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The future of the global power sector
Preparing for emerging opportunities and threats

Contents

Power industry challenges

There is little doubt that power is a key driver of human progress. In fact, to maintain our way of life and the economic development of our society, we require continuous access to power at an affordable price.

Given the impact of power on personal welfare and economic effectiveness, power suppliers must maintain strict quality standards to provide their services at competitive costs. As a result, utilities around the world must adhere to extremely high performance ratios. At the same time, they need to:

- Collaborate effectively to develop an infrastructure that guarantees supply over the medium and long-term, and
- Remain very respectful of the environment, particularly given society's reluctance to continue relying on polluting power generation technologies.

In light of these realities, utilities are facing a range of short-term challenges, which are driving the need to transform their business models. As part of this transformation, some utilities are looking for ways to:

- Manage their investment and operating costs more effectively.
- Integrate multiple power generation sources effectively, from small-scale renewables generated by micro-grids and other distributed generation sources, to larger scale conventionally fueled plants.
- Promote the effective development of new electric technologies capable of properly managing power systems that have a large penetration of renewable generation, distributed generation, energy storage, electric vehicles, demand management programs, etc.
- Nexus between power and water, e.g. 39% of all freshwater withdrawals in the US are used for power production.
- Develop outstanding commercial capabilities to proactively access the market.
- Adopt large scale IT technologies to improve service effectiveness and efficiency.
- Predict and prepare for ongoing regulatory, political and environmental changes, which could include re-regulation in certain cases.
- Internationalize the business by pursuing opportunities to grow in new markets and achieve the economies of scale they need to be competitive.

Although no single vision exists for the way the global power sector will evolve in the future, one truth is clear: the industry sits on the cusp of massive change. The way power companies respond will depend on where they operate, their regulatory environment, the structure of their portfolio of assets, evolving customer demands, their economic maturity and the level of technology adoption they require.

Yet, in most scenarios, the utility of the future will act as the glue that maintains the connections between multiple power generation sources – from small-scale distributed renewables to larger scale conventionally fueled plants, micro-grids and electric charging stations – and customers.

To succeed in this goal, the utility of the future will transform into that of a service company that enables effective energy solutions defined by high-quality service standards. This, however, will require major transformation of business and operating models. In short, today's utility model is outdated. Struggling to meet client needs while maintaining acceptable shareholder returns are currently common concerns.

Of course, the speed of change depends on where businesses are located. Conditions related to demand evolution, CO_2 regulation, regulations for distribution, transmission and retail, market structure, etc. are completely different in different regions.

In this assessment, our aim is not to provide a roadmap for the future, but rather to identify the drivers shaping this future in different global regions.

The current power company environment

Historically, the power sector was characterized by a mature technology and a stable legal framework that guaranteed the profitability of the business: companies were managed according to the excellence of their technical criteria.

However, due to the sector's social and economic impact, companies are under strong pressure to improve their efficiency to achieve not only greater cost competitiveness, but also an outstanding level of environmental performance.

This situation differs from one region to another, because of the different market growth levels:

- Mature markets, characterized by slow growth, typically experience a high level of competitiveness between players (as is the case in many European Union countries and the United States).

- Developing markets, such as South America, Asia or Africa, tend to have higher rates of growth coupled with a lower level of competitiveness. These circumstances tend to create more opportunities for doing business (and/or investments) in new markets and providing new services.

Additionally, power companies are under pressure to demonstrate responsible practices, innovation, flexibility, sustainability, resilience and tolerance.

To expand, improve their profitability, gain a competitive advantage and maintain their commitment to high levels of environmental performance, companies will have to make changes to their strategy and operational models, related to at least the following areas of focus:

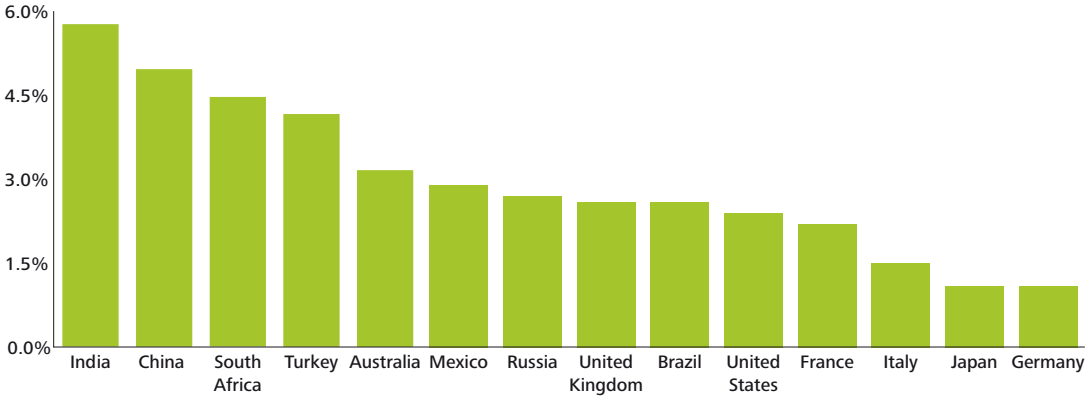
Areas of focus
As power companies seek to position for the future, they will need to resolve issues around:

- **Energy demand**
- **Penetration of renewable energies**
- **The degree of commitment to CO_2 emissions reduction**
- **The different cost of fuels and generation mix infrastructure**
- **Coal: an effective (cheap) solution?**
- **The increase in shale gas production**
- **Nuclear power upgrading or decommissioning**
- **Pressures to reduce power prices**
- **Ancient grid infrastructure and the need to adapt**

Due to the sector's social and economic impact, companies are under strong pressure to improve their efficiency to achieve not only greater cost competitiveness, but also an outstanding level of environmental performance.

Energy demand

Figure 1. Forecast potential GDP growth: average annual increase in percentage (2014-2030)

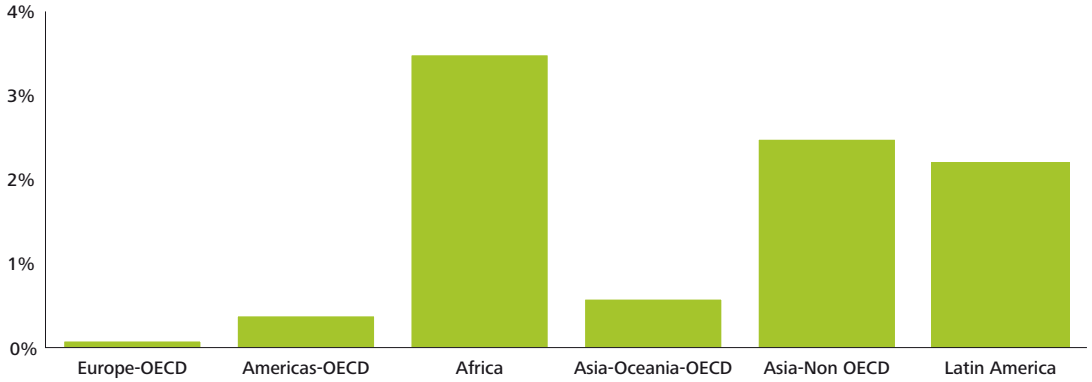


Source: OECD[1]

Due to higher levels of economic growth and anticipated improvements in the quality of life over the next few years, developing countries will likely see a rapid increase in power demand. India, for instance, is poised to see annual consumption increases of up to 3.2% between 2012 and 2040, while China's annual demand is forecast to grow by 2.1% for the same time period (Source: OECD[2]).

Conversely, consumption in OECD countries will evolve slowly. Between 2012 and 2040, the increase in annual power demand rates will remain low for regions like the United States (0.2 %) and may drop in the European Union (-0.1 %).

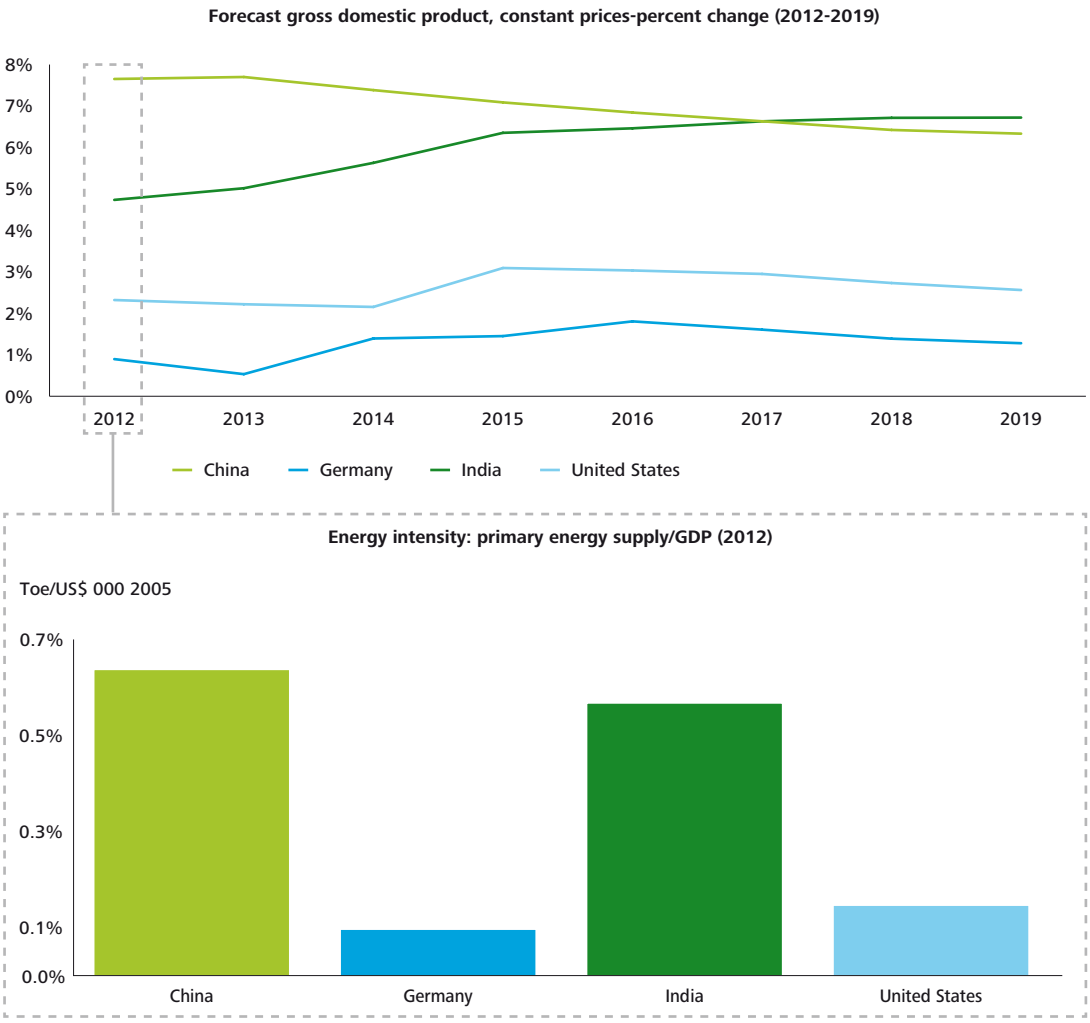
Figure 2. Forecast power demand increase (2012-2040)



Source: World Energy Outlook-International Energy Agency (2014)[3]

The forecast economic evolution and associated energy intensity of the developing countries explains the future foreseen demand.

Figure 3. Forecast gross domestic product, constant prices-percent change (2012-2019)/2012 energy intensity (primary energy supply/GDP)



Source: International Monetary Fund (January 2015)[4]/International Energy Agency (January 2015)[5]

Given these trends, utilities which operate in developed nations will need to counter low growth rates in their traditional markets by pursuing internationalization and exploring the viability of alternative businesses and/or solutions to maintain their growth.

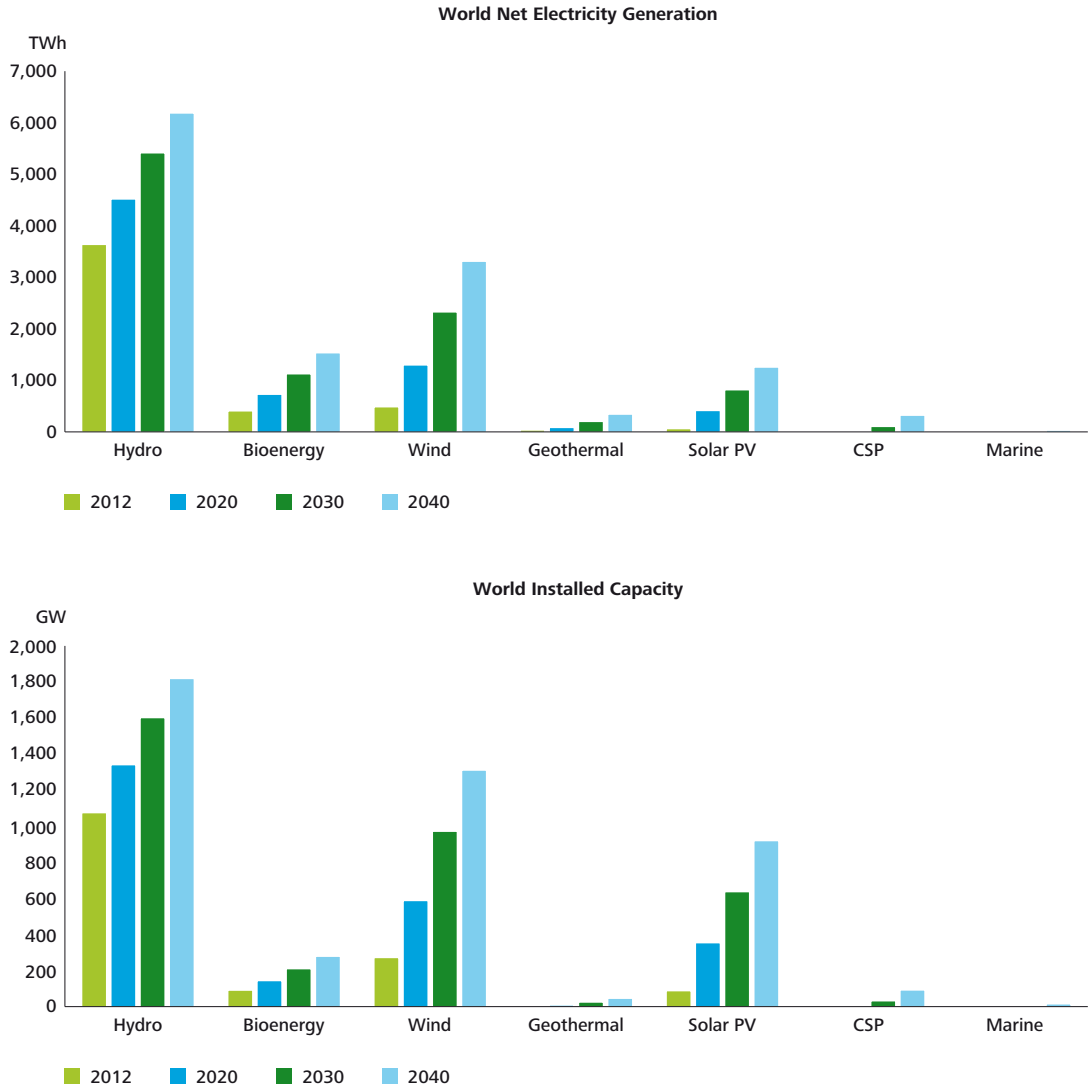
In some cases, the problem for incumbents is that their balance sheets may not enable expansion: they could establish an alternative strategy based on moving to an asset developer and/or operator model, more than asset owner.

Penetration of renewable energies

Over the last few years, utilities have increasingly relied on renewable energies to generate power for two main reasons:

- Governments in several areas around the world have established incentives to promote the installation of these facilities to guarantee their power supply and reduce the emission of polluting gases.
- At the same time, the improvement of renewable energy technologies and their associated monitoring and control processes are enabling more rapid adoption.

Figure 4. Forecast power generation and installed capacity by source (2012-2040)

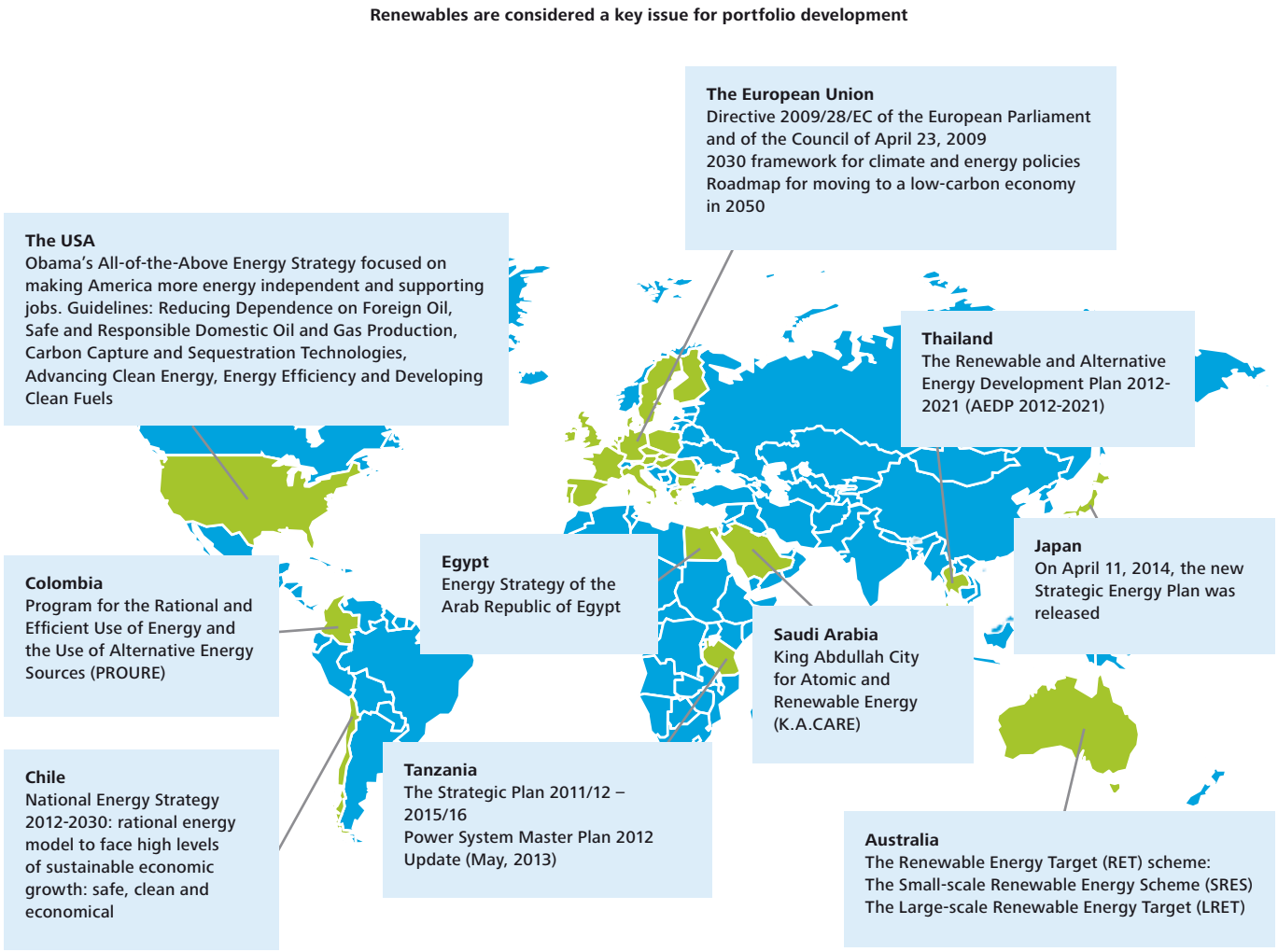


Source: World Energy Outlook-International Energy Agency (2014)[6]

According to current forecasts (source: World Energy Outlook-International Energy Agency (2014)[7], more than 2,457 gigawatts (GW) of power capacity will be installed worldwide over the next 25 years, while total renewable energy capacity will grow to 3,930 GW by 2035 to produce 11,573 terawatt hours (TWh) – representing 31.2% of total world power generation.

The most prevalent technologies will be hydro at 1,731 GW, wind at 1,130 GW and solar photovoltaic (PV) at 690 GW (source: World Energy Outlook-International Energy Agency (2014)[8].

Figure 5. Worldwide renewable energy policies



Renewable energies are becoming a very important part of the energy mix, particularly in developed countries where energy dependency and the performance of local resources are key issues on the political agenda. This is true particularly for countries like the United States, most European countries, Australia and Japan.

However, the widespread penetration of these technologies has taken a significant economic toll. Beyond the incentives established to promote renewables, these technologies have had a large impact on wholesale power markets, displacing traditional generation based on fossil fuels. This has raised new challenges for the operation of power systems with huge production volumes characterized by high volatility.

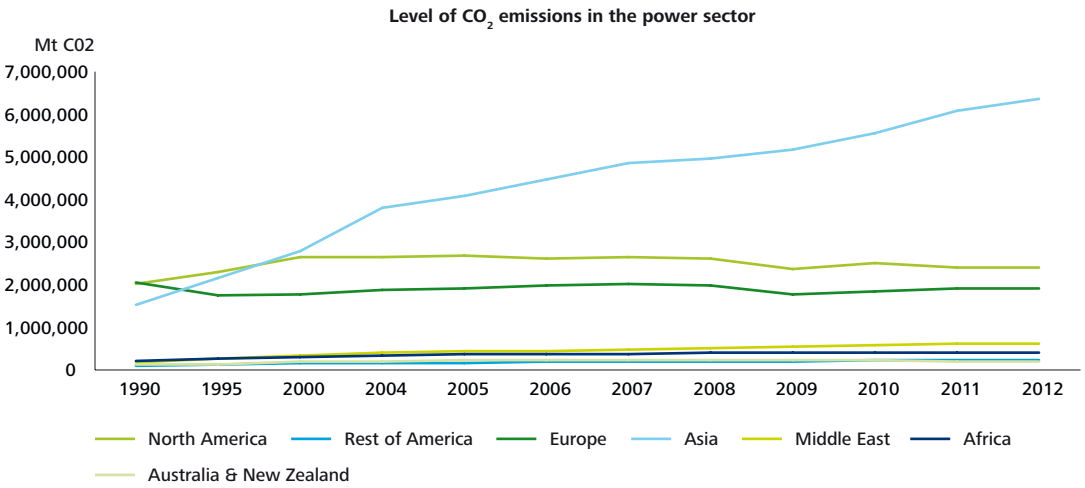
Degree of commitment to CO_2 emissions reduction

Some countries, particularly those in the European Union, are developing restrictive regulations to reduce CO_2 emissions and mitigate environmental impact. Based on these commitments, utilities have allocated considerable resources to avoid emitting polluting gases into the atmosphere.

Yet some of the world's major polluting countries have less strict commitments to climate change. This causes strong asymmetries between different regions in the world and consequently the configuration of the generation mix.

Moreover, in many regions/countries, existing carbon markets do not generate high enough price signals to motivate the power sector to modify its behavior. In fact, the switching price from coal to gas (in a range from €17 to €28 per megawatt hour; MWh) is more than three times higher than the spot price of carbon allowances in Europe (more than €7/European Union Allowance (EUA) in December 2014). As a result, it is more profitable to generate power from a polluting energy source than from natural gas combined with a cycle gas turbine.

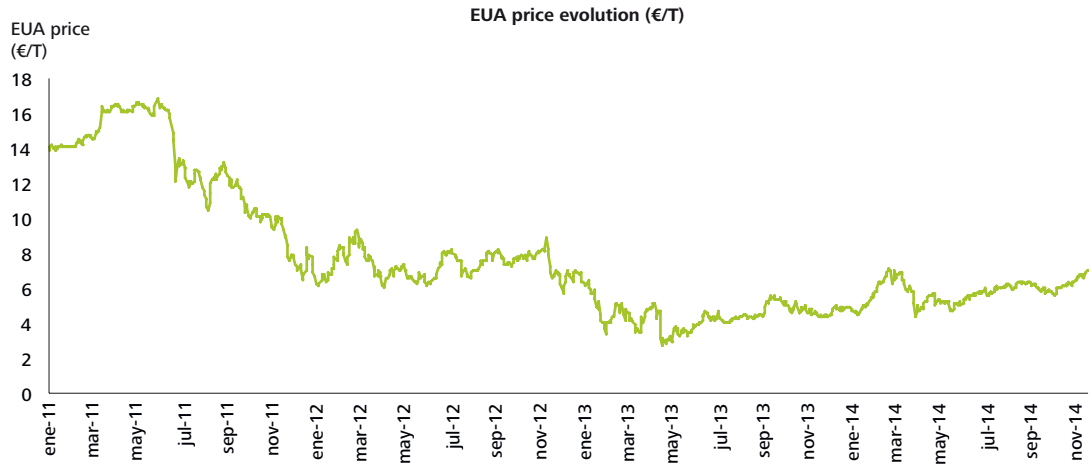
Figure 6. Level of CO_2 emissions in the power sector



Source: Deloitte Spain

Some countries, particularly those in the European Union, are developing restrictive regulations to reduce CO_2 emissions and mitigate environmental impact.

Figure 7. CO_2 emissions EU allowances price



Source: Deloitte Spain

Despite the restrictive regulations to reduce CO_2 emissions, from 1990 to 2012 CO_2 emissions increased by 52% globally. In the power sector, this increase reached 91% for the same period (Deloitte Spain analysis).

To curb the effect of these greenhouse gas emissions on both the planet and individuals, governments around the world are likely to apply even more restrictive regulatory frameworks in the years to come.

The different cost of fuels and generation mix infrastructure

The unequal distribution of energy inputs (natural gas and coal reserves, solar irradiance, wind and hydro sources) across geographies: technology development; and the specific characteristics of proprietary power systems (regulatory framework, structure of the power industry, etc.), results in different cost structures for power generation.

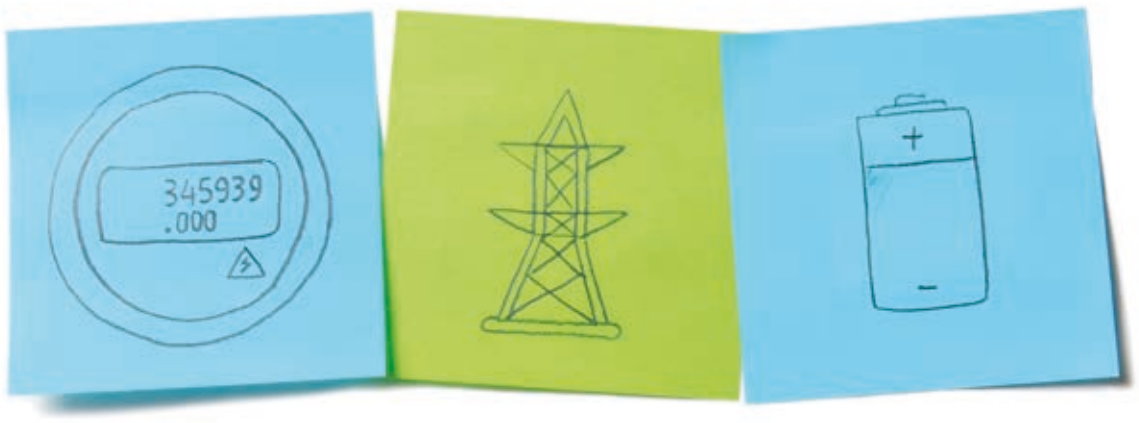
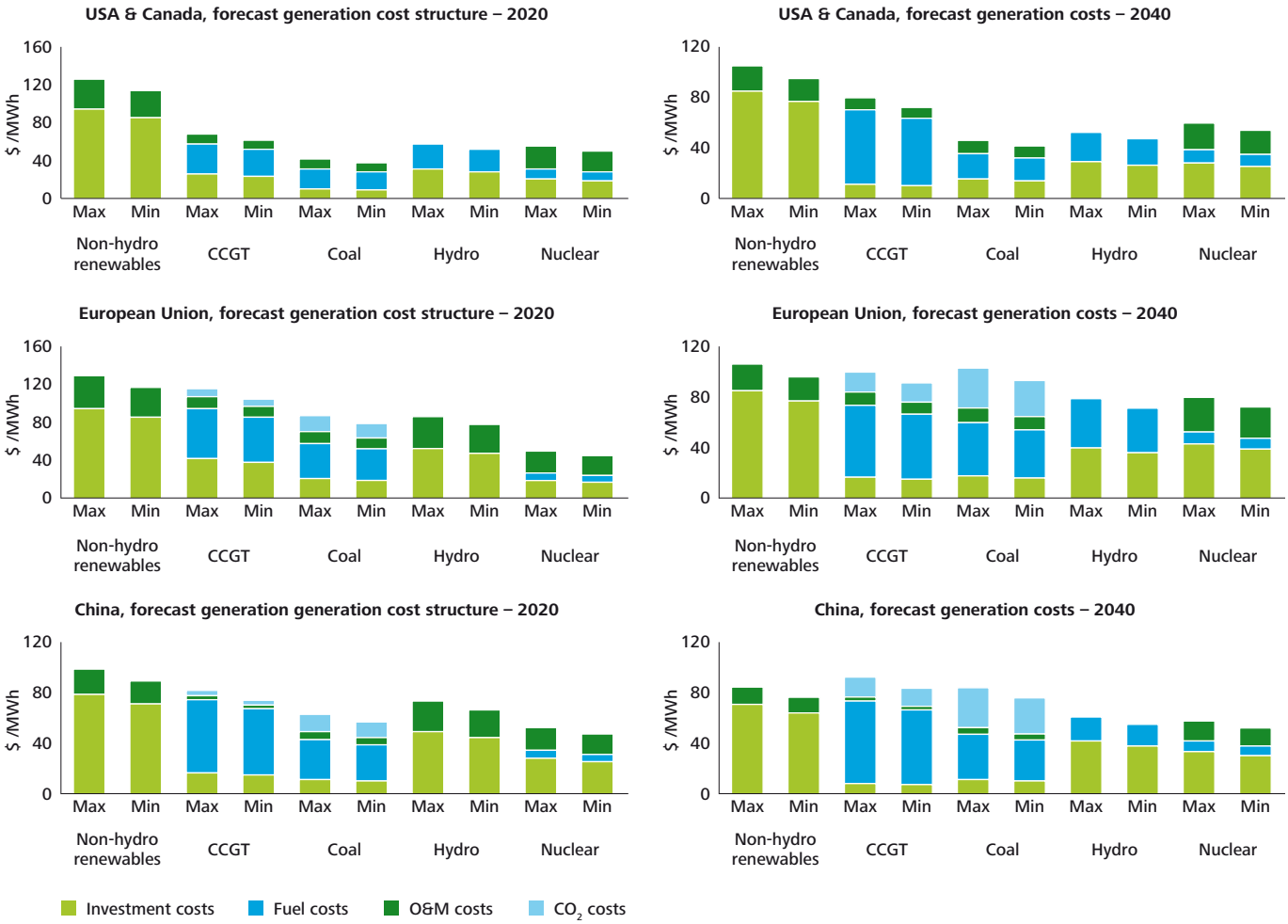


Figure 8. Generation cost structure in different areas (2020 and 2040)



Source: Deloitte Spain

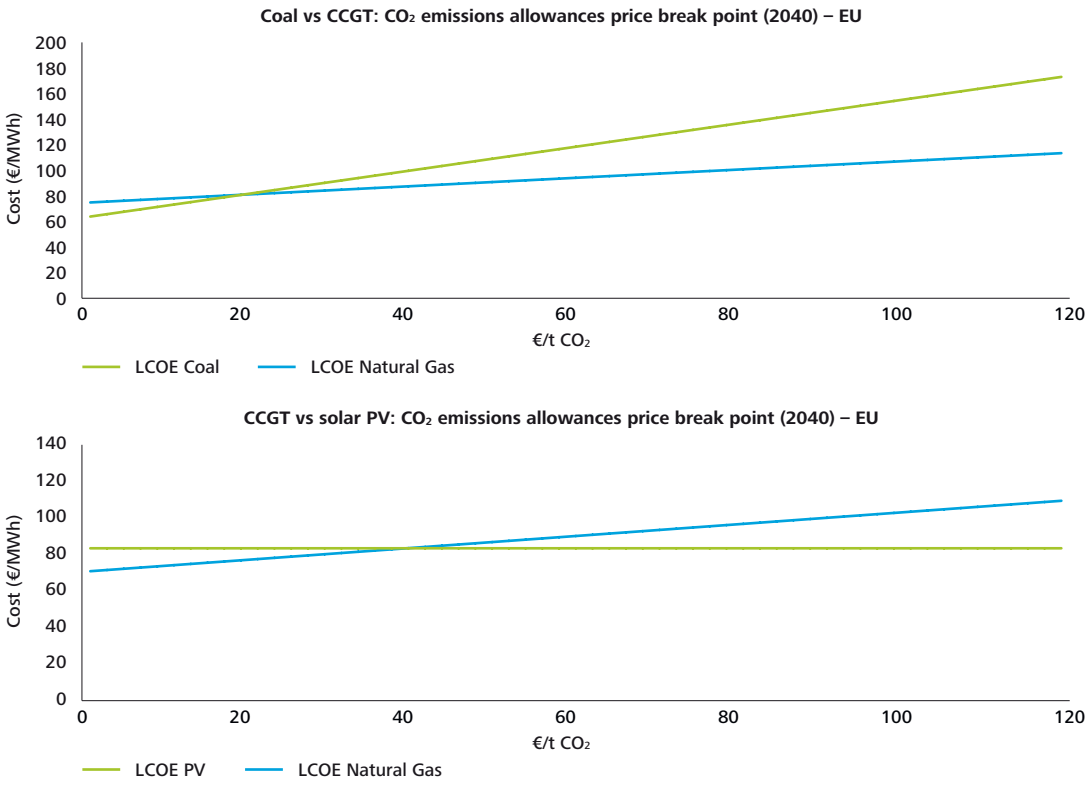
Consequently, the competitive position of power generation technologies is different across world regions, depending on their production cost structure. Additionally, competitive position varies according to policy incentives for specific generation technologies.

In general, we can establish that:

- Power generation with coal would be the most efficient conventional technology to produce power in all the evaluated areas in 2020.
- Hydro and nuclear are also effective solutions, but there are challenges linked to developing these kinds of facilities.
- By 2040, in Europe and China, natural gas combined cycle gas turbine (CCGT) could be as competitive as coal due to CO_2 emission allowances and fossil fuel evolution prices.
- In most cases, renewable energies would be less competitive in terms of direct cost than conventional technologies; however the gap will be reduced considerably from 2020 to 2040. In China in 2040, for instance, renewables will be as competitive as fossil fuel technologies.

On the other hand, changes in the price of fuel and/or CO_2 can modify the merit order, encouraging the replacement of one technology for another. In this case, power units with a lower load would modify their level of use. The graphs below provide a comparative assessment that evaluates the impact of allowance prices on a utility's competitive position.

Figure 9. Switching break point between natural gas CCGT and coal power units, and solar PV and CCGT facilities

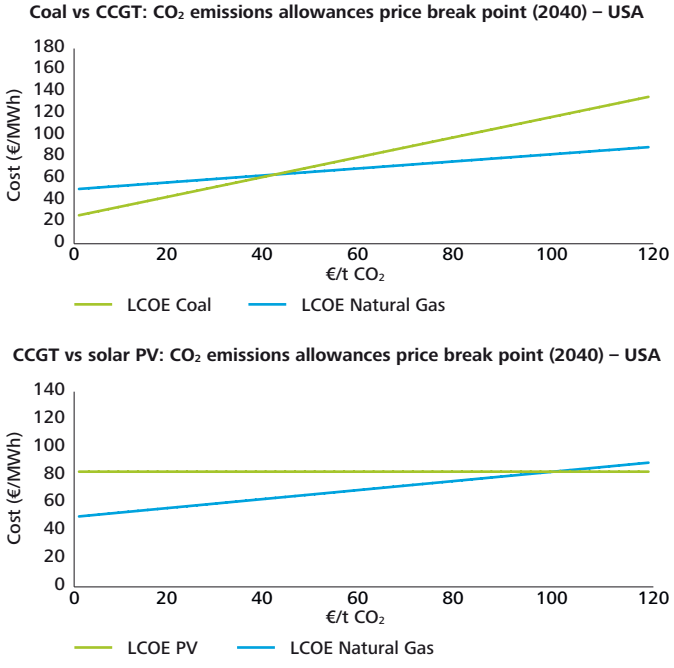


European Union

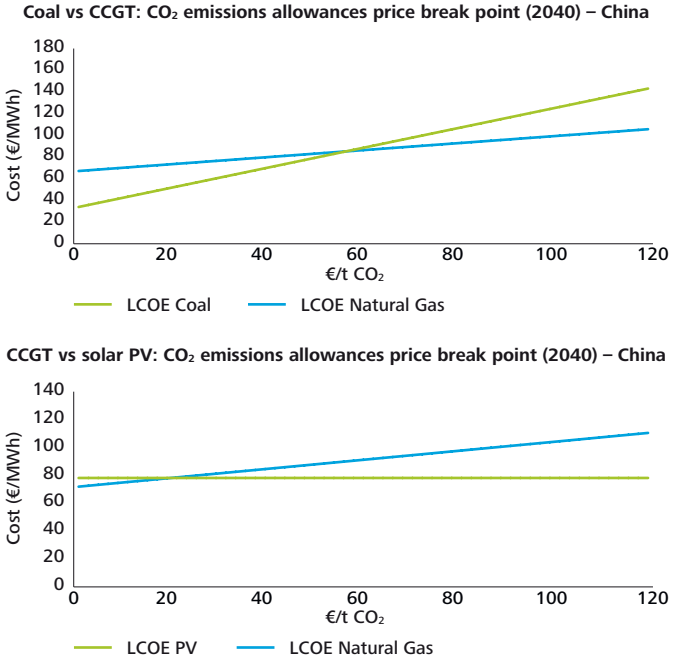
CCGT is a more effective power generation technology than coal-fired generation when CO_2 emissions allowance prices reach 21 €/t CO_2 in 2040.

Solar PV farms will be more effective than new CCGT facilities when the allowance price reaches roughly 29 €/t CO_2.

United States



China



Source: Deloitte Spain

Finally, the increased penetration of renewable energies, with very low marginal costs, leads to replacement of less effective fossil fuel power units, as it reduces the price in the wholesale market. In some power systems with large penetration of wind and solar energy, such as in Germany and Spain, reduced wholesale market prices are making it harder to develop new power capacity as price signals are too weak.

Energiewende
Renewables can depress wholesale prices, e.g. when the sun creates a midday jolt. This discourages investment in the flexible gas-powered generation needed to provide backup for windless, cloudy days. "The market dynamics are completely destroyed," says Peter Terium, CEO of RWE.

The Economist, July 28 2012 Article: Energiewende/Page 24

In order to mitigate the negative impact due to different marginal costs in the short and long-term, energy policy has to establish mechanisms to correct weak long-term price signals: e.g. long-term capacity auctions could attract the current incumbents and new players to install new capacity based on accurate long-term price signals based on long-term marginal costs.

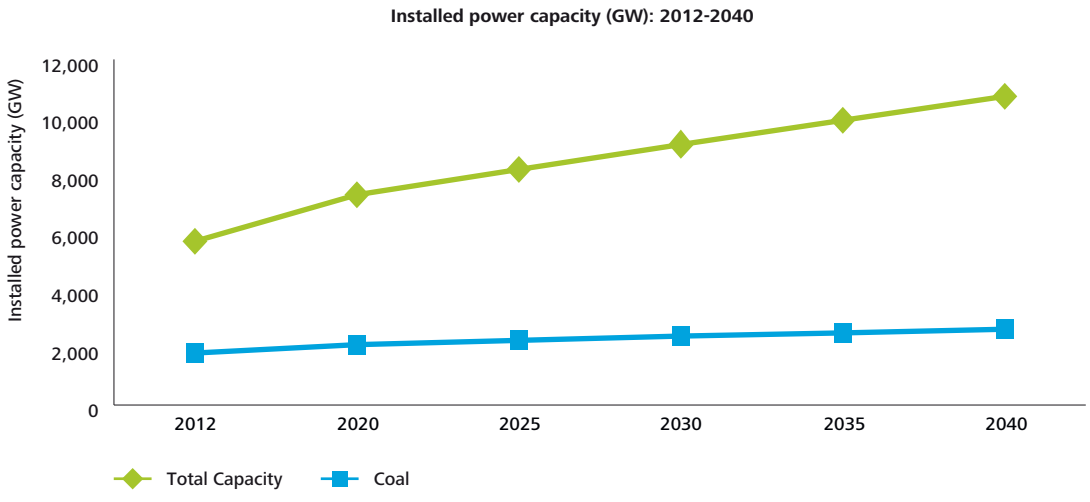
Coal: an effective (cheap) solution?

In some areas, coal is currently one of the most effective fuels to produce power due to its availability, its low restrictions to transport and its price. Coal prices[9] dropped from $118.8 per ton in 2008 to $71.4 per ton in 2013, and the 2020 forecast price is around $91.0 per ton ($100.0 per ton in Europe). Additionally, the current price of CO_2 emissions allowances is very low.

There is a great difference between the carbon intensity of natural gas and coal per MWh produced with each technology: 0.4 tCO_2/MWh versus 0.8-1.0 tCO_2/MWh. In the medium-term, climate policies will have an important impact on the competitiveness of this fossil fuel to produce power. In the absence of effective carbon capture and storage technologies, power production with coal will be less compatible with greenhouse gas reduction targets (Deloitte Spain analysis).

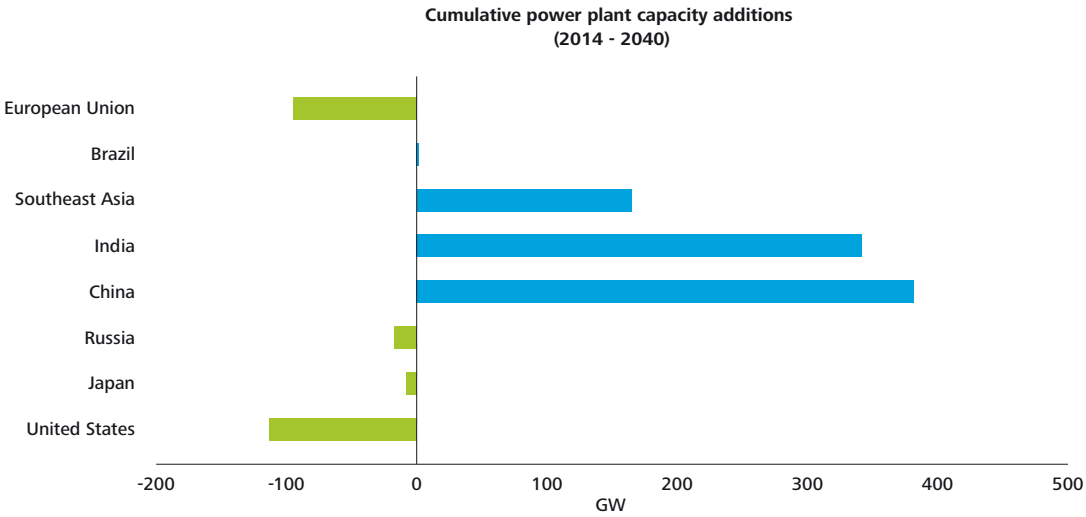
- From 2012 to 2040 worldwide power capacity could increase to 89%, however the forecast for coal units would only reach 46%.
- In 2012, coal-fired units accounted for 32% of total power capacity; in 2040 this percentage would drop to 25%.
- In Southeast Asia, India and China this technology will increase its capacity drastically, however there will be an equivalent reduction in the United States, Japan, Russia and Europe.

Figure 10. World and coal Installed power capacity (GW): 2012-2040



Source: World Energy Outlook-International Energy Agency (2014)[10]

Figure 11. Forecast coal Installed power capacity (GW): 2012-2040



Source: World Energy Outlook-International Energy Agency (2014)[11]

In 2020, the forecast switching price from coal to natural gas CCGT ranges from €17 to €28 per MWh. Today, CO_2 allowance prices do not actually balance out this difference (Deloitte Spain analysis).

In some areas, coal is currently one of the most effective fuels to produce power due to its availability, its low restrictions to transport and its price.

Increase in shale gas production

Are commodity benchmarks shifting?
Although crude oil and steam coal prices in the international market have traditionally stood as baseline commodity benchmarks for power companies around the world, that standard may change as natural gas markets become more global (decoupling of gas and oil prices is becoming a reality in many parts of the world). Gas production that has fueled domestic consumption in the United States, Canada and Australia is increasingly being exported to different countries. By roughly 2018, North American gas will likely make its way to the United Kingdom, a market that has typically imported it from less stable nations such as the Ukraine and Russia.

Despite this trend, United States LNG still constitutes only a small fraction of the global generation mix and will increase as export capacity develops further. Most countries continue to rely on other commodities to make up the difference, including fossil fuels, renewables (solar, wind, biomass) and nuclear power.

This mix likely provides a level of stability for countries that produce for domestic consumption. Net importers, however, may find themselves facing security of supply issues as current generation surpluses dwindle. As market dynamics shift, however, power companies will need to get more strategic about building a sufficiently affordable, diverse and environmentally sustainable fuel mix – one that responds both to variable market demand and shifting consumer expectations.

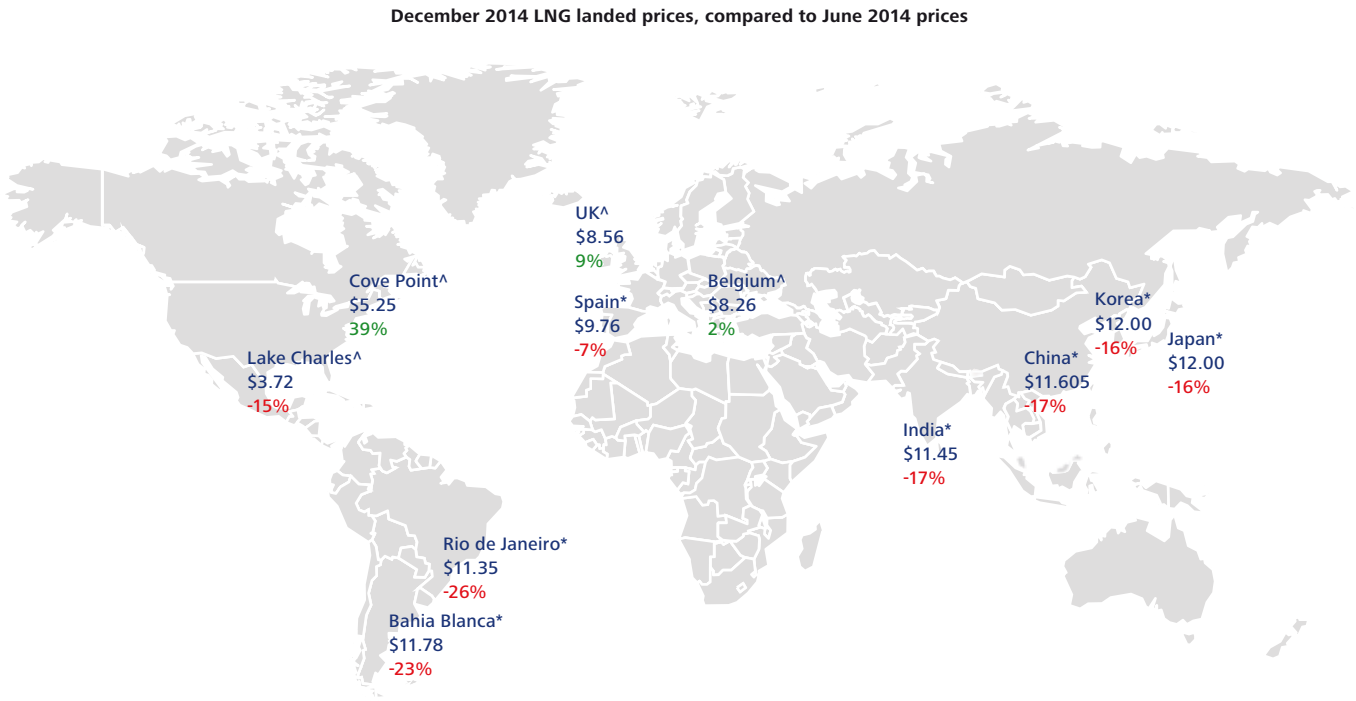
Hydraulic fracturing, or fracking, has changed the dynamics of the energy industry. As an easily accessible and comparatively inexpensive power source, shale gas could arguably edge out other forms of power generation and reduce the influence of oil-exporting countries. And the impact is potentially huge: according to the United States Energy Information Administration (EIA), the world's current technically-recoverable resources stand at 345 billion barrels of shale oil and 7,299 trillion cubic feet of shale gas,[12] equivalent to 206 trillion cubic meters – which is close to the amount of today's global proven natural gas reserves.[13] To put this shale gas resource estimate into some perspective, world proven reserves of natural gas as of January 1, 2013 were about 6,741 trillion cubic feet, and world technically recoverable gas resources were around 23,000 trillion cubic feet.[14]

Clearly, North America leads the shale exploration trend and will likely maintain its competitive advantage (a piece of data that addresses this fact is that shale gas represented 40% of total U.S. production of gas in 2012[15]) even if international players unlock their own shale gas resources and if power companies rethink their approach to the industry. As long as it remains a competitive source of supply, shale gas will pose a threat to other forms of power generation.

Now, major oil and gas companies are drilling for shale gas in countries such as Argentina, Mexico, Algeria, Denmark, Poland, Romania and China. Despite this dispersion, however, most countries are not exploiting local reserves; instead they're waiting to see how potential gas exports out of the United States may affect global energy prices. A boom in extraction from shale deposits combined with the fact that the United States has some of the world's lowest gas prices could help to break the indexing of LNG prices to crude oil. The reason for this is that LNG prices linked to gas hubs are expected to be lower than oil-indexed LNG prices (even after the huge drop of oil prices from mid-2014).[16]

All of this will lead to LNG markets becoming more international.

Figure 12. LNG price comparison in geographical regions



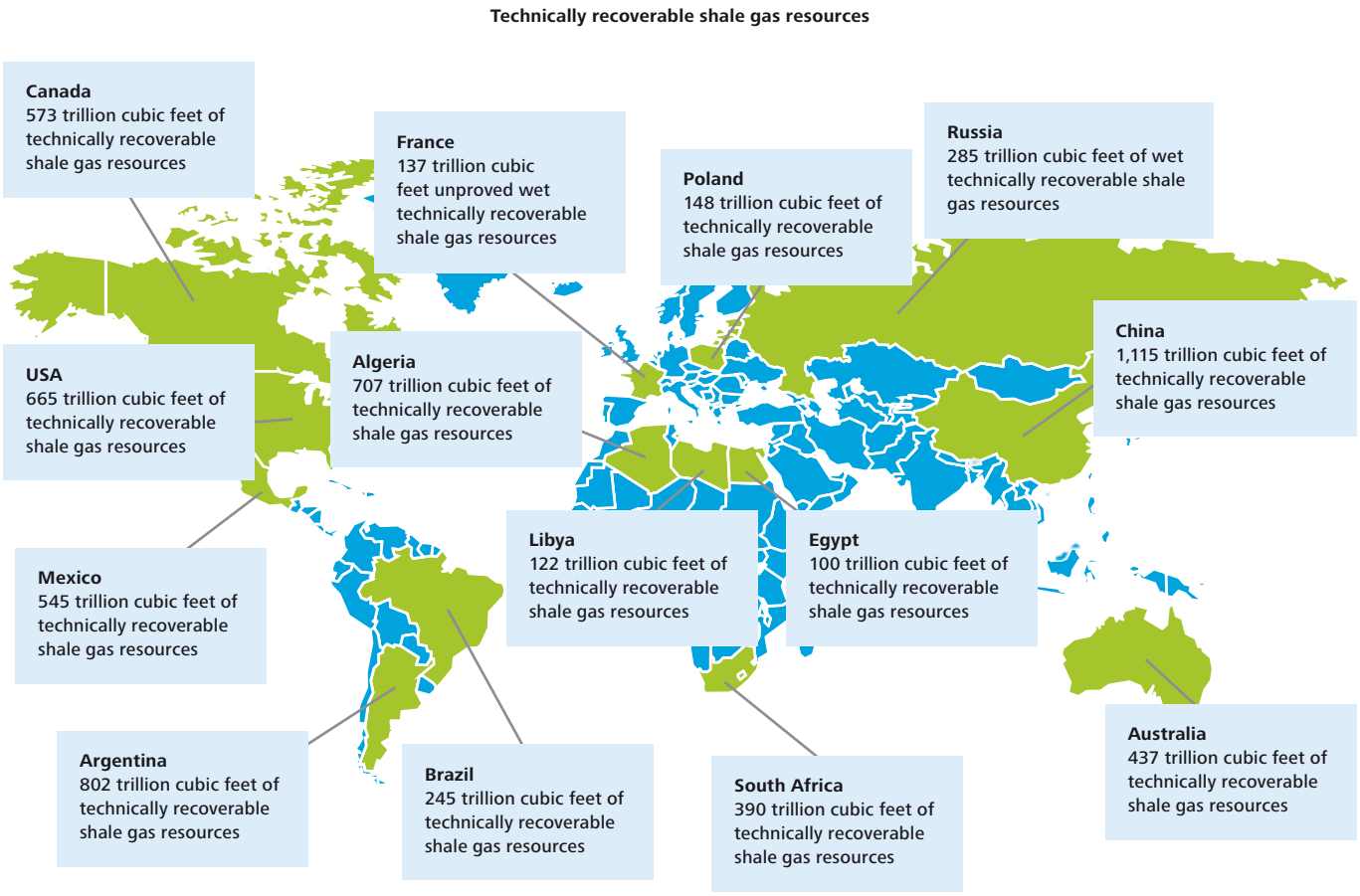
^ mainly hub based pricing contacts
* mainly oil price linked contracts

Source: Market Oversight, FERC website

The unlocking of shale gas resources can be a game-changer by, for example, enabling the European Union to reduce its natural gas dependency on Russia as shale gas resources out of the Ukraine, France and Poland grow and as the United States becomes a shale gas exporter. For China, it will be a good way to reduce natural gas imports as well.

Power generated from nuclear sources has a lower marginal cost than that generated using other conventional sources, while its production is carbon-free and guarantees supply.

Figure 13. Technically recoverable shale gas resources



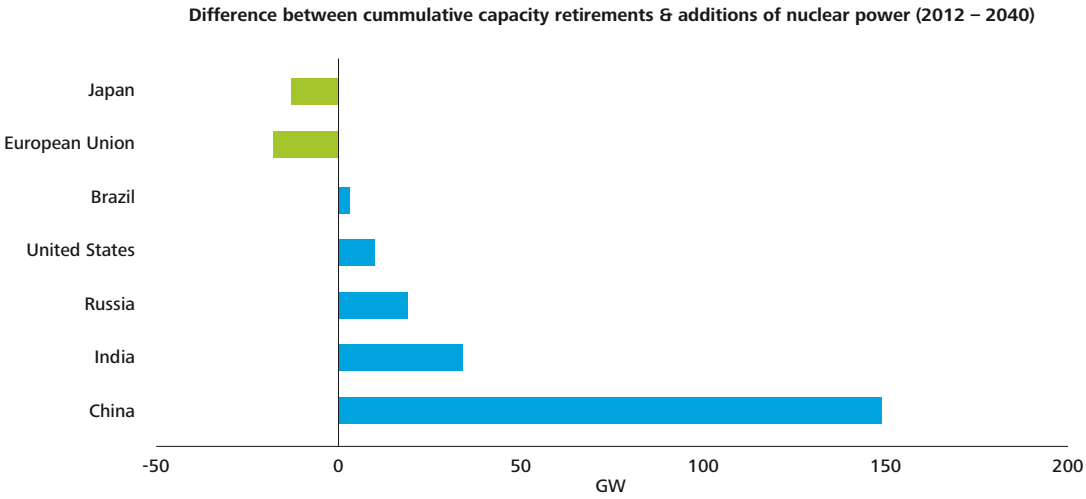
Nuclear power upgrading or decommissioning

Power generated from nuclear sources has a lower marginal cost than that generated using other conventional sources, while its production is carbon-free and guarantees supply. Yet countries with nuclear power plants (even if they have plans to close them) are facing increasing costs (new security standards) to keep them online. As power companies work to meet their CO_2 reduction objectives, they will need to encompass the surge of renewables, along with other thermal sources, to keep energy affordable for consumers while still realizing a reasonable economic return.

Apart from the need to replace old technologies with new ones, after the Fukushima incident the popularity of nuclear power dwindled and phase-out programs for this energy source are being considered in some regions. This leaves an energy demand gap that, despite the capacity surplus in some power systems, should be fulfilled to prevent the risk of energy dependence. Meanwhile, India (like other regions with high power demand) advocates the advantages of this technology and plans to install 34 GW of nuclear power capacity over the next three decades.

Whilst nuclear power seems to be on the decline across Europe, the United Kingdom is keen to develop a mixed energy supply strategy that includes a large amount of heavily subsidized nuclear new build.

Figure 14. Cumulative capacity retirements & additions per region and source in the New Policies Scenario, 2012 – 2040 (GW)



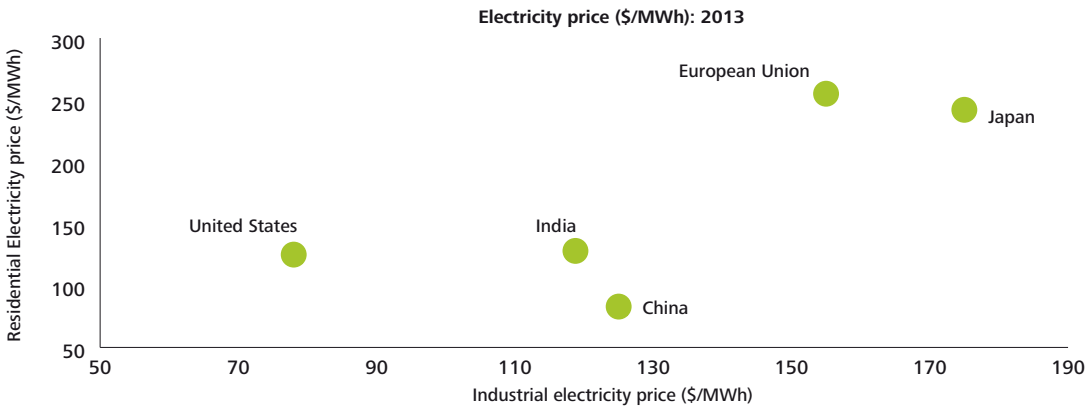
Source: World Energy Outlook-International Energy Agency (2014)[17]

From 2012 to 2035, the net increase of nuclear energy power capacity will be 185 GW: 302 GW will be new capacity and 117 GW will be decommissioned (Source: World Energy Outlook-International Energy Agency (2014)[18]).

Pressures to reduce power prices

Power is a key productivity factor and the competitiveness of economies and the welfare of citizens depend upon it. As a result, regulatory bodies are usually pressed to adopt measures to lower power prices.

Figure 15. Power prices (2013)



Source: Deloitte Spain

The impact of power prices on the economy is reflected in most countries as prices for industrial customers are lower than those for residential customers.

There are important differences in power prices across countries which affect the competiveness of utilities. That's because power is one of the main productive inputs. The United States and, at a lower level, India and China have a competitive advantage relative to Japan and the European Union: in the case of the United States, its industrial power price is between 2.2 and 2.0 times lower than the prices of some of its main competitors.

According to the 2030 forecast of industrial power prices (Deloitte Spain analysis):

- In Japan, power prices will drop by 15% due to reduced business sector demand for power, energy efficiency measures, changes in the generation portfolio and the use of more efficient technologies.
- The European Union will see an 8% increase in prices as generation and infrastructure costs rise and efforts to meet ambitious environmental requirements are implemented.
- Despite an increase of around 12% in the price of power, the United States will maintain a very competitive power price for business proposes: around $87/MWh. Demand during this period will not increase significantly due to an import effort in energy efficiency terms.
- China and India will see a rapid increase in prices during this period, of more than 20%, due to the rise in demand, the reduced availability of national energy inputs and the adoption of environmental requirements.

On the other hand, Japan and the European Union will likely see reductions in residential power prices (around 10% and 2% respectively) as current prices are extremely high. Yet, due to increased demand fueled by social welfare improvement, residential prices in China and India will be pushed up.

Ancient grid infrastructure and the need to adapt

A secure and reliable power system requires an appropriate grid infrastructure that must be renewed and maintained according to efficiency criteria. The implementation of new smart grid technologies will allow enhancements to the operation of this infrastructure, improving energy efficiency and supporting the development of new power models based on distributed generation.

After decades of under-investment, many transmission and distribution system operators will have to update their grid infrastructure and upgrade their monitoring, controlling and operating technologies to meet these new challenges.

New challenges for grid operators

- Optimize the grid infrastructure
- Maximize infrastructure availability
- Effectively manage demand
- Integrate various energy storage devices
- Effectively manage volatile generation sources (PV, wind, biomass and hydro) to mitigate the risk of sudden, unplanned generation capacity losses
- Monitor, forecast and manage a complex range of small and medium generation units
- Effectively manage energy reverse flows

The adoption of smart grid technologies, which are being deployed in most regions, will be the main lever power companies will use to meet most of these challenges.

Nevertheless, all of these challenges will need considerable investment. To assure this infrastructure investment, the revenue models of grid operators should be linked to the development of this infrastructure. In this way, the grid will not become a bottleneck for either the power system or for economic development. The regulatory framework should also be rational and predictable; utilities must not be subject to undue regulatory risks.

After decades of under-investment, many transmission and distribution system operators will have to update their grid infrastructure.

Utilities: key issues and trends

Power companies need to modify their management models to adapt to shifting realities, including price reductions that are leading to narrower margins, improvements in the quality of supply, demand for new services, a sharper focus on environmental protection, new technologies that modify the traditional business scope by focusing on the technical management of assets, and many others.

This means utilities should evolve their businesses to:

- Develop a more marketable approach that focuses on the client and provides higher value services.
- Adopt a business model that turns environmental awareness into a competitive advantage.
- Ensure that their infrastructure is managed taking into account new requirements and improving their quality standards.
- Make intensive use of information and telecommunication technologies.
- Operate in global markets, particularly where profit margins may be higher than in traditional markets.

Key issues:

- **Optimize the generation portfolio**
- **Adopt and take advantage of smart grids**
- **Support distributed generation based on renewable energies**
- **Internationalize**
- **Explore new management models and capabilities**
- **Transform customer engagement**
- **Realize efficiency improvements/cost reductions**
- **Turn regulation into a value driver**
- **Improve talent management**

Optimize the generation portfolio

Due to the high volatility of power prices and changing power environment (e.g. penetration of distributed generation, environmental requirements, volatility of fossil fuel markets, etc.), it is often sufficient for companies to design flexible strategies that let them take advantage of these uncertainties whilst adapting their business models as markets shift.

In some countries, the high penetration of renewable energies, combined with reduced demand following the economic crisis, has resulted in much lower power prices on the wholesale market. In these scenarios, flexible approaches can provide competitive advantages. All of these approaches must take into account predictions on the evolving regulatory frameworks, which allow power companies to make informed decisions regarding their generation portfolio configuration.

At present, some of the most significant power markets are redesigning their operating models to adapt to the high penetration of renewable energies and shifting away from models which incentivize the development of traditional generation technologies.

At an operating level, narrower margins in the power generation business require companies to improve their capital and project management capabilities when making new investments, reduce their operating costs, maximize the availability of power units and effectively manage their fossil purchases and their associated supply chains.

Adopt and take advantage of smart grids

Smart grids
Increasingly, power systems are defined by the rising use of information and telecommunications technologies in the generation, delivery and consumption of electrical energy.

Based on the intensive use of ITC, the grid components are monitored, controlled and managed in a smart mode, enabling "fuel automation" in the operation of the networks, enabling greater interaction between the company and its customers, and helping to manage distributed generation and other technologies (storage, electric vehicles, etc.).

In some countries, the high penetration of renewable energies, combined with reduced demand following the economic crisis, has resulted in much lower power prices on the wholesale market.

The intensive application of information technology in power grids will support real-time infrastructure management, increasing its reliability, availability and efficiency. The benefits associated with smart grids include:

- Improving the efficiency of power distribution.
- Accelerating response times to restore service after power disturbances.
- Reducing operating costs for utilities, including those associated with customer service, the switching process, billing, etc..
- Gaining the opportunity to interact with customers to manage the load curve more efficiently by permitting active demand response.
- Effectively integrating renewable energy systems.
- Effectively integrating energy storage devices.
- Potentially offering new services to customers.
- Considering new services for the power system, such as load balancing, ancillary services, etc.

The development of smart technologies requires a significant effort for power companies to implement the huge number of "smart initiatives" needed. This includes:

- Implementing the technologies necessary to monitor and control the grid and its components, such as an advanced metering infrastructure, a distribution management system, outage management systems, etc.
- Installing smart meters (electronic measurement devices used by utilities to communicate information related to things such as customer billing and electric system operation).
- Installing sensors to monitor grid infrastructure and distributed generation.
- Adjusting any installed protection devices.
- Adopting procedures and processes to manage issues such as balancing, ancillary services, operation criteria, reverse power flows, active demand management, storage, curtailing and smart metering.
- Designing and implementing security solutions to guarantee the confidentiality, availability and integrity of information.
- Acquiring new capabilities in operation and management for employees through change management programs.
- Improving communication and customer interaction to help them profit from new capabilities offered by "smart energy" solutions.

Support distributed generation based on renewable energies

The development of smart grids and renewable technologies, combined with lower costs to install renewable energy capacity, has made distributed generation particularly affordable.

Thanks to rising power costs and widespread power outages, the incentive to generate power at the point of consumption is growing. This is fueled, in part, by the improved efficiency and reduced costs associated with various forms of micro-generation.

In many parts of the world, businesses are springing up to support "up to the meter" services, such as renewable generation, including those that provide large-scale battery storage and technologies that can forecast day-ahead wind and solar capacity. Numerous electric service providers are also providing "behind the meter" services that leverage new technologies, such as solar PV panels, fuel cells, small-scale natural gas generators, advanced battery storage and micro-grids.

As a result of these shifts, traditional power companies are at risk of becoming the last resort providers, not the first. As they gaze towards the future, they will need to determine the role they will play in the distributed generation landscape, and in delivering value-added energy efficiency services, to ensure they can compete effectively with new market entrants and meet the evolving needs of consumers.

Currently, some utilities are reluctant to encourage the development of distributed generation in their grids because of the cost of implementing the necessary technology to control and monitor it, and the negative impact on the current utility generation business. As such, utilities have to analyze their strategy regarding these new business opportunities.

Transform customer engagement

The power industry doesn't have a reputation for customer focus. However, as customer expectations rise, social connectivity spreads and distributed generation gains steam, this will need to change. This is especially the case as customers who do not receive seamless multi-channel services, detailed consumption data, or billing accuracy and transparency, have gained the freedom to select the alternative power providers of their choice. These trends will play out in different ways, depending on the region where a utility operates.

In developed nations, for instance, high levels of social connectivity are already disrupting relationships between utilities and their customers. Even in less developed nations, mobile apps are being used for bill payment and could change customer relationship dynamics. In this environment, utilities will need to tap higher levels of business intelligence if they hope to retain existing customers and attract new ones. With social CRM (customer relationship management) solutions, for instance, companies can proactively identify simmering service issues before they escalate out of control.

Even in countries where smart meters are just being rolled out, power companies have an educational role to play. Customers are often unclear on how to use or access enhanced information around demand management. To achieve lasting behavioral change, utilities will need to explain the benefits of energy efficiency practices, introduce time-of-use rates that encourage energy-smart decisions and provide greater price transparency so that consumers can assess these cost benefits for themselves.

The new business environment will require modifying various commercial processes and practices, including those related to:

- **New customer channels**

  Social media can serve as a beneficial tool in recruitment, customer relations and brand reputation, and can also contribute to commercial success. Utilities know this, which is why they have extended their presence on social networks in recent years in an attempt to keep pace with the increasing adoption of smart technology, smartphones and web-enabled platforms.

  The combination of smart grid investments, social media and mobile apps has given utilities a host of new tools to improve their customer engagement. At the same time, customers now expect faster, more efficient service, as well as more opportunities to reduce their energy bills. Our view on the "new energy customer" and its digital interaction with power companies shows that:

  – Low-touch channels and self-service have reached a tipping point where consumers prefer these options for most transactional interactions.

  – Consumers in many regions are interested in engaging with their power providers through social media, in particular, for service convenience.

  – Younger consumers can offer a paradox: they prefer a complex mix of high-touch interactions, self-service and social media engagement.

- **Client segmentation and pricing**

  Using customer segmentation methodologies, based on analytics, it is possible to uncover customer decision patterns and forecast customer behaviors related to pricing, customer service, the characteristics of specific offers and services, etc.

- **New products and services**

  As utilities work to transform the customer relationship, their portfolio of services will change accordingly. In the short-term, utilities will supply products like:

  – Demand respond management

  – Home automation

  – Solutions based on distributed generation and energy storage

  – Energy efficiency programs, including management, financial support and providing technical advice

Additionally, the profile of the professionals in charge of developing these activities is very different than those responsible for running traditional utilities.

Utilities will need to tap higher levels of business intelligence if they hope to retain existing customers and attract new ones.

The price of power is one of the most relevant drivers of a country's competitive advantage and its citizens' welfare. For this reason, there are always strong pressures to reduce the price of power.

Realize efficiency improvements/cost reductions

As noted earlier, the price of power is one of the most relevant drivers of a country's competitive advantage and its citizens' welfare. For this reason, there are always strong pressures to reduce the price of power.

To manage the economic implications that these price reductions would entail, utilities must improve the efficiency and effectiveness of their business processes, and identify opportunities to differentiate their products.

Main guidelines to improve competitive position include:

- Improving staff capabilities through training and appropriate hiring and retention processes.
- Redesigning business procedures by eliminating unproductive tasks and redundant control activities.
- Reducing hierarchy levels to build lean organizations.
- Intensifying the use of effective information and communication technologies for administrative and operating activities.
- Increasing the performance ratio of generation units and improving their availability.
- Optimizing portfolio generation and the fossil fuel supply process.
- Implementing smart grids and smart metering to reduce operating costs linked to grid management, improve the quality of supply and deliver new services.
- Effectively managing regulatory issues.
- Developing a culture focused on the client through effective customer services, improved switching processes, the development of new services, etc.
- Developing an outstanding brand and corporate reputation.
- Entering new markets and internationalizing.

Turn regulation into a value driver

In most regions, the power sector is fully regulated. There are regulations relating to the:

- Polluting gases that can be released into the atmosphere.
- Use of natural sources to produce power.
- Fuels that are used in power production.
- Grid codes and the system of operation.
- Revenue models for renewable energies and grid businesses.
- Level of renewable energy penetration.
- Guarantee of supply.
- Quality of supply.
- Energy efficiency targets.
- Need to develop distributed generation.

As the regulatory framework evolves, power business profitability changes. To manage regulatory uncertainty (risk with its associated cost), the evolution of the framework must be rational and predictable. On the other hand, companies must be able to foresee regulatory changes in advance and modify their business models to realize competitive advantages from these changes.

2030 EU framework for climate and energy policies

EU leaders agreed on October 23, 2014 to reduce domestic 2030 greenhouse gas emissions by at least 40% compared to 1990 levels. This reduction target complements the other main building blocks of the 2030 policy framework for climate and energy, as proposed by the European Commission in January 2014. This 2030 policy framework aims to make the European Union's economy and energy system more competitive, secure and sustainable and also sets a target of at least 27% for renewable energy and energy savings by 2030.

Internationalize

Although some power companies have struggled to expand successfully internationally in the past, others have enjoyed success with this strategy. Companies which have expanded internationally are mainly European. German utilities E.ON and RWE, French utility GDF SUEZ, Italian utility ENEL, Spanish utility Iberdrola and many others – including Centrica in the United Kingdom – have a particularly international focus, with regional units in numerous countries. United States power utilities usually only expand across some states of the country, having not yet begun their expansion internationally.

Why are the traditional European utilities increasing their international presence?

Because their traditional markets are mature with very low growth ratios. The only way to guarantee a cash flow increase is by operating in new markets where they can realize a competitive advantage (mainly economies of scale).

Company	Countries in which developing activity
Iberdrola	Spain, Portugal, France, Germany, Belgium, Italy, Poland, the United Kingdom, the Czech Republic, Romania, Venezuela, Mexico, the United States, Canada, Brazil, Chile, Bulgaria, Greece, Cyprus, Latvia, Hungary, Switzerland, Turkey, Norway
E.On	Germany, the United Kingdom, Sweden, Italy, France, Belgium, the Netherlands, Luxembourg, Hungary, the Czech Republic, Slovakia, Romania, Russia, Brazil, Turkey
GDF SUEZ	France, Germany, Belgium, Spain, Greece, Hungary, Italy, Luxembourg, the Netherlands, Poland, Portugal, Romania, the United Kingdom, Turkey, Brazil, Chile, Costa Rica, Peru, South Africa, Morocco, Australia, New Caledonia, French Polynesia, Vanuatu, Wallis-et-Futuna, Saudi Arabia, Bahrein, the United Arab Emirates, Kuwait, Oman, Qatar, Canada, the United States, Mexico, Puerto Rico, Thailand, Laos, Singapore, India, Pakistan
ENEL	Italy, Belgium, Spain, Portugal, Slovakia, Greece, France, Bulgaria, Romania, Russia, Chile, Brazil, Peru, Argentina, Colombia
Gas Natural Fenosa	Spain, Australia, Colombia, Nicaragua, Costa Rica, Kenia, Mexico, Panama, Portugal, Puerto Rico, the Dominican Republic, Moldova
EDP	Portugal, Spain, Italy, France, Belgium, Poland, Romania, the United States, Canada, Brazil
EDF	France, the United Kingdom, Italy, Belgium, the United States, Poland, Brazil, Hungary
Vattenfall	Germany, Sweden, the Netherlands, Belgium, Finland, Denmark, Norway, France, Austria, the United Kingdom
Centrica	The United Kingdom, Ireland, the United States, Canada
RWE	Germany, Norway, Belgium, France, the United Kingdom, Italy, Croatia, Luxembourg, the Netherlands, Austria, Poland, Portugal, Switzerland, Spain, Slovakia, the Czech Republic

Expansion of some power utilities around the world

Utilities in Korea and China are slowly beginning to internationalize their businesses. Japan, Singapore and Hong Kong have begun to invest in the UK power and utilities sector, due to the stability of its regulatory and legal frameworks. Generally, the UK is seen as the first step towards European expansion, focusing on offshore wind generation and offshore power transmission.

Succeeding in international expansion depends not only upon the regulatory environment and political stability of the international regions companies are targeting, but also on the strength of both corporate balance sheets and risk management processes.

Many visions for the future of the power sector hinge on the revolutionary potential of ongoing technological innovation.

How do utilities develop their internationalization strategy?

- Purchasing a company
- Purchasing part of a company
- Developing a new infrastructure and establishing a PPA/agreement to manage the infrastructure
- Establishing strategic alliances with financial funds
- Capital programs

Explore new management models and capabilities

Many visions for the future of the power sector hinge on the revolutionary potential of ongoing technological innovation. Government incentives, customer demands, the need for more efficient asset management and other factors will drive utilities to evolve to new models, although slow economic growth in some regions may prevent radical change.

On the flip side, consumers' desire for lower costs and less carbon-intensive energy sources will keep pressure on both utility companies and regulators to invest in energy efficiency, renewable energies and new technologies that enable active demand participation. Given these variable drivers and constraints, power companies in different regions will need to adopt variable responses. For instance, utilities may want to:

- Prepare to face demand increases and/or decreases.
- Diversify their revenues by considering operating in new markets, commercializing new services, etc.
- Explore new partnership opportunities to exploit potential synergies.
- Develop internal processes to achieve/defend their competitive advantages.
- Identify profitable unbundling processes/mandatory unbundling processes.
- Develop business models based on sustainable development.

These new business approaches require the implementation of new operating models supported by outstanding monitoring, control and management solutions that use real-time technologies and big data to enable real-time decisions in any part of the world.

Similarly, analytics will play a larger role in interpreting the massive volumes of data generated by these IT solutions. Using analytics, utilities can interact with consumers by introducing effective time-of-use rates, make offers that resonate with different customers and enhance their own operational planning to align with real-time demands.

Analytic capabilities can also help utilities to enhance their customer targeting, billing accuracy and channel management, and add greater value as customers increasingly generate their own power.

Data consolidation across business units can improve customer service as well as financial planning, cost analysis and even the analysis of non-technical losses.

In asset management, the use of analytics can help to improve efficiency through predictive maintenance strategies, including failure predictions models which involve the management in real-time of a huge amount of information. Modern equipment includes sensors which can be used to monitor variables about its condition. These sensors send information to large databases, where it is stored. This information could be used to detect abnormal behavior and predict failure.

While many utilities have been slow to invest capital in these types of technologies, these are all areas where utilities around the globe have significant room for improvement. As such, they will demand increased attention and investment in coming years.

Improve talent management

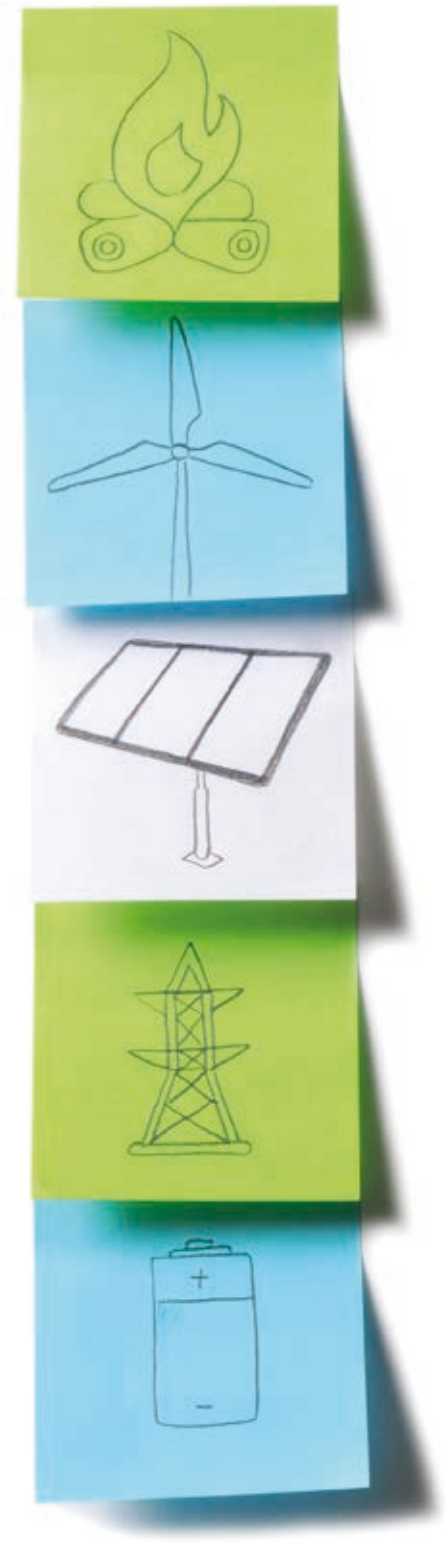
As the power industry evolves, utilities will have to change the profile of their professionals from technical experts focused on technical excellence to new professionals who possess management, analytical and commercial capabilities.

An aging workforce and widening skill gaps in the utility sector have begun to threaten ongoing operations. This situation will only get worse as power companies shift to more complex, data-driven, "smarter" technologies. The skills needed to operate and run a renewable generation plant differ from those required for conventional generation and mandate new approaches to talent development and attraction.

This is true not only at the operational level, but at the management level as well. As the utility sector evolves, a new breed of leader will be required to manage the major shifts anticipated for the years ahead.

In fact, the very nature of these changes will likely require utilities to adopt a new mindset or culture – one that promotes service and strategy innovation, encourages collaboration with local and regional regulators, and relentlessly maintains a customer-centric focus.

This will not be an easy transition for an industry that has prioritized safety and reliability above all else for a long time. But it will be necessary if power companies wish to address the high-priority issues driving changes in their regions.



Setting priorities for the years ahead

In a global landscape where capital costs are rising, regulations continue to tighten and talent becomes increasingly scarce, businesses in all sectors face unprecedented challenges. Arguably, however, these pressures are more acute for the utility industry, which is influenced not only by corporate mandates and the imperative for cost efficiency, but also by major macro-economic and geopolitical forces.

As utilities arrive at this crossroads, they will need to make a range of difficult decisions. They will need to determine how to embrace innovation and energy market transformation while still earning a sustainable profit. They will need to clarify their role in the distributed energy system by determining where they can best add value – as producers, distributors, managers, operators, financiers, support service providers or something else. They must also shore up their strategies related to renewable generation, energy efficiency and the role that gas might play in their generation portfolio.

Utilities now need to be much more committed to sustainable development than in the past, taking into consideration political, social, economic, and technological changes: old ways of thinking/working are not appropriate today, the ability to be flexible to change is the key.

To answer these questions effectively, companies must identify the most likely future scenarios for their jurisdiction's power system, consider the implications of each scenario on their company, develop alternative responses to each one and invest in the changes necessary to help them bridge any current gaps.

Although there are no hard and fast answers to these quandaries, options do exist for utilities willing to think through their opportunities for the future. We hope this report has helped to frame some of these options for you.

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Endnotes

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