burners to LFG. MMSD embraced the idea and built the project.

LFG is a viable energy source that can be used in lieu of natural gas, so instead of flaring it into the atmosphere, we leveraged it into cost savings estimated to be worth tens of millions of dollars over the next 20 years.
Veolia’s project with MMSD will achieve savings of US$35m over the term of the contract. This makes it a win not just for the environment, but also for MMSD, and a win for customers.

What we achieved

- Return on investment: the project is forecast to achieve savings of US$35m over the term of the contract. This makes it a win not just for the environment, but also for MMSD, and a win for customers.

- Reduction of carbon emissions: Veolia developed the first-ever Water Carbon Footprint study to measure the environmental impact of carbon, water and costs and a Water Impact Index that establishes the impact of human activity on water resources.

- Reduction of energy use

- Sustainability: by 2035, the wastewater plants will operate on 100% renewable energy, 80% of which will be produced internally. Currently, 70% of the electricity coverage of the Jones Island Plant is provided by the LFG-powered turbines, which operate on a mix of LFG and natural gas (the LFG pipeline first became operational in 2013); this will reach 100% when the pipeline operates at full capacity by 2035.

Energy efficiency and wastewater

Veolia dries the sludge from wastewater and turns it into fertilizer. More efficient drying of wastewater has saved two decatherms2 over five years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Decatherm per ton of solids dried</th>
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<tbody>
<tr>
<td>2008</td>
<td>19.6</td>
</tr>
<tr>
<td>2013</td>
<td>17.6</td>
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1 decatherm is the equivalent of 100,000 BTU.
Lessons learned
For me, the lessons are very simple:

- **We must start “connecting the drops”**
  We need to share best practice around the world. Water (like energy) is local, and we tend to think no other place can take on the burden of another. We can’t think in silos any more. We can’t ignore the impact on natural resources. We have to start thinking about how to connect these drops into a coherent whole.

- **We need to get out of “silo” thinking**
  At Veolia, we’ve redefined our mission as “resourcing the world.” We can’t afford to think in water and energy silos any more. We can’t ignore the impact on natural resources. We have to think in a more holistic way, considering the needs of both water and energy systems simultaneously.

Looking ahead
The public-private partnership with MMSD is the largest in the US; our relationship runs through to 2018. MMSD has set a goal of reducing its carbon footprint by 90% (from 2005 levels) by 2035; we are working on additional projects to help them achieve this and to further improve system performance.

Many of the benefits we realized in Milwaukee – and all of the lessons learned – apply equally to other cities. Cities tend to act like islands; we need to build bridges so they can adopt the best thinking from around the world.

Given the pressure on resources and extreme weather events, we are going to see the demand for energy-balanced solutions more and more. We expect the work we put into the Water Carbon Footprint study and the Water Impact Index to help spur better water practices. Measuring the impact of water usage is far more complicated than measuring that of carbon because the value of one liter of water in a water-stressed area is different from that in a water-rich area. Our tools take into account the quality of water, the quantity of water and where the user is located.

Sustainability isn’t just an appealing idea – it’s a must. It makes economic sense. We believe that cities will be differentiating themselves in the future on these grounds.
to think about all three. This really is a board-level issue: in the next 10 to 20 years, everyone will need to bridge the gap between these sectors and develop new solutions that are more sustainable.

We have to go beyond good – or even great – engineering
It’s not enough to build good infrastructure and put in place the best technology. We have to take account of changing demographics and climate change and come up with sustainable solutions. For example, at the landfill site, the methane gas was previously flared. This wasn’t seen as an issue. But now it’s an energy source, contributing to the economics of the wastewater plants, and greenhouse gas emissions have been reduced.

We need to embrace new ideas
The water sector is conservative by nature. Reliability is a 24-hour concern, and you need the water to be 100% safe. There is a natural desire not to put that at risk. However, this means it can be difficult to introduce new ideas and even harder to implement them. This is where the private sector can help. We need to bring in new thinking, new ideas and new approaches – the future of our planet depends on this.

“We can’t think ‘I’m a water expert’ or ‘I’m an energy expert’ any longer — it’s all connected.”

Laurent Auguste, Veolia

Laurent Auguste started his career in 1991 in Tokyo. He joined Veolia in 1995 as area manager in northern France. In 1999, after an initial placement in Shanghai, he founded and led Veolia’s water activity in South Korea, moving on to Japan in 2002. In 2008 he took up responsibility for the company’s water business in the Americas. Since 2013, he has led Veolia’s growth as a member of the Executive Committee.
Diversity in the boardroom is not a women’s issue. It’s a business issue.

Diversity is linked to improved financial performance. At a time of transformational change in the power and utilities sector, having more women in the boardroom could boost business and innovation.

Let’s bring more talent to the table. Join the conversation @ AlisonKayEY

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